

Medical–Surgical Nursing

8

NEUROLOGICAL SYSTEM

■ Anatomy and Physiology of the Nervous System 174

- Central Nervous System: Brain and Spinal Cord 174
- Neuron Structure and Function 175
- Peripheral Nervous System 176
- Autonomic Nervous System 177
- System Assessment 177

■ Diagnostic Procedures 178

- Skull Series 178
- Myelography 178
- Cerebral Angiography 178
- Magnetic Resonance Imaging 178
- Computerized Tomography Scan 179
- Tomography 179
- Positron Emission Tomography 179
- Electroencephalography 180
- Electromyography 180
- Lumbar Puncture 180
- System Implementation 180

■ Neurologic Dysfunction 180

- The Unconscious Client 180
- Increased Intracranial Pressure 183
- Cerebral Edema 185
- Hyperthermia 185

■ Seizure Disorders 186

- Convulsions/Seizures 186
- Epilepsy 187

■ Trauma 189

- Head Injury 189
- Spinal Cord Injury 190

■ Infectious Processes 195

- Brain Abscess 195
- Meningitis 195
- Encephalitis 196
- Postpolio Syndrome 196
- Creutzfeldt–Jakob Disease 197

■ Altered Blood Supply to Brain 198

- Brain Attack (Cerebrovascular Accident, Stroke) 198
- Types of Stroke 200
- Cerebral Aneurysm 200

■ Degenerative Disorders 201

- Multiple Sclerosis 201
- Myasthenia Gravis 202
- Parkinson's Disease 204

■ Cranial and Peripheral Nerve Disorders 205

- Trigeminal Neuralgia (Tic Douloureux) 205
- Bell's Palsy (Facial Paralysis) 206
- Ménière's Disease 206
- Bulbar Palsy 207
- Guillain–Barré Syndrome 207
- Amyotrophic Lateral Sclerosis (Lou Gehrig's Disease) 207

The icon ♦ denotes content of special importance for NCLEX®.

Surgical Intervention 208

General Preoperative Care 208
General Postoperative Care 208

Eye and Ear 209

Glaucoma 209
Cataracts 210
Ophthalmic Drugs 211
Retinal Detachment 211
Age-Related Macular Degeneration 212
Removal of Foreign Body from Eye 213
Stapedectomy 213
Irrigation of External Auditory Canal 213

**Neurological System
Review Questions 214**

Neurological System Answers with Rationale 217

CARDIOVASCULAR SYSTEM

Anatomy 220

Gross Structure of the Heart 220
Coronary Blood Supply 221
Gross Structure of Vasculature 221

Physiology 222

Regulation of Cardiac Function 222
Autonomic Nervous System Influence 223
System Assessment 224

Diagnostic Procedures 225

Chest X-Ray 225
12-Lead Electrocardiography 225
Echocardiography 227
Exercise Electrocardiography (Treadmill) 227
Ambulatory Electrocardiographic Monitoring 227
Scintigraphic (Nuclear Medicine) Studies 227
Cardiac Magnetic Resonance Imaging 228
Cardiac Catheterization/Coronary Angiography 228
Hemodynamic Monitoring 228
Central Venous Pressure Monitoring 229
System Implementation 229

Coronary Artery Disease 229

Coronary Atherosclerosis 229
Types of Angina 230
Myocardial Infarction 232

Valvular Disease (Murmurs) 233

Mitral Stenosis 233
Mitral Insufficiency 233

Mitral Valve Prolapse 233
Aortic Valve Stenosis 234
Tricuspid Stenosis 234
Tricuspid Insufficiency 234
Heart Failure 234
Cardiomyopathy 237
Acute Pulmonary Edema 237

Cardiac Procedures 238

Angioplasty 238
Atherectomy 238
Coronary Stents 238
Pacemaker Insertion 238
Surgical Procedures 239

Inflammatory Heart Disease 240

Infective (Bacterial) Endocarditis 240
Pericarditis 241

Peripheral Vascular Disorders 241

Hypertension 241
Hypertensive Crisis 242
Thromboangiitis Obliterans
(Buerger's Disease) 243
Raynaud's Disease and Phenomenon 243
Deep Vein Thrombophlebitis 243
Varicose Veins 244

**Surgical Interventions
for Vascular Disorders 245**

Femoral Popliteal Bypass Graft 245
Aortic Aneurysms 245

**Commonly Used Drugs for the
Cardiovascular System 246**

Summary of Cardiac Drug Categories 246
Specific Drug Categories 246

**Cardiovascular System
Review Questions 253**

Cardiovascular System Answers
with Rationale 256

RESPIRATORY SYSTEM

Anatomy of Respiratory System 258

Upper Airway 258
Lower Airway 258

Principles of Ventilation 258

Respiration 258

Respiratory Pressures 259
 Oxygen and Carbon Dioxide Diffusion and Transportation of Respiratory Gases 260
 Regulation of Respiration 261
 System Assessment 261
 Diagnostic Procedures 262
 System Implementation 263
 Hypoxic Condition 264

Infectious Diseases 265

Pulmonary Tuberculosis 265
 Pneumonia 267
 Legionnaires' Disease 268
 Emerging Viruses 268

Chronic Obstructive Pulmonary Disease..... 268

Chronic Bronchitis 269
 Bronchiectasis 269
 Emphysema 269
 Asthma 271

Restrictive Respiratory Disorders 271

Pleural Effusion 271
 Pneumothorax 272
 Acute Respiratory Distress Syndrome 272
 Cancer of the Lung 273

Thoracic Trauma..... 274

Trauma Assessment 274
 Trauma Implementation 275

Thoracic Injuries..... 275

Hemothorax or Pneumothorax 275
 Open Wounds of the Chest 275
 Fractured Ribs 275
 Flail Chest 275
 Cardiac Tamponade 276

Treatment for Traumatic Injury 276

Chest Tube 276
 Chest Drainage Systems 277
 Mechanical Ventilation 279
 Thoracic Surgical Procedures 279
 Tracheostomy 280
 Suctioning 281
 Passy-Muir Speaking Valve 282

Pulmonary Medications 283

Sympathomimetic (Adrenergic) Bronchodilators 283

Anticholinergic Bronchodilators 283
 Methylxanthine Bronchodilators 283
 Leukotriene Inhibitors/Receptor Antagonists 283
 Antimediators (Mast Cell Stabilizers)/Anti-Inflammatory Agents 284
 Mucokinetic Agents 284
 Antiprotozoal Drugs 284

Respiratory System Review Questions 285

Respiratory System
 Answers with Rationale 288

GASTROINTESTINAL SYSTEM

Anatomy and Physiology 290

Main Organs 290
 Accessory Organs 291
 System Assessment 293
 Diagnostic Procedures 294

General Gastrointestinal Conditions 296

Anorexia 296
 Nausea and Vomiting 296
 Constipation and Diarrhea 297

Disorders of the Upper Gastrointestinal Tract..... 297

Oral Infections 297
 Disorder of the Salivary Glands 298
 Malignant Tumors of the Mouth 298
 Radical Neck Dissection 298
 Cancer of the Larynx 299
 Laryngectomy 299
 Gastroesophageal Reflux Disease 300
 Esophageal Varices 300
 Esophageal Hernia (Hiatal Hernia) 301
 Esophageal Lesions 302

Gastric Disorders..... 302

Dyspepsia Indigestion 302
 Anorexia Nervosa 303
 Acute Gastritis 303
 Chronic Gastritis 303
 Peptic Ulcer Disease 304

Surgical Intervention 306

Gastric Cancer 306
 Postoperative Period 306

Inflammatory Bowel Disease	307	Regional Enteritis (Regional Ileitis, Crohn's Disease) 307 Ulcerative Colitis 307
Intestinal Disorders.....	308	Malignant Tumors of the Intestine 308 Appendicitis 309 Intestinal Obstruction 310 Herniorrhaphy 310 Diverticulosis and Diverticulitis 311 Hemorrhoids 311 Anorectal Surgery 312
Disorders of Liver, Biliary, and Pancreatic Function	312	Diagnostic Evaluation Studies 312 Jaundice 313 Viral Hepatitis 314 Cirrhosis 316
Complications.....	317	Portal Hypertension 317 Esophageal Varices 318 Hepatic Encephalopathy 318 Cholecystitis and Cholelithiasis 319 Acute Pancreatitis 320 Chronic Pancreatitis 322
Gastrointestinal System Review Questions	323	Gastrointestinal System Answers with Rationale 326
GENITOURINARY SYSTEM		
Anatomy and Physiology	328	Kidney Structure 328 Kidney Function 328
Renal Regulation of Fluid and Electrolytes	329	Composition of the Body 329 Dynamics of Intercompartmental Fluid Transfer 330 Fluid Imbalances 330
Electrolyte Imbalances.....	331	Potassium Imbalance 331 Sodium Imbalance 332 Calcium Imbalance 333 Magnesium Imbalance 333
Acid–Base Regulation	334	Principles of Acid–Base Balance 334 Regulatory Mechanisms 334
Acid–Base Imbalances.....	335	Metabolic Acidosis 335 Metabolic Alkalosis 336 Respiratory Acidosis 337 Respiratory Alkalosis 338 System Assessment 339
Diagnostic Procedures	339	Renal Function Tests 339 Renal Imaging 340 GU Examination 340 Cystoscopy 341 System Implementation 341
Renal Disorders	341	Injuries to the Kidney 341 Urinary Tract Infections 342 Cystitis 342 Pyelonephritis 343 Glomerulonephritis 343 Nephrotic Syndrome 344 Tuberculosis of the Kidney 345
Surgical Interventions for the Renal System.....	345	Cystostomy 345 Urolithiasis 345 Urinary Diversion 346 Nephrectomy 347
Renal Failure	347	Acute Renal Failure 347 Chronic Renal Failure 348 Uremic Syndrome (Uremia) 348
Dialysis.....	349	Peritoneal Dialysis 349 Hemodialysis 351 Dialysis Management 352 Renal Transplant 353
Male Genitourinary Disorders	354	Prostatitis 354 Benign Prostatic Hypertrophy 354 Cancer of the Prostate 354 Prostatectomy 355

Conditions of the Female Reproductive Tract	355	Spinal Surgery.....	381
Menstruation	355	Laminectomy, Discectomy, Etc.	381
Menopause	356	Spinal Fusion	382
Vulvitis/Vaginal Infections	357	Harrington Rod Instrumentation	382
Endometriosis	357		
Pelvic Inflammatory Disease	357		
Toxic Shock Syndrome	358		
Conditions of the Uterus	358		
Fibroid Tumors	358		
Surgical Interventions.....	358		
Tumors of the Breast	358		
Cancer in the Reproductive System	359		
Hysterectomy	360		
Anterior and Posterior Colporrhaphy	361		
Pelvic Exenteration	362		
Genitourinary System Review Questions	363		
Genitourinary System Answers with Rationale	366		
MUSCULOSKELETAL SYSTEM			
Anatomy and Physiology	368	INTEGUMENTARY SYSTEM	
Bone Structure	368	Anatomy and Physiology	391
Long Bones	368	Skin	391
Joints	368	Hair	391
System Assessment	368	Sweat Glands	391
Joint and Nerve Disease.....	369	System Implementation	392
Rheumatoid Arthritis	369		
Osteoarthritis	370	Common Skin Lesions	392
Gout	371	Pressure Ulcers	392
Orthopedic and Vascular Conditions	371	Cellulitis	392
Osteoporosis	371	Impetigo	392
Compartment Syndrome	372	Herpes Simplex	393
Osteomyelitis	373	Herpes Zoster (Shingles)	393
Fractures	373	Syphilis	393
Traction	374		
Fractured Ribs	378	Allergic Responses.....	394
Hip Conditions	378	Eczema (Atopic Dermatitis)	394
Knee Surgery	380	Contact Dermatitis	394
Arthroscopy	380		
Crutch Walking	381	Skin Conditions.....	394
Diagnostic Test for Problems of the Spine	381	Malignant Skin Tumors	394
Myelogram	381	Lupus Erythematosus	395
Blood and Blood Factors	405	Burns.....	395
Blood Components	405	Degree of Burn According to Depth	395
System Assessment	406		
System Implementation	406	Lyme Disease	399
Integumentary System Review Questions	401		
Integumentary System Answers with Rationale	403	Integumentary System Review Questions	401
BLOOD AND LYMPHATIC SYSTEM			
Blood and Blood Factors	405		

■ Transfusion Administration	406
■ Transfusion Reactions	407
Hemolytic or Incompatibility Reaction	407
Allergic Reactions	408
Bacterial Contamination	409
Transmission of AIDS	409
Transmission of Viral Hepatitis	409
Circulatory Overload	409
Massive Blood Transfusion Reaction	409
Transfusion-Related Acute Lung Injury	410
■ Disorders of the Blood.....	410
Purpuras	410
Agranulocytosis	410
Polycythemia Vera	411
Anemia	411
Iron-Deficiency Anemia	412
Megaloblastic Anemia	412
Aplastic Anemia	413
Thrombocytopenia	413
■ Spleen	414
Hypersplenism	414
Rupture of the Spleen	414
Splenectomy	414
■ Neoplastic Blood Disorders.....	414
Leukemia	414
Acute Myeloid Leukemia	415
Chronic Myeloid Leukemia	416
Chronic Lymphocytic Leukemia	416
Acute Lymphocytic Leukemia	416
■ Malignancy of the Lymphatic System....	416
Hodgkin's Disease	416
Non-Hodgkin's Lymphoma	417
■ Blood and Lymphatic System Review Questions	418
Blood and Lymphatic System	
Answers with Rationale	420
ENDOCRINE SYSTEM	
■ Anatomy and Physiology	422
Function	422
Structure	422
System Assessment	422
System Implementation	424
■ Pituitary Gland Disorders.....	424
Acromegaly (Anterior Pituitary Hyperfunction)	424
Gigantism (Anterior Pituitary Hyperfunction)	425
Hypophysectomy	425
Dwarfism (Anterior Pituitary Hypofunction)	425
Diabetes Insipidus (Posterior Pituitary Hypofunction)	426
■ Adrenal Cortex Disorders.....	426
Addison's Disease (Adrenocortical Insufficiency)	426
Addisonian Crisis	427
Cushing's Syndrome (Adrenocortical Hyperfunction)	427
Primary Aldosteronism	428
■ Adrenal Medulla Disorders.....	428
Pheochromocytoma (Hyperfunction)	428
Adrenalectomy	429
■ Thyroid Gland Disorders	429
Cretinism (Thyroid Hypofunction)	429
Hypothyroidism (Myxedema)	430
Myxedema Coma	430
Hashimoto's Thyroiditis	431
Thyrotoxicosis/Hyperthyroidism/ Graves' Disease	431
Thyroidectomy	432
Thyroid Storm (Thyrotoxic Crisis)	432
■ Parathyroid Gland Disorders.....	433
Hypoparathyroidism	433
Hyperparathyroidism	434
Parathyroidectomy	434
■ Pancreas Disorders.....	435
Diabetes Mellitus (Types I and 2)	435
Syndrome X—Metabolic Syndrome	439
■ Complications	440
Ketoacidosis	440
Insulin Reaction/Hypoglycemia	440
Chronic Complications	441
Functional Hyperinsulinism/Hypoglycemia	443
■ Endocrine System Review Questions	444
Endocrine System Answers with Rationale	446

PERIOPERATIVE CARE CONCEPTS**Preoperative and Postoperative Care.....448**

- Routine Preoperative Care 448
Postanesthesia Unit 448
Phase II Surgical Unit 449

Anesthesia.....451

- Preoperative Medications 451

Postanesthesia453

- Postoperative Medications 453

Common Postoperative Complications.....455

- Respiratory Complications 459
Pneumonia 459
Atelectasis 459

Deep Vein Thrombophlebitis 459

Pulmonary Embolism 459

Fat Embolism Syndrome 460

Adult Respiratory Distress Syndrome 461

Wound Infections 461

Wound Dehiscence and Evisceration 462

Disseminated Intravascular Coagulation 462

Fluid Replacement Therapy.....463

- Fluid Replacement Solutions 463
Intravenous Calorie Calculation 463
Intravenous Regulation 463

Perioperative Care Concepts Review Questions465

- Perioperative Care Concepts
Answers with Rationale 467

NEUROLOGICAL SYSTEM

The nervous system (together with the endocrine system) provides the control functions for the body. Unique in its incredible ability to handle thousands of bits of information and stimuli from the sensory organs, this system of nerves and nerve centers coordinates and regulates all of this data and determines the responses of the body.

ANATOMY AND PHYSIOLOGY OF THE NERVOUS SYSTEM

Central Nervous System: Brain and Spinal Cord

A. Brain.

1. Cerebrum or cortex is the largest part of the human brain. (Consists of two hemispheres—right and left—separated by a fissure. It is responsible for the integration of complex sensory and neural functions and the initiation and coordination of voluntary activity in the body.) Each hemisphere receives sensory information from the opposite side of the body and controls the skeletal muscle of the opposite side.
 - a. Function.
 - (1) Highest level of functioning.
 - (2) Governs all sensory and motor activity, thought, and learning.
 - (3) Analyzes, associates, integrates, and stores information.
 - ◆ b. Cerebral cortex (outer gray layer)—divided into four major lobes.
 - (1) Frontal.
 - (a) Precentral gyrus—motor function.
 - (b) Broca's area—motor speech area.
 - (c) Prefrontal—controls morals, values, emotions, and judgment.
 - (2) Parietal.
 - (a) Postcentral gyrus—integrates general sensation.
 - (b) Interprets pain, touch, temperature, and pressure.
 - (c) Governs discrimination.
 - (3) Temporal.
 - (a) Auditory center.
 - (b) Wernicke's area—sensory speech center.
 - (4) Occipital—visual area.
 - c. Basal ganglia.

- (1) Collections of cell bodies in white matter.
- (2) Controls motor movement.
- (3) Part of extrapyramidal tract.
2. Diencephalon.
 - a. Thalamus.
 - (1) Screens and relays sensory impulses to cortex.
 - (2) Lowest level of crude conscious awareness.
 - ◆ b. Hypothalamus—regulates autonomic nervous system, stress response, sleep, appetite, body temperature, fluid balance, and emotions.
3. Brain stem.
 - a. Midbrain—motor coordination, conjugate eye movements.
 - b. Pons.
 - (1) Contains projection tracts between spinal cord, medulla, and brain.
 - (2) Controls involuntary respiratory reflexes.
 - c. Medulla oblongata.
 - (1) Contains all afferent and efferent tracts.
 - (2) Decussation (intersection) of most upper motor neurons (pyramidal tracts).
 - (3) Contains cardiac, respiratory, vomiting, and vasomotor centers.
4. Cerebellum.
 - a. Connected by afferent/efferent pathways to all other parts of central nervous system (CNS).
 - b. Coordinates muscle movement, posture, equilibrium, and muscle tone.
- B. Spinal cord.
 1. Structure.
 - a. Conveys messages between brain and the rest of the body.
 - b. Extends from foramen magnum to second lumbar vertebra.
 - c. Inner column of H-shaped gray matter that contains two anterior and two posterior horns.
 - d. Posterior horns—contain cell bodies that connect with afferent (sensory) nerve fibers from posterior root ganglia.
 - e. Anterior horns—contain cell bodies giving rise to efferent (motor) nerve fibers.
 - f. Lateral horns—present in thoracic segments; origin of autonomic fibers of sympathetic nervous system.
 - g. White matter of cord contains nerve tracts.

- (1) Principal ascending tracts (sensory pathways).
- Lateral spinothalamic—governs pain, temperature (contralateral).
 - Anterior spinothalamic—governs touch, pressure (contralateral).
 - Posterior column to medial lemniscus—governs proprioception, vibration, touch, pressure (ipsilateral).
 - Spinocerebellar—governs bilateral proprioception to posterior and anterior portions of the cerebellum.
- (2) Principal descending tracts (motor pathways).
- Pyramidal, upper motor neuron, or corticospinal—from motor cortex to anterior horn cell. Tract crosses in medulla.
 - Extrapyramidal tracts consist of corticorubrospinal, corticoreticulospinal and vestibulospinal. These tracts facilitate or inhibit flexor/extensor activity.
2. Protection for CNS.
- Skull—rigid chamber with opening at the base (foramen magnum).
 - Meninges—three layers of protective membranes.
 - Dura mater—tough, fibrous membrane—forms falx, tentorium.
 - Arachnoid membrane—delicate membrane that contains subarachnoid fluid.
 - Pia mater—vascular membrane.
 - Ventricles are a communicating network of cavities filled with cerebrospinal fluid (CSF) located within the brain parenchyma.
 - Four ventricles—two lateral, the cerebral aqueduct, and the fourth ventricle.
 - Communication between subarachnoid space.
 - Subarachnoid space—formed by the arachnoid membrane and the pia mater.
 - Produce and circulate cerebrospinal fluid.
- ◆ d. CSF
- Secreted from choroid plexuses in lateral ventricles, third ventricle, and fourth ventricle.
- (2) Circulates within interconnecting ventricles and subarachnoid space.
- (3) Protective cushion; aids exchange of nutrients and wastes.
- (4) Normal pressure: 60 to 180 mm H₂O.
- (5) Volume: 80 to 200 mL, average 130 mL.
- (6) Allows fluid shifts from cranial cavity to the spinal cavity.
- e. Blood-brain barrier.
- CSF.
 - Brain parenchyma.
 - Structure of brain capillaries differs from other capillaries. Some substances that normally pass into most tissue are prevented from entering brain tissue. This barrier protects the brain from certain harmful agents and limits penetration of some drugs.
- f. Blood supply—conductor of oxygen vitally needed by nervous system.
- Internal carotids branch to form anterior and middle cerebral arteries.
 - Vertebral arteries arise from the subclavian arteries and merge to form the basilar arteries, which then subdivide into the two posterior cerebral arteries.
 - Circle of Willis—formed as the anterior communicating artery bridges the anterior cerebral arteries, and as the posterior communicating artery bridges each posterior and middle cerebral artery.
- ### Neuron Structure and Function
- A. Structure.
- Cell body (gray matter).
 - Processes (nerve fibers).
 - Axon conducts impulses from cell body.
 - Dendrites receive stimuli from the body and transmit them to the axon.
 - Synapse—chemical transmission of impulses from one neuron to another.
- B. Myelin sheath (white matter).
- Surrounds axon.
 - Insulates; correlates with function and speed of conduction.
 - Produced by neurilemma cells in peripheral nerve fibers (sheath of Schwann).
 - Produced by neuroglial cells in CNS fibers.
- ◆ C. Classification by function.
- Sensory (afferent)—conducts impulses from end of the organ to CNS.

2. Motor (efferent)—conducts impulses from CNS to muscles and glands.
 3. Internuncial (connector)—conducts impulses from sensory to motor neurons.
 4. Somatic—innervates body wall.
 5. Visceral—innervates the viscera.
- D. Reflex arc (basic unit of function).
1. Receptor—receives stimulus.
 2. Afferent pathway—transmits impulses to spinal cord.
 3. CNS—integration takes place at synapse between sensory and motor neurons.
 4. Efferent pathway—motor neurons transmit impulses from CNS to effector.
 5. Effector—the organ or muscle that responds to the stimulus.
- E. Regeneration of destroyed nerve fibers.
1. Peripheral nerve—can regenerate, possibly due to neurilemma.
 2. CNS—cannot regenerate; lacks neurilemma.

Peripheral Nervous System

Nerves (Cranial and Spinal)

- ◆ A. Cranial nerves—12 pairs of parasympathetic nerves with their nuclei along the brain stem.
- B. Spinal nerves (31 pairs).
 1. All mixed nerve fibers formed by joining the anterior motor and posterior sensory roots.
 2. Anterior root—efferent nerve fibers to glands and voluntary and involuntary muscles.
 3. Posterior root—afferent nerve fibers from sensory receptors. Contains posterior ganglion—the cell body of sensory neuron.

Dysfunction of Cranial Nerves

- A. Eye deviation from midline or unusual movements.
 1. Unilateral pupil dilation: compression of the third cranial nerve (controls pupillary constriction).
 2. Fixed pupils, often unequal: midbrain injury.
 3. Pinpoint, fixed pupils, often unequal: pontine damage.

CRANIAL NERVES

This table correlates cranial nerves (CN) to areas of the brain stem, classification, and major function. The brain stem is responsible for vital functions. Disruption of this area can cause cranial nerve deficits, ataxia, coma, or brain death. CN evaluation can identify the level of the lesion in the brain stem. New onset cranial nerve deficits or changes in response to stimulation may indicate brain herniation.

Nerve	Brain Stem Area	Classification		Major Functions
		Sensory/Motor	Major Functions	
Olfactory	Directly above midbrain	Sensory		Smell
Optic	Directly above midbrain	Sensory		Vision (acuity and field of vision); pupil reactivity to light and accommodation (afferent impulse)
Oculomotor	Midbrain	Motor		Most extraocular movements (EOMs): upward, downward and medial gaze, eyelid opening pupil size and reactivity (efferent impulse)
Trochlear	Midbrain	Motor		EOM (turns eye downward and laterally—inward gaze)
Trigeminal	Pons	Both		Movement of jaw, chewing; facial and mouth corneal reflex (sensory)
Abducens	Pons	Motor		EOM (turns eye laterally)
Facial	Pons	Both		Facial expression; taste; corneal (blink) reflex (motor); eyelid and lip closure
Acoustic	Pons	Sensory		Hearing; equilibrium—vestibular response
Glossopharyngeal	Medulla	Both		Gagging and swallowing (sensory); taste
Vagus	Medulla	Both		Gagging and swallowing (motor); speech (phonation), cough reflex
Spinal accessory	Medulla	Motor		Shoulder movement; head rotation, neck muscle
Hypoglossal	Medulla	Motor		Tongue movement; speech (articulation)

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- ◆ B. Reflexes present with dysfunction.
 - 1. Plantar (called Babinski): dorsiflexion ankle and great toe with fanning of other toes; indicates disruption of pyramidal tract.
 - a. Paralyzed side in cerebrovascular accident (CVA).
 - b. Bilateral presence with spinal cord injury.
 - 2. Corneal (blink): Loss of blink reflex indicates dysfunction of fifth cranial nerve (danger of corneal injuries).
 - 3. Gag: Loss of gag reflex indicates dysfunction on the ninth and tenth cranial nerves (danger of aspiration).

Autonomic Nervous System

- A. Structure and function.
 - 1. The term “autonomic” means that this system operates independently of desires and intentions.
 - 2. Part of the peripheral nervous system controlling smooth muscle, cardiac muscle, and glands.
 - 3. The autonomic nervous system (ANS) is divided into two components.
 - a. Sympathetic.
 - b. Parasympathetic.
 - c. Two divisions make involuntary adjustments for integrated balance (homeostasis).
- B. Diseases of sympathetic nerve trunks result in specific syndromes.
 - 1. Dilation of pupils.
 - 2. Bowel paralysis.
 - 3. Variations in pulse rate and rhythm.
- C. Structure of sympathetic nervous system—thoracolumbar division.
 - 1. Long postganglionic (adrenergic) fibers.
 - 2. Fibers arise in brain stem and descend to gray matter in spinal cord from C8 to L2.
- D. Structure of parasympathetic nervous system—craniosacral division.
 - 1. Short postganglionic (cholinergic) fibers.
 - 2. Cells lie in brain stem and sacral region of spinal cord.

System Assessment

- A. Evaluate client’s history regarding common signs, symptoms, and risk factors.
 - 1. Signs and symptoms.
 - a. Numbness, weakness.
 - b. Dizziness, fainting, loss of consciousness.
 - c. Headache, pain.
 - d. Speech disturbances.
 - e. Visual disturbances.
 - f. Disturbances in memory, thinking, personality.
 - g. Nausea, vomiting.

- 2. Risk factors.
 - a. Trauma.
 - b. Tumors.
 - c. Hypoxia.
 - d. Hemorrhage.
 - e. Infections.
 - f. Exposure to or ingestion of toxic substances.
 - g. Metabolic and endocrine disorders.
 - h. Hypertension.
- ◆ B. Assess client’s level of consciousness.
 - 1. Evaluate cerebral function (most sensitive and reliable index of consciousness).
 - 2. Evaluate level of consciousness.
 - 3. Assess behavior to determine level of consciousness: clouding, confusion, delirium, stupor, coma.
- ◆ C. Evaluate pupillary signs.
 - 1. Assess size: Measure in millimeters; compare each eye.
 - 2. Assess equality: equal, unequal, fluctuations.
 - 3. Assess reactions to light: brisk, slow, fixed.
 - a. Light reflex is most important sign differentiating structural from metabolic coma.
 - b. Early warning of deteriorating condition or elevated intracranial pressure (ICP).
 - 4. Evaluate unusual eye movements or deviations from midline.
- ◆ D. Evaluate motor function.
 - 1. Assess face and upper and lower extremities for:
 - a. Muscle tone, strength, equality; normal is equal bilaterally.
 - b. Voluntary movement.
 - c. Involuntary movements.
 - d. Reflexes: Babinski, corneal, gag.
 - 2. Evaluate patterns of motor function.
 - 3. Inappropriate—nonpurposeful.
 - a. Involuntary.
 - (1) Choreiform (jerky, quick).
 - (2) Athetoid (twisting, slow).
 - (3) Tremors.
 - (4) Spasms.
 - (5) Convulsions.
- E. Assess reflexes.
 - 1. Evaluate for presence of reflexes.
 - 2. Identify reflex response.
 - a. Scale is 0 to 4.
 - b. Absence of reflex is rated 0.
 - c. Weak response is rated 1.
 - d. Normal response is rated 2.
 - e. Exaggerated response is rated 3.
 - f. Hyperreflexia is rated 4.

- g. Clonus is an abnormal response of continued rhythmic contraction of the muscle after the stimulus has been applied.
- F. Evaluate sensory function.
- G. Evaluate vital signs.
 - ◆ 1. Increasing blood pressure (BP) with reflex slowing of pulse—compensatory stage with increasing intracranial pressure.
 - ◆ 2. Fall in blood pressure with increasing or irregular pulse—decompensation.
 - 3. Assess respiratory rate and rhythm.
- ◆ H. Evaluate intracranial pressure.
- ◆ I. Evaluate autonomic nervous system.
 - ◆ 1. Assess for sympathetic function.
 - a. Fight, flight, or freeze; diffuse response.
 - b. Increases heart rate, blood pressure.
 - c. Dilates pupils, bronchi.
 - d. Decreases peristalsis.
 - e. Increases perspiration.
 - f. Increases blood sugar.
 - ◆ 2. Assess for parasympathetic function.
 - a. Repair, repose; discrete response.
 - b. Decreases heart rate, blood pressure.
 - c. Constricts pupils, bronchi.
 - d. Increases salivation and peristalsis.
 - e. Dilates blood vessels.
 - f. Bladder contraction.
- J. Assess for pain.
 - 1. Assess for nonverbal signs of pain (e.g., facial grimaces, retracting from painful stimuli).
 - 2. Evaluate onset, location, intensity, duration, and aggravating factor.
 - 3. Observe for precipitating factors, associated manifestations, and alleviating factors.
 - 4. Assess ability to distinguish between sharp and dull sensation; use cotton-tip applicator and wooden end.

DIAGNOSTIC PROCEDURES

Skull Series

- A. Procedure: x-rays of head from different angles.
- B. Purpose: to visualize configuration, density, and vascular markings.
- C. Tomograms: layered vertical or horizontal x-ray exposures.

Myelography

- A. Injection of dye or air into lumbar or cisternal subarachnoid space followed by x-rays of the spinal column.
- ◆ B. Purpose: to visualize spinal subarachnoid space for distortions caused by lesions or tumors.

- C. Potential complications.
 - 1. Same as for lumbar puncture.
 - 2. Cerebral meningeal irritation from dye.
- D. Nursing implementation.
 - 1. If dye is used, elevate head and observe for meningeal irritation.
 - 2. If air is used, keep head lower than trunk.
 - 3. Frequently observe neurological signs and vital signs and compare to baseline.
 - 4. Check for adequate voiding.

Cerebral Angiography

- A. Injection of radiopaque dye into femoral, carotid, and/or vertebral arteries followed by serial x-rays.
- B. Purpose: to visualize cerebral vessels and localize lesions such as aneurysms, occlusions, angiomas, hematomas, tumors, arteriovenous malformations, or abscesses.
- ◆ C. Potential complications.
 - 1. Anaphylactic reaction to dye.
 - 2. Local hemorrhage.
 - 3. Vasospasm.
 - 4. Adverse intracranial pressure.
- ◆ D. Nursing implementation.
 - 1. Prior to procedure.
 - a. Check for allergies.
 - b. Take baseline assessment.
 - c. Measure neck circumference.
 - 2. During procedure and postprocedure.
 - a. Have emergency equipment available.
 - b. Monitor neurological and vital signs for shock, level of consciousness, hemiparesis, hemiplegia, and aphasia.
 - c. Monitor puncture site for bleeding as well as swelling of neck and difficulty in swallowing or breathing.
 - d. Apply ice collar for carotid punctures as ordered.

Magnetic Resonance Imaging

- A. Visualization of distribution of hydrogen molecules in the body in three dimensions.
- B. Purpose: to differentiate types of tissues, including those in normal and abnormal states (includes brain, both tumors and vascular abnormalities, as well as cardiac, respiratory, and renal conditions).
- C. Magnetic resonance imaging (MRI) yields greater contrast in the images of soft-tissue structures than CT scan.
- D. Requires longer time to complete. May not be appropriate when evaluating life-threatening situations.

SAFETY MEASURES AND NURSING INTERVENTIONS FOR THE MRI

- Review client history for contraindications: pins, plates, pacemakers, artificial heart valves, or other implants that may be dislodged by a magnetic field.
- Explain procedure.
- Obtain informed consent.
- Assess ability to withstand being in a confined area—client must remain in a cylindrical machine for up to 90 minutes. Open MRI may be required for those who cannot tolerate closed spaces.
- Have client use the bathroom before test.
- Have client remove all jewelry, hair clips, clothing with metal fasteners, dentures.
- Instruct client to remove hearing aids and glasses before entering the scanner.
- Closely monitor clients with potential respiratory or cardiac collapse.

Computerized Tomography Scan

- A. Procedure: a diagnostic imaging procedure that uses a combination of x-rays and computer technology to produce horizontally and vertically cross-sectional images of the body to analyze relative tissue density as an x-ray beam passes through. Done with or without contrast.
- B. Purpose: Provides detailed three-dimensional images of any part of the body, including the bones, muscles, fat, and organs, to determine location and extent of tumors, infarcted areas, vascular lesions/ abnormalities, or tissue atrophy.
- C. Nursing implementation.
 1. Explain procedure; advise client that he or she will have to lie still.
 2. Obtain informed consent.
 3. Assess for allergy to iodine, a component of the contrast material.
 4. Withhold food for approximately 2 hours; contrast may cause nausea and vomiting.
 5. Have client use the bathroom before the test.
 6. Have client remove all hair pieces, pins, and clips prior to computerized tomography (CT) of head.
 7. Instruct client to remove hearing aids and glasses before the test.

Tomography

- ♦ A. Type of brain scan that relies on tissue density and shadows to reflect internal state of brain tissue.
- B. EMI scanner (CT scan).
- C. Xenon computed tomography quantitative cerebral blood flow (Xe/CT/CBF).
 1. Precisely measures blood flow to various areas of the brain.

2. Defines degree and extent of ischemia in an acute neurologic condition.
3. Enables clinicians to identify irreversibly damaged brain tissue hours to days before changes become evident on standard CT or MRI tests.
4. Most often used to select stroke clients for thrombolytic therapy.
5. Identifies and manages vasospasm after subarachnoid hemorrhage.
6. Diagnoses brain death by confirming the absence of cerebral blood flow.
7. Determines the effect of hyperventilation when used with head trauma clients with increased intracranial pressure (ICP).
8. Evaluates the effectiveness of interventions to increase cerebral perfusion (e.g., hypertensive therapies).
9. Provides both quantitative and qualitative measurement of blood flow.
10. Xenon gas eliminated from body within 20 minutes, test can be repeated quickly if needed.
11. Client prep as for normal noncontrast CT.

Positron Emission Tomography

- A. Procedure: a computerized image of regional metabolic activity of the body tissues used to determine the presence of disease. The test involves injecting a very small dose of a radioactive glucose, called a radiotracer, into a vein. A scanner is used to make detailed, computerized pictures of areas inside the body where the glucose is metabolized, blood flows, and oxygen is extracted.
- B. Purpose: A positron emission tomography (PET) scan differs from other imaging tests such as CT scan or MRI in that it reveals cellular-level metabolic changes occurring in an organ or tissue where disease processes begin.
 1. A PET scan can often detect these very early changes, whereas a CT or MRI detects changes a little later—as the disease causes changes in the structure of organs or tissues.
 2. PET scans can detect cancer, brain disorders (including brain tumors, memory disorders, and seizures), and other CNS problems.
- C. Nursing implementation.
 1. Explain procedure. Advise client that he or she will have to lie still during procedure and may require sedation—if so, use carefully with head injury or surgery. Explain that the client will have two intravenous (IV) lines.
 2. Obtain informed consent.
 3. Withhold food for approximately 4–6 hours.
 4. Have client use the bathroom before the test.

Electroencephalography

- A. Procedure: graphic recording of brain's electrical activity by electrodes placed on the scalp.
- B. Purpose: to detect intracranial lesion and characteristic abnormal electrical activity (seizures).
- C. Nursing implementation.
 1. Wash hair.
 2. Withhold sedatives or stimulants.
 3. Administer fluids as ordered.

Electromyography

- A. Procedure: recording the potential of muscle action by surface or needle electrodes.
- B. Purpose: to diagnose or localize neuromuscular disease.

Lumbar Puncture

- ◆ A. Procedure: insertion of spinal needle through L3–4 or L4–5 interspace into lumbar subarachnoid space.
- B. Purpose.
 1. To obtain cerebrospinal fluid (CSF).
 2. To measure intracranial pressure and spinal fluid dynamics.
 3. To instill air, dye, or medications.
- C. Potential complications: headache, backache, and herniation with brain stem compression (especially if intracranial pressure is high).
- D. Nursing implementation.
 1. Explain procedure. Advise client that he or she will have to lie or sit still during procedure.
 2. Obtain informed consent.
 3. Have client empty bowel and bladder before the test.
 4. Monitor vital signs.
 5. Position client in a position that will facilitate enlarging the opening of the vertebral space.
 - a. Lying on side with feet drawn up, head to chest on edge of bed.
 - b. Sitting on side of bed, leaning over bedside table, support feet on flat surface.
 6. Assist with specimen collection and spinal fluid dynamics.
 7. Post procedure.
 - a. Maintain client in prone position for 2 hours or flat side-lying for 2–3 hours to avoid headache.
 - b. Assess puncture site for CSF leakage—a complication of lumbar puncture (LP).
 8. Label specimens, send to lab; note color and amount of fluid.
 9. Assess for signs of shock.
 10. Maintain asepsis and administer fluids unless contraindicated.

- E. Spinal fluid dynamics—Queckenstedt–Stookey test.
 1. Normal pressure is 60–150 mm H₂O when client is in lateral recumbent position. Pressure increases with jugular compression and drops to normal 10–30 seconds after release of compression.
 2. Partial block: slow rise and return to normal.
 3. Complete block: no rise.

♦ System Implementation

- A. Observe for and treat seizure activity.
- B. Monitor vital signs for signs of hyperthermia, increased intracranial pressure, and infection.
- C. Observe motor and sensory function.
- D. Observe pupillary signs for metabolic or structural complications.
- E. Prevent muscle weakness and atrophy through range-of-motion exercises.
- F. Promote bowel and bladder function.
- G. Maintain nutritional status.
- H. Prevent complications of immobility (e.g., skin breakdown).
- I. Provide emotional support for client and family during hospitalization and upon discharge.
- J. Monitor cardiac and respiratory function for identification of potential complications.
- K. Provide appropriate preoperative and postoperative nursing interventions.
- L. Establish an individualized rehabilitative program.
- M. Administer drug therapy and monitor side effects.
- N. Institute nursing implementation to assist in decreasing intracranial pressure.
- O. Establish appropriate measures for pain relief.

NEUROLOGIC DYSFUNCTION

The Unconscious Client

Definition: Unconsciousness is a state of depressed cerebral functioning with altered sensory and motor function.

Assessment

- A. Possible causes: vascular disorders, intracranial mass, head trauma, cerebral toxins, metabolic disorders, acute infection.
 1. Intracranial.
 - a. Supratentorium mass/lesion compressing or displacing brain stem.
 - b. Infratentorium destructive lesions.
 2. Extracranial.
 - a. Metabolic encephalopathy (most common).
 - b. Psychiatric conditions.

- ◆ B. Glasgow Coma Scale below provides objective, consistent way to monitor client's neurological condition.
 1. Comatose state based on three areas associated with level of consciousness.
 - ◆ 2. Scoring system.
 - a. Based on a scale of 1 to 15 points.
 - b. Any score below 8 indicates coma is present; the lowest score, 3, indicates severe impairment or that the client may be deceased.
 - ◆ 3. Eye opening is the most important indicator.
- C. Respiratory function and airway patency.
- D. Adequate circulation.
- E. Fluid and electrolyte balance.

GLASGOW COMA SCALE	
A. Motor response.	Points
1. Obeys a simple command	6
2. Localizes painful stimuli; attempts to remove offending stimulus; lack of obedience	5
3. Withdrawn—moves purposelessly in response to pain	4
4. Abnormal flexion—decorticate posturing	3
5. Extensor response—decerebrate posturing	2
6. No motor response to pain	1
B. Verbal response.	Points
1. Oriented—to time, place, and person	5
2. Confused conversation; disorientation in one or more spheres	4
3. Inappropriate or disorganized use of words (cursing); lack of sustained conversation	3
4. Responds with incomprehensible sounds	2
5. No verbal response (Record T if an endotracheal or tracheostomy tube is in place)	1
C. Eye opening.	Points
1. Spontaneous when a person approaches	4
2. In response to speech	3
3. Only in response to pain	2
4. Do not open, even to painful stimuli (Record C if eyes are closed by swelling)	1

This scale is a tool for assessing a client's response to stimuli. Scores range from 3 (deep coma) to 15 (normal). Add numbers to determine a total score.

Implementation

- ◆ A. Maintain open airway and adequate ventilation.
 1. Check for airway obstruction.
 - a. May result in retention of carbon dioxide (with cerebral vasodilation, edema, and increased intracranial pressure).
 - b. Hypoxia (with potential irreversible brain damage).
 - ◆ 2. Monitor respiratory signs and symptoms continuously.
 - a. Color, chest expansion, deformities.
- ◆ b. Rate, depth, and rhythm of respirations.
- c. Air movement at nose/mouth or through endotracheal tube.
- d. Breath sounds, adventitious sounds.
- e. Accumulation of secretions or blood in mouth.
- f. Signs of respiratory distress: hypoxemia, hypercapnia, or atelectasis.
- ◆ 3. Provide airway.
 - a. Head tilt; modified jaw thrust if cervical injury suspected.
 - b. Cuffed endotracheal or tracheostomy tube (maintain airway, avenue for suctioning and/or mechanical ventilation).
 - c. Assisted ventilation if necessary.
- 4. Position client to facilitate breathing.
 - a. Side-lying or semiprone (to prevent tongue from occluding airway and secretions from pooling in pharynx).
 - b. Frequent change of position.
- 5. Provide pulmonary toilet.
 - a. Deep breathing and coughing if not contraindicated.
 - b. Suctioning of secretions as necessary.
- 6. Have emergency equipment available.
- B. Maintain adequate circulation.
 - ◆ 1. Blood pressure.
 - a. Hypertension—result of increased intracranial pressure.
 - b. Hypotension—result of immobility.
 - 2. Pulse.
 - a. Check quality and presence of all pulses.
 - b. Check rate and rhythm of apical and/or radial pulse.
 - c. Hypoxia may cause arrhythmias.
 - d. Usually premature ventricular contractions.
 - C. Monitor neurological status.
 1. Level of consciousness.
 2. Pupillary signs.
 3. Motor function.
 4. Sensory function.
 - ◆ D. Maintain nutrition, fluid and electrolyte balance.
 1. Keep client NPO while unconscious (check for gag and swallowing reflexes).
 2. Give intravenous fluids, hyperalimentation as required—check for dehydration.
 3. Use caution with IV rates in presence of increased intracranial pressure.
 4. Record intake, output, and daily weight.
 5. Maintain oral and nasal hygiene.
 6. Resume oral intake carefully as consciousness returns.
 - a. Check gag reflex.

- b. Use ice chips or water as first liquid.
 - c. Keep suction equipment ready.
- E. Promote elimination.
1. Urinary: retention catheter.
 - a. Maintain daily hygiene of meatus.
 - b. Ensure patency to prevent bladder distention, urinary stasis, infection, and urinary calculi.
 - c. Evaluate amount, color, consistency of output; check specific gravity.
 2. Bowel: suppositories and enemas.
 - a. Establish routine elimination patterns.
 - b. Observe for complications.
 - c. Check for paralytic ileus.
 - (1) Abdominal distention.
 - (2) Constipation and/or impaction.
 - (3) Diarrhea.
- F. Maintain integrity of the skin.
- ◆ 1. High risk of pressure ulcers due to:
 - a. Loss of vasomotor tone.
 - b. Impaired peripheral circulation.
 - c. Paralysis, immobility, and loss of muscle tone.
 - d. Hypoproteinemia.
 - 2. Loss of sensation of pressure, pain, or temperature—decreased awareness of developing pressure ulcers or burns.
 - 3. Monitor for edema: dependent areas.
 - 4. Skin care.
 - a. Clean and dry skin; avoid powder because it may cake.
 - b. Massage with lotion around and toward bony prominences once a day if area is not red.
 - c. Alternate air fluidized therapy bed with egg crate mattress.
 - d. Keep linen from wrinkling; avoid mechanical friction against linen.
 - e. Turn client every 2 hours; position with pillows to protect pressure on bony prominences.
- G. Maintain personal hygiene.
- ◆ 1. Eye: Loss of corneal reflex may contribute to corneal irritation, keratitis, blindness.
 - a. Assess corneal reflex and signs of irritation.
 - b. Instill artificial tears or close eyelids and cover with moistened pads to protect cornea.
 - 2. Nose: Trauma or infection in nose or nasopharynx may cause meningitis.
 - a. Observe for drainage of CSF.
 - b. Clean and lubricate nares; do not clean inside nostrils.
- c. Change nasogastric (NG) tube per policy and PRN.
 - 3. Mouth: Mouth breathing contributes to drying and crusting excoriation of mucous membranes, which may contribute to aspiration and respiratory tract infections.
 - a. Examine the mouth daily with a good light.
 - b. Clean teeth, gums, mucous membranes, tongue, and uvula to prevent crusting and infection; lubricate lips.
 - c. Inspect for retained food in the mouth of clients who have facial paralysis; follow with mouth care.
 - ◆ 4. Ear: Drainage of CSF from the ear indicates damage to the base of the brain and a danger of meningitis.
 - a. Inspect ear for drainage of CSF; if clear drainage tests positive for glucose (using a Labstix), drainage is CSF. Notify physician immediately.
 - b. Loosely cover ear with sterile, dry dressing.
- ◆ H. Maintain optimal positioning and movement.
1. Prevent further trauma.
 - a. Maintain body alignment, support head and limbs when turning, logroll.
 - b. Do not flex or twist spine or hyperextend neck if spinal cord injury is suspected.
 2. Provide adequate positioning.
 - a. Disuse of muscle leads to contractures, osteoporosis, and compromised venous return.
 - b. Maintain and support joints and limbs in most functional anatomic position.
 - c. Avoid improper use of knee gatch or pillows under knee.
 - d. Use a footboard or high-top sneakers to prevent footdrop. If sneakers are used, be sure to remove daily and inspect feet.
 3. Avoid complete immobility.
 - a. Perform range of motion (against resistance if possible), weight bearing, and/or tilt table.
 - b. Change position every 2 hours.
- I. Provide psychosocial support for client and family.
1. Assume that an unconscious client can hear; frequently reassure and explain procedures to client.
 2. Encourage family interaction.
- ◆ J. Institute safety precautions.
1. Use side rails at all times.
 2. Remove dentures and dental bridges.
 3. Remove contact lenses.
 4. Avoid restraints.

5. Do not leave client who is unstable unattended for more than 15–30 minutes.
6. Keep tongue blade at bedside.

Increased Intracranial Pressure

Definition: An increase in intracranial bulk due to blood, CSF, or brain tissue leading to an increase in pressure. Can be caused by trauma, hemorrhage, tumors, abscess, contusion, hydrocephalus, edema, inflammation, or metabolic insult to the body. This is a potentially life-threatening situation because it diminishes cerebral perfusion pressure (CPP), increases the risks of brain ischemia and infarction, and is linked to a poor prognosis.

Assessment

- ◆ A. Level of consciousness (LOC): most sensitive indication of increasing intracranial pressure (ICP)—changes from restlessness to confusion to declining level of consciousness and coma.
 1. Orientation to person, place, purpose, time.
 2. Response to verbal/tactile stimuli or simple commands.
 3. Response to painful stimuli: purposeful/nonpurposeful, decorticate, decerebrate, no response.
- ◆ B. Respiration: rate, depth, and rhythm are more sensitive indications of intracranial pressure than blood pressure and pulse—abnormal breathing patterns associated with ICP.
 1. Cheyne–Stokes—rhythmically waxes and wanes, alternating with periods of apnea.
 2. Neurogenic hyperventilation.
 - a. Sustained regular, rapid, and deep.
 - b. Low midbrain, middle pons.
 3. Apneustic—irregular breathing with pauses at end of inspiration and expiration.
 4. Ataxic (Biot's)—totally irregular, random rhythm and depth.
 5. Apnea may occur.
- ◆ C. Headache—tension, displacement of brain.
- ◆ D. Vomiting—irritation of vagal nuclei in floor of fourth ventricle; may be projectile.
- ◆ E. Pupillary changes.
 1. Unilateral dilation of pupil; slow reaction to light (light reflex is most important sign differentiating structural from metabolic coma).
 2. Unilateral, fixed, dilated pupil is ominous sign requiring immediate action—may indicate transtentorial herniation of the brain.
- ◆ F. Motor function—weakness, hemiplegia, positive Babinski, seizure activity.
 1. Assessment of posturing in response to noxious stimuli.

- a. Decorticate—nonfunctioning cortex, internal capsule (upper-extremity flexion, and may stiffen and extend legs).
 - b. Decerebrate—brain stem lesion (total stiff extension of one or both arms and legs).
- ◆ G. Pulse and blood pressure.
1. Monitor for trends; changes are often unreliable and occur late with increasing intracranial pressure.
 2. Rise in blood pressure, widening pulse pressure; reflex slowing of pulse.
 - a. Cushing's triad—when systolic pressure rises and pulse slows but is more forceful. Tells you ICP is rising but body is coping, irregular respirations. Cushing's triad is a medical emergency as it is the sign of brain stem compression and impending death.
 - ◆ b. When systolic pressure drops (below 50 mm Hg) and pulse becomes irregular, thready, and rapid, body is no longer coping—danger.
 - H. Hyperthermia—possible complication—can signal infection, hemorrhage, or traction on the hypothalamus or brain stem.

SIGNS SUGGESTING INCREASED INTRACRANIAL PRESSURE (ICP)

Normal pressure is 10 to 15 mm Hg.

- Level of consciousness (LOC) is the most sensitive indication of increased ICP.
- Specific signs to assess for:
 1. Observe for deteriorating LOC, restlessness, confusion, irritability to declining level of consciousness and coma.
 2. Check for severe headache caused by tension and displacement of the brain.
 3. Observe for vomiting—caused by irritation of the vagal nuclei floor of fourth ventricle.
 4. Assess papillary changes—dilated or pinpoint, slow/no reaction to light; fixed dilated pupils is an ominous sign requiring immediate nursing intervention.
 5. Assess deterioration in motor function—weakness, hemiplegia, positive Babinski, abnormal posturing (decorticate or decerebrate), flaccidity, seizure activity.
 6. Assess vital signs:
 - a. Cushing reflex—a late sign characterized by severe hypertension with rise in blood pressure, widening pulse pressure (systolic–diastolic), and bradycardia.
 - b. Note abnormalities in respiration, especially periods of apnea; Cheyne–Stokes respirations, central neurogenic hyperventilation, temperature elevation.

Implementation

- A. Acute phase: surgical management.
 1. ICP monitoring.

- a. Used to guide clinical plan of care and treatment for clients at risk for or who have increased ICP. Should be used if Glasgow Coma Scale (GCS) score is < 8 or if client has abnormal CT or MRI.
 - (1) Methods:
 - (a) Ventriculostomy: A specialized catheter is placed in the lateral ventricle coupled with an external transducer.
 - i. To insert an intraventricular catheter, a burr hole is drilled through the skull. This directly measures the pressure in the ventricle and allows for administration of drugs, sampling, and removal of CSF. The intraventricular catheter is thought to be the most accurate method.
 - ii. The ICP can be monitored this way. The ICP also can be lowered by draining CSF out through the catheter.
 - iii. The catheter may be hard to get into place when the intracranial pressure is high.
 - (b) Fiber optic catheter: Uses a sensor transducer located within the tip of the catheter. The catheter is placed within the ventricle or brain tissue. It allows for direct measurement of brain pressure. If an epidural sensor is used, it is inserted between the skull and dural tissue. The epidural sensor is placed through a burr hole drilled in the skull. This procedure is less invasive than other methods, but it cannot remove excess CSF.
 - (c) Subarachnoid bolt or screw: A hollow screw is inserted through a hole drilled in the skull. It is placed between the arachnoid membrane and the cerebral cortex. This method is used if the client needs to be monitored right away. This allows the sensor to record from inside the subdural space.
 - b. Complications: Infection is a major and serious complication of ICP monitoring.

May give prophylactic antibiotics. Risks for infection increased with:

- (1) ICP monitoring > 5 days.
- (2) Use of ventriculostomy.
- (3) Concurrent systemic infection.
- (4) Presence of CSF leak.

B. Acute phase: medical management.

- ◆ 1. Elevate head of bed: 30 or 40 degrees as ordered—this allows gravity to drain cerebral veins.
 - a. Avoid Trendelenburg position.
 - b. Avoid tilting client's head, which would impede venous flow through jugular veins.
- ◆ 2. Limit fluid intake; restricted to 1200 mL/day.
- ◆ 3. Maintain normal body temperature—administer Tylenol (acetaminophen) as ordered and temperature-regulating blanket. Prevent shivering, which can raise ICP. Thorazine (chlorpromazine) will control shivering.
- ◆ 4. Administer medications: steroids, osmotic diuretics.
 - ◆ a. Steroids (Decadron [dexamethasone]) decrease cerebral edema by their anti-inflammatory effect and decrease capillary permeability in inflammatory processes, thus decreasing leakage of fluid into tissue.
 - ◆ b. Histamine blocker (Zantac [ranitidine]) is given concomitantly with steroids to counter excess gastric acid secretion.
 - ◆ c. Mannitol decreases cerebral edema; provides diuretic action by carrying out large volume of water through nephrons. Sometimes combined with Lasix (furosemide) to increase excretion of water and sodium from kidneys.
 - ◆ d. Hypertonic IV solution administered because it is impermeable to blood-brain barrier; reduces edema by rapid movement of water out of ventricles into bloodstream.
 - ◆ e. Sedation may be ordered to counter effects of noxious stimuli of ICP and make client comfortable.
- ◆ 5. Maintain patent airway and administer mechanical ventilation. Maintain PaCO₂ at 25–30 mm Hg to cause vasoconstriction of cerebral blood vessels, decrease blood flow, and decrease ICP.
- ◆ 6. Prevent further complications.
 - a. Monitor neurological dysfunction versus cardiovascular shock.
 - b. Prevent hypoxia: Avoid morphine—it masks signs of increased ICP.

- c. Monitor fluids: Administer electrolytes for hypo- and hypernatremia and acid-base balance. (If client is receiving a loop diuretic, electrolyte replacement is indicated.)
- ◆ 7. Decrease environmental stimuli: Dim lights, speak softly, limit visitors, avoid routine procedures if client is resting, etc.
- ◆ C. Chronic phase: surgical management.
 1. Ventriculoperitoneal shunt systems (most common). Designed to shunt cerebrospinal fluid from the lateral ventricles into the peritoneum.
 2. Preoperative care.
 - a. Follow care of client with increased intracranial pressure.
 - b. Prepare client for craniotomy if necessary.
 3. Postoperative care.
 - a. Monitor closely for signs and symptoms of increasing intracranial pressure due to shunt failure.
 - b. Check for infection (a common and serious complication). If present, removal of the shunt system is indicated in addition to appropriate chemotherapy.
 - c. Position client supine and turn from back to unoperative side.

Cerebral Edema

Definition: Swelling of the brain that disrupts the stable relationship of the three components housed in the skull: brain, cerebrospinal fluid, and blood.

Characteristics

- ◆ A. Cerebral edema causes the intracranial pressure (ICP) to rise.
- B. Characterized by accumulation of fluid in the extracellular space, intracellular space, or both.
- C. Regardless of the cause, cerebral edema results in an increase in tissue volume, with the potential to cause ICP.
- D. Three types.
 1. Vasogenic edema results from increased extracellular fluid—most common type.
 2. Cytotoxic edema—the result of local disruption of the functional and/or morphologic integrity of cell membrane. Develops from destructive lesions or trauma to the brain resulting in cerebral hypoxia or anoxia, sodium depletion, syndrome of inappropriate antidiuretic hormone (SIADH) secretion.
 3. Interstitial edema, associated with movement of cerebrospinal fluid.

Assessment

- ◆ A. Earliest indicator is change in level of consciousness (LOC).
 1. Lethargic.
 2. Talkative or quiet.
 3. Restlessness.
 4. Irritability.
 5. Nausea and vomiting.
 6. Disorientation: first to time, then to place and person.
- B. Altered respiratory pattern.
- ◆ C. Pupillary changes.
 1. Unequal pupils.
 2. Sluggish response to light.
 3. Fixed and dilated pupils.
 4. Pupillary dysfunction is first noted on the ipsilateral side.
 5. Oculomotor dysfunction— inability to move eyes upward, ptosis of the eyelid.
- D. Decorticate or decerebrate posturing.
- ◆ E. Monitor for late signs of increased ICP.
 1. Cushing's triad: increased systolic blood pressure, widened pulse pressure, and slowed heart rate.
 2. Irregular respirations.
 3. Rise in temperature.

Implementation

See Nursing Management for Increased Intracranial Pressure.

Hyperthermia

◆ **Definition:** Temperature of 41°C (106°F); associated with increased cerebral metabolism, increasing risk of hypoxia, dysfunction of thermoregulatory center—trauma, tumor, cerebral edema, CVA, intracranial surgery; prolonged exposure to high environmental temperatures—heatstroke; infection.

Assessment

- A. Shivering.
- B. Respiratory function—ventilation and patent airway.
- C. Cardiac function—pulse and rhythm; arrhythmias.
- D. Urinary function—color, specific gravity, and amount.
- E. Nausea and vomiting.
- F. Increased temperature—when very high, seizures.
- G. Peripheral pulses for systemic blood flow.
- H. Skin and mucous membranes for signs of dehydration.

Implementation

- ◆ A. Maintain patent airway if temperature is very high.

- ◆ B. Provide safety measures for possible seizure activity.
- ◆ C. Monitor fluid balance by observing skin condition, urine output, lung sounds, peripheral pulses.
- ◆ D. Provide methods for inducing hypothermia.
 1. External—cool bath, fans, ice bags, hypothermic blanket (most common).
 - ◆ 2. Drugs.
 - a. Thorazine (chlorpromazine)—reduces peripheral vasoconstriction, muscle tone, shivering; depresses thermoregulation in hypothalamus.
 - b. Demerol (meperidine)—relaxes smooth muscle, reduces shivering.
 - c. Phenergan (promethazine)—dilates coronary arteries, reduces laryngeal and bronchial irritation.
 3. Extracorporeal—usually reserved for surgery.
- E. Monitor effects of hypothermia.
 1. Prevent shivering.
 - a. Shivering increases CSF pressure and oxygen consumption.
 - b. Treatment: chlorpromazine or meperidine.
 - ◆ 2. Prevent trauma to skin and tissue.
 - a. Frostbite—crystallization of tissues with white or blue discoloration, hardening of tissue, burning, numbness.
 - b. Fat necrosis—solidification of subcutaneous fat, creating hard tissue masses.
 - c. Initially give complete bath and oil the skin; during procedure, massage skin frequently with lotion or oil to maintain integrity of the skin.
 - ◆ 3. Monitor and prevent respiratory complications.
 - a. Hypothermia may mask infection, cause respiratory arrest.
 - b. Institute measures to maintain open airway and adequate ventilation.
 4. Monitor and prevent cardiac complications.
 - a. Hypothermia can cause arrhythmias and cardiac arrest.
 - b. Monitor cardiac status and have emergency equipment available.
 5. Monitor renal function.
 - a. Insert Foley catheter.
 - b. Monitor urinary output, blood urea nitrogen (BUN); may monitor specific gravity.
 6. Prevent vomiting and possible aspiration; client may have loss of gag reflex and reduced peristalsis.
 7. Monitor changes in neurological function during hypothermia.

SEIZURE DISORDERS

Convulsions/Seizures

Definition: Temporary alterations in brain function resulting in sudden episodes of altered consciousness or involuntary movement expressing themselves as a changed mental state, tonic or clonic movements, and various other symptoms. Seizures may occur as isolated events, possibly after head trauma, and do not persist once the underlying cause is eliminated.

Characteristics

- A. Causes: cerebral trauma, congenital defects, epilepsy, infection, tumor, circulatory defect, anoxia, metabolic abnormalities, excessive hydration, idiopathic, acute alcohol withdrawal.
- ◆ B. Classification.
 1. **Tonic convulsion:** sustained contraction of muscles.
 2. **Clonic convulsion:** alternating contraction–relaxation of opposing muscle group.
 3. **Epileptiform:** any convulsion with loss of consciousness.

Assessment

- A. Identify if aura present.
- B. Observe type of motor activity.
- C. Observe pattern of seizure activity.
- D. Identify length of seizure activity.
- E. Evaluate loss of bowel or bladder control.
- F. Evaluate loss of consciousness.
- G. Observe for signs of respiratory distress.
- H. Identify characteristics during the postictal state.

Implementation

- ◆ A. Observe and record characteristics of seizure activity.
 1. Level of consciousness.
 2. Description of any aura.
 3. Description of body position and initial activity.
 4. Motor activity: initial body part involved, character of movements (tonic/clonic), progression of movement, duration, biting of the tongue.
 5. Respiration, color.
 6. Pupillary changes, eye movements.
 7. Incontinence, vomiting.
 8. Total duration, frequency, number of seizures, injuries.
 9. Postictal state.
 - a. Loss of consciousness.
 - b. Sleepiness.
 - c. Impaired speech, motor or thinking.

- d. Headache.
- e. Neurological and vital signs.
- ◆ B. Protect client from trauma.
 - 1. Ensure patent airway; may need to use a nasal airway.
 - 2. Do not force any object between teeth if they are already clenched.
 - 3. Avoid use of any restraints; loosen restrictive clothing.
 - 4. Remove any objects from environment that may cause injury.
 - 5. Stay with client.
 - 6. If the client is standing, place him/her on the floor; protect head and body from hard surfaces.
 - 7. Be prepared to suction.
 - 8. Keep side rails up; pad side rails.
- C. Provide nursing care after seizure.
 - 1. Keep turned to side to prevent aspiration.
 - 2. Reorient to environment when awakened.

Epilepsy

◆ *Definition:* A combination of several disorders characterized by chronic, recurrent seizure activity; a symptom of brain or CNS irritation. A seizure is an abnormal, sudden, excessive discharge of electrical activity within the brain.

Characteristics

- A. Incidence in United States may be as low as 1 million or as high as 2.5 million—many clients hide their seizure disorder.
- B. Major problems may be an electrical disturbance (dysrhythmia) in nerve cells in one section of the brain.
- C. Seizures are associated with changes in behavior, mentation and motor or sensory activity.
- D. Causes may be related to several factors.
 - 1. Genetic factors, trauma, brain tumor, circulatory or metabolic disorders, toxicity, or infection.
 - 2. May be symptoms of underlying brain pathology such as scar tissue, vascular disease, meningitis, or secondary to a birth injury.
 - 3. Heredity may play a part in absence, akinetic, or myoclonic seizures.
- E. Diagnostic tests include CT to determine underlying CNS changes, EEG for a distinctive pattern, MRI, blood studies, lumbar puncture, etc.

Assessment

- ◆ A. Observe specific phases of seizure activity.
 - 1. Occurs without warning or following an aura (peculiar sensation that warns of an impending seizure—dizziness, visual or auditory sensation).
 - 2. Behavior at onset of seizure.
 - a. Change in facial expression—fixation of gaze, flickering eyelids, etc.
 - b. Sound or cry at time of seizure.
 - ◆ B. Observe movements of body.
 - 1. Tonic phase—parts of body involved, length of time (usually 10–20 seconds).
 - 2. Clonic phase—parts of body that jerk, sequence of jerking movements, how long activity lasts (usually 30–40 seconds).
 - C. Observe behavior following seizure.
 - 1. State of consciousness, orientation.
 - 2. Motor ability, speech ability, activity.
 - D. Seizure history through client report or observation.
 - 1. Seizure onset, pattern or sequence of progression, precipitating events, frequency, description.
 - 2. Whether seizure is a simple staring spell or prolonged convulsive movements.
 - 3. Excess or loss of muscle tone or movement.
 - 4. Disturbance of behavior, mood, sensation, and/or perception.
 - 5. Prodromal signs or symptoms: mood changes, irritability, insomnia, etc.
 - 6. Effect of epilepsy on life and lifestyle (work limitations, social interaction, psychological adjustment).

Generalized Seizures: Four Types

- ◆ A. Tonic-clonic seizures, traditionally known as “grand mal.”
 - 1. May begin with an aura, then a tonic phase—symmetrical stiffening or rigidity of muscles, particularly arms and legs, followed by loss of consciousness.
 - 2. Clonic phase follows—hyperventilation with rhythmic jerking of all extremities.
 - 3. May be incontinent of urine and feces.
 - 4. May bite tongue.
 - 5. May last 2–5 minutes.
 - 6. Full recovery may take several hours.
- ◆ B. Absence seizures, formerly “petit mal.”
 - 1. Brief, often just seconds, loss of consciousness; almost no loss or change in muscle tone.
 - 2. May occur 100 times/day. More common in children; may appear to be “daydreaming.”
- ◆ C. Myoclonic seizures.
 - 1. Characterized by a brief, generalized jerking or stiffening of the extremities; jerks may be single or multiple.
 - 2. May occur as single movement or in groups; seizure may throw person to the floor.

- ◆ D. Atonic or akinetic seizures, also called “drop attacks.”
 1. Characterized by sudden, momentary loss of muscle tone.
 2. Usually causes person to fall to the ground (injuries from falling are common).

◆ Partial Seizures (Focal Seizures)

- A. Simple partial seizure.
 1. Localized (confined to a specific area).
 - a. **Motor symptoms:** abnormal unilateral movement of leg or arm.
 - b. **Sensory symptoms:** abnormal smell or sensation.
 - c. **Autonomic symptoms:** Include tachycardia, bradycardia, increased respirations, skin flushing, epigastric distress.
 - d. **Psychic symptoms:** May report déjà vu or fearful feelings.
 2. Client remains conscious throughout episode and may report an aura before seizure takes place.
- B. Complex partial (psychomotor) seizure; may progress to generalized tonic-clonic.
 1. Area of brain most involved is temporal lobe (thus this type of seizure is called psychomotor).
 2. Characterized by a period of altered behavior and automatism (client is not aware of behavior); evidenced by such mannerisms as lip smacking, chewing, picking at clothes, focal motor activity, such as posturing or jerking movements.
 3. Client loses consciousness for a few seconds.
- C. Idiopathic or unclassified seizures.
 1. This type of seizure accounts for half of all seizure activity.
 2. Occurs for no known reason and fits into no generalized or partial classification.

Implementation

- ◆ A. Prevent injury during seizure.
 1. Remove objects that may cause harm.
 2. Remain with client during seizure.
 3. Do not force jaws open during seizure.
 4. Do not restrict limbs or restrain.
 5. Loosen restrictive clothing.
 6. Turn head to side, if possible, to prevent aspiration and allow secretions to drain.
 7. Check that airway is open. Do not initiate artificial ventilation during a tonic-clonic seizure.
- ◆ B. Observe and document seizure pattern.
 1. Note time, level of consciousness, and presence of aura before seizure.

- 2. Record type, character, progression of movements.
- 3. Note duration of seizure and client's condition throughout.
- 4. Observe and record postictal state.
- ◆ C. Administer and monitor medications.
 1. Seizure control may be achieved with one or a combination of drugs.
 2. Dosage is adjusted to achieve seizure control with few side effects.
 - ◆ 3. Medications must be given continuously and on time throughout life of client to maintain therapeutic blood levels.
 - ◆ 4. Dilantin (phenytoin).
 - a. Prevents seizures through depression of motor areas of the brain.
 - b. Side effects: gastrointestinal (GI) disturbance, visual changes, rash, anemia, gingival hyperplasia.
 - c. Check complete blood counts (CBC) and calcium levels.
 - d. Give PO drug with milk or meals; supplemental vitamin D and folic acid.
 5. Valium (diazepam).
 - a. Give to stop motor activity associated with status epilepticus; for restlessness.
 - b. Side effects: If given IV, monitor for respiratory distress.
 6. Luminal (phenobarbital).
 - a. Reduces responsiveness of normal neurons to impulses arising in focal site.
 - b. Side effects: drowsiness, ataxia, nystagmus, respiratory depression.
 - ◆ 7. Tegretol (carbamazepine).
 - a. Inhibits nerve impulses by limiting influx of sodium ions across cell membranes.
 - b. Give with meals; monitor for side effects—diplopia, blurred vision, ataxia, vomiting, leukopenia.
 8. Klonopin (clonazepam).
 - a. Decreases frequency, duration, and spread of discharge in minor motor seizures (absence, akinetic, myoclonic seizures).
 - b. Side effects: lethargy, ataxia, vertigo, thrombocytopenia—monitor CBC.
 9. Neurontin (gabapentin).
 - a. Do not take 1 hour before or less than 2 hours after antacids.
 - b. Monitor liver function studies regularly (as ordered) to detect early signs of hepatitis or liver problems.
 10. Cerebyx (fosphenytoin).
 - a. Thought to modulate sodium channels of neurons, modulate calcium flux across

- neuronal membranes, enhance sodium-potassium ATPase activity of neurons and glial cells.
- b. Must be prescribed in PE units.
- c. Side effects: nystagmus, dizziness, somnolence, drowsiness.
- D. Promote physical and emotional health.
 - 1. Establish regular routines for eating, sleeping, and physical activity.
 - 2. Avoid alcohol, stress, and excessive fatigue.
 - 3. Foster self-esteem and promote self-confidence.
 - 4. Contact Epilepsy Foundation of America.
 - a. Recent studies suggest specially trained dogs can tell when a seizure is about to happen.
 - b. For clients with poorly controlled seizures, suggest referral to special programs.
- E. Surgical treatment.
 - 1. When attempts to control seizure fail, excision of tissue involved in the seizure activity may be a safe and effective treatment.
 - 2. Goal: control—reduce client's uncontrolled seizures.
 - 3. Postop care—general postop care for a client having intracranial surgery.

♦ STATUS EPILEPTICUS

- A seizure that lasts longer than 4 minutes, or successive seizures without regaining consciousness.
- A potential complication with all seizures—a neurological emergency with generalized tonic-clonic seizures.
- Cause may be sudden withdrawal from medication, infection, head trauma, metabolic disorders, alcohol withdrawal.
- Management.
 - a. Maintain airway.
 - b. Notify physician.
 - c. Administer oxygen.
 - d. Monitor IV medication: Valium, Dilantin, Luminal.

TRAUMA

Head Injury

Definition: A trauma to the skull resulting in varying degrees of injury to the brain by compression, tension, and/or shearing force. A traumatic brain injury (TBI) is a serious form of injury.

♦ Types of Injury

- A. Concussion—violent jarring of brain within skull; temporary loss of consciousness.
 - ◆ 1. Symptoms are worse at point of impact.
 - a. Immediate loss of consciousness (usually no longer than 5 minutes).

- b. Amnesia for events surrounding injury.
- c. Headache.
- d. Drowsiness, confusion, dizziness.
- e. Visual disturbances.
- f. Possible brief seizure activity, with transient apnea, bradycardia, pallor, hypotension.
- 2. Postconcussion syndrome.
 - a. Persistent headache.
 - b. Dizziness.
 - c. Irritability, insomnia, tiredness.
 - d. Impaired memory and concentration, learning problems.
 - e. May last a few days to several months.
- ◆ B. Contusion—bruising, injury of brain.
 - 1. Acceleration—slower-moving contents of cranium strike bony prominences or dura (coup).
 - 2. Deceleration—moving head strikes fixed object and brain rebounds, striking opposite side of cranium (contrecoup).
- C. Fracture—linear, depressed, compound, comminuted, closed or open. Location alters the presentation of symptoms.
 - 1. Battle's sign (postauricular ecchymosis) and raccoon eyes (periorbital ecchymosis usually associated with tear in dura and subsequent leakage of CSF).
 - 2. Rhinorrhea (CSF leakage from the nose) or otorrhea (CSF leakage from the ears) generally confirms the fracture has traversed the dura. The risk of infection is increased with CSF leak. Antibiotics may be given to prevent meningitis.
- D. Hematoma.
 - ◆ 1. Epidural—most serious; hematoma between dura and skull from tear in meningeal artery; forms rapidly.
 - ◆ 2. Subdural—under dura; due to tears in veins crossing subdural space; forms slowly.
 - 3. Intracerebral—usually in frontal and temporal lobes; usually caused by gunshot wounds, stabbing, depressed skull fractures, long history of systemic hypertension, contusion.
- ◆ E. Subarachnoid hemorrhage—bleeding directly into brain, ventricles, or subarachnoid space.
 - 1. Monitor symptoms suggestive of complications.
 - a. Keep BP within normal limits—administer drugs as ordered.
 - b. Administer phenobarbital to control seizures; codeine for pain; corticosteroids for edema; fibrinolytic inhibitor (Amicar [aminocaproic acid]) to minimize risk of rebleed.

2. Maintain bed rest, prevent exertion, keep room quiet and dark.
3. Prevent straining, administer laxatives and stool softeners.
4. Avoid stimulants like caffeine (e.g., coffee).
- F. Intracerebral hemorrhage—usually multiple hemorrhages around contused area.

Assessment

- ◆ A. Level of consciousness, unconsciousness, or confusion.
- ◆ B. Patent airway and breathing pattern.
- ◆ C. Headache, nausea, vomiting.
- ◆ D. Pupillary changes—ipsilateral dilated pupil.
- ◆ E. Changes in vital signs, reflecting increased intracranial pressure or shock.
- F. Vasomotor or sensory losses.
- G. Rhinorrhea, otorrhea, nuchal rigidity.
- H. Overt scalp or skull trauma.
- I. Positive Babinski sign (dorsiflexion of toes when bottom of foot is stroked).

Implementation

- ◆ A. Primary nursing objective is to recognize, prevent, and treat complications; observe for signs of increased intracranial pressure.
- ◆ B. Maintain adequate respiratory exchange—increased CO₂ levels increase cerebral edema.
 1. Maintain patent airway.
 2. Encourage to avoid coughing (increases ICP); may require frequent suctioning.
- ◆ C. Complete neurological assessment, including Glasgow Coma Scale, every 15 minutes initially, then every hour until stable, then every 4 hours.
 1. Awaken client as completely as possible for assessment.
 2. Maintain slight head elevation to reduce venous pressure.
- D. Monitor temperature—utilize hypothermia as ordered to reduce fever.
- E. Control pain and restlessness.
 - ◆ 1. Avoid morphine, a respiratory depressant that might increase ICP.
 - 2. Use codeine or other mild, safe analgesic.
- F. Monitor and treat seizure activity—administer anticonvulsants as ordered.
- ◆ G. Observe for complications.
 1. Shock—significant cause of death.
 2. Cranial nerve paralysis.
 3. Rhinorrhea (fracture ethmoid bone) and otorrhea (temporal).
 - a. Check discharge—bloody spot surrounded by pale ring called halo or ring sign.
 - b. Do not attempt to clean nose or ears.
 - (1) Do not suction nose.
 - (2) Instruct client not to blow nose.

- ◆ 4. Ear—drainage of CSF from the ear indicates damage to the base of the brain and a danger of meningitis.
 - a. Inspect ear for drainage of CSF.
 - b. Loosely cover ear with sterile, dry dressing.
- 5. Eye—loss of corneal reflex may contribute to corneal irritation, keratitis, blindness.
 - a. Assess corneal reflex and signs of irritation.
 - b. Instill artificial tears or close eyelids and cover with moistened pads to protect cornea.
- 6. Fluid and electrolyte imbalance—diabetes insipidus.
- H. Prevent infection.
 1. High risk of meningitis, abscess, osteomyelitis, particularly in presence of rhinorrhea, otorrhea.
 2. Maintain strict asepsis.
- I. Prevent complications of immobility.
 1. Continue range-of-motion activities.
 2. Prevent contractures.
- J. Establish individualized rehabilitation program.

Spinal Cord Injury

Definition: Partial or complete disruption of nerve tracts and neurons resulting in paralysis, sensory loss, altered reflex activity, and autonomic nervous system dysfunction.

Characteristics

- A. The mechanisms of trauma associated with spinal cord injury (SCI) are usually related to vertebral fracture; resulting injuries include flexion, hyperflexion, hyperextension, flexion–rotation, rotation beyond normal range, axial-loading/compression, and penetrating injury.
 - ◆ 1. Most common causes of abnormal spinal cord movements.
 - a. Acceleration—when an external force is applied in rear-end collision, upper torso and head are forced backward and then forward.
 - b. Deceleration—in a head-on collision, the external force is applied from the front.
 - 2. Direction of motion.
 - a. Hyperflexion.
 - b. Hyperextension.
 - c. Axial loading.
 - d. Excessive rotation.
- B. Common traumas.
 1. Automobile and motorcycle accidents.
 2. Sports and industrial injuries.
 3. Falls and crushing injuries, stab wounds, bullets.

- C. Other conditions associated with spinal cord pathology.
 - 1. Infections, tumors.
 - 2. Disruption of blood supply to cord—thrombus.
 - 3. Degenerative diseases.
 - 4. Congenital or acquired anomalies—spina bifida, myelomeningocele.
- D. Improper handling and transport may result in extension of cord damage.
- E. Vascular disruption, biochemical changes, and direct tissue damage cause pathology associated with trauma.
 - 1. Inflammatory process leads to edema and neuronal dysfunction.
 - 2. Ischemia and hypoxia due to vasoconstriction, edema, and hemorrhage.
 - 3. Hypoxia of gray matter stimulates release of catecholamines, which increases hemorrhage and necrosis.

♦ AUTONOMIC HYPERREFLEXIA

- Also called autonomic dysreflexia—a massive, uncompensated cardiovascular reaction mediated by the sympathetic nervous system.
- Occurs in clients with lesions above T6, most often those with cervical injuries, after spinal shock has resolved.
- Acute emergency—result of exaggerated autonomic responses to stimuli (most often distended bladder or impacted rectum). Treat immediately to prevent stroke, status epilepticus, myocardial infarction, even death.
- Symptoms include severe headache, profuse diaphoresis, nausea, bradycardia, hypertension, piloerection, blurred vision, spots in the visual field, nasal congestion, and anxiety.
- Interventions focused on reducing blood pressure and eliminating stimulus.
 - a. Immediately elevate head to decrease blood pressure and monitor vital signs every 15 minutes.
 - b. Eliminate stimulus—relieve bladder distention by catheterizing or remove fecal mass.
- If severe hypertension does not resolve with removal of stimulus, an antihypertensive drug will be ordered (Apresoline [hydralazine]) IV.

Classification of Cord Involvement

- ♦ A. Functional deficiencies.
 - 1. Level of spinal cord involvement dictates consequences of the cord injury.
 - 2. Quadriplegia (tetraplegia): All four extremities functionally involved—cervical injuries (C1 through C8).
 - 3. Paraplegia: Both lower extremities functionally involved—thoracic–lumbar region (T1 through L4).

- B. Transection of the cord.
 - 1. Complete cord transection.
 - a. All voluntary motor activity below injury is permanently lost.
 - b. All sensation dependent on ascending pathway of segment is lost.
 - c. Reflexes may return if blood supply to cord below injury is intact.
 - 2. Incomplete injuries.
 - a. Motor and sensory loss varies and is dependent on degree of incompleteness.
 - ♦ b. Extent of reflex dysfunction dependent on location of neurological deficit.
- ♦ C. Types of injuries.
 - 1. Central cord syndrome—leg function returns, arm function does not, as damage has occurred to peripheral cord, which innervates arms.
 - a. More common in older adults.
 - b. Motor weakness in both upper and lower extremities—greater in upper extremities than lower.
 - (1) Sensory dysfunction varies according to site of injury.
 - (2) Bladder dysfunction is variable.
 - c. Frequently a result of hyperextension of osteoarthritic spine.
 - 2. Brown–Séquard syndrome—one side of cord damaged, resulting in paralysis on one side of body and loss of sensation on the other side.
 - a. Transection or lesion of half of spinal cord.
 - b. Usually caused by penetrating injuries (e.g., gunshot, stabbing).
 - c. Characteristics.
 - (1) Loss of motor function (paralysis), position and vibratory sense, vasomotor paralysis on the same side (ipsilateral) and below the hemisection.
 - (2) Loss of pain and temperature sensation on the opposite side—contralateral (below the level of the lesion or hemisection).
 - 3. Anterior cord syndrome—paralysis below the level of injury, loss of temperature and pain sensation below the level of injury.
 - a. Often caused by a flexion injury.
 - b. Lesion on anterior two-thirds of cord.
 - c. Compression caused by disk or bony fragment.
 - d. May be caused by spinal artery occlusion.
 - e. Characteristics.
 - (1) Complete motor paralysis from site of injury and below.

- (2) Hypoesthesia—decreased pain sensation and loss of temperature below the injury.
- (3) Because posterior cord tracts are not injured, sensation of touch, position, vibration, and motion remains intact.
- 4. Posterior cord syndrome—weakness in isolated muscle groups, tingling, pain, decreased or absent reflexes in the involved area.
 - a. Associated with hyperextension trauma.
 - b. Results from compression or damage to the posterior part of the spinal cord.
 - c. Loss of proprioception.
 - d. Pain, temperature sensation, and motor function below the level of the lesion remain intact.
- 5. Horner's syndrome—ipsilateral ptosis of the eyelid, constricted pupil, and facial anhidrosis (inability to perspire).
- D. Upper and lower motor neuron damage.
 - 1. Upper motor neuron originates in cerebral cortex and terminates at anterior horn cell in cord.
 - a. Postspinal shock reflexes return, resulting in spastic paralysis. No reflex return if blood supply to cord is lost.
 - b. Spasms and reflexes used to retrain activities of daily living—bowel evacuation and bladder control.
 - 2. Lower motor neuron begins at anterior horn cell and becomes part of peripheral nerve to muscle, motor side of reflex arc.
 - a. Areflexia continues, flaccid paralysis.
 - b. Usually cauda equina injuries.

Assessment

- ◆ A. Level of injury. The last cord segment in which normal motor, sensory, and reflex activity can be demonstrated is labeled level of injury (e.g., "C5, level of injury" means neurofunction is intact for C5 but not C6).
- B. Degree of sensory, motor, and reflex loss depends upon severity of cord damage.
- C. Respiratory insufficiency or failures occur in injuries above C4 due to lack of diaphragm innervation.
- D. Assess general sensory function in all extremities: touch, pressure, pain.
- E. Assess motor response to command.
 - 1. Pattern of motor dysfunction yields information about anatomic location of lesions, independent of level of consciousness.
 - 2. Appropriate response—spontaneous movement to stimulus or command.

- 3. Absent response—hemiplegia, paraplegia, quadriplegia.
- 4. Use minimal amount of stimulus necessary to evoke a response.
- F. Assess for bladder control.
 - 1. Reflex (autonomic or spastic) bladder occurs when reflexes are still present and, with stimulation, the bladder involuntarily empties.
 - 2. Spastic bladder responds to minor stimulus and empties before it is full.
- G. Evaluate bowel control.
 - 1. Observe ability to evacuate stool.
 - 2. Assess consistency and number of stools.
 - 3. Identify need for bowel training program.

♦ SPINAL SHOCK

- Absence of reflexes slightly above and completely below level of lesion. (This is a *neurologic emergency* that requires immediate attention.)
- Temporary condition: lasts days to months.
- Initial flaccid paralysis, absent reflexes, loss of sensation, loss of urinary and bowel retention, hypotension (especially positional), bradycardia.
- Active rehabilitation may begin in the presence of spinal shock.

Implementation

- A. Complete a head-to-toe neurological examination to determine motor, sensory, and reflex loss due to spinal cord injury.
- ◆ B. Provide emergency care—suspect spinal cord injury if neurological deficits present in extremities.
 - 1. Immobilize entire body, especially head and neck; do not flex head; stabilize cervical spine.
 - 2. Transport in log fashion with sufficient help.
 - 3. Maintain open airway and adequate ventilation—high cervical injuries can cause complete paralysis of muscles for breathing; observe for signs of respiratory failure.
- ◆ C. Immobilize client, as ordered, to allow fracture healing and prevent further injury.
 - 1. Special beds (Stryker frame) permit change of position between prone and supine.
 - a. Maintain optimal body alignment.
 - b. Place client in center of frame without flexing or twisting.
 - c. Position arm boards, footboards, canvas.
 - d. Turn; reassure client while turning.
 - e. Free all tubings; secure bolts and straps.
 - 2. Regular hospital beds used in many rehabilitation centers. (Some use Roto-Rest beds or Foster frame.)

- ◆ 3. Halo traction with body cast allows for early mobilization. (See also page 376.)
 - a. Consists of a circular headpiece with four pins: two anterior, two posterior. These are inserted into client's skull, and then halo jacket or cast is applied.
 - b. Once fracture is stable, the headpiece can be attached to halo vest.
 - c. Assess client's neurological status for decreased strength or changes in movement.
 - ◆ d. Never turn or move the client by pulling on the halo traction.
 - e. Assess for tightness of the jacket. Be sure one finger can fit under the jacket.
 - f. Assess skin integrity to be sure there are no pressure areas from the cast or jacket; protect with fleece or foam.
 - g. Provide care to the pin sites.
 - ◆ h. Keep correct-size wrench available at all times for any emergency situation that may occur and require removal of the device.
 - i. If client requires cardiopulmonary resuscitation, the anterior portion of the vest will be loosened and the posterior portion will remain in place to provide stability.
- 4. Soft and hard collars and back braces used about 6 weeks postinjury.
- ◆ 5. Maintain skeletal traction if part of treatment.
 - a. Cervical tongs for hyperextension (Crutchfield, Gardner-Wells, Vinke).
 - (1) Traction is applied to vertebral column by attaching weights to pair of tongs.
 - (2) Tongs are inserted into outer layer of parietal area of skull.
 - b. Facilitates moving and turning of client while maintaining spine immobilization.
 - c. Observe site of insertion for redness or drainage, alignment and position of traction, and pressure areas.
- D. Complete frequent neurological assessment: Note changes in muscle tone, motor movement, sensation, bladder and bowel function, presence or absence of sweating, temperature, and reflexes.
- ◆ E. Monitor for autonomic nervous system disturbances.
 - 1. Heart, lung, and bowel sounds for complications, such as embolus, ileus.
 - 2. Temperature fluctuations—unable to adapt to environmental changes or infection-related.
 - a. Excessive perspiration causes dehydration.
- ◆ b. Absence of perspiration leads to hyperthermia.
- ◆ F. Prevent postural hypotension and syncope, which occur when head is elevated.
 - 1. Apply Ace bandage or TED elastic hose.
 - 2. Administer ephedrine PO 30 minutes before client is to get up.
- ◆ G. Monitor for autonomic dysreflexia. (See page 191.)
 - 1. Signs and symptoms: extreme hypertension, flushing, bradycardia, headache (usually occipital), sweating, diplopia, convulsions.
 - 2. Provide immediate treatment.
 - a. Catheterize bladder; manually evacuate bowel.
 - b. May administer parasympatholytic (Banthine [propantheline bromide]) or ganglionic blocking agent (Hyperstat [diazoxide], Apresoline [hydralazine]).
 - c. If client is lying down and fracture status permits, immediately elevate the head of bed or elevate client to sitting position.
 - 3. Control factors that precipitate episode to prevent recurrence.
 - a. Set up regular bowel and bladder programs.
 - b. Apply Nupercainal (dibucaine) ointment prior to rectal stimulation.
 - c. Administer alpha-adrenergic blocking agents [Dibenzyline (phenoxybenzamine)] BID.
- H. Prevent infections.
 - 1. Administer prophylactic antibiotics while client is on catheterizations.
 - 2. Evaluate client with elevated temperature for urinary or respiratory infection.
- ◆ I. Prevent circulatory complications.
 - 1. Turn entire body every 2 hours. Give range-of-motion exercises to extremities.
 - 2. Apply Ace bandages and TED elastic hose to legs.
 - 3. Monitor for edema, thrombus, and emboli; provide prompt anticoagulant therapy if needed.
 - 4. Do not overhydrate based on blood pressure (normal BP is 100/60 or below).
- ◆ J. Maintain optimal positioning.
 - 1. Logroll with firm support to head, neck, spine, and limbs; do not allow neck flexion.
 - 2. Maintain good body alignment with 10-degree flexion of knees, heels off mattress or canvas, and feet in firm dorsiflexion.
 - 3. During convalescence, provide cervical collar, tilt table, wheelchair, braces, parallel bars.

- K. Promote optimal physical activity.
 - 1. Provide physical therapy, exercises, range of motion.
 - 2. Encourage independent activity.
 - 3. Provide extensive program of rehabilitation and self-care.
- ◆ L. Maintain integrity of the skin.
 - 1. Turn client every 2 hours and check skin.
 - 2. Do not administer IM medication below the level of the lesion due to impaired circulation and potential skin breakdown.
 - 3. Provide elastic stockings to improve circulation in legs.
 - 4. Later, instruct client how to look for and prevent injury; reinforce the necessity for self-care.
 - 5. Provide prompt treatment of pressure areas.
- ◆ M. Promote adequate nutrition, fluid and electrolyte balance.
 - 1. Provide diet adequate in protein, vitamins, calories, and bulk; limit milk.
 - 2. Avoid citrus juices, which alkalinize the urine; give cranberry juice and vitamin C tabs to acidify urine.
 - 3. Avoid gas-forming foods.
 - 4. Monitor calcium, electrolytes, and hemoglobin.
 - 5. Restrict fluids if client is on intermittent catheterization; otherwise, encourage fluids—3000 mL+ per day.
- N. Provide psychological support to client and family.
 - 1. Support client and family through grief process.
 - 2. Promote sustained therapeutic relationships.
 - 3. Provide diversionary activities, socialization.
 - 4. Promote independence; teach client to problem solve.
 - 5. Give encouragement and reassurance but never false hope.
 - 6. Encourage family involvement in care.
 - 7. Provide sexual counseling if needed.
 - a. Client should be aware of his or her sexual abilities postinjury.
 - b. Role perception may need expansion.
 - 8. During rehabilitation stage, provide employment counseling if needed.
- O. Establish individualized rehabilitation program for client.
 - 1. Based on level of injury.
 - 2. Determined by willingness of client to adapt to new body image.
 - 3. Availability of family and community support services.
- ◆ P. Optimal bladder function.
 - 1. During spinal shock, bladder is atonic with urinary retention; danger of overdistention, stretching.
 - 2. Possible reactions.
 - a. Hypertonic, retention with overflow—sacral reflex center injury (lower motor neuron).
 - b. Hypertonic, sudden reflex voiding— injury above sacral area (upper motor neuron).
 - 3. Check for bladder distention, voiding, incontinence, and symptoms of infection.
 - 4. Provide aseptic intermittent catheterizations—prophylactic antimicrobials (Nitrofurantoin [nitrofurantoin]).
 - 5. Prevent urinary tract infection, calculi.
 - a. Monitor urinary residuals.
 - b. May have periodic bladder and kidney function studies—intravenous pyelogram (IVP), cystogram.
 - 6. Initiate bladder retraining.
 - a. Hypertonic—sensation of full bladder, trigger areas, regulation of fluid intake.
 - b. Hypotonic—manual expression of urine (Credé maneuver).
 - 7. Administer medications to treat incontinence.
 - a. Hypertonic—propantheline bromide, diazepam.
 - b. Hypotonic—bethanechol chloride.
- ◆ Q. Optimal bowel function.
 - 1. Incontinence and paralytic ileus occur with spinal shock; later, incontinence, constipation, impaction.
 - 2. For severe distention, administer neostigmine methylsulfate and insert rectal tube, which decompresses intestinal tract.
 - 3. Give enema only if necessary. Excessive amount of fluid distends bowel. Manual evacuation is preferred.
 - 4. Initiate bowel retraining.
 - a. Record bowel habits before and after injury.
 - b. Provide well-balanced diet with high-fiber foods—fruits, vegetables, grains (bran), and legumes.
 - c. Encourage fluid intake—2000 to 3000 mL per day.
 - d. Provide stool softeners, bulk producers, mild laxative.
 - e. Encourage the development of muscle tone.
 - f. Administer suppository (glycerin or Dulcolax [bisacodyl]) as indicated.

- g. Most important is to establish a regular, consistent routine and time for elimination.
- ◆ R. Pharmacology.
1. Corticosteroids—high-dose steroid protocol using Medrol (methylprednisolone) must be given intravenously within 8 hours of injury to be effective. It is used to prevent secondary spinal cord damage from edema and ischemia. Initial loading dose given, followed by a maintenance dose over the next 23 hours.
 - a. Criteria for selection.
 - (1) Spinal cord injury less than 8 hours old.
 - (2) Spinal lesion cannot be below L2 or be a cauda equina lesion.
 - b. Special considerations.
 - (1) Pregnant client.
 - (2) Client less than 13 years old.
 - (3) Client with penetrating spinal cord lesion.
 - (4) Client with fulminating infection like tuberculosis (TB), AIDS, or severe diabetes mellitus.
 2. Vasopressors—used in the immediate critical care period to treat bradycardia or hypotension due to spinal shock.
 3. Antispasmodics—used to treat spasms. They depress the central nervous system and inhibit transmission of impulse from spinal cord to skeletal muscle (not always effective).
 - a. Lioresal (baclofen).
 - b. Paraflex (chlorzoxazone).
 - c. Flexeril (cyclobenzaprine hydrochloride).
 - d. Valium (diazepam).
 - e. Norflex (orphenadrine citrate).
 - f. Dantrium (dantrolene sodium).
 4. Analgesics.
 - a. Nonsteroidal anti-inflammatory drugs (NSAIDs).
 - b. Opioids, nonopioids.
 - c. Tricyclic antidepressants [Elavil (amitriptyline), Tofranil (imipramine)].
 - d. Anticoagulant—heparin or low-molecular-weight heparin for deep vein thrombosis (DVT) prophylaxis.

INFECTIOUS PROCESSES

Brain Abscess

Definition: Infectious process resulting in an encapsulated collection of pus usually found in the temporal lobe, frontal lobe, or cerebellum. May result from local or

systemic infection. Primary cause often ear, tooth, mastoid, or sinus infection. May also be from a distant site like pulmonary infection, bacterial endocarditis, or skull fracture.

Assessment

- A. Increased temperature unless abscess is walled off, in which case temperature can be subnormal.
- B. Headache, anorexia, malaise, vomiting.
- C. Neurological deficits relative to area involved (focal seizures, blurred vision, etc.).
- D. Signs of increased intracranial pressure.
- E. Weight loss.

Implementation

- A. Observe neurological signs for alterations.
- B. Decrease temperature.
 1. Sponge bath.
 2. Antipyretic drugs.
 3. Cooling blanket.
- C. Administer appropriate antibiotics for causative agent.
- D. Prepare client and family for surgical intervention.
- E. Provide appropriate postoperative care.

Meningitis

◆ *Definition:* An acute infection of the pia–arachnoid membrane, usually as the result of another bacterial infection such as upper respiratory, otitis media, or pneumonia (may be viral). May result in a degeneration of nerve cells or congestion of adjacent brain tissue.

Assessment

- ◆ A. Inflammation, infection, and increased intracranial pressure cause the cardinal signs and symptoms.
 1. Headache, high fever, nuchal rigidity, and changes in mental status are first indications.
 2. Later symptoms include nausea, vomiting, disorientation, muscle aches, and positive Kernig's sign.
- ◆ B. Observe for signs of meningeal irritation.
 1. Brudzinski's sign: Flexion of head causes flexion of both thighs at hips and knee flexion.
 2. Kernig's signs: Supine position, thigh and knee flexed to right angles. Extension of leg causes spasm of hamstring, resistance, and pain.
 3. Nuchal rigidity.
- C. Other symptoms may be severe headache, stiff neck and back, photophobia.
- D. As illness progresses, lethargy, irritability, stupor, coma, possible seizures.
- E. Diagnosis made by testing CSF obtained by lumbar puncture.

Implementation

- ◆ A. Maintain patent airway—give oxygen as ordered.
- ◆ B. Treat the infective organism—antimicrobial therapy by intravenous route for 2 weeks, followed by oral antibiotics.
- ◆ C. Droplet isolation for 24 hours after antibiotic therapy is initiated.
 1. Treat all secretions from nose and mouth as infectious.
 2. Check nasal cultures for organism.
- ◆ D. Treat increased intracranial pressure or seizures. (Mannitol may be ordered for cerebral edema.)
- E. Control body temperature.
- F. Provide adequate fluid and electrolyte balance—be aware of fluid overload, which can cause cerebral edema.
- G. Provide bed rest and a quiet environment; sedate if needed. Do not give narcotics or sedatives that would interfere with neurologic assessment.
- ◆ H. Prevent complications of immobility.
 1. Raise head of bed 30 to 45 degrees—decreases ICP.
 2. Reposition frequently and provide range-of-motion exercises.
- I. Relieve headache and fever with acetaminophen.
- J. Maintain restful environment with dim lights to decrease photophobia.

Encephalitis

Definition: Severe inflammation of the brain caused by arboviruses or enteroviruses. Can be fatal. Diagnosed by CT, MRI, PET scan, and spinal fluid culture. Polymerase chain reaction (PCR) test is a laboratory method for detecting the presence and/or level of antibodies to an infectious agent in serum. It allows for early detection of herpes simplex virus (HSV) and West Nile encephalitis antibodies, substances made by the body's immune system to fight a specific infection.

♦ Assessment

- A. Fever, headache, vomiting.
- B. Signs of meningeal irritation.
- C. Neuronal damage, drowsiness, coma, paralysis, ataxia.
- D. Symptoms vary and depend on organism and area of brain involved.
- E. Symptoms resemble meningitis but have a more gradual onset.

Implementation

- A. Monitor vital signs frequently.

- ◆ B. Monitor neurological signs for alterations in client's condition.
- ◆ C. Administer anticonvulsant medications such as Dilantin.
- ◆ D. Administer glucocorticoids to reduce cerebral edema.
- E. Administer sedatives to relieve restlessness.
- F. Administer antiviral medications as ordered.
- G. Manage fluid and electrolyte balance to prevent fluid overload and dehydration.
- H. Position client to maintain patent airway and prevent contractures. Provide range-of-motion exercises.
- I. Promote adequate nutrition through tube feedings, and parenteral hyperalimentation if necessary.
- J. Provide hygienic care (e.g., skin care, oral care, and perineal care).
- K. Provide safety measures if client is confused.

Postpolio Syndrome

- ◆ *Definition:* A neurological condition caused by the polio virus that invaded the central nervous system decades earlier.

Characteristics

- A. Risk of developing postpolio syndrome (PPS).
 - ◆ 1. Risk manifests as people reach age 45–60 (35 years from the original polio infection).
 - 2. Progresses over time but becomes a major risk if acute health problem develops.
 - 3. Clients who had nonparalytic or "mild" polio are also at risk for developing PPS.
- B. For original polio infection, see Pediatrics chapter, pages 742, 744, and 747.
- ◆ C. Cause of PPS appears to be neuromuscular failure—chronic overuse of polio-damaged nerves and muscles together with normal aging process.
- D. If no medical records are available, electromyographic testing will confirm diagnosis of PPS.

Assessment

- ◆ A. Clinical manifestations of PPS.
 1. Excessive fatigue.
 2. Muscle weakness (both in muscles involved in original infection and those that were not).
 3. Joint pain.
 4. Breathing problems.
 5. Impaired swallowing.
 6. Intolerance to cold.
 7. Inability to carry out activities of daily living.
- B. Onset usually insidious; but with any sudden change in health status (severe illness or general anesthesia for surgery), onset may be sudden.

Implementation

- A. No specific treatment for PPS.
- B. Management is targeted at controlling symptoms, especially fatigue, weakness, and pain. Overexertion can worsen weakness and fatigue.
- C. Promote pacing of activities to avoid feelings of fatigue.
- D. Planning includes rest periods as well as learning to use assistive devices such as canes, scooters, and wheelchairs.
- E. Adaptive equipment will help with self-care.
- F. Physical therapy can support fitness and mobility in light of limitations.
- G. Weight loss interventions are helpful if the client is overweight.
- H. Management of client focuses on lifestyle modifications to conserve energy and to support maximal performance of activities of daily living (ADLs).
- I. Rigorous and aggressive therapy used after initial polio infection is contraindicated during the post-polio period.
- J. An interdisciplinary team approach is essential to manage the client.
- K. Monitor for respiratory function.
 - 1. Position for maximum chest excursion.
 - 2. Monitor oxygen—may present risk if breathing based on hypoxic drive, not CO₂.
 - 3. Muscle-relaxing medications and narcotic analgesics may be life-threatening if respirations are depressed.
 - 4. Assess for speech, swallowing, or respiratory difficulties. Take nursing measures to prevent aspiration. These are similar to those described for clients with Guillain–Barré syndrome.
- L. Effective pain management through pharmacologic and nonpharmacologic approaches will help the client to remain active and achieve a greater sense of well-being.
- M. Protection from the cold will aid in pain relief.
- N. Surgery presents special risks.
 - 1. General anesthesia not tolerated well—regional anesthesia is a better option.
 - 2. Clients should not have nonessential surgical procedures performed.
- O. Maintain blood volume, fluid and electrolyte balance (especially important to replace potassium after surgery).
- P. Cold intolerance may present a special challenge for client undergoing surgery.
- Q. Results of experiencing reemergence of symptoms:
 - 1. Can be devastating to the client.
 - 2. May impact psychological well-being.
 - 3. May evoke a sense of fear, anxiety, and/or depression.

- R. Nurse can help the client by active listening, providing information about PPS, encouraging participating in support groups, and helping client gain a sense of control through active participation in lifestyle modifications.

Creutzfeldt–Jakob Disease

Definition: Rare and fatal degenerative brain disorder that leads to dementia and, ultimately, death. It is thought to be caused by prion protein. Prions are small infectious pathogens containing protein but lacking nucleic acid.

Characteristics

- A. Causes.
 - 1. May be inherited (10%).
 - 2. Clients who received human growth hormone prior to more stringent purification methods instituted after 1978.
 - 3. Clients who receive corneal transplants or cadaver dural grafts.
- B. Types.
 - 1. Sporadic Creutzfeldt–Jakob Disease (CJD).
 - 2. Familial CJD.
 - 3. Acquired CJD.
 - 4. Variant CJD (vCJD)—from infected beef; also called mad cow disease; found in Great Britain.
- C. Incubation ranges from 4 to 20 years.

Assessment

- A. There are no diagnostic tests to detect CJD. It is definitively determined by autopsy and examination of brain tissue.
- B. Onset is gradual, with memory loss as first symptom.
 - 1. Assess for memory loss progressing to global dementia.
 - 2. Sometimes resembles other dementia-like brain disorders such as Alzheimer's, but CJD disease usually progresses much more rapidly.
 - 3. Other symptoms may include: personality changes, anxiety, depression, memory loss, impaired thinking, blurred vision, insomnia, difficulty speaking, difficulty swallowing, sudden, jerky movements.
 - 4. Death may occur after a few months.

Implementation

- A. Nursing care emphasizes safety, skin and mouth care, nutrition, and comfort.

- B. Prevention focuses on both caution in handling body fluids (blood or tissue) from clients with this diagnosis and, for mad cow disease, not eating contaminated beef.
- C. The U.S. Blood Bank implemented guidelines in 2000 that refuse blood from anyone who has lived in Great Britain for more than 6 months.

ALTERED BLOOD SUPPLY TO BRAIN

Brain Attack (Cerebrovascular Accident, Stroke)

◆ **Definition:** A sudden focal neurological deficit due to cerebrovascular disease; the most common cause of brain disturbances.

A stroke is a medical emergency. Prompt treatment is crucial. Early action can minimize brain damage and potential complications.

Characteristics

- ◆ A. Causes.
 - 1. Thrombosis.
 - 2. Embolism.
 - 3. Hemorrhage (extradural, subdural, subarachnoid, or intracerebral).
- B. Risk factors.
 - 1. Circulatory—atherosclerosis, hypertension, anticoagulation therapy, cardiac valvular disease, synthetic valve and organ replacement, atrial arrhythmias.
 - 2. Diabetes.
 - 3. Sickle cell disease.
 - 4. Substance abuse.
 - 5. Sedentary lifestyle.
 - 6. Hyperlipidemia.
 - 7. Polycythemia.
 - 8. Use of oral contraceptives.
- ◆ C. Interruption of blood supply to brain via carotid and vertebral–basilar arteries—causes cerebral anoxia.
- D. Cerebral anoxia longer than 10 minutes to a localized area of the brain—causes cerebral infarction (irreversible changes).
- E. Surrounding edema and congestion—causes further dysfunction.
- ◆ F. Lesion in cerebral hemisphere (motor cortex, internal capsule, basal ganglia)—results in manifestations on the contralateral side.
- G. Permanent disability unknown until edema subsides. Order in which function may return: facial, swallowing, lower limbs, speech, arms.

MEDICAL IMPLICATIONS

- ◆ **Transient ischemic attack (TIA):** a precursor symptom or warning of impending CVA.
 - A. Rapid onset and short duration (30 minutes to 24 hours); by definition, must be resolved within this time period. No permanent neurological deficit.
 - B. Most common symptoms: vision loss, diplopia, contralateral hemiparesis, aphasia, confusion, slurred speech, and vertigo.
- ◆ **Carotid endarterectomy:** surgical procedure for carotid stenosis—often done following TIA or in presence of bruit indicating stenosis.
 - A. Procedure removes atherosclerotic plaque from arterial wall.
 - B. Monitor closely first 24 hours for cerebral ischemia or thrombosis or intolerance from carotid clamping.

◆ Assessment

- A. **Generalized signs**—headache; hypertension; changes in level of consciousness, convulsions; vomiting, nuchal rigidity, slow bounding pulse; Cheyne–Stokes respirations.
- B. **Focal signs**—upper motor lesion in motor cortex and pyramidal tracts: hemiparesis, hemiplegia, central facial paralysis, language disorders, cranial dysfunction, conjugate deviation of eyes toward lesion, flaccid hyperreflexia (later, spastic hyporeflexia).
- C. Evaluate general residual manifestations.
 - 1. Memory deficits; reduced memory span; emotional lability.
 - 2. Visual deficits such as homonymous hemianopia (loss of half of each visual field).
 - 3. Apraxia (can move but unable to use body part for specific purpose).
- D. Evaluate client for rehabilitative program.

◆ BRAIN LESION MANIFESTATIONS

Left Hemisphere

Lesion manifestations

- ◆• Usually dominant, containing speech center; right hemiplegia; aphasia, expressive, and/or receptive.
- Behavior is slow, cautious, disorganized.
- Impaired left/right discrimination.
- Slow performance.
- Aware of deficits: depression, anxiety.
- Impaired comprehension related to language and math.

Nursing guidelines

- Do not underestimate ability to learn.
- Assess ability to understand speech.
- Act out, pantomime communication; use client's terms to communicate; speak in normal tone of voice.
- Divide tasks into simple steps; give frequent feedback.

◆ BRAIN LESION MANIFESTATIONS (Continued)

Right Hemisphere

Lesion manifestations

- Left hemiplegia; spatial-perceptual deficits.
- ◆ Behavior is impulsive, quick; unaware of deficits; poor judge of abilities, limitations; neglect of paralyzed side.
- Tends to deny or minimize problems.
- Rapid performance, short attention span.
- Impulsive, safety problems.
- Impaired judgment.
- Impaired time concept.

Nursing guidelines

- Do not overestimate abilities.
- Use verbal cues as demonstrations; pantomimes may confuse.
- Use slow, minimal movements and avoid clutter around client.
- Divide tasks into simple steps; elicit return demonstration of skills.
- Promote awareness of body and environment on affected side.

Implementation

- A. Initial nursing objective is to support life and prevent complications.
- ◆ B. Give oxygen as needed. Begin at 3 L/min unless client has chronic obstructive pulmonary disease (COPD).
- ◆ C. Maintain patent airway and ventilation—elevate head of bed 20–30 degrees unless shock is present—encourage lying flat in bed if possible (except for ADLs).
- ◆ D. Monitor clinical status to prevent complications.
 1. Neurological.
 - a. Assess for recurrent CVA, increased intracranial pressure, bulbar involvement, hyperthermia.
 - b. Continued coma—negative prognostic sign.
 2. Cardiovascular—shock and arrhythmias, hypertension.
 3. Apply elastic stockings or pneumatic compression stockings as ordered to reduce risk of deep vein thrombosis.
 4. Lungs—pulmonary emboli.
- ◆ E. Maintain optimal positioning during bed rest period—prevent contractures.
 1. During acute stages, quiet environment and minimal handling to prevent further bleeding.
 2. Upper motor lesion—spastic paralysis, flexion deformities, external rotation of hip.
 3. Positioning schedule—2 hours on unaffected side; 20 minutes on affected side; 30 minutes prone, BID–TID.
 4. Begin passive-active range-of-motion exercises, four to five times daily.

5. Complications common with hemiplegia—frozen shoulder (vulnerable to injury due to stroke-induced injury to muscles); footdrop, use footboard.

- ◆ F. Maintain skin integrity: Provide skin care every 2 hours; special protocol for back, bony prominences, and skin.
- G. Maintain personal hygiene: Encourage self-help.
- ◆ H. Keep side rails up and safety straps on if required.
- I. Promote adequate nutrition, fluid and electrolyte balance.
 1. Encourage self-feeding with swallowing and assess if gag reflexes present.
 2. Food should be placed in unparalyzed side of mouth.
 3. Enteral feeding or gastrostomy feeding may be necessary.
- J. Promote elimination.
 1. Bladder control may be regained within 3–5 days.
 2. Offer urinal or bedpan every 2 hours, day and night.
 3. Diet should have roughage and fiber to encourage elimination and prevent fecal impaction.
 4. Activity and exercises will stimulate elimination.
- K. Provide emotional support.
 1. Behavior changes as consciousness is regained—loss of memory, emotional lability, confusion, language disorders.
 2. Reorient, reassure, and increase self-esteem by encouraging client. Establish means of communication.
- ◆ L. Promote rehabilitation to maximal functioning.

COLLABORATIVE CARE FOR A STROKE CLIENT

Prevention

1. Control of hypertension.
2. Control of diabetes mellitus.
3. Treatment of underlying cardiac problems.
4. Anticoagulation therapy with Coumadin (warfarin sodium) for clients with atrial fibrillation.
5. Smoking cessation.
6. Limit alcohol intake.
7. Surgical intervention if client has an aneurysm and is at risk for bleeding.
8. Carotid endarterectomy.
9. Carotid artery stent.
10. Transluminal angioplasty.
11. Extracranial–intracranial (EC–IC) bypass.

(continues)

COLLABORATIVE CARE FOR A STROKE CLIENT (Continued)

Acute Care

1. Maintain airway.
2. Maintain hydration—fluid therapy.
3. Treatment of cerebral edema.
4. Drug therapy.
 - a. Antiplatelet drugs are usually chosen to prevent further strokes in clients who have had TIA related to atherosclerosis.
 - b. Platelet inhibitors used: aspirin (acetylsalicylic acid), Plavix (clopidogrel), Ticlid (ticlopidine), Persantine (dipyridamole), Aggrenox (combined Persantine [dipyridamole] and aspirin), Coumadin for clients with atrial fibrillation.
5. Surgical therapy.
 - a. Carotid endarterectomy.
 - b. Carotid artery stent.
 - c. Transluminal angioplasty.
 - d. Extracranial-intracranial (EC-IC) bypass.

Types of Stroke

- A. Ischemic stroke—thrombotic or embolic.
1. Drug therapy—tissue plasminogen activator (tPA).
 - a. Must be administered within 3 hours of the onset of clinical signs. Some stroke centers can administer IV up to 4.5 hours of the onset. Tissue plasminogen activator is also given intra-arterially up to 6 hours after onset.
 - b. Timing of the administration of the med is the most critical factor.
 - c. Screening includes:
 - (1) Noncontrast CT or MRI to rule out hemorrhagic stroke.
 - (2) Coagulation studies.
 - (3) Screen for a recent history of a GI bleed.
 - (4) Head trauma within the past 3 months.
 - (5) Major surgery within the past 14 days.
 - d. During drug infusion:
 - (1) Monitor neurological signs to assess for improvement or for potential deterioration related to intracerebral hemorrhage.
 - (2) Control of BP is critical during treatment and for 24 hours following.
 2. Surgical therapy.
 - a. MERCI retriever—MERCI stands for mechanical embolus removal for cerebral ischemia.
 - b. During this procedure, which is used for ischemic strokes, a catheter with a coiled

tip is placed directly into the blood vessel, allowing the physician to pull the clot out.

- B. Hemorrhagic stroke.
1. Surgical decompression if needed.
 2. Clipping, wrapping or coiling of aneurysm.
 3. Medical therapy.
 - a. Anticoagulants and platelet inhibitors are contraindicated.
 - b. Calcium-channel blocker Nimotop (nimodipine) is given to clients with subarachnoid hemorrhage to decrease the effects of vasospasm and minimize cerebral damage.
 - (1) Must assess BP and atrial pressure (AP) prior to administration.
 - (2) Hold if AP \leq 60 beats/min or systolic BP \leq 90 mm Hg, contact physician.
 - c. Hyperthermia is treated with aspirin or Tylenol (acetaminophen).
 - (1) Increase in body temp can increase brain metabolism and cause further brain damage.
 - (2) Cooling blankets may also be used. Monitor client temperatures closely.
 - (3) Maintaining temperature during the first 24 hours after a stroke is most important in preventing detrimental outcomes.
 - d. Seizure prevention—5–7% of stroke victims have seizures.
 - (1) Antiseizure drug such as Dilantin is given if a seizure occurs.
 - (2) Seizure prophylaxis is recommended in the acute period after intracerebral or subarachnoid hemorrhage. In other types of strokes, it is not recommended.

Cerebral Aneurysm

- ♦ *Definition:* A dilation of the walls of a weakened cerebral artery leading to rupture from arteriosclerosis or trauma.

Assessment

- ♦ A. Alteration in level of consciousness (LOC) may be earliest sign—monitor for subtle changes indicating a change in condition.
- B. Suggest pupillary reaction, diplopia.
 - C. Slurred speech, drowsiness may be early signs LOC is deteriorating.
 - D. Hemiparesis, nuchal rigidity, headache.

Implementation

- ♦ A. Establish and maintain a patent airway.
- ♦ B. Closely monitor client.

- ◆ 1. Check for deteriorating condition—pulse, blood pressure, level of responsiveness.
- 2. Monitor respiratory status—reduced oxygen increases chances of cerebral infarction.
- C. Place client on bed rest in semi-Fowler's or side-lying position (elevate bed 15–30 degrees to promote venous drainage).
- D. Turn and deep-breathe client every 2 hours.
- E. Suction only with specific order.
- F. Provide darkened room without stimulation (e.g., limit visitors and lengthy discussions).
- G. Avoid any exertion or strenuous activity; provide range-of-motion exercises.
- H. Provide diet low in stimulants such as caffeine. Restrict fluid intake to prevent increased intracranial pressure.
- I. Monitor intake and output.
- ◆ J. Monitor vital signs for hypertension or cardiac irregularities. *Do not take rectal temperature due to vagal stimulation leading to cardiac arrest.*
- K. Observe for complications indicating rebleeding, DVT, or increased size of aneurysm.
- L. Surgical therapy: aneurysm and hemorrhage.
 - 1. Immediate evacuation of aneurysm-induced hematomas greater than 3 cm.
 - 2. Clipping, wrapping, or coiling of the aneurysm to prevent bleeding—Gugliemi detachable coils (GDCs) provide immediate protection against hemorrhage by decreasing pulsation within the aneurysm.
 - 3. Over time, a thrombus forms within the aneurysm. Plugging the weak, bulging section of the artery or fistula stops blood flow to the affected area and markedly decreases the risk of rupture.
 - 4. Coils are designed to remain anchored within the aneurysm or fistula and do not require eventual removal.
- D. Demyelination of nerve fibers occurs within long conducting pathways of spinal cord and brain.
- E. Lesions (plaques) are irregularly scattered—disseminated in pyramidal tract, posterior column, and ventricle of brain.
- F. Destruction of myelin sheath creates patches of sclerotic tissue, degeneration of the nerve fiber, and disturbance in conduction of sensory and motor impulses.
- G. Initially, the disease is characterized by periods of remission with exacerbation and variable manifestations, followed by irreversible dysfunction.
- H. Clinical course may extend over 10–20 years.
- I. Diagnostic tests: abnormal EEG, lumbar puncture (LP) indicating increased gamma globulin but normal serum levels.

Assessment

- A. Clinical manifestations—variable, depending on area of involvement: sensory fibers, motor fibers, brain stem, cerebellum, internal capsule. Often insidious and gradual.
- ◆ B. Initial signs and symptoms: ataxia, diplopia, blurred vision, impaired speech; ascending numbness, starting in the feet.
- ◆ C. Weakness, paralysis, uncoordinated, intention tremor; spasticity, numbness, tingling, analgesia, anesthesia, loss of position sense; heat intolerance and symptoms of overheating.
- D. Lhermitte's sign is a transient sensory symptom described as an electric shock radiating down the spine or into the limbs with neck flexion.
- E. Bladder/bowel retention or incontinence.
- F. Impaired vision (nystagmus), dysphagia.
- G. Emotional instability, impaired judgment.
- H. Charcot's neurologic triad—nystagmus, intention tremor, scanning speech.

DEGENERATIVE DISORDERS

Multiple Sclerosis

◆ *Definition:* A chronic, slowly progressive, noncontagious, degenerative disease of the CNS. Characterized by demyelination of the neurons, this disease affects the brain and spinal cord.

Characteristics

- A. Definite cause unknown; may be autoimmune, associated with a deficit in the T lymphocytes.
- B. Precipitating factors: pregnancy, fatigue, stress, infection, and trauma.
- C. Incidence is greater in colder climate, equal in the sexes, and usually occurs between 20 and 40 years of age. More than 300,000 in United States alone are affected.

CHARCOT'S TRIADS

There are two sets of Charcot's triads, both of which are sets of clinical signs relating to quite separate diseases. One pertains to multiple sclerosis; the other refers to ascending cholangitis. Charcot's triads are named for Jean-Martin Charcot (1825–1893), the French neurologist who first described these combinations of signs in relation to these diseases.

Charcot's triad 1: the combination of nystagmus, intention tremor, and scanning or staccato speech. This triad is sometimes associated with multiple sclerosis but is not, as previously considered by some authors, pathognomonic for multiple sclerosis.

Charcot's triad 2: the combination of jaundice; fever, usually with rigors; and right upper quadrant abdominal pain. Occurs as a result of ascending cholangitis. When the presentation also includes hypotension and mental status changes, it is known as Reynolds' pentad.

Implementation

- ◆ A. Avoid precipitation of exacerbations.
 1. Avoid fatigue, stress, infection, overheating, chilling.
 2. Establish regular program of exercise and rest.
 3. Provide a balanced diet, low in fat, rich in linoleic acid.
- ◆ B. Administer and assess effects of medications.
 1. Steroids hasten remission. Deltasone (prednisone) is used for short-term therapy.
 2. Librium (chlordiazepoxide) for mood swings.
 3. Lioresal (baclofen) or Dantrium (dantrolene) for spasticity.
 4. Urecholine (bethanechol) to relieve urinary retention, or Ditropan (oxybutynin) to increase bladder capacity.
 5. Tegretol to treat paresthesia.
 6. Symmetrel (amantadine) or Cylert (pemoline) to treat fatigue.
 7. Inderal or an anticonvulsant (Neurontin) to treat ataxia.
 8. Interferons (Betaseron [interferon beta-1b] and Avonex [interferon beta-1a]) used in relapsing-remitting multiple sclerosis (MS).
- C. Promote optimal activity.
 1. Moderation in activity with rest periods.
 2. Physical and speech therapy.
 3. Diversionary activities, hobbies.
 4. During exacerbation, client is usually put on bed rest.
- D. Promote safety.
 1. Sensory loss—regulate bath water, caution with heating pads, inspect skin for lesions.
 2. Motor loss—avoid waxed floors, throw rugs; provide rails and walker.
 3. Diplopia—eye patch.
- E. Promote regular elimination—bladder/bowel training programs.
- F. Alternative treatments: hyperbaric oxygen, nutrition supplements (omega 3 and 6).
- G. Provide education and emotional support to client and family.
 1. Encourage independence and realistic goals; assess personality and behavior changes; observe for signs of depression.
 2. Provide instruction and assistive devices; provide information about services of the National Multiple Sclerosis Society.
- H. Assess and prevent potential complications.
 1. Most common: urinary tract infection, calculi, pressure ulcers.
 2. Common cause of death: respiratory tract infection, urinary tract infection.

3. Contractures, pain due to spasticity, metabolic or nutritional disorders, regurgitation, depression.

Myasthenia Gravis

- ◆ *Definition:* A neuromuscular disease characterized by marked weakness and abnormal fatigue of voluntary muscles. Cause is unknown; question autoimmune reaction.

Characteristics

- A. Clients with myasthenia have a high incidence of thymus abnormalities and frequently have systemic lupus erythematosus.
- B. Basic pathology is a defect in transmission of nerve impulses at the myoneural junction, the junction of motor neuron with muscle.
- ◆ C. Normally, acetylcholine is stored in synaptic vesicle of motor neurons to skeletal muscles. Defect may be due to
 1. Deficiency in acetylcholine/excess acetylcholinesterase.
 2. Defective motor-end plate and/or nerve terminals.
 3. Decreased sensitivity to acetylcholine.
- D. Muscles supplied by bulbar nuclei (cranial nerves) are commonly involved.
- ◆ E. Muscle involvement usually progresses from ocular to oropharyngeal, facial, proximal muscles, respiratory muscles.
- F. Generally, there is no muscle atrophy or degeneration; there may be periods of exacerbations and remissions.
- G. Symptoms are related to progressive weakness and fatigue of muscles when used; muscles generally strongest in the morning.

Assessment

- A. Changes in eyes (affected first): ptosis, diplopia, and eye squint.
- B. Impaired speech; dysphagia; drooping facies; difficulty chewing, closing mouth, or smiling; breathing difficulty and hoarse voice.
- C. Respiratory paralysis and failure.
- D. Severe weakness during Tensilon (edrophonium) test.

Implementation

- A. Assist with disease diagnosis.
 - ◆ 1. Have Tensilon available for physician to inject—rapid, brief-acting anticholinesterase for testing purposes.
 - 2. Assess results of Tensilon injections.
 - a. Positive for myasthenia—improvement in muscle strength.

- b. Negative—no improvement or even deterioration.
 - B. Administer medications as ordered.
 - ◆ 1. Anticholinesterase drugs increase levels of acetylcholine at myoneural junction.
 - ◆ a. Prostigmin (neostigmine), Mestinon (pyridostigmine), Mytelase (ambenonium)—main difference is duration of effect.
 - ◆ b. Tensilon (edrophonium).
 - c. Monitor side effects.
 - (1) Related to effects of increased acetylcholine in parasympathetic nervous system: sweating, excessive salivation, nausea, diarrhea, abdominal cramps; possibly bradycardia or hypotension.
 - (2) Excessive doses lead to cholinergic crisis—atropine given as cholinergic blocker.
 - d. Nursing measures.
 - (1) Give medication exactly on time, 30 minutes before meals.
 - (2) Give medication with milk and crackers to reduce gastrointestinal upset.
 - (3) Observe therapeutic or any toxic effects; monitor and record muscle strength and vital capacity.
 - 2. Steroids.
 - a. Suppress immune response. Immunosuppressive drugs such as Deltazone, Imuran (azathioprine), Restasis (cyclosporine), CellCept (mycophenolate mofetil), and Prograf (tacrolimus) may also be used. These medications improve muscle strength by suppressing the production of abnormal antibodies. Their use must be carefully monitored by a physician because they may cause major side effects.
 - b. Usually the last resort after anticholinesterase and thymectomy.
 - ◆ 3. The following drugs must be avoided:
 - a. Streptomycin, kanamycin, neomycin, gentamicin—block neuromuscular transmission.
 - b. Ether, quinidine, morphine, curare, procainamide, beta-adrenergic blockers, [Innovar (droperidol), opioid analgesic], sedatives—aggravate weakness of myasthenia.
 - 4. Psychotropic drugs (e.g., lithium carbonate, phenothiazines, benzodiazepines, tricyclic antidepressants) have been associated with worsening of myasthenia gravis (MG).
- ◆ C. Monitor client's condition for complications.
 - 1. Vital signs.
 - 2. Respirations: depth, rate, vital capacity, ability to deep-breathe and cough.
 - 3. Swallowing: ability to eat and handle secretions.
 - 4. Muscle strength.
 - 5. Speech: Provide method of communication if client is unable to talk.
 - 6. Bowel and bladder function.
 - 7. Psychological status.
 - D. Promote optimal activity.
 - 1. Plan short periods of activity and long periods of rest.
 - 2. Time activity to coincide with maximum muscle strength.
 - 3. Encourage normal activities of daily living.
 - 4. Encourage diversionary activities.
 - E. Provide education and emotional support for client and family.
 - 1. Give reassurance and facts about the disease, medications and treatment regimen, importance of adhering to medication schedule, difference between myasthenic/cholinergic crisis, and emergency care.
 - 2. Instruct client to avoid infection, stress, fatigue, and over-the-counter drugs.
 - 3. Instruct client to wear identification medal and carry emergency card.
 - 4. Provide information about services of Myasthenia Gravis Foundation.
 - F. Provide appropriate nursing measures in the event of thymectomy surgery.
 - ◆ G. Use of Tensilon.
 - 1. Tensilon test differentiates crises, as symptoms are similar.
 - 2. Give Tensilon; if strength improves, it is symptomatic of myasthenic crisis and the client needs more medication. If weakness is more severe, it is symptomatic of cholinergic crisis and overdose has occurred.
 - 3. Be prepared for emergency with atropine, suction, and other emergency equipment for respiratory arrest.
 - 4. Crisis with respiratory insufficiency—client cannot swallow secretions and may aspirate.
 - a. Maintain bed rest.
 - b. May require endotracheal or tracheostomy tube to assist with ventilation.
 - c. Monitor vital capacity, blood gases.
 - d. Give atropine and may hold anticholinesterase (cholinergic).
 - e. Begin anticholinesterase (myasthenic).

CRISIS CONDITIONS

- Myasthenic crisis
 - a. Acute exacerbation of disease may be due to rapid, unrecognized progression of disease; failure of medication; infection; or fatigue or stress.
 - b. Myasthenic symptoms—weakness, dyspnea, dysphagia, restlessness, difficulty speaking.
- Cholinergic crisis
 - a. Cholinergic paralysis with sustained depolarization of motor-end plates is due to overmedication with anticholinesterase.
 - b. Symptoms similar to myasthenic state—restlessness, weakness, dysphagia, dyspnea.
 - c. Cholinergic symptoms—fasciculation, abdominal cramps, diarrhea, nausea, vomiting, salivation, sweating, increased bronchial secretion.

Parkinson's Disease

Definition: A degenerative disease resulting in dysfunction of the extrapyramidal system.

Characteristics

- A. Possible causes: atherosclerosis, drug induced, postencephalitic, idiopathic.
- B. Degeneration of basal ganglia due to depleted concentration of dopamine.
- C. Depletion of dopamine correlated with degeneration of substantia nigra (midbrain structures that are closely related functionally to basal ganglia).
- D. Loss of inhibitory modulation of dopamine to counterbalance cholinergic system and interruption of balance-coordinating extrapyramidal system.
- E. Slowly progressive disease with high incidence of crippling disability; mental deterioration occurs very late.

Assessment

- ◆ A. Assess stage of disease—five stages: unilateral, bilateral, impaired balance, fully developed severe disease, confinement to bed or wheelchair.
- B. Identify presence of initial symptoms.
 1. Slowing of all movements.
 2. Aching shoulders and arms.
 3. Monotonous and indistinct speech.
 4. Writing becomes progressively smaller.
- C. Evaluate major symptoms.
 - ◆ 1. Tremor at rest, especially in hands and fingers (pill rolling).
 - a. Increases when stressed or fatigued.
 - b. May decrease with purposeful activity or sleep.

2. Rigid or blank facial expression (masklike).
 - a. Drooling, difficulty swallowing or speaking.
 - b. Short, shuffling steps with stooped posture.
 - c. Propulsive gait.
 - d. Immobility of muscles in flexed position, creating jerky cogwheel motions.
 - e. Loss of coordinated and associated automatic movement and balance.
3. Bradykinesia—abnormal slowness and reduction in automatic movement; sluggishness of responses.
4. Increased muscle tone rigidity.

Implementation

- ◆ A. Administer and monitor drugs—drug therapy is aimed at correcting an imbalance of neurotransmitters within the CNS.
 1. Symmetrel (amantadine): Used to treat clients with mild symptoms but no disability; side effects uncommon with usual dose.
 - ◆ 2. Anticholinergic drugs: Most effective is Parsidol (ethopropazine); used to treat tremors and rigidity and inhibit action of acetylcholine; side effects include dry mouth, dry skin, blurring vision, urinary retention, and tachycardia.
 - ◆ 3. Larodopa, Dopar (levodopa) (converted in body to dopamine).
 - a. Reduces akinesia, tremor, and rigidity.
 - b. Passes through blood-brain barrier.
 - c. Effectiveness may decline after 2–3 years.
 - d. Side effects.
 - (1) Anorexia, nausea, and vomiting (administer drug with meals or snack; avoid coffee, which seems to increase nausea).
 - (2) Postural hypotension, dizziness, tachycardia, and arrhythmias (monitor vital signs; caution client to sit up or stand up slowly; have client wear support stockings).
 - e. Contraindicated in clients with closed-angle glaucoma, psychotic illness, and peptic ulcer disease.
 - ◆ 4. Sinemet—combination of carbidopa and levodopa: Has fewer side effects than levodopa.
 5. Antihistamines: Reduce tremor and anxiety; side effect is drowsiness.
 6. Antispasmodics (Artane [trihexyphenidyl], Kemadrin [procyclidine]): Improve rigidity but not tremor.
 7. Parlodel (bromocriptine): Drug often used to replace levodopa when it loses effectiveness.

- a. Acts on dopamine receptors.
 - b. Side effects: anorexia, nausea, vomiting, constipation, postural hypotension, cardiac arrhythmias, headache.
 - c. Contraindicated in clients with mental illness, myocardial infarction, peptic ulcers, peripheral vascular disease.
- ♦ B. Avoid the following drugs:
1. Phenothiazines, reserpine, pyridoxine, vitamin B₆: Block desired action of levodopa.
 2. Monoamine oxidase inhibitors: Precipitate hypertensive crisis.
 3. Methyldopa: Potentiates effects of the primary drug.
- C. Maintain regular patterns of elimination.
1. Constipation is often a problem due to side effects of medications, reduced physical activity, muscle weakness, and excessive drooling.
 2. Provide stool softeners, suppositories, mild cathartics.
- ♦ D. Promote physical therapy and rehabilitation.
1. Provide preventive, corrective, and postural exercises.
 2. Institute massage and stretching exercises, stressing extension of limbs.
 3. Encourage daily ambulation: Have client lift feet up when walking and avoid prolonged sitting.
 4. Facilitate adaptation for activities of daily living and self-care, encourage rhythmic patterns to attain timing, foster independence, utilize special aids and devices.
 5. Remove hazards that might cause falls.
- E. Provide education and emotional support to client and family.
1. Remember—intellect is usually not impaired.
 2. Assess changes in self-consciousness, body image, sexuality, moods.
 3. Instruct client to avoid emotional stress and fatigue, which aggravate symptoms.
 4. Instruct client to avoid foods high in vitamin B₆ and monoamine oxidase.
- F. Complete preoperative teaching for specific surgical intervention.
1. Stereotactic surgery to reduce tremor.
 - a. Pallidotomy—lesion in globus pallidus.
 - b. Thalamotomy—lesion in ventrolateral portion of thalamus.
 2. **Deep brain stimulation (DBS):** Implantation of electrodes through burr holes into either the thalamus or globus pallidus of brain. These are connected to a pulse generator in the chest (similar to a pacemaker). The device is programmed to deliver a set current to the targeted brain location. Unlike ablation

treatments, DBS can be adjusted to control symptoms better and is reversible. The device can be removed.

- G. Provide appropriate nursing care following surgery.

CRANIAL AND PERIPHERAL NERVE DISORDERS

Trigeminal Neuralgia (Tic Douloureux)

♦ **Definition:** A sensory disorder of the fifth cranial nerve, resulting in severe, recurrent paroxysms of sharp, facial pain along the distribution of the trigeminal nerve. Etiology and pathology are unknown; incidence is rare, more common in women in fifth or sixth decade of life.

Assessment

- A. Assess for trigger points on the lips, gums, nose, or cheek.
- B. Conditions that stimulate symptoms: cold breeze, washing, chewing, food/fluids of extreme temperatures.
- C. Assess pain—limited to those areas innervated by the three branches of the fifth nerve.
- D. Diagnostic tests.
 1. History and physical exam.
 2. Brain or CT scan.
 3. Audiologic evaluation.
 4. EMG.
 5. CSF analysis to rule out MS.
 6. MRI to rule out MS.

Implementation

- A. Observe and record characteristics of the attack.
 - B. Record method client uses to protect face.
 - C. Avoid extremes of heat or cold.
 - D. Provide small feedings of semiliquid or soft food.
 - E. Administer medication and record effects.
- ♦ F. Complete postoperative care.
1. Ophthalmic nerve—client needs protective eye care.
 2. Maxillary and mandibular nerves.
 - a. Avoid hot food and liquids, which might burn.
 - b. Instruct client to chew on unaffected side to prevent biting denervated portion.
 - c. Encourage client to visit dentist within 6 months.
 - d. Provide frequent oral hygiene to keep the mouth free of debris.

Surgical Treatment

- A. Peripheral: glycerol rhizotomy— injection into one or more branches of the trigeminal nerve.

- B. Intracranial.
 - 1. Percutaneous radiofrequency rhizotomy.
 - 2. Microvascular decompression.
 - 3. Gamma Knife radiosurgery.

MEDICAL IMPLICATIONS

Medical—Pharmacologic

- 1. Massive doses of vitamin B₁₂.
- 2. Tegretol, Carbatrol (carbamazepine) remains criterion standard of treatment for this condition.
- 3. Dilantin (phenytoin) has a lower rate of success; the dose varies greatly among clients.
- 4. Neurontin (gabapentin) seems to be effective in some cases.
- 5. Lamictal (lamotrigine) has proven effective. Dosage should be increased slowly for better tolerance (e.g., 25 mg daily dose each week; up to 250 mg twice a day).

Surgical Care

- 1. Surgical therapy can be divided into external or percutaneous procedures.
- 2. Microvascular decompression (MVD).
- 3. Alcohol injection of the trigeminus.
- 4. Glycerol injection of the gasserian ganglion to selectively destroy the pain-transmitting fibers.
- 5. Percutaneous radiofrequency rhizotomy.
- 6. Percutaneous microcompression with balloon inflation.

Radiation

- 1. Gamma Knife treatment.

Alternative Options

- 1. Acupuncture has proven to be successful.

- D. Protect facial muscles.
 - 1. Provide face sling to prevent stretching of weakened muscles and loss of tone.
 - 2. Promote active facial exercises to prevent loss of muscle tone and support of facial muscles.
- E. Monitor diet.
 - 1. Instruct client to chew food on unaffected side.
 - 2. Provide attractive, easy-to-eat foods to prevent anorexia and weight loss.
- F. Provide special eye care to protect cornea and prevent keratitis, dark glasses, artificial tears.
- G. Reassure and support.

Ménière's Disease

♦ *Definition:* Dilatation of the endolymphatic system causing degeneration of the vestibular and cochlear hair cells.

Characteristics

- A. Etiology is unknown.
- B. Possible causes may include allergies, toxicity, localized ischemia, hemorrhage, viral infection, and edema.
- C. Surgical procedures.
 - 1. Surgical division of vestibular portion of nerve or destruction of labyrinth may be necessary for severe cases.
 - 2. Endolymphatic shunt.
 - 3. Vestibular nerve section.
 - 4. Labyrinthotomy.
 - 5. Labyrinthectomy.

Assessment

- A. Chronic recurrent process.
- ♦ B. Severe vertigo, nausea, vomiting, nystagmus, and loss of equilibrium.
- C. Impaired hearing and tinnitus.
- D. Nutritional needs, which will depend on amount of nausea and vomiting.

Implementation

- ♦ A. Maintain bed rest during acute attack.
 - 1. Prevent injury during attack.
 - 2. Provide side rails if necessary.
 - 3. Keep room dark when photophobia is present.
- ♦ B. Provide drug therapy.
 - 1. Vasodilators (nicotinic acid).
 - 2. Diuretics, antihistamines (Benadryl), anticholinergics.
 - 3. Sedatives.
- C. Monitor diet therapy.
 - 1. Low sodium.
 - 2. Lipoflavonoid vitamin supplement.
 - 3. Restricted fluid intake.
- D. Assist with ambulation if necessary.

Bell's Palsy (Facial Paralysis)

♦ *Definition:* A lower motor neuron lesion of the seventh cranial nerve, resulting in paralysis of one side of the face. May occur secondary to intracranial hemorrhage, tumor, meningitis, trauma. Diagnosis made by exclusion. No definitive tests.

Assessment

- A. Flaccid muscles.
- B. Shallow nasolabial fold.
- C. Ability to raise eyebrows, frown, smile, close eyelids, or puff out cheeks.
- D. Upward movement of eye when attempting to close eyelid.
- E. Loss of taste in anterior tongue.

Implementation

- ♦ A. Majority of clients recover in a few weeks without residual effects.
- B. Palliative measures account for majority of interventions; acupuncture; moist heat, massage.
- C. Monitor use of analgesics and steroids.

Bulbar Palsy

◆ **Definition:** A dysfunction of the ninth and tenth cranial nerves. The disease is secondary to tumors, infections, vascular or degenerative diseases.

Assessment

- ◆ A. Glossopharyngeal paralysis: absent gag reflex; difficulty swallowing, increased salivation; anesthesia of posterior palate and base of tongue.
- ◆ B. Vagal paralysis: difficulty with speech, breathing, and regurgitation.
- C. Possible aspiration.
- D. Breathing capability.
- E. Difficulty in swallowing.
- F. State of depression and fear.

Implementation

- A. Medical/surgical treatment is directed toward underlying cause.
- B. Nursing care is directed toward prevention of complications.
- C. Keep suction equipment at bedside.
- D. Elevate head of bed.
- E. Provide oral care.
- F. Maintain open airway.
- G. Keep emergency equipment available.
- H. Avoid milk products and sticky carbohydrates.
- I. Use small cup instead of straw for liquids.
- J. Provide relationship therapy.
 - 1. Give client time to express fears and concerns.
 - 2. Provide consultation for depression if present.

Guillain–Barré Syndrome

◆ **Definition:** An acute, rapidly progressing and potentially fatal form of polyneuritis. Immune system overreacts to an infection, destroying the myelin sheath.

Characteristics

- A. Etiology is unknown.
- B. Occurs at any age but increased incidence between 30 and 50 years of age.
- C. Both sexes equally affected.
- D. Presyndrome clients may report a mild upper respiratory infection or gastroenteritis.
- E. Recovery is a slow process, taking 2 months to 2 years.
- F. Diagnostic test results: cerebrospinal fluid (CSF) contains high protein, abnormal EMG, and nerve conduction.

Assessment

- ◆ A. Initial symptom of weakness of lower extremities with ascending paralysis/paresthesia.

- B. Gradual progressive weakness of upper extremities and facial muscles (24–72 hours); paresthesias may precede weakness.
- C. Respiratory failure occurs in some clients.
- D. Cardiac arrhythmias, tachycardia.
- E. Sensory changes—usually minor, but in some cases severe impairment of sensory information occurs.

Implementation

- ◆ A. No specific treatment available; supportive treatment includes monitoring for complications (respiratory, circulatory).
- B. Carefully observe for respiratory paralysis and inability to handle secretions.
- C. Provide chest physiotherapy and pulmonary toilet.
- D. Maintain cardiovascular function.
 - 1. Monitor vital signs and cardiac rhythm.
 - 2. Vasopressors and volume replacement.
- ◆ E. Prevent complications of immobility.
 - 1. Turn frequently.
 - 2. Provide skin care.
- F. Provide appropriate diversion.
- G. Reassure client, especially during paralysis period.
- H. Previous treatment included corticosteroids; this is now considered controversial.

Amyotrophic Lateral Sclerosis (Lou Gehrig's Disease)

◆ **Definition:** The most common motor neuron disease of muscular atrophy. It is a rapidly fatal, upper and lower motor neuron deficit affecting the limbs.

Characteristics

- ◆ A. May result from several causes.
 - 1. Nutritional deficiency related to disturbance in enzyme metabolism.
 - 2. Vitamin E deficiency resulting in damage to cell membranes.
 - 3. Metabolic interference in nucleic acid production by nerve fibers.
 - 4. Autoimmune disorder.
- B. Inherited as an autosomal dominant trait in 10% of cases.
- C. Occurs after age 40; most common in men.
- D. Is fatal within 2–6 years after onset. Rilutek (riluzole) slows progression of the disease.
- E. Diagnostic tests: EMG and muscle biopsy; increased protein in CSF.

Assessment

- A. Atrophy and weakness of upper extremities.
- ◆ B. Difficulty swallowing and chewing.
- C. Respiratory excursion and breathing patterns.
- D. Impaired speech.

- E. Secondary depression.

Implementation

- A. Assist with rehabilitation program to promote independence.
- ◆ B. Monitor for complications.
 - 1. Prevent skin breakdown: reposition regularly, provide back care, and utilize pressure-relieving devices.
 - 2. Prevent aspiration of food or fluids: Offer soft foods and keep client in upright position during meals.
 - 3. Promote bowel and bladder function.
- C. Provide emotional support.

SURGICAL INTERVENTION

General Preoperative Care

Assessment

- A. Follow general assessment modalities for preoperative care.
- B. Observe and record neurological symptoms relative to site of problem (clot, lesion, aneurysm, etc.), for example:
 - 1. Paralysis.
 - 2. Seizure foci.
 - 3. Pupillary response.

Implementation

- A. Provide psychological support to client and family.
- B. Prep and shave cranial hair (save hair).
- C. Apply scrub solution to scalp, as ordered.
- D. Avoid using enemas unless specifically ordered; the strain of defecation may lead to increased intracranial pressure.
- E. Explain postoperative routine orders such as neurological checks and headaches.
- F. Administer steroids or mercurial diuretics as ordered, to decrease cerebral edema.
- G. Insert NG tube and/or Foley catheter, as ordered.

General Postoperative Care

Assessment

- A. Follow general assessment modalities for postoperative clients.
- ◆ B. Observe neurological signs.
 - 1. Evaluate level of consciousness.
 - a. Orientation to time and place.
 - b. Response to painful stimuli: Pinch Achilles tendon or test with safety pin.
 - c. Ability to follow verbal command.
 - 2. Evaluate pupil size and reactions to light.
 - a. Are pupils equal, not constricted or dilated?

- b. Do pupils react to light?
- c. Do pupils react sluggishly or are they fixed?
- 3. Evaluate strength and motion of extremities.
 - a. Are hand grasps present and equal?
 - b. Are hand grasps strong or weak?
 - c. Can client move all extremities on command?
 - d. Are movements purposeful or involuntary?
 - e. Do the extremities have twitching, flaccid, or spastic movements (indicative of a neurological problem)?

◆ C. Observe vital signs.

- 1. Keep client normothermic to decrease metabolic needs of the brain.
- 2. Observe respirations for depth and rate to prevent respiratory acidosis from anoxia.
- 3. Observe blood pressure and pulse for signs of shock or increased intracranial pressure.

◆ D. Evaluate reflexes.

- 1. Babinski—positive Babinski is elicited by stroking the lateral aspect of the sole of the foot, backward flexion of the great toe, or spreading of other toes.
 - a. Most important pathological reflex in neurology.
 - b. If positive, indicative of pyramidal tract involvement (usually upper motor neuron lesion).
- 2. Romberg—when client stands with feet close together, he or she falls off balance. If positive, may have cerebellar, proprioceptive, or vestibular difficulties.
- 3. Kernig—client is lying down with thigh flexed at a right angle; extension of the leg upward results in spasm of hamstring muscle, pain, and resistance to additional extension of leg at the knee (indicative of meningitis).
- E. Observe for headache, double vision, nausea, or vomiting.

Implementation

- ◆ A. Maintain patent airway.
 - 1. Oxygen deprivation and an increase of carbon dioxide may produce cerebral hypoxia and cause cerebral edema.
 - 2. Intubate if values indicate to be necessary:
 - a. PO₂ below 80 mm Hg.
 - b. PCO₂ above 50 mm Hg.
- ◆ B. Suction if necessary, but not through nose without specific order.
- C. Maintain adequate oxygenation and humidification.

- ◆ D. Place client in semiprone or semi-Fowler's position (or totally on side). Turn every 2 hours, side to side (unless contraindicated by surgical procedure).
- ◆ E. Maintain fluid and electrolyte balance.
 1. Do not give fluid by mouth to semiconscious or unconscious client.
 2. Weigh to determine fluid loss.
 3. Administer IV fluids slowly; overhydration leads to cerebral edema.
- F. Record accurate intake and output.
- G. Watch serial blood and urine samples; sodium regulation disturbances accompany head injuries.
- H. Keep temperature down with cooling blanket if necessary. If temperature is down, the metabolic requirements of brain as well as oxygen requirements are less.
- ◆ I. Take vital and neurological signs every 15–30 minutes until stable.
- ◆ J. Use seizure precautions. Administer anticonvulsants as ordered.
- K. Provide hygienic care, including oral hygiene.
- L. Observe dressing for unusual drainage (bleeding, cerebrospinal fluid).
- M. Prevent straining with bowel movements.
- N. Administer steroids and osmotic diuretics to decrease cerebral edema.
- ◆ O. Observe for and treat postoperative complications.
 1. Increased intracranial pressure.
 2. Seizures.
 3. Hemorrhage.
 4. Wound infection.
 5. Brain abscess.
 6. Meningitis.

◆ PRECAUTIONS FOR CARE OF NEUROSURGICAL CLIENT

- A. Do not lower head in Trendelenburg position or place in supine position.
- B. Do not suction through nose without specific order.
- C. Be careful when administering sedation and narcotics.
 1. Cannot evaluate neurological status.
 2. May cause respiratory embarrassment.
- D. Do not give oral fluids unless client is fully awake.
- E. Do not administer enemas or cathartics (may cause straining, which then increases intracranial pressure).
- F. Do not place on operative side if large tumor or bone is removed.

Characteristics

- ◆ A. Glaucoma classified into two main types: open-angle and angle-closure.
- B. Also classified by cause: primary, cause is not known; secondary, cause is known.
- ◆ C. Primary open-angle (chronic) glaucoma.
 1. Results from an overproduction or obstruction to the outflow of aqueous humor. Aqueous humor flows from the trabecular network, Schlemm's canal, or aqueous veins.
 2. About 60% to 70% of all glaucoma cases are of this type.
- ◆ D. Primary angle-closure (narrow angle—acute) glaucoma follows an untreated attack of acute angle-closure glaucoma.
 1. Results from an obstruction to the outflow of aqueous humor.
 2. Causes of obstruction.
 - a. A narrow angle between the anterior iris and the posterior corneal surface.
 - b. Shallow anterior chambers.
 - c. A thickened iris that causes angle closure upon pupil dilation.
 - d. A bulging iris that presses on the trabecula to close the angle.
 3. Caused by trauma, drugs, or inflammation.

Assessment

- ◆ A. Type of glaucoma.
 1. Primary open-angle—slow, progressive course.
 2. Angle-closure.
 3. Other glaucomas (associated with inflammation, trauma, surgery, etc.).
- ◆ B. Risk conditions: over 40 years of age, diabetes, African American, hypertensive, familial history of glaucoma, and history of eye injury.
- ◆ C. Results of Schiotz or Goldman's Applanation Tonometer Test (7 to 21 mm Hg is normal) and optic-disc cupping.
- ◆ D. Primary open-angle manifestations.
 1. Slow loss of peripheral vision.
 2. Eventual loss of central vision; tunnel vision.
- ◆ E. Primary angle-closure glaucoma manifestations (accounts for 10% of all glaucomas).
 1. Unilateral inflammation.
 2. Pain; pressure over eye.
 3. Increased intraocular pressure (24–32 mm Hg to much higher). One-sixth of clients have pressure within normal range.
 4. Moderate pupil dilation, nonreactive to light.
 5. Cloudy cornea.
 6. Blurring and decreased visual acuity.
 7. Photophobia.
 8. Halos around light.
 9. Nausea and vomiting.

EYE AND EAR

Glaucoma

Definition: An eye disorder in which intraocular pressure is too high for the health of the eye—causes atrophy of the optic nerve and peripheral visual field loss.

Implementation

- A. Chronic or primary open-angle glaucoma.
 - 1. Decrease aqueous humor production through beta blockers or prostaglandins.
 - 2. Treated first with medication. New drugs include topical α_2 -selective adrenergic agonists, carbonic anhydrase inhibitors and prostaglandin analogs.
 - ◆ 3. When medication no longer controls intraocular pressure and peripheral vision is lost, prepare client for argon laser treatments.
 - a. Trabeculoplasty—laser alters trabecular meshwork and facilitates aqueous humor drainage.
 - b. Trabeculectomy—creates a new opening at limbus to allow drainage of aqueous humor.
 - c. Seton implants (Moltemo).
 - d. Photocoagulation—uses argon laser heat to destroy portions of the ciliary body.
 - e. Cyclocryotherapy—freezes tissue and destroys portions of the ciliary body.
- B. Acute or primary angle-closure glaucoma.
 - 1. Treat as a medical emergency problem.
 - ◆ 2. Administer drugs to lower intraocular pressure (IOP)—beta blockers, IV or oral carbonic anhydrase inhibitors, or topical adrenergic agonists.
 - 3. Prepare client for laser peripheral iridotomy (definitive treatment).
 - a. Allows aqueous humor to flow from posterior to anterior chamber.
 - b. Administer ordered drugs: Salagen (pilocarpine), Diamox (acetazolamide), mannitol, etc.
- C. Provide postoperative care.
 - ◆ 1. Administer cycloplegic eye drops to affected eye to relax the ciliary muscle and decrease inflammation.
 - 2. Observe unaffected eye for symptoms of acute angle-closure glaucoma if cycloplegic drops are given by mistake.
 - ◆ D. Instruct client to limit activities that increase intraocular pressure—straining, coughing, stooping, or lifting.

Cataracts

Definition: Clouding or opacity of the lens that leads to blurred vision.

Characteristics

- ◆ A. Opacity is due to physical changes of the fibers or chemical changes in protein of the lens—most often caused by the slow, degenerative changes of age. Leading cause of blindness worldwide.

- B. The goal of cataract surgery is to restore functional vision.
- C. Surgical procedure is usually based on individual needs.
 - 1. If any inflammation is present, surgery is not performed.
 - 2. Cataracts are usually removed under local or topical anesthesia.
 - 3. Some simple cataracts are removed by use of alpha chymotrypsin, which weakens the zonular fibers that hold the lens in position.
 - 4. Surgery is performed on one eye at a time.
- ◆ D. Types of surgical extraction.
 - 1. **Extracapsular**—the lens is lifted out without removing the posterior lens capsule.
 - 2. **Phacoemulsification (ultrasonic)**—the lens is broken up by ultrasonic vibrations and extracted via extracapsular route.
- E. Intraocular lens implant at time of surgery is a common alternative to sight correction with glasses.
 - 1. Cataracts are now removed through smaller incisions to promote rapid visual rehabilitation.
 - 2. New intraocular lens designs have helped to prevent lens epithelial cell migration.

Implementation

- ◆ A. Check that client understands preoperative instructions.
 - 1. Client must be transported to and from hospital.
 - 2. Client must have someone at home for assistance following surgery.
 - 3. Client should be NPO, and shampoo hair before surgery.
 - 4. Review instructions to decrease intraocular pressure (do not bend, cough, strain, or lift).
- ◆ B. Administer prescribed preoperative medications.
 - 1. Mydriatics and cycloplegics (Cyclogyl [cyclopentolate]) to paralyze ciliary muscle—note whether pupil dilates following drug instillation.
 - a. Instruct client to wear dark glasses to minimize photophobia that may occur from drugs.
 - b. Monitor for signs of systemic toxicity (e.g., CNS effects and tachycardia).
 - 2. Topical antibiotics—prevention of infection.
- C. Provide postoperative care. Most procedures are done on outpatient basis.
 - ◆ 1. Instruct client in postoperative drugs.
 - a. Mydriatics are occasionally used.
 - b. Steroids (prednisolone suspension) and antibiotic drops.
 - c. Analgesics.

- ◆ 2. Instruct in ways to alleviate symptoms that could result in complications.
 - a. Increased intraocular pressure may occur with nausea and vomiting, restlessness, coughing or sneezing, lifting more than 15 pounds, constipation.
 - b. Observe for signs of infection: increasing redness, tearing, green drainage, or photophobia.
- ◆ 3. Instruct client to notify physician of sudden pain in operative eye—may be due to ruptured vessel or suture.
- ◆ 4. Apply dressing and shield at night to prevent injury to operative eye if ordered. Unoperative eye is usually left uncovered.
- 5. There is research that indicates that postop activity restrictions and nighttime eye shields are not necessary. However, many physicians still instruct clients to avoid activities that will increase IOP such as bending, coughing, stooping, or lifting, and instruct client on head positioning.
- 6. Reinforce instructions on dressing changes and eye drops. (Client returns to physician's office first postoperative day for change of dressing.)
- 7. Inform client that temporary glasses are prescribed 1–4 weeks postoperatively if lens is not implanted.
- D. Assist client with specific adjustment problems.
 - ◆ 1. Intraocular lens implant at time of surgery is very common.
 - a. This lens provides means of focusing light on the retina—approximates human lens.
 - b. If no implant, the eye cannot accommodate and glasses must be worn at all times.
 - c. Mydriatic drops frequently used to prevent lens displacement.
 - 2. Cataract glasses magnify—objects appear closer. Teach client to accommodate, judge distance, and climb stairs carefully.

Ophthalmic Drugs

- ◆ A. Miotics: pilocarpine HCl 1–4% solution; Carbastat, Miostat (carbachol); cholinergic agonists.
 - 1. Action is contraction of ciliary muscle, which increases flow of aqueous humor.
 - 2. Treatment for glaucoma and certain types of lens implants.
 - 3. Side effects: headache, conjunctiva irritation, and inflammation.
- ◆ B. Beta blockers: Timoptic (timolol); Betoptic, Kerlone (betaxolol), Betagan (levobunolol).

- 1. Action is to reduce intraocular pressure by decreasing formation of aqueous humor or may facilitate outflow of aqueous humor.
- 2. Treatment for glaucoma.
- 3. Side effects: eye irritation.
- ◆ C. Carbonic anhydrase inhibitors: Diamox (acetazolamide), Daranide (dichlorphenamide).
 - 1. Action is to restrict action of the enzyme necessary to produce aqueous humor—thus, decrease aqueous production.
 - 2. Treatment for glaucoma.
 - 3. Side effects: CNS disturbance, GI irritation, acidosis, hypokalemia.
- ◆ D. Hyperosmotic agents: glycerin (oral) or mannitol (IV).
 - 1. Action is to draw fluid from the eye (increase blood osmolarity)—reduce intraocular pressure.
 - 2. Treatment for cataract surgery as preoperative medication.
 - 3. Side effects: CNS—headache, confusion, blurred vision; GI irritability, nausea, dehydration.
- E. Nonselective adrenergic agonists: Adrenalin (epinephrine), Propine (dipivefrin).
 - 1. Action is to increase aqueous outflow and decrease aqueous production.
 - 2. Topical treatment for glaucoma.
- F. Topical antibiotics are used to prevent infection.

Retinal Detachment

Characteristics

- ◆ A. The retina is the part of the eye that perceives light; it coordinates and transmits impulses from its seeing nerve cells to the optic nerve.
- B. There are two primitive retinal layers: the outer pigment epithelium and an inner sensory layer.
- C. Retinal detachment occurs when
 - 1. The two primitive layers of the retina separate, due to the accumulation of fluid between them.
 - 2. Both retinal layers elevate away from the choroid, due to a tumor.
- D. As the detachment extends and becomes complete, blindness occurs.

Assessment

- A. Opacities before the eyes.
- B. Flashes of light.
- C. Floating spots—blood and retinal cells freed at the time of the tear cast shadows on the retina as they drift about the eye.
- D. Progressive constriction of vision in one area.
 - 1. The area of visual loss depends on the location of detachment.

2. When the detachment is extensive and rapid, the client feels as if a curtain has been pulled over his or her eyes.
3. Painless.

Implementation

- ◆ A. Provide preoperative care.
 1. Keep client on bed rest.
 2. Cover both eyes with patches to prevent further detachment.
 3. Position client's head so the retinal hole is in the lowest part of the eye.
 4. Immediate surgery with drainage of fluid from subretinal space so that retina returns to normal position.
 5. Retinal breaks are sealed by various methods that produce inflammatory reactions (chorioretinitis).
 - a. Cryosurgery—cold probe applied to sclera causes a chorioretinal scar. Most common procedure.
 - b. Diathermy—causes retina to adhere to choroid.
 - c. Laser—seals small retinal tears before detachment occurs.
- ◆ B. Provide postoperative care.
 1. Maintain safe environment.
 - a. Keep side rails up.
 - b. Feed client.
 - c. Maintain bed rest for 1 or 2 days.
 - d. Give client call bell and answer immediately.
 2. Prevent complications.
 - a. Observe for hemorrhage, which is a common complication. Notify physician immediately of any sudden, sharp eye pain, restlessness.
 - b. Cover both eyes; keep lights dim.
 - c. Position so area of detachment is in dependent position. (If air bubble is present, position on abdomen.)
 - d. Prevent clinical manifestations that can cause hemorrhage.
 - (1) Nausea and vomiting.
 - (2) Restlessness.
 - e. Encourage client to do deep breathing but to avoid coughing (increases intraocular pressure).
 - f. Administer good skin care to prevent breakdown.
 3. Provide emotional support.
 - a. Provide audible stimulation.
 - b. Warn client as you enter the room and always speak before touching.
 - c. Orient to surroundings.

- C. Provide client instruction.
 1. Convalescent period.
 - a. Wear patch at night to prevent rubbing of eyes.
 - b. Wear dark glasses; avoid squinting.
 - c. No reading for 3 weeks.
 2. Postconvalescent period.
 - a. Avoid straining and constipation.
 - b. Avoid lifting heavy objects for 6–8 weeks.
 - c. Avoid bending from the waist.
 - d. May return to more active life in 6–8 weeks.

Age-Related Macular Degeneration (ARMD or AMD)

◆ *Definition:* Macula cells fail to function and cell regeneration lessens, which causes loss of central vision.

Characteristics

- ◆ A. The leading cause of new cases of uncorrectable vision loss in adults over 60 years of age.
 1. Most cases are age-related.
 2. Much more common in Caucasians than in African Americans.
- B. There are two types.
 1. Dry (atrophic)—photo receptors in the macula of the retina fail to function and are not replaced due to age.
 2. Wet (exudative)—less common but more severe form in which retinal tissue degenerates, allowing fluid to leak into the subretinal space.

Assessment

- ◆ A. Painless loss of central vision in one or both eyes.
 1. Blurred vision.
 2. Distortion of straight lines.
 3. Dark spot in the central vision area.
- B. Decreased ability to distinguish colors.
- C. Check if client has difficulty with everyday activities—reading, driving, watching television, recognizing faces.

Implementation

- A. Assist client to learn to compensate for visual deficit in the home.
- B. Discuss client's fear of blindness.
- C. Discuss optical aids available, closed-circuit television, telescopic lenses.
- D. Refer client to a low-vision support group.
- E. If client is hospitalized with this condition, orient to room, remove clutter, assist with meals, and always identify self when entering room.

- F. Alternative therapy and prevention: vitamin and nutrient supplements (lutein, lycopene, zinc, beta-carotene, vitamin C, vitamin E).

♦ Removal of Foreign Body from Eye

- A. Have client look upward.
- B. Expose and evert lower lid to expose conjunctival sac.
- C. Wet cotton applicator with sterile normal saline, and gently twist swab over particle and remove it.
- D. If particle cannot be found, have client look downward. Place cotton applicator horizontally on outer surface of upper lid.
- E. Grasp eyelashes with fingers, and pull upper lid outward and upward over cotton stick.
- F. With twisting motion upward, loosen particle and remove.
- G. If penetrating object—do not remove. Cover with cup, do not bend, and notify physician STAT.

Stapedectomy

Characteristics

- A. Surgery is performed when the client has otosclerosis.
- ♦ B. Otosclerosis is a condition in which the stapes is replaced.
 - ◆ 1. A graft is placed over the oval window and a prosthesis is positioned between the incus and covered oval window.
 - 2. Stapes replacement surgery has a high success rate, with the client experiencing improved hearing.
- C. Surgical procedure.
 - ◆ 1. An incision is made deep in the ear canal, close to the eardrum, so that the drum can be turned back and the middle ear exposed.
 - 2. The surgeon frees and removes the stapes and the attached footplate, leaving an opening in the oval window.
 - 3. The client can usually hear as soon as this procedure has been completed.

- ♦ 4. The opening in the oval window is closed with a plug of fat or Gelfoam, which the body will eventually replace with mucous membrane cells.
- ♦ 5. A steel wire or a Teflon piston is inserted to replace the stapes.
 - a. It is attached to the incus at one end and to the graft or plug at the other end.
 - b. The wire transmits sound to the inner ear.
- 6. External canal is packed, covered with “eye patch” dressing over auricle.

Implementation

- ♦ A. Position client in low-Fowler's, on unoperated side, or as ordered.
- B. Do not turn the client.
- C. Put side rails up.
- D. Have client deep-breathe every 2 hours until ambulatory, but do not allow client to cough.
- ♦ E. Check for drainage; report excessive bleeding.
- F. Prevent vomiting.
- G. Give antibiotics as ordered.
- H. Client may have vertigo when ambulatory; stay with the client and avoid quick movements.
- I. Advise client not to smoke.

Irrigation of External Auditory Canal

- A. Remove any discharge on outer ear.
- B. Place emesis basin under ear.
- ♦ C. Gently pull outer ear upward and backward for adult, or downward and backward for child.
- D. Place tip of syringe or irrigating catheter at opening of ear.
- ♦ E. Gently irrigate with solution at 95°F to 105°F (35°–40.5°C), directing flow toward the sides of the canal.
- F. Dry external ear.
- G. If irrigation does not dislodge wax, instillation of drops will need to be carried out.

NEUROLOGICAL SYSTEM REVIEW QUESTIONS

1. Following a car accident, a newly admitted client seems concerned about his sudden loss of memory. He seeks out the nurse for an explanation. Before responding to the client, the nurse needs to consider that
 1. Her answer should be reassuring and brief because the client is still very anxious.
 2. She needs to wait until all the test results are in before responding.
 3. The client's amnesia is a result of his guilt.
 4. The client's anxious behavior would be best dealt with by having the physician order a tranquilizer.
2. The nurse has orders to administer Dilantin (phenytoin) 100 mg IV as an anticonvulsant. The priority action while administering this drug is to
 1. Administer the drug as quickly as possible to prevent a seizure.
 2. Assess for infiltration of the drug.
 3. Assess for effects of the drug.
 4. Check pupil dilation of the client to assess for overdose.
3. A 42-year-old client has been diagnosed with a right-sided acoustic neuroma. The tumor is large and has impaired the function of the seventh and eighth cranial nerves. Which of the following nursing actions will be carried out to prevent complications?
 1. Keeping a suction machine available.
 2. Use of an eye patch or eye shield on the right eye.
 3. Use of only cool water to wash the face.
 4. Advising the client to use only the left eye.
4. A client admitted to a surgical unit for possible bleeding in the cerebrum has vital signs taken every hour to monitor the neurological status. Which of the following neurological checks will give the nurse the best information about the extent of bleeding?
 1. Pupillary checks.
 2. Spinal tap.
 3. Deep tendon reflexes.
 4. Evaluation of extrapyramidal motor system.
5. A client with an admitting diagnosis of head injury has a Glasgow Coma Scale score of 3–5–4. The nurse's understanding of this test is that the client
 1. Can follow simple commands.
 2. Will make no attempt to vocalize.
3. Is unconscious.
4. Is able to open his eyes when spoken to.
6. The nursing diagnosis that would have the highest priority in the care of a client who has become comatose following a cerebral hemorrhage is
 1. Impaired physical mobility.
 2. Altered nutrition: less than body requirements.
 3. Ineffective airway clearance.
 4. Constipation.
7. A 28-year-old male client is admitted to the hospital for a suspected brain tumor. While assessing this client, the nurse would keep in mind that the most reliable index of cerebral status is
 1. Pupil response.
 2. Deep tendon reflexes.
 3. Muscle strength.
 4. Level of consciousness.
8. If a client with increased intracranial pressure (ICP) demonstrates decorticate posturing, the nurse will observe
 1. Flexion of both upper and lower extremities.
 2. Extension of elbows and knees, plantar flexion of feet, and flexion of the wrists.
 3. Flexion of elbows, extension of the knees, and plantar flexion of the feet.
 4. Extension of upper extremities and flexion of lower extremities.
9. A client was in an automobile accident and sustained a head injury. Following admission to the hospital, a diagnosis of increasing intracranial pressure was made. The nursing intervention appropriate in the care of this client is to
 1. Teach controlled coughing and deep breathing.
 2. Provide a quiet and brightly lit environment.
 3. Elevate the head 15 to 30 degrees.
 4. Encourage the intake of clear fluids.
10. The nurse enters the room of a client who is in the clonic phase of a tonic-clonic seizure. The initial nursing action should be to
 1. Insert a padded mouth gag.
 2. Place some padding under the head.

3. Gently restrain the limbs.
4. Obtain equipment for orotracheal suctioning.
- 11.** A client, admitted to the emergency room following a car accident, complains of a severe headache and demonstrates nuchal rigidity and Kernig's sign. The nurse will assess for which complication?
1. Subdural hemorrhage.
2. Increased intracranial pressure.
3. Shock.
4. Subarachnoid hemorrhage.
- 12.** A 16-year-old girl has a known arteriovenous malformation of the middle cerebral artery. In talking to the school nurse, she complains of a headache and stiff neck. The nurse would take which of the following actions?
1. Call her mother and have her picked up from school to see the physician.
2. Send her home right away to rest.
3. Make preparations for emergency transfer to an acute care setting.
4. Have the client rest for 2 hours, then reevaluate the situation.
- 13.** A client is admitted following an automobile accident in which he sustained a contusion. The nurse knows that the significance of a contusion is that
1. It is reversible.
2. Amnesia will occur.
3. Loss of consciousness may be transient.
4. Laceration of the brain may occur.
- 14.** A client is admitted to the trauma unit with a suspected arterial bleed in his head following an injury. He is experiencing periods of confusion and lucidity. As the nurse assesses his status, she will further assess for
1. Subdural hematoma.
2. Increased intracranial pressure.
3. Epidural hematoma.
4. Increased blood pressure.
- 15.** A 24-year-old client is admitted to the hospital following an automobile accident. She was brought in unconscious with the following vital signs: BP 130/76, P 100, R 16, T 98°F. The nurse observes bleeding from the client's nose. Which of the following interventions will assist in determining the presence of cerebrospinal fluid?
1. Obtaining a culture of the specimen using sterile swabs and sending to the laboratory.
2. Allowing the drainage to drip on a sterile gauze and observing for a halo or ring around the blood.
3. Suctioning the nose gently with a bulb syringe and sending specimen to the laboratory.
4. Inserting sterile packing into the nares and removing in 24 hours.
- 16.** A young client who was hit by a car was fortunate because the level of his injury did not interrupt his respiratory function. The cord segments involved with maintaining respiratory function are
1. Thoracic level 5 and 6.
2. Thoracic level 2 and 3.
3. Cervical level 7 and 8.
4. Cervical level 3 and 4.
- 17.** Following an accident, a client is admitted with a head injury and concurrent cervical spine injury. The physician will use Crutchfield tongs. The purpose of these tongs is to
1. Hypoextend the vertebral column.
2. Hyperextend the vertebral column.
3. Decompress the spinal nerves.
4. Allow the client to sit up and move without twisting his spine.
- 18.** A quadriplegic client tells the nurse that he believes he is experiencing an episode of autonomic hyperreflexia (dysreflexia). The first nursing intervention is to
1. Ask him what he thinks has precipitated this episode.
2. Assess his blood pressure and pulse.
3. Elevate his head as high as possible.
4. Assist him in emptying his bladder.
- 19.** In developing a nursing care plan for a client with multiple sclerosis, the nurse would not include
1. Preventive measures for falls.
2. Interventions to promote bowel elimination.
3. Instructions on doing only moderate activities.
4. Techniques to promote safe swallowing.
- 20.** Myasthenic crisis and cholinergic crisis are the major complications of myasthenia gravis. Which of the following is essential nursing knowledge when caring for a client in crisis?
1. Weakness and paralysis of the muscles for swallowing and breathing occur in either crisis.
2. Cholinergic drugs should be administered to prevent further complications associated with the crisis.
3. The clinical condition of the client usually improves after several days of treatment.
4. Loss of body function creates high levels of anxiety and fear.

- 21.** A 21-year-old male has a confirmed diagnosis of a brain tumor. Following surgery for a tumor near the hypothalamus, the nursing assessment should include observing for
1. Inability to regulate body temperature.
 2. Bradycardia.
 3. Visual disturbances.
 4. Inability to perceive sound.
- 22.** For a client who has ataxia, which of the following tests would be performed to assess the ability to ambulate?
1. Kernig's.
 2. Romberg's.
 3. Riley-Day's.
 4. Hoffmann's.
- 23.** The nurse is counseling a client with the diagnosis of glaucoma. She explains that if left untreated, this condition leads to
1. Blindness.
 2. Myopia.
- 24.** A male client has just had a cataract operation without a lens implant. In discharge teaching, the nurse will instruct the client's wife to
1. Feed him soft foods for several days to prevent facial movement.
 2. Keep the eye dressing on for 1 week.
 3. Have her husband remain in bed for 3 days.
 4. Allow him to walk upstairs only with assistance.
- 25.** A client has just been admitted with a diagnosis of detached retina and surgery is scheduled. The preoperative ophthalmic medication that will most likely be ordered for this client will be
1. Atropine sulfate.
 2. Miostat, Carbastat (carbachol).
 3. Salagen (pilocarpine).
 4. Timoptic (timolol maleate).

NEUROLOGICAL SYSTEM ANSWERS WITH RATIONALE

1. (1) The client is very anxious, and his ability to comprehend and process information is extremely limited. A quiet, reassuring manner with a brief, concrete response will be most helpful at this point. Interventions to decrease the client's anxiety are the priority here, whether or not the cause is guilt feelings.

NP:P; CN:PS; CL:C

2. (2) It is important to assess for infiltration because it can cause erosion of the tissue and even loss of a limb. Injecting the drug at a faster rate may induce severe hypotension. Assessing for effects of the drug is too general an answer (3) and pupil dilation will not reveal overdose (4).

NP:P; CN:PH; CL:A

3. (2) The seventh nerve closes the eyelid. Without a patch, the cornea is subject to damage. The temperature of the water (3) does not matter. A suction machine (1) is not necessary.

NP:I; CN:PH; CL:AN

4. (1) Pupillary checks reflect function of the third cranial nerve, which stretches as it becomes displaced by blood, tumor, etc.

NP:E; CN:PH; CL:A

5. (4) A Glasgow Coma Scale score of 3–5–4 means that the client is able to open his eyes when spoken to and can localize pain, attempting to remove noxious stimuli when motor function is tested. He is not able to follow commands. He is able to vocalize but is confused. Verbal response is usually tested by asking the client to state who he is, where he is, or what day it is.

NP:E; CN:PH; CL:C

6. (3) An unconscious person is unable to independently maintain a clear airway; therefore, the highest priority should be given to planning and providing nursing interventions that promote effective airway clearance. The other nursing diagnoses are of lower priority.

NP:AN; CN:PH; CL:AN

7. (4) The state or level of consciousness is the most reliable index of cerebral status.

NP:A; CN:PH; CL:C

8. (3) Decorticate posturing results from lesions of the corticospinal tracts within or near to the cerebral hemispheres. When assessing decortication, the nurse observes adduction of the upper arms with the elbows, wrists, and fingers flexed. The legs are extended and internally rotated. Plantar flexion of the feet is also noted.

NP:A; CN:PH; CL:C

9. (3) Elevating the head promotes reduction of cerebral edema through gravity drainage. Coughing increases intracranial pressure. The environment should be non-stimulating (dim lights and quiet) to limit the risk of seizures. Fluids are restricted to avoid increasing the cerebral edema.

NP:I; CN:PH; CL:A

10. (2) Preventing cerebral trauma during the convulsion is a priority activity. Placing some form of padding under the head will protect the skull and brain from injury. Inserting a mouth gag (1) and restraining the limbs (3) are unsafe interventions. The nurse would not leave a seizing person to go and obtain equipment (4).

NP:I; CN:PH; CL:A

11. (4) Hemorrhage or blood in the CSF, within the brain, ventricles, or subarachnoid space, is irritating to the meninges and causes headache and nuchal rigidity.

NP:A; CN:PH; CL:AN

12. (3) The client's complaints are consistent with meningeal irritation from bleeding into the subarachnoid space; therefore, she needs immediate transfer to an acute care setting.

NP:I; CN:H; CL:AN

13. (4) Laceration, a more severe consequence of closed head injury, occurs as the brain tissue moves across the uneven base of the skull in a contusion. Contusion causes cerebral dysfunction, which results in bruising of the brain. A concussion causes transient loss of consciousness and retrograde amnesia, and is generally reversible.

NP:AN; CN:PH; CL:C

14. (3) Epidural hematomas usually form quickly within 6 hours after injury, as a result of an arterial bleed. They usually cause periods of confusion and lucidity and may or may not cause loss of consciousness. Epidural hematomas are fatal if left untreated; subdural hematomas—not epidural hematomas—have the highest mortality of all head injuries.

NP:A; CN:PH; CL:AN

15. (2) The halo or “bull’s-eye” sign seen when drainage from the nose or ear of a head-injured client is collected on a sterile gauze is indicative of CSF in the drainage. The collection of a culture specimen (1) using any type of swab or suction would be contraindicated because brain tissue may be inadvertently removed at the same time or other tissue damage may result.

NP:I; CN:PH; CL:AN

16. (4) Nervous control for the diaphragm (phrenic nerve) exists at C3 or C4. Quadriplegia involves cervical injuries at C1–C8.

NP:AN; CN:PH; CL:C

17. (2) The purpose of the tongs is to decompress the vertebral column through hyperextending it. Both (1) and (3) are incorrect because they might cause further damage. Option (4) is incorrect because the client cannot sit up with the tongs in place; only the head of the bed can be elevated.

NP:AN; CN:PH; CL:K

18. (3) Blood pressure can become dangerously elevated during an episode of dysreflexia and can cause cerebral and retinal hemorrhages. Elevating the head will help prevent these complications and should be the nurse's first action. Identifying the precipitant (1) is useful in terminating the episode by removing the noxious stimulus that provoked the exaggerated autonomic response. A full bladder may precipitate dysreflexia, and emptying the bladder (4) would be appropriate if it was the precipitant. The blood pressure and pulse (2) should be monitored throughout the episode of dysreflexia.

NP:I; CN:PH; CL:AN

19. (4) Clients with MS do not usually have difficulty swallowing; therefore, techniques to promote safe swallowing would not be included on a care plan. The three other responses are important aspects in client care and should be included in the care plan.

NP:P; CN:PH; CL:C

20. (1) The client cannot handle his own secretions, and respiratory arrest may be imminent. Atropine may be administered to prevent crisis. Anticholinergic drugs are administered to increase the levels of acetylcholine at the myoneural junction. Cholinergic drugs (2) mimic the actions of the parasympathetic nervous system and would not be used.

NP:P; CN:PH; CL:A

21. (1) The hypothalamus controls body temperature, fluid balance, particular emotions (such as pleasure and fear), sleep, and appetite. The visual area (3) is controlled by the occipital lobe. The temporal lobe contains the auditory center (4). Bradycardia (2) can be caused by a problem in the medulla oblongata.

NP:A; CN:PH; CL:A

22. (2) Romberg's test is the ability to maintain an upright position without swaying when standing with feet close together and eyes closed. Kernig's sign (1), a reflex contraction, is pain in the hamstring muscle when attempting to extend the leg after flexing the thigh.

NP:P; CN:PH; CL:C

23. (1) The increase in intraocular pressure causes atrophy of the retinal ganglion cells and the optic nerve and leads eventually to blindness.

NP:I; CN:PH; CL:C

24. (4) Without a lens, the eye cannot accommodate. It is difficult to judge distance and climb stairs when the eyes cannot accommodate. Therefore, the client should walk up and down stairs only with assistance.

NP:I; CN:PH; CL:A

25. (1) Mydriatic drugs are used preoperatively so that the pupil is widely dilated. Either atropine sulfate or epinephrine HCl is commonly used. Salagen (pilocarpine) (3) and Miostat (carbamylcholine) (2) are miotics used for glaucoma and certain types of lens implants. Timoptic (timolol maleate) (4) is a beta blocker used for glaucoma.

NP:P; CN:PH; CL:C

CARDIOVASCULAR SYSTEM

The heart and the circulatory system, both systemic and pulmonary, constitute one of the most essential systems of the body; failure to function results in death of the organism. The heart is a hollow muscular organ that, by contracting rhythmically, effectively pumps the blood through the circulatory system to nourish all of the body tissues.

ANATOMY

Gross Structure of the Heart

Layers

- A. Pericardium—protective covering.
 - 1. Fibrous pericardium—fibrous sac.
 - 2. Serous pericardium—allows for free cardiac motion.
- B. Epicardium—covers surface of heart, extends onto great vessels, and becomes continuous with inner lining of pericardium.
- C. Myocardium—muscular portion of heart that pumps blood and is responsible for the contractile force of the heart.
- D. Endocardium—thin, delicate layer of tissue that lines cardiac chambers and covers surface of heart valves.

Chambers of the Heart

Definition: The heart is a four-chambered muscular organ. It is divided by a thick, muscular wall into right and left halves. Each half is divided into upper and lower chambers; upper chambers are called atria and lower chambers are called ventricles.

- ◆ A. Right atrium (RA)—(receiving chamber) is a thin-walled, distensible, low-pressure collecting chamber that receives deoxygenated blood from the systemic venous system and sends most blood to the right ventricle during ventricular diastole or filling. The venous blood remaining in right atrium is propelled forward into the right ventricle during atrial systole or contraction.
 - 1. Inlets: superior vena cava, inferior vena cava, coronary sinus, thebesian veins.
 - 2. Outlet: tricuspid valve.
- B. Right ventricle (RV)—(ejecting chamber) is a thin-walled, low-pressure crescent-shaped pump

for propelling blood into the low-resistance pulmonary circuit.

1. Normal thickness: 0.5 cm.
 2. Inlet: right atrium, tricuspid valve.
 3. Outlet: pulmonic valve into pulmonary artery.
 4. Generates pressure of 25 mm Hg, which is enough to close tricuspid valve and open pulmonic valve—propelling blood into pulmonary artery and lungs.
 5. Work load of right ventricle is less than that of left ventricle because pulmonary system is normally low pressure; therefore there is less resistance to blood flow.
- C. Left atrium (LA)—(receiving chamber) is a thin-walled, medium-pressure collecting chamber that receives oxygenated blood from the pulmonary venous system.
1. Inlets: four pulmonary veins.
 2. Outlet: mitral valve.
- D. Left ventricle (LV)—(ejecting chamber) is a thick-walled, high-pressure, cone-shaped pump for propelling blood into the high-resistance systemic circuit.
1. Normal thickness: 1.5 cm (about two to three times the thickness of the right ventricle).
 2. Inlet: left atrium, mitral valve.
 3. Outlet: aortic valve into aorta.
 4. Must generate a higher pressure than right ventricle because it is contracting against the high-pressure systemic circulation where there is a much greater resistance to blood flow.

Valves

Definition: Valves are strong membranous openings responsible for maintaining the forward flow of blood through the chamber. These valves open and close passively in response to pressure and volume changes within chambers of the heart.

- ◆ A. Atrioventricular valves prevent backflow of blood from the ventricles to the atria during systole.
 1. Tricuspid—right heart valve; between right atrium and right ventricle.
 - a. Three cusps or leaflets.
 - b. Open during ventricular diastole.
 - c. Free edges anchored to papillary muscles in right ventricle by chordae tendineae, which contract when the ventricular walls contract (systole).
 2. Mitral—left heart valve; between left atrium and left ventricle.
 - a. Two cusps or leaflets.

- b. Open during ventricular diastole.
- c. Free edges anchored to papillary muscles in the left ventricle by chordae tendineae, which contract when the ventricular walls contract (systole).
- B. Semilunar valves prevent backflow from the aorta and pulmonary artery into the ventricles during diastole.
 - 1. Pulmonic—three cusps or leaflets; opens from the right ventricle into the pulmonary artery.
 - 2. Aortic—three cusps or leaflets; opens from the left ventricle into the aorta; orifices for coronary arteries arise from wall of aorta above two of the three cusps.
- C. Valves function passively.
 - 1. Close when backward pressure pushes blood backward.
 - 2. Open when forward pressure forces blood in a forward direction.

Conduction System

Definition: Conduction system is composed of specialized tissue that allows rapid transmission of electrical impulses through the myocardium.

- ◆ A. Sinoatrial (SA) node—main pacemaker of heart in which normal rhythmic self-excitatory impulse is generated.
 - 1. Located at the junction of right atrium and superior vena cava.
 - 2. Activates myocardial cells, initiates process of depolarization.
 - 3. 60–100 electrical impulses/min.
 - 4. External control is through autonomic nervous system.
 - a. Sympathetic—increases rate.
 - b. Parasympathetic—slows rate.
 - 5. Nerves affect cardiac pumping in two ways.
 - a. Change heart rate.
 - b. Change strength of contraction of the heart.
 - 6. Intrinsic automaticity—initiates electrical impulses automatically.
- B. Internodal tracts—transmission of electrical impulses through atria from sinoatrial node to atrioventricular node.
- C. Atrioventricular (AV) node—contains delay tissue that delays impulse transmission, allowing atrial contraction to eject blood into ventricle before ventricular contraction (“atrial kick”).
- D. Bundle of His.
 - 1. Conducts electrical impulse from AV node into ventricles.
 - 2. Divides into right bundle branch and left bundle branch.

- E. Purkinje fibers—conduct electrical impulse from right and left bundle branches to all parts of the ventricles.

Coronary Blood Supply

Definition: Oxygen and other nutrients are supplied to the cells of the heart by vessels of the coronary circulation. Coronary circulation consists of coronary arteries and coronary veins. Coronary artery blood flow to the myocardium occurs primarily during diastole, when coronary vascular resistance is lower. To maintain adequate blood supply through coronary arteries to nourish the myocardium, mean arterial pressure (MAP) must be at least 60 mm Hg. A MAP between 60 and 70 mm Hg is necessary to maintain vital body organs (e.g., brain and kidneys).

- A. Coronary arteries—transport oxygen-rich blood from the heart, under high pressure, to the body tissues.
 - 1. Right coronary artery (RCA)—in most people supplies
 - a. AV node.
 - b. Right ventricle.
 - c. Inferior and posterior walls of left ventricle.
 - 2. Posterior descending coronary artery (PDA) supplies posterior wall of left ventricle.
 - 3. Left coronary artery—left main (LM) and left anterior descending (LAD) supply
 - a. Intraventricular septum.
 - b. Bundle branches.
 - c. Anterior wall and apex of left ventricle.
 - 4. Left circumflex coronary artery (LCX) supplies
 - a. Left atrium.
 - b. Lateral and posterior surfaces of left ventricle.
 - c. Sometimes portions of intraventricular septum.
 - d. Sinoatrial (SA) node in about 45% of people.
 - e. AV node in about 10% of people.
 - f. Peripheral branches arise from both LCX and LAD and form a network of vessels throughout myocardium.
- ◆ B. Veins—generally parallel arterial system.
 - 1. Coronary sinus veins empty into right atrium.
 - 2. Thebesian veins empty into right atrium.

Gross Structure of Vasculature

Arteries

- A. The function of the arteries is to transport blood under high pressure to the body tissues.

1. Arteries have thick, elastic walls.
 2. Move blood forward through the circulatory system.
- B. Arterioles.
1. Small arteries with little elastic tissue and more smooth muscle.
 2. Serve as major control of blood pressure and flow.
 3. Respond to O₂ and CO₂ levels by constricting or dilating.

Capillaries

Definition: Microcirculation between arterioles and venules. The exchange of fluid, cellular nutrients, and metabolic waste products takes place through thin-walled vessels.

- A. Capillary walls are thin and permeable to fluid and small substances.
- B. Blood flow is slowest in capillaries.

Veins

♦**Definition:** Primary function is to act as conduits for transport of the blood from tissues back to the heart.

- A. Venous system.
 1. Low-pressure, high-volume system.
 2. Walls are thin but muscular.
 3. Walls are able to contract or expand, thereby storing a small or large amount of blood.
 4. Larger veins have valves to maintain forward blood flow and prevent backflow.
- ♦ B. Factors influencing venous return.
 1. Muscle contraction (e.g., walking, leg exercises).
 2. Gravity (e.g., elevating legs).
 3. Competent valves.
 4. Respiration.
 - a. Inspiration increases venous return.
 - b. Expiration decreases venous return.
 5. Compliancy of right heart (central venous pressure [CVP]).
- C. Venules: small vessels made up of muscle and connective tissue. Collect blood from capillary beds and direct it to larger veins.

PHYSIOLOGY

Regulation of Cardiac Function

Contraction

♦**Definition:** The heart muscle utilizes chemical energy to do the work of contraction—a shortening or increase in tension.

- A. The sarcomere is the unit of contraction and contains the proteins actin and myosin.
- B. Sliding theory of contraction.

1. Actin slides inward on myosin causing shortening of sarcomere, resulting in systole.
 2. When calcium is used up, actin and myosin slide apart, resulting in systole.
- C. Each cardiac cell is composed of many sarcomeres.

Cardiac Muscle Principles

- ♦ A. Frank-Starling law: the greater the heart is filled during diastole, within physiological limits, the greater the quantity of blood pumped into the aorta and pulmonary artery.
 1. The heart can pump a large amount of blood or a small amount depending on the amount that flows into it from the veins.
 2. It automatically adapts to whatever the load or volume may be (within physiological limits of the total amount the heart can pump).
- B. All-or-none principle: Cardiac muscle either contracts or does not contract when stimulated.
- C. Two phases of contractility.
 1. Isometric—increasing tension while maintaining length of muscle fiber.
 2. Isotonic—shortening muscle fiber while tension remains constant.
- D. Cardiac output (CO)—the amount of blood pumped out by the heart in one minute.
 1. Calculation: CO = SV (stroke volume) × HR (heart rate).
 - a. Cardiac output is 4–7 L/min.
 - b. Varies according to body size; cardiac index is used to adjust for differences in body size.
 2. Stroke volume—amount of blood ejected from the ventricle with each contraction.
 3. Factors affecting cardiac output.
 - a. Heart rate.
 - b. Stroke volume.
 - (1) Preload—volume of blood in the ventricles before contraction.
 - (2) Afterload—peripheral vascular resistance that the left ventricle must pump against.
 - (3) Contractility.
 - E. Cardiac reserve—ability of heart to respond to increased demands by increasing cardiac output. CO is increased by increasing heart rate or increasing stroke volume, by increasing either preload or contractility. Increased demands on cardiovascular system may be due to many conditions, such as exercise, stress, hypovolemia, etc.

Properties of Cardiac Cells

- ♦ A. Automaticity: ability to initiate an electrical impulse without external stimuli; spontaneously and repetitively.

1. Although all cells of the heart can initiate an electrical impulse, certain areas of the heart will initiate impulses within the following ranges:
 - a. SA node: 60–100.
 - b. Junctional node: 40–60.
 - c. Bundle branch Purkinje system: 20–40.
 2. Causes depolarization and repolarization.
- ◆ B. Conductivity: ability to transmit electrical impulse.
- ◆ C. Contractility: ability of muscle to shorten in response to electrical impulse.
- ◆ D. Excitability: ability to be stimulated by an impulse (depolarization).
- ◆ E. Refractoriness: inability to respond to a stimulus until the cells return to a resting state (repolarized).
 1. Absolute refractory period—no amount of electrical stimulation will cause contraction.
 2. Relative refractory period—a strong enough electrical stimulation will cause contraction.
- F. Electrical and mechanical properties determine system function.

Pulse

Definition: The rhythmic dilation of an artery caused by the contraction of the heart.

- A. Number of times the “ventricles” contract.
 - B. Rate—extrinsically controlled by the ANS, which adjusts rapidly to regulate CO.
 - C. Increased heart rate = increased myocardial O₂ demand.
- ◆ D. Pulse deficit—difference between apical and radial pulse, due to weakened or ineffective contraction of heart.
- ◆ E. Pulse pressure—difference between systolic and diastolic pressure.

Blood Pressure

- A. A measure of pressure exerted on walls of arterial systems.
 1. Systolic BP is the maximum amount of pressure exerted on the walls of the arterial system when the heart contracts.
 2. Diastolic BP is pressure within the arterial system following contraction during the “relaxation” phase.
- B. Factors influencing blood pressure.
 1. CO (cardiac output).
 2. SVR (systemic vascular resistance—resistance created in the small arteries and arterioles).
 3. Volume of fluid: hypovolemia (decreased blood pressure) such as hemorrhage.
 4. Diameter and elasticity of blood vessels; for example, arteriosclerosis (increased blood pressure).

Autonomic Nervous System Influence

Cardiac Muscle

- ◆ A. Sympathetic nervous system (adrenergic)—innervates all cardiac muscle.
1. Secretes epinephrine and norepinephrine.
 2. Response stimulates beta₁ receptors.
 - a. Increases SA node rate of discharge.
 - b. Increases conductivity.
 - c. Increases contractility of cardiac muscle.
 - d. Increases cell irritability.
- ◆ B. Parasympathetic nervous system (cholinergic)—innervates primarily atrial tissue.
1. Mediated via vagus nerve.
 2. Secretes acetylcholine.
 3. Maintenance of homeostasis—“brake of heart.”
 - a. Decreases SA node rate of discharge.
 - b. Decreases conductivity, especially of AV node.
 - c. Decreases atrial contractility.

Systemic Blood Vessels

- ◆ A. Sympathetic nervous system.
1. Vasoconstriction of blood vessels through action mainly on alpha₁ receptors of precapillary sphincter (one exception: vasodilation of coronary arteries).
 2. Causes vasodilation of selected blood vessels via beta₂ receptor stimulation.
- ◆ B. Parasympathetic nervous system.
1. Usually predominates so that blood vessels are not vasoconstricted.
 2. Effect is vasodilation in certain areas such as cerebrum, salivary glands, and lower colon.

Baroreceptor Reflex

- ◆ A. Most important circulatory reflex is called baroreceptor reflex.
1. Initiated by baroreceptors (also called pressoreceptors) located in arch of the aorta and at beginning of internal carotid arteries.
 2. Rise in pressure results in baroreceptors transmitting signals to CNS to inhibit sympathetic action.
 3. Other signals, in turn, sent to circulatory system reduce pressure back toward normal.
 4. Result is decreased heart rate, vasodilation and decreased blood pressure.
- B. Effect of decreased pressure on baroreceptors.
1. Sympathetic stimulation overrides vagal response.
 2. Result is increased heart rate, vasoconstriction, and increased blood pressure.

◆ Other Chemical Controls of Blood Pressure

- A. Kidney.
 - 1. Juxtaglomerular apparatus releases renin, which causes vasoconstriction to increase blood pressure.
 - 2. Adrenal cortex releases aldosterone, causing sodium and water to be reabsorbed. This increases blood volume and blood pressure.
- B. Antidiuretic hormone (vasopressin)—acts on kidney tubules to reabsorb water, thereby increasing blood volume and blood pressure.
- C. Histamine release from mast cells' response to antigen.
 - 1. Arterioles dilate.
 - 2. Venules constrict.
- D. Capillary fluid shift mechanisms (balance of hydrostatic/oncotic forces); for example, decreased blood pressure or an increase in oncotic pressure allows capillaries to reabsorb interstitial fluid.

System Assessment

- ◆ A. Assess client's cardiac history.
 - ◆ 1. Pain—onset, character, location, radiation, duration, intensity, precipitating or aggravating factors, relieving factors, and intensity/severity on a scale of 0–10.
 - a. Ischemic pain of angina.
 - (1) Substernal, neck, jaw, arms/shoulders; vague pressure, radiates; confused with "indigestion."
 - (2) Precipitated by emotional or physical activity, relieved by rest or Tridil (nitroglycerin).
 - b. Pain of myocardial infarction.
 - (1) Similar location of angina, more intense.
 - (2) Accompanied by dyspnea, diaphoresis, nausea/vomiting; not precipitated.
 - (3) Not relieved by rest or nitroglycerin.
 - ◆ 2. Dyspnea—subjective feeling of inability to get enough air.
 - a. Dyspnea on exertion (DOE) occurs with activity.
 - b. Orthopnea occurs while in a reclining position—client sits up or uses several pillows to sleep.
 - c. Paroxysmal nocturnal dyspnea (PND) interrupts client's sleep—gets up to relieve.
 - ◆ 3. Respiratory rate and depth.
 - a. Tachypnea: increase in rate of breathing.
 - b. Hyperpnea: increase in depth of breathing (causes decrease in PCO₂).

4. Cough—dry or productive of mucoid foamy sputum with heart failure; pink tinged with acute pulmonary edema.

5. Cyanosis—bluish mucous membranes or skin color due to significant deficiency of oxygen in the blood (O₂ saturation less than 85%).

6. Fatigue—result of decreased cardiac output.

7. Palpitations—awareness of rapid or irregular heartbeat.

8. Syncope—transient loss of consciousness due to inadequate cerebral blood flow (e.g., bradycardia).

◆ 9. Edema.

a. Bilateral, dependent (ankles or sacrum) due to accumulation of interstitial fluid secondary to increased venous pressure (e.g., volume overload)—accompanied by weight gain.

b. Unilateral due to venous insufficiency.

10. Skin—color, temperature, dry or moist, hair growth, nails, capillary refill.

B. Evaluate pressure through inspection and palpation of venous and arterial systems.

1. Internal jugular veins—located deep in sternocleidomastoid muscle.

2. Venous pulsations.

a. Observe venous pulsation in neck to assess central venous pressure (CVP) and adequacy of circulating blood volume.

b. Assessment of jugular venous pressure (JVP) done to estimate volume and pressure on right side of heart. Increased JVP causes increased jugular vein distention.

c. Normal JVP 3–10 cm H₂O. Increase caused by

- (1) Right ventricular failure.
- (2) Tricuspid stenosis or regurgitation.
- (3) Pulmonary hypertension.
- (4) Cardiac tamponade.
- (5) Constrictive pericarditis.
- (6) Hypervolemia.
- (7) Superior vena cava obstruction.

3. Arterial system.

a. Neck—carotid artery.

b. Upper extremities—radial, brachial, and ulnar.

c. Lower extremities—femoral, popliteal, posterior tibial, dorsalis pedis, pedal.

4. Grading peripheral pulses.

a. 0 = absent.

b. 1+ = weak.

c. 2+ = diminished.

d. 3+ = strong.

e. 4+ = full/bounding.

5. Pulsus paradoxus: systolic blood pressure drop greater than 10 mm Hg during inspiration (cardiac tamponade).

CONSIDER GERIATRIC STATUS

- Valves thicker and stiffer.
- SA node: decreased number of pacemaker cells.
- Sympathetic nerve system.
 - a. Decreased response to physical stress (e.g., exercise).
 - b. Decreased response to psychological stress.
 - c. Less sensitive to beta-adrenergic agonist drugs.
- Arterial blood vessels: thicker, with decreased elasticity, resulting in elevated blood pressure.

- ◆ C. Assess heart sounds by auscultation.
 1. Auscultatory areas.
 - a. Aortic: second intercostal space right of sternum.
 - b. Pulmonic: second intercostal space left of sternum.
 - c. Tricuspid: fifth intercostal space left, close to sternum.
 - d. Mitral: fifth intercostal space mid-clavicular line at the apex of the heart.
 - e. PMI: point of maximal impulse.
 - ◆ 2. Heart sounds—frequency, pitch, intensity, duration.
 - a. S₁ (“lub”)—closure of mitral and tricuspid valve.
 - b. S₂ (“dub”)—closure of aortic and pulmonic valve.
 - c. S₃ and S₄—diastolic filling sounds.
 - (1) S₃—rapid filling of ventricle in early diastole; heard after S₂; sign of heart failure in client over age 40.
 - (2) S₄—coincides with atrial contraction due to poorly compliant ventricle; prior to S₁; normal in older adult.
 - ◆ 3. Murmurs: turbulence of blood flow through valve; classified by their timing and heard between heart sounds.
 - a. Systolic: occurring between S₁ and S₂.
 - (1) Mitral and tricuspid insufficiency.
 - (2) Aortic and pulmonic stenosis.
 - (3) Patent foramen ovale.
 - (4) Ventricular septal defect.
 - b. Diastolic: occurring between S₂ and S₁.
 - (1) Mitral and tricuspid stenosis.
 - (2) Aortic and pulmonic insufficiency.
 - c. Location: point where murmur is loudest.
 - d. Radiation: transmission from point of maximal intensity to surrounding areas.
 - e. Quality: blowing, harsh, musical, or rumbling.

- f. Pitch: high, medium, or low.
- g. Pattern: determined by intensity over time.
 - (1) Crescendo: soft to loud.
 - (2) Decrescendo: loud to soft.
 - (3) Crescendo-decrescendo: soft to loud to soft.
 - (4) Plateau: same throughout.
- h. Intensity (loudness): Grade 1–6.
 - (1) Grade 1 = barely audible through stethoscope.
 - (2) Grade 6 = audible with the stethoscope just off the client’s skin.
- 4. Pericardial friction rub due to inflammation—“squeak” timed with heart sounds.
- D. Evaluate arterial pressure.
 - ◆ 1. Measurement of blood pressure—indirect via cuff.
 - a. Both arms.
 - b. Lying, standing.
 - 2. Presence of bruits (sound of abnormal turbulence of blood flow usually around obstruction).
- E. Evaluate chest x-ray to determine abnormalities of lung fluids and cardiac silhouette.
- F. Assess lungs for adventitious sounds.
 1. Rales: fine, medium, coarse.
 2. Rhonchi: sibilant, sonorous.
- G. Assess client’s readiness for a cardiac rehabilitation program.

DIAGNOSTIC PROCEDURES

Chest X-Ray

- A. Silhouette of heart, chambers, and great vessels observed on routine chest x-ray.
- B. Pulmonary vascular congestion seen when there is increased left heart pressure.
- C. Enlarged heart seen with dilation/hypertrophy.

12-Lead Electrocardiography

- A. An electrocardiogram (ECG or EKG) is a surface record of the electrical activity of the heart.
- B. Purpose: to determine areas of myocardial ischemia, injury or necrosis, cardiac irregularities, and electrolyte imbalances. (See **Figures 8-1** through **8-9**.)
 1. Noninvasive.
 2. Limited to resting state of heart function.
- C. ECG components.
 - ◆ 1. Normal cardiac cycle.
 - a. P wave—atrial depolarization.
 - b. P-R interval—conduction through the electrical system, SA node, AV node, and His-Purkinje system.

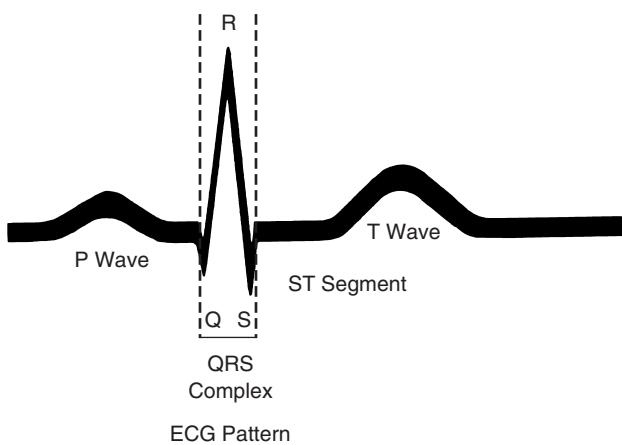


Figure 8-1 ECG pattern

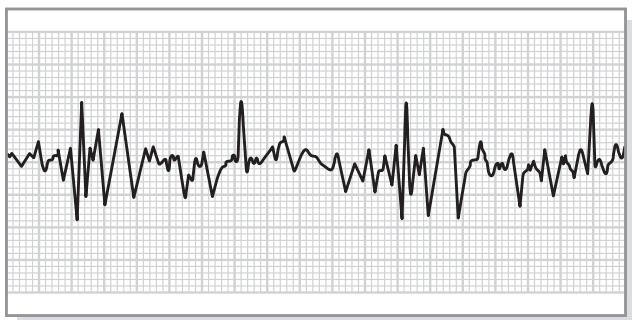


Figure 8-2 ECG pattern showing artifact



Figure 8-3 Sinus bradycardia

Reproduced from *Arrhythmia Recognition: The Art of Interpretation*, courtesy of Tomas B. Garcia, MD.

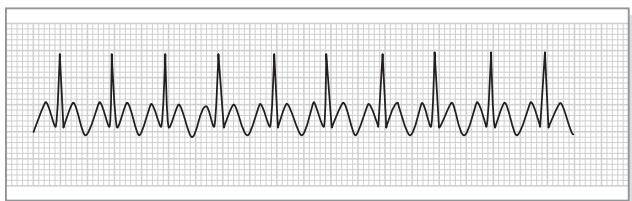


Figure 8-4 Atrial flutter

Reproduced from *Arrhythmia Recognition: The Art of Interpretation*, courtesy of Tomas B. Garcia, MD.



Figure 8-5 Atrial fibrillation

Reproduced from *Arrhythmia Recognition: The Art of Interpretation*, courtesy of Tomas B. Garcia, MD.

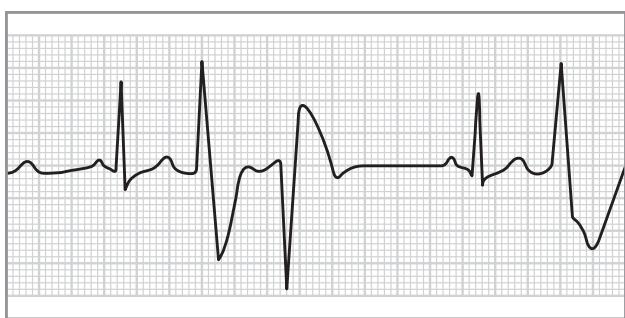


Figure 8-6 Multifocal PVCs

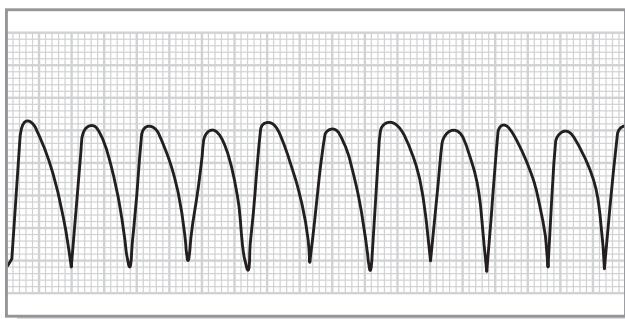


Figure 8-7 Ventricular tachycardia

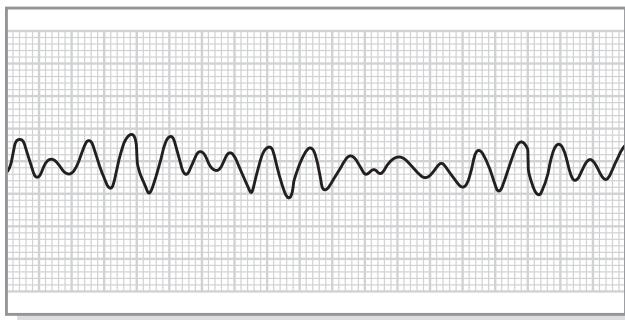


Figure 8-8 Ventricular fibrillation

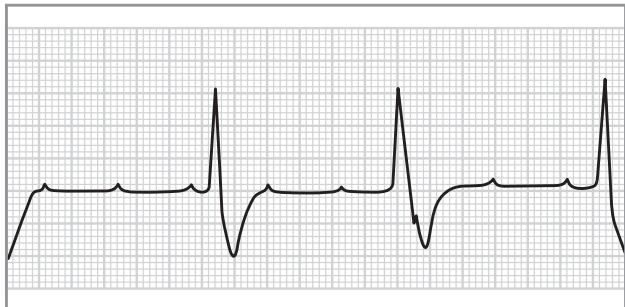


Figure 8-9 Third-degree heart block

- c. QRS wave—ventricular depolarization.
- d. ST segment—early ventricular repolarization.
- e. T wave—rapid ventricular repolarization.
- ◆ 2. Interpretation of ECG.
 - a. Determine heart rate by calculating atrial rate (P-P interval) and ventricular rate (R-R interval). Normal 60 to 100—one P wave for each QRS complex.
 - b. Determine regularity of rhythm (atrial and ventricular).
 - c. Measure P-R interval to determine conduction time through electrical system (0.12 to 0.20 second).
 - d. Measure QRS duration to determine ventricular conduction time (0.04 to 0.10 second).
 - e. Measure Q-T interval—represents ventricular systole. Duration varies with heart rate.
 - f. Note configuration and relation of P waves to QRS. Note for ST-segment depression or elevation, T-wave inversion.
- ◆ 3. Etiology of arrhythmias.
 - a. Ischemia, electrolyte imbalance, acid–base imbalance, hypoxia, myocardial stretch, sympathetic stimulation, antiarrhythmic agents.
 - b. Precipitating or contributing disease states—heart failure, coronary artery disease, myocardial infarction, congenital or acquired heart disease, hyperthyroidism.

Echocardiography

- A. Noninvasive cardiac procedure that records sound vibrations and reflects mechanical cardiac activity.
- B. Used to detect valvular/structural anomalies, ventricular wall thickness, decreased (hypokinesis) or absent (akinesis) wall movement, ventricular ejection fraction, intramural thromboses.
- C. May demonstrate exercise-induced ventricular wall motion abnormalities when performed during exercise (or pharmacologic-induced stress).
- D. Transesophageal (TEE): as probe passes through esophagus, strictures can be viewed without interference from lungs or ribs.

Exercise Electrocardiography (Treadmill)

- A. Noninvasive electrocardiography procedure for evaluating myocardial response to increased demands (exercise).

- B. Treadmill or bicycle used.
- C. Monitor vital signs and ECG for ischemic changes.
- D. Clients with positive test may be referred for cardiac catheterization and/or coronary arteriography.
- E. Test often combined with scintigraphic studies or echocardiography.

Ambulatory Electrocardiographic Monitoring

- A. Records ECG for 24–48 hours.
- B. Identifies episodes of ischemic ST-segment depression, rhythm changes, and/or correlation with symptoms.
- C. Silent (asymptomatic) episodes recorded.

IMPORTANT CARDIAC EFFECTS OF ELECTROLYTES			
Electrolytes	Normal Value	Decreased (Hypo)	Increased (Hyper)
K (potassium)	3.5–5.0	Flat T waves, ST depression U wave, ventricular dysrhythmia	Peaked T waves, wide QRS ↑ PR interval, asystole
Mg (magnesium)	1.3–2.1	↑ Ventricular dysrhythmia	
Ca (calcium)	9.0–10.3	↑ QT interval ↓ Inotropic effect	↓ QT interval ↑ Inotropic effect

Scintigraphic (Nuclear Medicine) Studies

- A. Involves intravenous (IV) injection of radioactive isotopes; thallium-201 or technetium-99 sestamibi; myocardial uptake is proportionate to blood flow.
- B. Special camera scans heart to identify areas of diminished uptake reflecting region of hypoperfusion.
- C. When combined with exercise, or pharmacologic vasodilation, region of hypoperfusion may represent ischemia or scar, and may then perfuse at rest indicating reversible ischemia.
- D. Technetium-99m pyrophosphate is taken up by an area of myocardial infarction and produces a “hot spot.”
- E. Positron emission tomography (PET)—two radionuclides are used: one evaluates myocardial perfusion; the second shows myocardial metabolic function. In a normal heart, scans match; differences indicate ischemic or myocardial injury.

Cardiac Magnetic Resonance Imaging

- A. Magnetic resonance imaging (MRI) provides high-resolution images of heart and great vessels without radiation exposure or use of iodinated contrast media.
- B. Demonstrates pericardial disease, myocardial thickness, chamber size/defects, aneurysms.

Cardiac Catheterization/Coronary Angiography

- ◆ A. Invasive angiography procedure in which a catheter is passed into the heart and its major vessels for examination of blood flow, pressures in chambers and vessels, and oxygen content and saturation. The catheter may be passed through the arterial system into the left side of the heart or through the venous system into the right side of the heart.
- B. Radiopaque compound is injected into the heart chambers and coronary vessels for selective arteriography.
 - 1. Evaluates blood flow through chambers.
 - 2. Demonstrates anatomy of coronary circulation.
 - 3. Reveals coronary occlusive disease.
- ◆ C. Obtain baseline data prior to test.
 - 1. History of allergy, especially shellfish, iodine, or drugs.
 - 2. Serum blood urea nitrogen (BUN) and creatinine for renal function.
 - 3. Obtain baseline vital signs.
 - 4. Check coagulation studies.
 - 5. Mark peripheral pulses bilaterally.
- ◆ D. Nursing responsibilities prior to procedure.
 - 1. Be sure consent form is signed.
 - 2. Assess client/family understanding of the procedure.
 - 3. Reinforce physician's explanation.
 - 4. Describe cath lab and equipment or show video.
 - 5. Provide techniques to decrease anxiety and fear.
 - 6. Keep NPO 8 hours or as ordered.
 - 7. Administer pretest medications.
- E. Postprocedure responsibilities.
 - 1. Compare data with baseline data obtained prior to procedure.
 - ◆ 2. Notify physician if blood pressure (taken every 15 minutes for 1 hour, then every 30 minutes for 2 hours) is decreased by 10% from baseline.
 - 3. Take apical pulse for 1 full minute to determine if arrhythmia is present.
 - 4. Monitor urine output.
 - 5. Encourage increased PO fluid intake to flush system (contrast dye is nephrotoxic).

- ◆ 6. Keep on bed rest in supine position with leg straight for prescribed time.
- ◆ 7. Maintain hemostasis at access site by pressure (e.g., sandbag) for several hours.
- 8. Check puncture site frequently for bleeding, swelling, hematoma.
- 9. Observe for allergy to dye.
 - a. Tachycardia.
 - b. Nausea and vomiting.
 - c. Shortness of breath.
 - d. Rash.
- ◆ 10. Palpate pulses distal to catheter insertion site to assess for perfusion.
 - a. Palpable pulses—bilateral and strong (grade 0, 1+, 2+, 3+, 4+).
 - b. Color—no cyanosis or pallor.
 - c. Temperature of skin—warm.
 - d. No pain.
- F. Observe for complications.
 - 1. Respiratory complications—hypoxia, hypoventilation, hypoxia, pulmonary edema.
 - 2. Hypovolemia due to osmotic diuresis.
 - 3. Notify physician if peripheral pulse is lost or if pain, tingling, or coolness occurs.
 - 4. Arrhythmias or alterations of heart rate.
 - 5. Cardiac tamponade—notify physician immediately.
 - 6. Decreased urine production (< 30 mL/hr).
- G. Discharge teaching.
 - 1. Instruct client to
 - a. Avoid strenuous activity as directed.
 - b. Immediately report bleeding at insertion site, chest pain, shortness of breath, difficulty breathing, tingling, numbness, or change in color/temperature of extremities.
 - c. Restrict lifting to < 10 lb for prescribed time.
 - 2. Clients with stent placement will require anti-coagulation therapy for 6–8 weeks. Instruct client to
 - a. Take medication at the same time each day.
 - b. Follow up with laboratory tests as ordered to maintain therapeutic blood levels.
 - c. Avoid activities that could cause bleeding.
 - d. Follow lifestyle guidelines recommended: smoking cessation; weight management; low-fat, low-cholesterol diet; limit alcohol intake; exercise.

Hemodynamic Monitoring

The goal of hemodynamic monitoring is to maintain adequate tissue perfusion.

- ◆ A. Pulmonary artery catheter measures several parameters.
 1. CVP 5–10 cm H₂O (same as right atrial pressure—RAP): normal is 5 mm Hg.
 - ◆ 2. Pulmonary artery pressure (PAP): normal is 20/10 mm Hg with mean of 15 mm Hg.
 - ◆ 3. Pulmonary artery wedge pressure (PAWP): mean pressure 10 mm Hg.
- B. Pulmonary artery catheter has four to five lumens.
 1. Proximal lumen used to measure CVP and inject selected solutions.
 2. Distal lumen used to measure PAWP.
 3. Third lumen used for balloon inflation.
 4. Fourth lumen used to measure cardiac output; includes temperature-sensitive wire that allows determination of cardiac output using thermodilution.
- C. Prepare for insertion.
 1. Prepare pressure (300 mm Hg) solution bag with heparin.
 2. Balance zero transducer.
 - a. Transducer must be at level of client's right atrium (fourth intercostal space).
 - b. Continuously monitor client's ECG.
 3. Assist physician to insert catheter.
- ◆ D. Obtain pulmonary capillary wedge pressure (PCWP) readings.
 1. Expose distal port for PAWP.
 2. Inject air into balloon port and leave in no longer than required to obtain wedge.
 3. Observe waveform change—wedge pressure "A" depicts left atrial contraction and left ventricular relaxation, and "V" depicts left atrial relaxation and left ventricular contraction.

Central Venous Pressure Monitoring

- ◆ A. Central venous pressure (CVP) is pressure within right atrium and reflects right ventricular function—indicates the right side of the heart's ability to manage fluid load.
 1. CVP is a guide for fluid replacement.
 2. It is a measure of circulating blood volume.
- ◆ B. Changes in CVP correlate with client's clinical status.
 1. Elevated CVP can be late sign of left ventricular failure or hypervolemia.
 2. Lowered CVP indicates hypovolemia.
- ◆ C. CVP measured by height of column of water in a manometer (see **Figure 8-10**).
 1. Measuring CVP is done by using zero mark on manometer as standard reference point.
 2. Transducer placed at phlebostatic axis.
 - ◆ 3. Normal CVP is 5–10 cm H₂O.

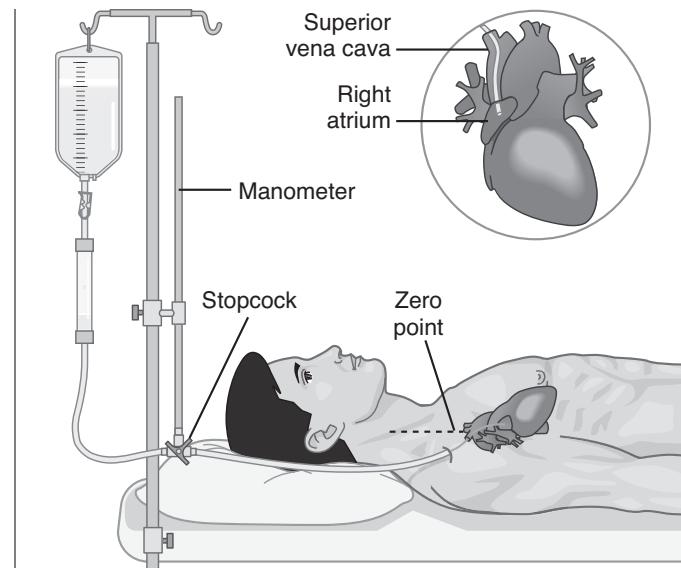


Figure 8-10 CVP reading: Manometer zero must be level with client's right atrium.

◆ System Implementation

- A. Monitor apical pulse for alterations in cardiac rhythm and rate.
- B. Monitor for alterations in blood pressure.
- C. Assess peripheral pulses to determine adequacy of circulation.
- D. Monitor laboratory values for alterations in electrolytes, coagulation, and cardiac enzymes to prevent complications.
- E. Provide diet appropriate for client's need.
- F. Provide emotional support for client and family when alterations in lifestyle are indicated.
- G. Administer and instruct client on medications and their side effects.
- H. Instruct client on preoperative and postoperative care modalities.
- I. Monitor for complications following surgical intervention.
- J. Plan an acceptable rehabilitation program with client and family.
- K. Administer life support measures when client's condition is compromised.

CORONARY ARTERY DISEASE

Coronary Atherosclerosis

- ◆ *Definition:* The most common type of cardiovascular disease—occurs as the result of accumulation of fatty materials (lipids and, the primary one, cholesterol) and fibrous tissue, which narrow the lumen of coronary arteries. Clinical manifestations of disease reflect ischemia to the myocardium, resulting from inadequate blood supply to meet metabolic demands.

Characteristics

- A. This form of heart disease originates from an abnormal accumulation of fatty substances and fibrous tissue.
- B. Continued development of coronary artery disease (CAD) involves an inflammatory response.
- C. Deposits are formed on vessel walls called atherosmas or plaque, which narrows vessel and obstructs blood flow.
- D. Fibrous cap of plaque may be thick and stable or thin; if thin, it may rupture and form a thrombus.
- E. The thrombus may obstruct blood flow and lead to sudden cardiac death or myocardial infarction (MI).

Assessment

- ◆ A. Assess for presence of risk factors.
- ◆ B. Evaluate chest pain.
 - 1. Angina, burning, squeezing, crushing tightness substernally or in precordial area. Pain may radiate to neck, jaw, shoulder, arms.
 - 2. Associated with nausea, vomiting, increased perspiration, and cool extremities.
- ◆ C. Assess heart sounds for presence of arrhythmias and/or murmurs.

Implementation

- ◆ A. Risk reduction (lifestyle modification).
 - 1. Engage in regular aerobic exercise.
 - 2. Reduce caloric intake if overweight.
 - 3. Refrain from smoking.
 - 4. Control hypertension, diabetes.
 - 5. Nutritional therapy: Adhere to a diet that emphasizes a decrease in saturated fat and cholesterol.
 - a. American Heart Association (AHA) Step 1 diet.
 - b. For further restrictions of saturated fats and cholesterol, an AHA Step 2 diet is recommended.
 - c. For elevated triglycerides, eliminate or reduce simple sugars and alcohol.
 - 6. Stress reduction.
- B. Lipid-lowering agents.
- C. Revascularization.
 - 1. Percutaneous transluminal coronary angioplasty (PTCA).
 - 2. Stent placement.
 - 3. Atherectomy.
 - 4. Laser angioplasty.
 - 5. Coronary artery bypass grafting (CABG).
- D. In-hospital care.
 - 1. Monitor vital signs, particularly blood pressure and pulse.
 - 2. Evaluate ECG findings for changes of ischemia, injury, or necrosis.

- 3. Administer nitrates if chest pain present.
- 4. Evaluate chest pain—type, duration, radiation, relieved with medication.
- 5. Monitor breath sounds and signs of peripheral edema to detect early complications.

RISK FACTORS

- Major factors: without presence of other risk factors; may cause CAD.
 - a. Cigarette smoking.
 - b. Hypertension.
 - c. Increased cholesterol.
- Uncontrollable factors.
 - a. Age: increased risk with increasing age.
 - b. Gender: increased risk in males.
 - c. Heredity: increased risk with family history.
- Controllable factors.
 - a. Diabetes.
 - b. Obesity.
 - c. Lack of exercise.
 - d. Stress.

Types of Angina**Stable Angina Pectoris**

◆ *Definition:* Intermittent chest pain or discomfort due to the inability of coronary arteries to meet oxygen needs of myocardium. Angina is the result of ischemia caused by reversible cell injury.

Assessment

- ◆ A. Precipitating factors:
 - 1. Physical exertion.
 - 2. Emotional upset.
 - 3. Tachyarrhythmias.
 - 4. Extremes of temperature, especially cold.
 - 5. Smoking.
 - 6. Consumption of heavy meal.
 - 7. Sexual activity.
- ◆ B. Evaluate pain.
 - 1. Location: precordial, substernal.
 - 2. Character: compressing, choking, burning, squeezing, crushing heaviness.
 - 3. Radiation: arm or jaw, neck, back.
 - 4. Duration: usually 5–15 minutes, relieved by rest or nitroglycerin.
- ◆ C. Observe for signs of dyspnea, diaphoresis, unrelieved discomfort.
- ◆ D. Assess ECG changes (may not be present at rest); ST-segment depression or elevation during pain.

Implementation

- ◆ A. Current approach to therapy is to decrease oxygen demand of myocardium—restrict activity.

- B. Understand medication usage for stable angina.
 - 1. Action of nitroglycerin medication.
 - a. Dilates coronary arteries that are not atherosclerotic to increase blood flow to myocardium.
 - b. Lessens cardiac work by decreasing venous return—decreases peripheral vascular resistance.
 - 2. Beta blocker—reduces cardiac response to exertion and stress.
 - 3. Aspirin (acetylsalicylic acid; ASA) inhibits platelet activity.
 - 4. Morphine sulfate for relief of pain from myocardial ischemia.
 - 5. Side effects: hypotension, headache, bradycardia.
 - ◆ 6. Instruct in use of sublingual nitroglycerin (tablets or metered-dose mouth spray).
 - a. Usual recommended dosage: one tablet; may be repeated at 5-minute intervals until pain is relieved, up to three doses.
 - b. If pain persists after 15 minutes, instruct client to seek immediate medical attention (call 911 where available).
 - c. May be used prophylactically before engaging in activity known to precipitate angina.
 - d. Take precautions for postural hypotension.
 - e. Keep tablets in tightly closed, dark-glass bottle.
 - f. Do not allow tablets to age—drug potency is 3–6 months.
 - g. Wear Medic-Alert band and keep medication on person at all times.
 - ◆ 7. Alternative: Instruct client in use of nitroglycerin ointment/transdermal patch.
 - a. Apply directly to skin.
 - b. Remove patch and wash off remaining ointment before new application.
 - c. Change skin placement with each application.
 - d. Wear patch as directed by physician.
- C. Provide client instruction.
 - 1. Learn to live in moderation; physical activity should be sufficient to maintain general physical state, but short of causing angina.
 - 2. Change in lifestyle.
 - a. Avoid stress and emotional upset.
 - b. Engage in regular exercise.
 - c. Reduce caloric intake if overweight.
 - d. Refrain from smoking.
 - e. Avoid saturated fats and cholesterol.
 - f. Instruct client in use of medication.

- ◆ D. Other antianginal agents.
 - 1. Beta blockers: Inderal (propranolol), Tenormin (atenolol) reduce myocardial oxygen requirements during exertion and stress.
 - 2. Calcium-entry blocking agents: Calan, Isoptin (verapamil), Cardizem (diltiazem) dilate coronary arteries, lower blood pressure, reduce heart rate—effective for vasospastic angina.
 - 3. Platelet-inhibiting agents: low-dose aspirin or Plavix (clopidogrel).
- E. Myocardial revascularization (if medical management ineffective).
 - 1. Percutaneous transluminal coronary angioplasty (PTCA).
 - 2. Stent placement.
 - 3. Atherectomy.
 - 4. Laser angioplasty.
 - 5. Coronary artery bypass grafting (CABG).

◆ Unstable Angina

Definition: Also called preinfarction angina—previously stable angina has new onset while at rest, lasts longer, is less responsive to medication. Signifies dynamic change in the vessel (a *supply* problem). Most clients have complex coronary stenoses with plaque rupture, ulceration, or hemorrhage with subsequent thrombus formation; may occur due to vasospasm.

Assessment

- A. Unstable angina leads to myocardial infarction (MI).
 - 1. ST-elevated MI (STEMI).
 - 2. Non-ST-elevated MI (non-STEMI).
- ◆ B. ECG changes—transient ST-segment depression or T-wave flattening or inversion, or ST-segment elevation (vasospastic angina).
- C. Serial ECG recordings ordered.
- D. Presence of S₃ diastolic filling sound.
- E. Serial cardiac enzyme determinations (troponin elevation may indicate small amount of myocardial damage).
- ◆ F. Unstable status may progress to complete occlusion and MI or may resolve and return to stable angina.
- G. Noninvasive and invasive cardiac diagnostic procedures to identify diseased coronary artery.

◆ Implementation

- A. Immediate medical intervention; bed rest, with cardiac and hemodynamic monitoring.
- B. Heparin infusion (weight-based bolus, then infusion titrated to achieve activated partial thromboplastin time [APTT] ratio 1.5–2.3).
- C. Platelet-inhibiting agents (ASA, Plavix).
- D. Narcotic pain management (morphine sulfate).
- E. Oxygen administration (2–4 L/min).

- F. Tridil (nitroglycerine) infusion titrated for pain relief (requires continuous blood pressure monitoring for hypotension).
 - 1. Potent, concentrated drug; must be diluted in glass bottle of D₅W or sodium chloride 0.9%.
 - 2. Given as a continuous infusion. Begin at 5 µg/min.
 - 3. Increase by increments every 3–5 minutes, until the desired response occurs.
 - 4. IV infusion pump is used to deliver continuous flow rate.
 - 5. Closely monitor blood pressure (BP), PAP, PCWP, HR, CO.
- G. Administration of beta blockers.
- H. Antiembolic therapy.
- I. Revascularization management (PTCA, CABG).

Myocardial Infarction

♦ **Definition:** The process by which cardiac muscle cells die due to insufficient blood supply (oxygen deprivation). Caused by vessel occlusion due to thrombus formation on ruptured or eroded coronary artery atheroma; coronary artery embolism or vasospasm; decreased blood volume with shock and/or hemorrhage; direct trauma.

Assessment

- ♦ A. Assess pain (history very important)—precipitating factors, interventions leading to relief, associated symptoms.
- ♦ B. Identify anxiety, feeling of doom.
- ♦ C. Note dyspnea, nausea, vomiting, and diaphoresis.
- ♦ D. Low-grade temperature elevation after 24 hours.
- ♦ E. Diagnostic findings.
 - 1. History of ischemic type chest discomfort (very important).
 - 2. Serial 12-lead ECGs to note evolutionary changes that reflect areas of involvement.
 - a. ST elevated (STEMI, acute injury).
 - b. ST-segment depression (subendocardial infarction).
 - c. Evolving abnormal Q waves (transmural infarction).
 - 3. Serial cardiac enzymes lab tests. (See Chapter 11, Laboratory Tests.)
 - a. Elevated creatinine kinase-myocardial band (CK-MB)—rises in 3–6 hours after onset of myocardial damage, peaks in 12–24 hours, returns to normal in 48–72 hours.
 - b. Myoglobin—protein found in cardiac and skeletal muscle. Sensitive and early indicator of myocardial infarction, occurring 1–2 hours following injury. Declines rapidly after approximately 7 hours.

- c. Troponin—myocardial muscle protein released after injury.
 - (1) Troponin T—peaks in 12 hours; high specificity at 3–6 hours following onset of injury.
 - (2) Troponin I—rises in 4–6 hours (remains elevated 6 days).
- 4. Elevated white blood cells (WBCs) and sedimentation rate.
- 5. Isotope scanning of myocardium.
- 6. Echocardiogram.
- F. Infarction sites.
 - 1. Transmural—entire thickness of myocardium involved—produces Q wave on reflecting ECG leads.
 - 2. Subendocardial—death confined to inner layer of myocardium—produces non-Q wave MI.
 - 3. Location: depends on which coronary artery is occluded.
 - a. Most MIs occur in left ventricle, with damage limited to area supplied by blocked vessel.
 - b. Left ventricular infarcts may be localized to anterior, septal, inferior, posterior, or lateral walls.
 - (1) RCA blockage = inferior wall infarcts.
 - (2) LAD blockage = anterior or anteroseptal infarcts.

Implementation

- ♦ A. Immediate hospitalization for early diagnosis of acute myocardial injury by ECG, serial enzymes.
- ♦ B. Pain management with sublingual Tridil (nitroglycerine) or intravenous narcotics (morphine sulfate).
- ♦ C. Early reperfusion therapy by PTCA or thrombolysis (streptokinase, tissue plasminogen activator; tPA) to reduce infarction size.
- D. Antiplatelet therapy.
- E. Anticoagulant continuation therapy following reperfusion (heparin weight-based bolus, then infusion titrated to keep APTT ratio 1.5–2.3).
- ♦ F. Coronary care unit continuous monitoring.
 - 1. Physical and emotional rest.
 - 2. Bed rest with bedside commode.
 - 3. Liquid diet for 24 hours, then advanced.
 - 4. Stool softeners to prevent constipation/Valsalva maneuver.
 - 5. Beta blocker therapy (reduces reinfarction rate and sudden death).
 - 6. Angiotensin-converting enzyme (ACE) inhibitor if low ejection fraction (reduces mortality).

7. Lidocaine for frequent and complex premature ventricular contractions (PVCs), ventricular tachycardia.
 8. Lipid-lowering agents (if appropriate).
- G. Monitor for complications.
1. Arrhythmias.
 2. Heart failure.
 3. Cardiogenic shock.
 4. Papillary muscle dysfunction (new murmur).
 5. Pericarditis (friction rub).
 6. Ventricular aneurysm/cardiac rupture.
- H. Step-down care with telemetry cardiac monitoring progressive ambulation.
- I. Rehabilitation with progressive ambulation and client teaching about lifestyle modification, prudent (AHA) Step 2 diet, medications, etc.

DIAGNOSTIC STUDIES FOR CARDIAC DISEASE*			
Cardiac Enzymes	Rises	Peaks	Returns to Normal
CK-MB	4–6°	12–24°	48–72°
Troponin T	3–6°	12°	> 9 days
Troponin I	3–6°	12°	> 9 days
Myoglobin	30–60 min	6–10°	12–24°
		Moderate	
C-reactive protein (CRP)	Normal	Risk	High Risk
	< 1 mg/L	< 1–3 mg/L	> 3 mg/L
		Moderate	
Homocysteine	Normal	Risk	High Risk
	< 12 µmol/L	12–15 µmol/L	> 15 µmol/L
Congestive Heart Failure Marker	Normal		
B-type natriuretic peptide (BNP)	< 100 pg/mL		

*See cardiac enzymes tests in Chapter 11, Laboratory Tests.

VALVULAR DISEASE (MURMURS)

Mitral Stenosis

♦ *Definition:* A progressive fibrous thickening and calcification of the valve cusps that results in the leaflets fusing and becoming stiff, causing narrowing of lumen of mitral valve.

Assessment

- A. Evaluate history for congenital heart disease or rheumatic heart disease.
- ♦ B. Assess for signs of decreased cardiac output. Asymptomatic until valve area is less than 1.5 cm² and tachycardia or atrial fibrillation occurs.

- C. Assess for symptoms and signs of left, and then right, ventricular failure.
- D. Auscultate heart sounds for diastolic murmur and opening snap crescendo and loud S₁ at apex.
- E. Assess for complications.
 1. Atrial fibrillation.
 2. Subacute infective (bacterial) endocarditis.
 3. Thrombi formation.

Implementation

- A. Treat heart failure and arrhythmias.
- B. Decrease cardiac workload.
- ♦ C. Prevent and/or treat infections—prophylactic antibiotic therapy used to prevent recurrence of infection.
- ♦ D. Monitor administration of anticoagulants for treatment and/or prevention of thrombi/emboli in clients with atrial fibrillation.
- E. Provide emotional support to client.
- F. Prepare client for plan if there is no calcification of valve or for surgical replacement of the mitral valve.

Mitral Insufficiency

♦ *Definition:* Congenital or acquired abnormality of the valve that prevents the mitral valve from closing completely during systole, allowing regurgitation (backflow) of blood from left ventricle to atrium.

Assessment

- A. Assess for presence of cardiac disease associated with mitral insufficiency.
 1. Rheumatic heart disease.
 2. Congenital disease.
 3. Infective (bacterial) endocarditis.
 4. Rupture of chordae tendineae supporting structures.
 5. Rupture or dysfunction of papillary muscle.
 6. Dilatation of left ventricle.
 7. Decreased cardiac output (fatigue, weakness).
 8. Dyspnea on exertion.
 9. Orthopnea.
 10. Atrial fibrillation.
- B. Observe for evidence of heart failure.
- ♦ C. Auscultate at apex for decreased intensity of S₁; pansystolic murmur; S₃.
- ♦ D. Assess for palpable thrill.
- ♦ E. Evaluate for systemic emboli.

Implementation

Same as for *mitral stenosis*.

Mitral Valve Prolapse

Definition: Leaflets of the mitral valve enlarge and prolapse into left atrium during systole.

Assessment

- A. Asymptomatic.
- B. May experience chest pain, palpitations, exercise intolerance.

Implementation

- A. Benign abnormality.
- B. Can progress to mitral regurgitation.

Aortic Valve Stenosis

♦ **Definition:** The narrowing of the aortic valve opening due to fibrosis and calcification. This results in increased afterload to the left ventricle.

Assessment

- A. Assess history for predisposing conditions.
 - 1. Rheumatic heart disease. (Mitral valve commonly affected as well.)
 - 2. Arteriosclerosis.
 - 3. Congenital defect.
- ♦ B. Observe for dizziness and syncope with exertion.
- C. Observe for symptoms of heart failure.
- D. Auscultate for systolic murmur; faint S₂ at aortic area.
- E. Assess for dyspnea, angina.
- F. If client to receive Tridil (nitroglycerin), monitor client frequently as significant drop in BP may occur and can worsen chest pain.

Implementation

- A. Follow nursing care protocols for clients with heart failure.
- B. Prepare client psychologically and physiologically for prosthetic valve replacement.
- C. Aortic valve replacement may be done with traditional open heart surgery or transcatheter aortic valve replacement (TAVR), also called transcatheter aortic valve implantation (TAVI).
 - 1. TAVR is a procedure for select clients with severe symptomatic aortic stenosis who are not candidates for traditional open chest surgery or are high-risk operable candidates.
 - 2. TAVR is performed on a beating heart and does not require cardiopulmonary bypass. The TAVR valve is made of bovine (cow) pericardium and is supported with a metal stent.
 - 3. The most common approaches are transfemoral and transapical.

Aortic Insufficiency

♦ **Definition:** Allows blood to regurgitate (backflow) into left ventricle from the aorta. The left ventricle compensates and dilates to accommodate increased blood volume; leads to left ventricular hypertrophy.

Assessment

- A. Assess for presence of the following conditions:
 - 1. Rheumatic heart disease.
 - 2. Marfan syndrome.
 - 3. Arteriosclerotic and hypertensive dilatation of aortic root.
 - 4. Dissecting aortic aneurysm.
 - 5. Prosthetic valve leakage.
- B. Observe for signs of heart failure.
- ♦ C. Assess for pounding arterial pulse (Corrigan-type arterial pulse) in the neck.
- ♦ D. Observe if widened pulse pressure present (difference between systolic and diastolic pressure).
- E. Auscultate for early diastolic murmur.
- F. Assess for weakness, severe dyspnea, hypotension.

Implementation

Same as for *aortic valve stenosis*.

Tricuspid Stenosis

♦ **Definition:** Narrowing of the valve lumen, usually associated with mitral valve defect (extremely uncommon).

Assessment

- A. Assess for presence of the following conditions:
 - 1. Rheumatic heart disease with mitral valve involvement.
 - 2. Congenital disease.
 - 3. Infective (bacterial) endocarditis.
- ♦ B. Observe for evidence of heart failure.
- ♦ C. Auscultate for late diastolic murmur—use bell over tricuspid area.

Implementation

- A. Follow nursing protocols for clients with heart failure.
- B. Prepare client psychologically and physiologically for valvotomy or tricuspid valve replacement.

Tricuspid Insufficiency

♦ **Definition:** Allows regurgitant blood flow back into the right atrium from the ventricle—usually due to right ventricular dilation (extremely uncommon).

Assessment

- A. Note chest x-ray for heart dilatation and failure.
- B. Auscultate for holosystolic murmur over tricuspid area.
- C. Observe for symptoms of heart failure.

Implementation

Same as for *tricuspid stenosis*.

Heart Failure

Definition: Insufficient cardiac output to meet metabolic needs of the body. Regardless of type, it results in decreased

cardiac output (forward failure) and venous congestion (backward failure) secondary to pump failure.

Characteristics

- A. Differentiate heart failure types: left-sided or right-sided, systolic or diastolic, high output failure, and acute or chronic.
- ◆ B. Heart failure may be due to left-sided cardiac failure or right-sided failure.
 - 1. One side of the heart may fail separately from the other side because the heart is two separate pumping systems.
 - 2. Impaired pumping ability results in the heart's inability to maintain adequate circulation.
- ◆ C. Either the left or right ventricle may be affected; while most heart failure begins on the left side when the left ventricle cannot pump blood out of the chamber, failure usually then progresses to both ventricles.
 - 1. Coronary artery disease and hypertension are the usual causes of left-sided failure.
 - 2. Pulmonary congestion occurs and pressure is increased in the left ventricle, causing dyspnea and shortness of breath.
 - 3. Pressure in the left atrium increases, which increases pressure in the pulmonary circulation.
 - 4. Venous congestion occurs due to decreased compliance (decreased relaxation) of the left ventricle (decreased preload).
 - 5. Acute pulmonary edema may result from left ventricular failure.
- ◆ D. Right ventricular failure—congestion occurs when blood is not pumped adequately from the systemic circulation into the lungs, resulting in systemic congestion.
 - 1. The right side of the heart cannot eject blood and, therefore, cannot handle all of the blood that flows into it from venous circulation.
 - 2. Congestion of the viscera (liver congestion) and peripheral tissues occurs.
 - 3. Signs of right-sided failure will be edema of the extremities; congestion of gastrointestinal (GI) tract causes nausea and vomiting.
- E. Differentiating systolic from diastolic dysfunction—heart failure is manifested as systolic and diastolic dysfunction, or both.
 - ◆ 1. Systolic dysfunction.
 - a. Inadequate ventricular emptying leads to increased preload, diastolic volume and pressure (the tissues do not receive adequate circulatory output).
 - b. Most common causes are coronary artery disease, hypertension, and cardiomyopathy, with viruses and toxic substances such as

alcohol and medications being a possible cause.

- c. Conventional therapy includes diuretics (loop diuretics preferred), Lanoxin (digoxin), ACE inhibitors, and beta blockers to improve performance of left ventricle.
- d. The above regimens may be inappropriate for diastolic dysfunction; avoid Lanoxin and vasodilators.
- ◆ 2. Diastolic dysfunction.
 - a. Resistance to ventricular filling as a consequence of reduced ventricular compliance—results in prolonged ventricular relaxation time.
 - b. Ejection fraction may be normal or increased.
 - c. Clients cannot tolerate reduced blood pressure or plasma volume so diuretics, ACE inhibitors and vasodilators are usually contraindicated. Lanoxin is also contraindicated.
 - d. May respond to calcium-channel blockers and beta blockers (to slow the heart rate).
 - e. Nitrates may be used to decrease preload.
 - f. High output failure occurs with hypermetabolic states (infection, hyperthyroidism) and requires increased blood flow to meet oxygen demands.
 - g. Acute vs. chronic: acute is abrupt onset (MI); chronic is progressive deterioration.

Assessment: Left-Sided Failure

- ◆ A. Evaluate for presence of pulmonary symptoms.
 - 1. Dyspnea, labored breathing (early symptoms).
 - 2. Orthopnea (difficulty breathing when lying flat).
 - 3. Moist, hacking cough.
 - 4. Bibasilar crackles.
 - 5. Cyanosis or pallor; cool extremities.
 - 6. Increased pulmonary artery and/or pulmonary wedge pressure.
- ◆ B. Assess for anxiety, weakness, and fatigue (after activities that usually are not tiring).
- C. Identify behavior changes.
- D. Check for palpitations and diaphoresis.
- E. Assess for gallop rhythm—presence of S_3 .
- F. Evaluate for tachycardia, arrhythmias, and cardiomegaly.
- G. Assess for reduced pulse pressure.

◆ Assessment: Right-Sided Failure

- A. Assess client for presence of conditions that could lead to right ventricular failure.
 - 1. Any disease resulting in left ventricular failure.
 - 2. Pulmonary embolism.

- 3. Fluid overload.
- 4. Chronic obstructive pulmonary disease (COPD).
 - a. Pulmonary hypertension.
 - b. Cor pulmonale.
- 5. Cirrhosis, portal hypertension.
- ◆ B. Evaluate symptoms primarily related to systemic congestion.
 - 1. Peripheral edema (pitting type) in dependent parts: feet, legs, sacrum, back, buttocks.
 - a. Results from elevation in venous pressure.
 - b. Necessitates good skin care and positioning.
 - 2. Ascites, which can result in pulmonary distress.
 - 3. Anorexia and nausea due to congestion in liver and gut.
 - 4. Weight gain.
 - 5. Oliguria during day and polyuria at night.
 - 6. Hepatomegaly and tenderness in right upper quadrant of abdomen.
 - 7. Fatigue from poor tissue perfusion.
 - 8. Difficulty concentrating.

Implementation

- ◆ A. Goal is to reduce workload on the heart, increase efficiency of contractions, and reduce fluid.
- ◆ B. Provide physical rest and emotional support.
- ◆ C. Optimize oxygenation—bed rest with Fowler's position.
 - 1. Oxygen therapy based on degree of pulmonary congestion.
 - 2. May require oxygen (cannula better than mask) or intubation.
- D. Reduce preload (volume of blood heart receives) and afterload (resistance to pump).
- ◆ E. Monitor medications.
 - 1. ACE inhibitors (decrease renin angiotensin-aldosterone response).
 - a. Monitor for hypotension, hypovolemia, and hyponatremia (if receiving diuretics).
 - b. Dosage according to BP, fluid and renal status, and degree of cardiac failure.
 - c. Avoid nonsteroidal anti-inflammatory drugs (NSAIDs): Counteract action of ACE inhibitors, diuretics.
 - 2. Diuretics to improve urine output to reduce preload: Lasix (furosemide), Aldactone (spironolactone).
 - 3. Beta blockers to decrease effects of catecholamines.
 - 4. Lanoxin if ejection fraction is < 40% (for systolic dysfunction).
 - a. Increases contractility and improves cardiac output.
 - b. Not used in diastolic failure.
 - 5. Administer nitrates (ischemia) for vasodilation.

- 6. Administer beta blocker.
- 7. Administer potassium chloride for electrolyte replacement.
- ◆ F. Monitor diet—sodium restriction, as ordered to reduce fluid retention; and monitor and maintain fluid restriction as ordered.
- G. Monitor brain natriuretic peptide (BNP) assay to detect abnormal hormone levels produced by failing ventricles.
- H. Monitor daily weights.
- I. Monitor for complications of treatment.
 - ◆ 1. Lanoxin toxicity.
 - a. Most common predisposing factor for toxicity is hypokalemia, which potentiates the effect of Lanoxin.
 - b. Low potassium levels (from diuretics) lead to excitable heart and dysrhythmias.
 - ◆ 2. Electrolyte imbalance from diuretics, especially decreased potassium.
 - 3. Oxygen toxicity, especially with COPD clients.
 - 4. Myocardial failure.
 - 5. Cardiac dysrhythmia.
 - 6. Pulmonary infarction; emboli, pneumonia from bed rest—circulatory stasis.
- J. Prepare clients psychologically and physiologically for ventricular assist devices (VADs) or paracorporeal pumps if indicated. They may need either of these devices if:
 - 1. Their heart has been weakened after recent heart surgery (called *cardiogenic shock*).
 - 2. They cannot be weaned from the heart-lung machine after heart surgery.
 - 3. They are waiting to get a long-term, implantable VAD.
- K. VADs assist the heart by helping the ventricles pump blood, easing the workload of the heart in clients with heart failure.
 - 1. If the device is used to help (or “unload”) the left ventricle, it is called a left ventricular assist device (LVAD).
 - 2. If it is used to “unload” the right ventricle, it is called a right ventricular assist device (RVAD).
- L. Paracorporeal VADs are inserted through a long, thin tube (called a catheter) placed in the femoral vein or femoral artery.
 - 1. One type of paracorporeal VAD, called the TandemHeart System, has an external pump that takes blood from a catheter placed in the client's left atrium and sends it to the femoral artery.
 - 2. Another type of paracorporeal VAD, called the Impella, has a very small pump located on the tip of a catheter.
 - a. The Impella catheter is inserted into the client's femoral artery. A camera is then

- used to guide the Impella catheter into the left ventricle.
- b. The Impella works by sending blood from the left ventricle to the ascending aorta, which is the main blood vessel leaving the left ventricle.
 3. In some clients, paracorporeal VADS can be used for longer periods, such as while they are waiting for a heart transplant.

Cardiomyopathy

Definition: Heart muscle disease that primarily affects structural or functional ability of myocardium. It is classified as primary or secondary and manifests as three types: dilated, hypertrophic, and restrictive cardiomyopathy.

Characteristics

- A. Types.
 1. Dilated: most common type. Diffuse inflammation and rapid degeneration of myocardial fibers, leading to decreased contractile function and dilation of both ventricles. This results in impaired systolic function and decreased cardiac output.
 2. Hypertrophic: asymmetrical ventricular hypertrophy, leading to hypercontractility of the left ventricle, obstruction of the left ventricle outflow, and stiffness of the ventricular walls. This results in impaired ventricular filling and decreased cardiac output.
 3. Restrictive: least common; impairs diastolic volume and stretch, resulting in decreased cardiac output.
- ◆ B. Regardless of the type manifested or cause, result is impaired pumping of the heart and decreased cardiac output.
- C. Decreased stroke volume stimulates sympathetic nervous system resulting in increased vascular resistance with eventual left ventricular failure.

Assessment

- ◆ A. Effort dyspnea and fatigue due to elevated left ventricular diastolic pressure and low cardiac output.
- ◆ B. Physical signs include pitting edema, sinus tachycardia, basal rales, low blood pressure, and possible enlarged liver.
- C. Chest x-ray reveals cardiomegaly.

Implementation

- ◆ A. Treatment begins with finding any specific cause (most often there is none) and treating it.

1. Therapy for heart failure and low cardiac output is implemented.
 2. Combined afterload and preload reduction with ACE inhibitors, hydralazine plus nitrate, is the mainstay of treatment.
 3. Lanoxin, diuretics are also used in the treatment protocol.
- B. Nursing focus is aimed at improving cardiac output.
- ◆ 1. Bed rest and increased oxygenation.
 - a. Gradually increase activity alternating with rest.
 - b. Identify activities that cause shortness of breath and teach client how to plan.
 - 2. Monitor medications—compliance is vital.
 - 3. Plan with client how to reduce anxiety—stress exacerbates condition.

Acute Pulmonary Edema

♦ Definition: A medical emergency characterized by excessive fluid in the pulmonary interstitial spaces or alveoli, usually due to severe, acute left ventricular decompensation.

Characteristics

- ◆ A. Most common cause is greatly elevated capillary pressure resulting from acute failure of left heart pump and pooling of blood in lungs.
- B. Fluid fills alveoli and causes bronchospasm.
- C. May also be associated with barbiturate/opiate poisoning or other noncardiac condition.

Assessment

- A. Observe initially for anxiety, feelings of impending doom, and restlessness.
- B. Observe for marked dyspnea.
- C. Assess for pink, frothy sputum.
- D. Evaluate for marked cyanosis.
- E. Observe for profuse diaphoresis—cold and clammy.
- F. Evaluate for tachyarrhythmias.
- G. Evaluate for (S_3) diastolic sound.
- H. Evaluate for marked increase in pulmonary artery and/or pulmonary capillary wedge pressure.
- I. Evaluate for hypoxemia and low PCO_2 (hyperventilation).

Implementation

- ◆ A. Place in high-sitting position—feet over side of bed.
- ◆ B. Administer oxygen at 6 L/min.
- ◆ C. Administer drugs: diuretics, Lanoxin (digoxin), morphine, Tridil (nitroglycerin) to improve myocardial contractility and reduce preload (volume of blood in ventricle after diastole).

- D. Instruct client in deep breathing.
- E. Monitor fluid intake and output; weigh daily.
- F. Monitor vital signs and hemodynamic parameters (PCWP).
- G. Provide sedation with ordered medication. Observe respiratory rate and depth.
- H. Monitor drug therapy used for preload or afterload: Tridil (nitroglycerin), Nipride (nitroprusside), Apresoline (hydralazine).
- ♦ I. Rotating tourniquets on client's extremities used in emergency situation to reduce venous return to heart and pool blood temporarily in extremities, thus reducing preload. Not commonly used—may be used in emergencies.

CARDIAC PROCEDURES

Angioplasty

- A. Percutaneous transluminal coronary angioplasty procedure that can be balloon stent or laser to open narrowed or blocked arteries.
- B. Preparation of client.
 - 1. NPO after midnight.
 - 2. In cath lab, catheter is inserted through groin or arm and contrast dye is injected.
 - 3. Procedure takes 30–60 minutes.
 - 4. Vital signs checked frequently following procedure.

Atherectomy

- A. Procedure used to cut away blockage (plaque responsible for narrowing of the artery).
- B. There are several atherectomy techniques.
 - 1. Rotational extraction, using a high-speed rotational burr, a cutting device that removes plaque through a vacuum suction system.
 - 2. Rheolytic thrombectomy, a system designed for clot removal via a special pump to deliver a saline “jet” to break away the clot, transform it into fragments, and vacuum it out.

Coronary Stents

- A. A stainless steel structure placed in a coronary vessel to expand and help keep the artery open.
- B. Stents are metabolic wires implanted at the site of a narrowed coronary artery.
- C. Treatment of choice for lesions in diseased bypass grafts.

Pacemaker Insertion

Definition: A temporary or permanent device to initiate and maintain heart rate when client's intrinsic pacemaker is unreliable.

Assessment

- A. Assess client for conditions requiring pacemaker insertion.
 - 1. Conduction defect following heart surgery.
 - 2. Heart block (usually third-degree [complete] heart block) due to anterior MI.
 - 3. Tachyarrhythmias (overdrive pacing).
 - 4. Bradyarrhythmias (“sick sinus syndrome”).
- B. Assess vital signs for baseline data.
- C. Obtain and assess monitor rhythm strips for baseline.
- D. Determine type of pacemaker inserted.
 - ♦ 1. Temporary pacemaker—external generator used in emergency situations.
 - a. Pacing lead wire threaded transvenously to right ventricle and attached to external power source.
 - b. Right atrial and ventricular epicardial wires placed during heart surgery, exist transthoracically and connected to external pulse generator.
 - c. Transcutaneous—gelled electrode patches placed anteriorly and posteriorly.
 - d. Used for heart block, bradycardia, or tachyarrhythmias.
 - e. Client at risk for microshock if transvenous or transthoracic.
 - ♦ 2. Permanent pacemaker.
 - a. Pacing lead wire with electrodes inserted through central vein and advanced into apex of right ventricle.
 - b. Pulse generator implanted into subcutaneous tissue below clavicle.
 - c. Demand—mode functions only if client's own heart rate is inadequate (most common type).
 - (1) Pacemaker is set at a specific rate and is inhibited if client's heart rate is adequate.
 - (2) May be dual-chamber or AV synchronous.
 - (3) Used mainly in bradyarrhythmias or heart block.
 - (4) Programmable pacemaker allows noninvasive adjustment of pacemaker.

Implementation

- A. Observe for hematoma at site of insertion.
- B. Immobilize extremity on side of pacemaker generator.

- C. Do not lift client under arm on side of pacemaker.
- ♦ D. Evaluate pacemaker function/malfunction.
 - 1. Absence of pacemaker artifact when client's rate is inadequate (failure to sense or discharge).
 - 2. Failure of pacemaker inhibition (failure to sense)—leads to inappropriate pacing.
 - 3. Pacing without depolarization response (failure to capture).
 - 4. Assess for cardiac tamponade (decreased BP).
 - 5. Monitor for hiccoughs—indicates dislodged pacing wire.
- E. Monitor vital signs.
- F. Provide client teaching.
 - 1. Purpose of pacemaker.
 - 2. Medication dose and side effects.
 - 3. Monitoring pulse.
 - 4. Signs and symptoms of infection.
 - 5. No range of motion (ROM) on affected side for 2 days.
 - 6. Wear medical alert bracelet and carry pacemaker ID card.
 - 7. Follow up with pacemaker evaluation (e.g., clinic).
 - 8. Avoid large electromagnetic fields.
- ♦ G. Counsel client to observe for pacemaker malfunction.
 - 1. Dizziness or fatigue.
 - 2. Shortness of breath.
 - 3. Slowed pulse rate (five beats less than pacemaker rate).
 - 4. Chest pain.
 - 5. Edema or weight gain.

Surgical Procedures

Definition: Surgical procedures on the cardiac vessels, valves, or myocardium.

Assessment

- A. Assess type of heart surgery to be done.
 - ♦ 1. **Percutaneous transluminal coronary angioplasty (PTCA)**—less invasive than bypass surgery and preferred as initial procedure.
 - a. A catheter with a deflated balloon is threaded into artery at site of blockage.
 - b. Balloon is inflated and opens artery by breaking up and compressing plaque against artery wall.
 - c. Stent often placed to maintain patency.
 - ♦ 2. **Coronary bypass surgery**—healthy sections of a leg or chest blood vessel are grafted distal to blocked area of coronary artery.
 - ♦ 3. **Commissurotomy of stenosed valve.**
 - a. Closed commissurotomy—finger inserted to dilate valvular opening.

- b. Open commissurotomy—dissection of scarred area by means of a scalpel.
- ♦ 4. **Valve replacement**—artificial, or prosthetic, valves; heterografts (porcine or bovine).
- 5. **Transplantation**—therapeutic option for severe heart disease.
 - a. Immunosuppressant drugs decrease body's rejection of foreign protein (another's human heart).
 - b. Clients must balance risk of rejection with risk of infection.
- B. Evaluate client's knowledge of operative procedure to prepare for preoperative teaching.
- C. Assess vital signs, heart and lung sounds, other vital parameters for baseline data.

Implementation

- ♦ A. Observe for fluid and electrolyte imbalance.
 - 1. Obtain lab specimens for hypokalemia and hyperkalemia.
 - 2. Measure CVP for hypovolemia and volume overload.
 - 3. Measure blood gases for acidosis and alkalosis.
 - 4. Monitor hematocrit and hemoglobin.
 - 5. Weigh daily after voiding and before breakfast.
- ♦ B. Observe respiratory function.
 - 1. Client receives mechanical ventilation for varying length of time postoperatively.
 - a. Endotracheal intubation with cuffed tube.
 - b. Suction airway PRN.
 - c. Auscultate for bilateral breath sounds.
 - d. Monitor pulmonary volumes; pulse oximetry.
 - 2. Auscultate for abnormal lung sounds.
- ♦ C. Observe for circulatory complications.
 - 1. Decreased blood pressure.
 - 2. Tachycardia, thready pulse.
 - 3. Weak peripheral pulses.
 - 4. Decreased urine output.
 - 5. Skin—cool, clammy, cyanotic.
 - 6. Restlessness.
 - 7. Elevated cardiac and central venous pressures.
 - 8. Electrolyte imbalance.
- ♦ D. Observe for signs of cardiac tamponade (mediastinal/chest tubes output over 100 mL/hr).
- ♦ E. Place in semi-Fowler's position to facilitate cardiac and respiratory function.
- ♦ F. Administer pain medication such as morphine sulfate IV.
- ♦ G. Monitor IV fluid and blood requirements by use of intracardiac pressures, blood pressure, urine output, hemoglobin and hematocrit.
 - 1. Keep CVP between 5 and 12 cm water pressure (or 0–6 mm Hg) or as directed by physician.

- 2. Keep urine above 30 mL/hr.
- 3. Hematocrit maintained at 30–35.
- H. Maintain circulation.
 - 1. Inotropic medications.
 - 2. Vasoactive medications.
 - 3. IV fluids.
 - 4. Antibiotics.
- ♦ I. Maintain kidney function.
 - 1. Keep urine output above 30 mL/hr with IV fluids or plasma expanders.
 - 2. Maintain blood pressure above 90 mm Hg systolic.
 - 3. Diuresis is common.
 - 4. Report cloudy or pink urine.
- ♦ J. Maintain patent chest tubes.
 - 1. Used to remove fluid and air from mediastinum/pleural space.
 - 2. Maintain 20 cm H₂O suction.
- ♦ K. Maintain body temperature. (Clients are usually hypothermic following cardiac surgery.)
 - 1. Raise body temperature gradually.
 - a. Blankets used cautiously following hypothermic surgical procedure.
 - b. Monitor core temperature with pulmonary artery (PA) catheter.
 - 2. Client at risk for developing fever caused by infection or postpericardiotomy syndrome.
 - a. Bed rest and anti-inflammatory agents are primary treatment.
 - b. Keeping temperature below 100°F – 37.7°C prevents increased metabolic rate, which increases cardiac workload.
- ♦ L. Assess level of consciousness (LOC), pupil response, motor response.
 - 1. Neurologic complications may result from extracorporeal perfusion or aorta clamping.
 - 2. Orient client frequently.
- ♦ M. Administer anticoagulant therapy for valve replacements.
- ♦ N. Monitor laboratory values for anticoagulation.
 - 1. Partial thromboplastin time for heparin administration based on weight and sliding scale protocol.
 - 2. Prothrombin time/international normalized ratio (INR) for Coumadin (warfarin sodium) therapy.
- ♦ O. Monitor for complications associated with valve replacement.
 - 1. Conduction defects (may require temporary pacing).
 - 2. Cardiac tamponade.
 - 3. Supraventricular tachyarrhythmias (may use pacemaker overdrive).
 - 4. Malfunction of prosthetic valve (murmur).
- P. Monitor for complications associated with use of cardiopulmonary bypass.
 - 1. Fluid and electrolyte imbalance.
 - 2. Decreased cardiac output.
 - 3. Coagulation defects.
 - 4. Atelectasis (hypoventilation).
 - 5. Thromboembolic disorders.
 - 6. Alterations of BP.
 - 7. Cardiac tamponade.
 - 8. Arrhythmias.
 - 9. Renal failure.
 - 10. Neurologic dysfunction.
 - 11. Pain.
- Q. Progressive care.
 - 1. Progressive ambulation.
 - 2. Lifestyle modification teaching (smoking cessation, AHA diet, exercise).
 - 3. Medications (antithrombotics/anticoagulants, inotropic agents, beta blockers, antihypertensives, antiarrhythmics).
 - 4. Sternal incision protection/wound care.

INFLAMMATORY HEART DISEASE

Infective (Bacterial) Endocarditis

Definition: An infection of the lining of the heart and valves caused by pathogenic microorganisms.

Characteristics

- ♦ A. Acute—fulminating disease due to organisms engrafted on a preexisting heart lesion.
 - 1. Occurs following open heart surgery or with IV drug use.
 - 2. Causative agents—gram-positive, gram-negative bacilli, yeasts; more rapid serious infection with *Staphylococcus aureus*.
- B. Subacute—slowly progressive disease of rheumatic or congenital lesions or prosthetic valve.
 - 1. Occurs following dental, genitourinary, gynecological procedures, bacteremia, or surgery.
 - 2. *Streptococcus* most common organism.
- ♦ Assessment
 - A. Observe for chills, diaphoresis, lassitude, anorexia, weight loss, arthralgia.
 - B. Check for fever and night sweats that recur for several weeks.
 - C. Assess for regurgitant heart murmur.
 - D. Identify history of recent infection, dental work, cystoscopy, IV drug use.
 - E. Evaluate for systemic emboli.
 - 1. Assess for petechiae on skin or mucous membranes: tender, red nodules on fingers, palms, or toes (arterial emboli).

2. Splenic infarction—pain, upper left quadrant, radiating to left shoulder.
3. Renal infarction—hematuria, pyuria, flank pain.
4. Cerebral infarction—hemiparesis or neurological deficits.
5. Pulmonary infarction—cough, pleuritic pain, dyspnea, hemoptysis.
- F. Evaluate lab tests—increased WBC, erythrocyte sedimentation rate (ESR), blood culture, echocardiogram.

Implementation

- ◆ A. Maintain intensive chemotherapy with antibiotic drugs for several weeks.
- B. Follow general nursing measures.
 1. Decrease cardiac workload—bed rest.
 2. Ensure physical and emotional rest.
- C. Encourage fluids.
- D. Anticoagulant therapy contraindicated because of danger of cerebral hemorrhage.
- E. Monitor for signs of congestive heart failure (CHF).
- F. Prophylactic antibiotics for high-risk client with existing cardiac lesion or prosthetic valve.

Pericarditis

Definition: Inflammation of the pericardium.

Assessment

- A. Assess for possible cause of inflammation.
 1. Transmural infarction—frequent cause.
 2. Inflammation of heart or lungs.
 3. Radiation.
 4. Trauma/cardiac surgery.
 5. Neoplasms.
- ◆ B. Evaluate type of pain—stabbing and knifelike; starts at sternum and radiates to neck and shoulder or back; aggravated by deep inspiration, supine position, and turning from side to side; relieved by sitting.
- C. Identify if pericardial friction rub is present.
- D. Assess vital signs for indication of infection.
- ◆ E. Evaluate lab tests—increased WBC, ESR, slightly elevated cardiac enzymes, and ECG changes (elevated ST segment, inverted T waves).

Implementation

- ◆ A. Maintain client on bed rest in semi-Fowler's position.
- B. Administer and observe for side effects of salicylates and Indocin (indomethacin).
- C. Monitor vital signs.
- ◆ D. Monitor for pericardial friction rub on forced expiration with client in forward leaning position.

- E. Relieve pain with analgesics.
- F. Prepare client for pericardiocentesis if required.
- G. Observe for complications following pericardiocentesis.
 1. Monitor vital signs and CVP for possible cardiac tamponade recurrence.
 2. Auscultate heart sounds to determine if decrease in intensity of heart sound is present.
- ◆ H. Monitor for pericarditis complications.
 1. Pericardial effusion leading to tamponade.
 2. Constrictive pericarditis—prevents adequate diastolic filling of ventricles, leading to decreased cardiac output.

PERIPHERAL VASCULAR DISORDERS

Hypertension

- ◆ *Definition:* Blood pressure that is greater than either 140 mm Hg systolic or 90 mm Hg diastolic.

Characteristics

- A. Approximately 50 million people have hypertension in United States—only 25% are controlled to normotensive.
- B. More frequent in African Americans. Higher incidence in white men than women before age 50; after age 50, this is reversed.
- C. Risk factors.
 1. Obesity.
 2. Family history.
 3. Age > 60 years.
 4. Race.
 5. Diabetes.
 6. Smoking.
 7. Dyslipidemia.
 8. Gender—male.
- D. Types of hypertension.
 - ◆ 1. Primary or essential—no known etiology (accounts for 90% of clients).
 - ◆ 2. Secondary—directly related to another condition.
 - a. Renal disease.
 - b. Endocrine disorders.
 - (1) Pheochromocytoma.
 - (2) Adrenal cortex lesions—hyperaldosteronism, Cushing's syndrome.
 - c. High-dose estrogen use.
 - d. Pregnancy.
 - e. Acute autonomic dysreflexia.
 - f. Increased intracranial pressure.

Assessment

- A. Assess for risk factors by evaluating history.

- ◆ B. Assess for common manifestations.
 1. Headache in early AM.
 2. Loud S₂ heart sound.
 3. Epistaxis.
- C. Identify if target organ complications are present.
 1. Brain—mental and neurologic abnormalities.
 2. Kidneys—renal insufficiency (especially if diabetic).
 3. Cardiovascular system—left ventricular hypertrophy, heart failure, atherosclerosis, peripheral vascular disease (PWD).
 4. Eyes—narrowing of arteries, papilledema, visual disturbances.

Implementation

- ◆ A. Lifestyle modifications.
 1. Weight loss.
 2. Reduce sodium intake.
 3. Maintain adequate intake of dietary potassium and magnesium.
 4. Decrease stress.
 5. Engage in regular aerobic exercise.
 6. Limit alcohol intake.
 7. Stop smoking.
- ◆ B. Drug therapy (combination frequently used).
 - ◆ 1. Diuretics.
 - a. Act on kidneys to increase urine output.
 - b. Thiazides: Diuril (chlorothiazide).
 - c. Loop (potent) diuretics: Lasix, Bumex (bumetanide).
 - d. Potassium-sparing (Aldactone)—weak diuretic effect, often used in combination with other diuretic.
 - ◆ 2. Beta blockers (Inderal).
 - a. Decrease response to sympathetic stimulation; decrease contractility and myocardial workload.
 - b. Can cause bradycardia, conduction blocks.
 - 3. ACE inhibitors: Capoten (captopril)—inhibit the conversion of angiotensin I to angiotensin II.
 - a. Allow blood vessels to dilate.
 - b. Help prevent target organ damage.
 - c. May cause dry cough, due to increased bradykinin levels.
 - d. Used cautiously with renal insufficiency.
 - e. May cause hyperkalemia if potassium supplements also used.
 - 4. Angiotensin II receptor blockers: Cozaar (losartan).
 - a. Dilate vessels without increasing bradykinin levels.
 - b. Used for those who cannot tolerate ACE inhibitor.
 - c. May cause hyperkalemia if potassium supplements also used.

- 5. Calcium-channel blockers: Procardia (nifedipine).
 - a. Relax smooth muscles.
 - b. Block calcium flow into the cell.
- 6. Central alpha agonists: Catapres (clonidine)—centrally acting agents that cause vasodilation.
 - a. Available in transdermal patch changed weekly.
 - b. May cause sedation, dry mouth.
- 7. Alpha₁ blockers: Minipress (prazosin)—peripherally acting antiadrenergic.
 - a. Risk for postural hypotension.
 - b. Also used for prostatic urinary obstruction.
- 8. Arterial vasodilators: Apresoline (hydralazine)—direct acting.
 - a. May cause tachycardia—often used with beta blocker.
 - b. May cause fluid retention—monitor weight.
- C. Client education.
 1. Importance of regimen compliance.
 2. Not to discontinue medication abruptly.
 3. Avoid concurrent use of alcohol.
 4. Check with physician before taking over-the-counter (OTC) medications (e.g., NSAIDs counteract the effect of many antihypertensive agents).

Hypertensive Crisis

Definition: Critical (“accelerated/malignant”) elevation of blood pressure that becomes acute and life-threatening.

Assessment

- ◆ A. Assess for signs/symptoms.
 1. Diastolic blood pressure usually over 120 mm Hg.
 2. Known history of hypertensive disease or diseases that cause hypertension (e.g., renal vascular disease, head injury).
 3. Medical therapy (medications and compliance) or use of sympathomimetic drug.
- B. Monitor for potential end-organ complications.
 1. Depressed level of consciousness.
 2. Focal neurologic signs.
 3. Chest pain.
 4. Pulmonary edema.
 5. Signs of renal failure (azotemia—increased BUN and creatinine).

Implementation

- ◆ A. Monitor vital signs, ECG, and neurological signs closely.
 1. Assess blood pressure every 5 minutes with antihypertensive drug therapy.

- 2. Avoid too-rapid reduction in blood pressure.
- 3. Note for end-organ signs/symptoms worsening with rapid pressure reduction.
- 4. Note for side effects of antihypertensive agents (tachycardia).
- ◆ B. Administer antihypertensive medications (and particular agents relative to cause of crisis) as prescribed.
 - 1. Drug most frequently used is Nipride (nitroprusside) because of its rapid onset of action (increased intracranial pressure). Possible cyanide poisoning with high doses.
 - 2. Drugs such as Apresoline (hydralazine hydrochloride), Cardene (nicardipine hydrochloride), or Brevibloc (esmolol hydrochloride) take longer to act than Nipride.
- ◆ C. Monitor urinary output closely.
 - 1. Indwelling urinary catheter may be indicated.
 - 2. Oliguria or anuria should be reported immediately.
- ◆ D. Maintain client on strict bed rest.
 - 1. Elevate head of bed 45 degrees.
 - 2. Keep room quiet.
- E. Support client and assist to remain calm.
 - 1. Do not leave the client unattended.
 - 2. Use anxiety-reducing measures; client may sense impending doom and be frightened.
- ◆ F. Provide safety interventions.
 - 1. Keep side rails up if client is not fully alert.
 - 2. Employ seizure precautions if indicated.
 - 3. Place client on side if level of consciousness is diminished to prevent aspiration.
 - 4. Keep suction equipment readily available.
- E. Instruct client to prevent chemical, mechanical, and thermal trauma to feet.
- F. Monitor peripheral pulses frequently.
- G. May require arterial bypass surgery or amputation.

Raynaud's Disease and Phenomenon

Definition: Episodic vasospasms of the small cutaneous arteries, usually involving the fingers and toes. Primarily seen in young women.

Assessment

- ◆ A. Raynaud's disease.
 - 1. Primary idiopathic paroxysmal arteriolar vasospasm due to abnormality of the sympathetic nervous system.
 - 2. Precipitated by cold or emotional stimuli; relieved by warmth.
 - 3. Bilateral or symmetric pallor and cyanosis followed by redness of the digits (usually fingers).
 - 4. May have throbbing and paresthesia during recovery.
 - 5. Ulcers near fingertips.
- ◆ B. Raynaud's phenomenon.
 - 1. Often related to underlying collagen or connective tissue disease (rheumatoid arthritis, lupus).
 - 2. May be unilateral and involve few digits, but usually symmetric.
 - 3. Pallor, cyanosis, redness, and changes in skin temperature in response to cold or strong emotion.

Implementation

- ◆ A. Encourage client to stop smoking.
- ◆ B. Encourage client to avoid precipitating factors such as cold temperature and emotional stress—keep warm.
- ◆ C. Wear warm clothing when in cold weather: boots, gloves, etc.
- D. Protect hands from injury—wounds heal slowly.
- E. Keep skin soft with emollients—avoid dry skin.
- F. Administer vasodilator drugs.
 - 1. Calcium-channel blocker—Procardia (nifedipine).
 - 2. Nitrates (transdermal or oral).
- G. May require sympathectomy.

Thromboangiitis Obliterans (Buerger's Disease)

Definition: Inflammatory occlusions of distal arteries and veins. Most often affects males under 40 years of age who smoke.

Assessment

- ◆ A. Observe for signs of arterial insufficiency: impaired pulse, intermittent claudication, pain, postural color changes in foot.
- B. Disease may involve upper and lower extremities.
- C. Observe for signs of neuropathy; decreased sensation, paresthesia.

Implementation

- ◆ A. Urge client to stop smoking.
- ◆ B. Administer vasodilator drugs to increase blood supply to lower extremities: Trental (pentoxifylline).
- ◆ C. Administer low-dose aspirin.
- D. Instruct client in foot care.

Deep Vein Thrombophlebitis

- ◆ **Definition:** Formation of clot in a vein with inflammatory changes in the vein wall. Most prevalent sites: deep veins of lower extremities and pelvis. Usually begins in calf and propagates proximally.

Characteristics

- A. Persons most vulnerable are from 45 to 65 years of age.
- ◆ B. Causes of deep vein thrombophlebitis (DVT; Virchow's triad).
 1. Impaired venous flow—stasis. Associated with periods of inactivity (bed rest, surgery, long plane trips, or car rides).
 2. Endothelial injury exposes platelets in blood-stream to collagen, promoting thrombosis.
 - ◆ 3. Hypercoagulopathy (increased tendency to clot).
 - a. Dehydration.
 - b. Malignancy (breast, prostate, ovary, pancreas).
 - c. Polycythemia and sickle-cell disease.
 - d. Use of oral contraceptive agents and smoking.
 - e. Inherited disorders (antithrombin III deficiency).

Assessment

- A. Symptoms closely related to size and location of clot—may have no signs or symptoms.
- ◆ B. Assess leg.
 1. Unilateral edema.
 2. Calf pain—dull ache.
 3. Changes in color and temperature; may be warm with red color, but may also be pale “milk leg.”
 4. Affected area may also feel firm and hard.
 5. Distended superficial veins.
 6. Homan's sign (not recommended or reliable and may mobilize clot).
- ◆ C. Doppler flow studies, phlebography, and impedance plethysmography confirm diagnosis.

Implementation

- ◆ A. Administer anticoagulant therapy.
 1. Heparin therapy for 7–10 days.
 2. Coumadin (warfarin) prescribed for 3 months; dose adjusted to keep INR between 2.0 and 3.0.
 3. Observe for signs of bleeding (urine, stool occult blood, ecchymosis).
- ◆ B. Maintain strict bed rest for minimum 3–4 days.
 1. Do not use knee gatch or pillows under knees.
 2. Elevate foot of bed 20 degrees.
 3. Handle affected limb with care to prevent compression of tissue.
- ◆ C. Monitor for pulmonary embolism (PE).
 1. Assess subtle changes; report immediately (confusion, anxiety, restlessness).
 2. Cough; rapid, shallow respirations; dyspnea.
 3. Chest pain that is worse with deep breath.
 4. Tachycardia.
- D. Position client to avoid venous stasis and turn every 2 hours.

- E. Take vital signs at least every 4 hours.
- ◆ F. Promote venous return.
 1. Use ROM exercises on unaffected limbs only.
 2. Do not massage or exercise affected leg.
 3. Apply antiembolic stocking to unaffected leg or use pneumatic compression device.
- ◆ G. Provide client education.
 1. Avoid standing in one position or sitting for long periods (either walk or lie flat; avoid crossing legs at knees; elevate legs while sitting).
 2. Avoid wearing constrictive clothing.
 3. Wear support hose.
 4. Understand correct use of anticoagulants and the necessity for follow-up lab tests.
 - a. Include measures to reduce risk of bleeding (soft toothbrush, electric razor).
 - b. Avoid contact sports; notify physician if injury occurs.
 - ◆ 5. Teach prevention.
 - a. Elevate foot of bed.
 - b. Avoid sitting in chair for long periods.
 - c. Leg and ankle exercises.
 - d. Pneumatic compression devices/thromboembolic devices (TEDs).
 - e. Low-dose heparin or low-molecular-weight heparin.

Varicose Veins

Definition: A condition in which the veins are dilated and tortuous caused by incompetent venous valves.

Characteristics

- A. Causes.
 1. Pregnancy.
 2. Standing for long periods of time.
 3. History of DVT.
 4. Prolonged and heavy lifting.
- B. Pathology.
 1. Most commonly affects superficial saphenous veins.
 2. Possible inherited defect of valves or vein wall.

Assessment

- ◆ A. Visible dilated, tortuous veins.
- ◆ B. Assess for dull aching, heaviness in legs after standing.
- ◆ C. Observe for edematous ankles with itching.
- D. Skin brown above ankles from blood that has escaped due to increased venous pressure.
- E. Secondary ulceration (medial ankle).

Implementation

- A. Encourage client to use antiembolic stockings, support hose.

- B. Elevate legs when possible.
- C. Educate client to see need for cessation of smoking (makes blood hypercoagulable).
- D. Prevent constrictive clothing and positions; protect legs from pressure/trauma.
- E. Prepare client for vein stripping or sclerosing injections.

SURGICAL INTERVENTIONS FOR VASCULAR DISORDERS

Femoral Popliteal Bypass Graft

Definition: Prosthetic or autologous vein graft is anastomosed to the artery proximal and distal to the atherosclerotic obstruction.

Assessment

- ◆ A. Observe peripheral circulation pre- and postoperatively.
 - 1. Check for presence of distal pulses—use Doppler if necessary.
 - 2. Check that extremities are warm and pink postoperatively.
 - 3. Compare both extremities.
- ◆ B. Check vital signs, particularly blood pressure.
- C. Check for comorbidity (heart or renal disease).

Implementation

- ◆ A. Mark on skin where pulses are palpated or heard.
- ◆ B. Keep leg flat postoperatively initially—avoid wound strain.
- ◆ C. Monitor edema in operative leg—usual but may require compression hosiery and diuretic; resolves in 4–8 weeks.
- ◆ D. Administer perioperative antibiotics, postoperative anticoagulants, and antithrombotics as prescribed and monitor drug lab effects.
- E. Report bleeding from wound.
- F. Encourage ambulation/exercise postdischarge.

Aortic Aneurysms

Definition: A localized abnormal dilatation of the vascular wall occurring most often in the abdominal aorta and less commonly in the thoracic aorta.

Characteristics

- ◆ A. Caused by weakening of arterial wall due to atherosclerosis; thoracic aneurysm due to trauma, Marfan syndrome.
- B. Risk factors include dyslipidemia, diabetes mellitus, smoking, hypertension, family history.
- C. Highest incidence in older men—25% also have peripheral vascular occlusive disease.

Assessment

- A. Evaluate symptoms to determine area involved.
 - ◆ 1. Abdominal aneurysm.
 - a. Pulsating mass in abdomen may be palpated.
 - b. Bruit over aorta.
 - c. Lumbar pain radiating to flank and groin indicates impending rupture.
 - d. Detected by abdominal computed tomography (CT) scan or sonography.
 - ◆ 2. Thoracic aneurysm.
 - a. Pain—most are asymptomatic—substernal, back or neck.
 - b. Symptoms due to pressure—dysphagia, hoarseness, dyspnea.
 - c. Most accurate means for imaging are CT scan and MRI.
- B. Assess vital signs to obtain baseline data.
- C. Evaluate peripheral pulses.

Implementation

- ◆ A. Control hypertension—with antihypertensives (e.g., beta blocker).
- B. Prepare asymptomatic client for surgery if aneurysm exceeds 5 cm in diameter.
- C. Monitor fluid balance. Administer whole blood when needed.
- D. Prepare symptomatic client for immediate surgery.
- ◆ E. Provide postoperative nursing management.
 - 1. Follow same procedures as for open heart surgery if client has thoracic aneurysm; monitor vital signs and hemodynamic variables.
 - 2. Observe circulatory status distal to graft site.
 - 3. Observe all peripheral pulses and temperature of extremities.
 - 4. Monitor renal function with accurate intake and output (cross clamp of aorta during surgery).
 - 5. Observe for emboli to brain or lung.
 - 6. Monitor neurological signs.
 - 7. Monitor for complications.
 - a. Hypertensive preoperatively, but can easily become hypotensive due to excessive bleeding.
 - b. Acute renal failure. (Monitor intake and output [I&O].)
 - c. Hemorrhage from graft site. (Assess for back bruising.)
 - d. Cerebral vascular accident.
 - e. Paraplegia.
 - f. Infection.

COMMONLY USED DRUGS FOR THE CARDIOVASCULAR SYSTEM

Summary of Cardiac Drug Categories

ACE Inhibitors: Use to treat high blood pressure, post heart attack and kidney disease.

Also useful in management of heart failure by decreasing stress on heart muscle.

Antiarrhythmics: Help heart to beat in a regular rhythm.

Anticoagulants: Slow down blood-clotting process. Prescribed for blocked arteries or blood clot in an artery.

Antioxidants: Prevent chemical reaction in blood causing oxidation, which leads to plaque formation.

Antiplatelets: Prevent platelets from clumping or forming clots. They lower the risk of heart attack.

Beta Blockers: Lower heart rate and blood pressure, thus reducing work of the heart.

Calcium-Channel Blockers: Used for high blood pressure to prevent artery spasm or angina, or to control rapid heartbeat.

Cardiac Glycosides: Help to maintain normal heart rhythm and rate. Also strengthen heart muscle.

Cholesterol-Lowering Agents: Lower blood cholesterol levels, reducing risk of developing coronary heart disease.

Diuretics: Lower blood pressure by allowing kidneys to rid body of excess fluid.

Nitrates: Dilate blood vessels, which decrease workload of the heart. Primary indication is to prevent or stop angina.

Specific Drug Categories

Diuretics

A. Action: most diuretics block sodium reabsorption in tubules of kidney, thereby eliminating water.

B. Agents.

◆ 1. Thiazide and thiazide-like diuretics.

a. Common preparations: Diuril (chlorothiazide), Hydrodiuril (hydrochlorothiazide), Hygroton (chlorthalidone), Exna (benzthiazide), Enduron (methyclothiazide), etc.

b. Thiazide-like: Thalitone (chlorthalidone), Lozol (indapamide), Zaroxolyn, Mykrox (metolazone).

c. Administration: oral and parenteral.

d. Advantages: potent by mouth; effective antihypertensives.

e. Disadvantages: electrolyte imbalances; loss of potassium, metabolic alkalosis, hypotension, hyperlipidemia.

f. Nursing implementation.

(1) GI upset, gout, hyperglycemia.

(2) Allergic reaction.

(3) Monitor kidney function (BUN, serum creatinine), signs of hypokalemia.

◆ 2. Potassium-sparing agents.

a. Common preparations: Aldactone (spironolactone), Dyrenium (triamterene).

b. Administration: oral only.

c. Advantages: conserve potassium.

d. Disadvantages: weak diuresis; usually not effective when used alone.

e. Nursing implementation.

(1) Electrolyte imbalance; hyperkalemia.

(2) Gynecomastia and nitrogen retention.

(3) If diarrhea or GI problems occur, give after meals.

(4) If drowsy, headache, or lethargy, decrease dose as ordered.

◆ 3. Loop diuretics: moderate to severe volume overload.

a. Common preparations: Lasix (furosemide), Bumex (bumetanide), Edecrin (ethacrynic acid), Demadex (torsemide).

b. Administration: oral and parenteral.

c. Advantages: rapid, potent action useful in cases of severe pulmonary edema and refractory edema.

d. Nursing implementation/evaluation.

(1) Note weight loss with diuresis.

(2) Monitor/watch for signs of electrolyte imbalance (potassium and chloride loss); dehydration.

(3) Thirst, nausea, skin rash; monitor blood pressure.

(4) Hyperuricemia, secondary aldosteronism, hyperglycemia.

(5) Give oral doses with food to decrease GI side effects.

e. Adverse reactions: hypotension, electrolyte imbalance, rash, azotemia.

Nitrates

A. Action.

1. Promotes vasodilation by reducing vascular tone in arteries and veins.

2. Decreases venous blood return to heart (preload)—primary action.

3. Decreases peripheral arterial vascular resistance (afterload)—in larger doses.

- 4. Reduces myocardial oxygen consumption and pulmonary congestion.
- B. Uses.
 - 1. First-line therapy for acute angina.
 - 2. Heart failure related to ischemic heart disease.
- ◆ C. Agents.
 - 1. Short acting—for acute attack or prophylactically.
 - a. Sublingual—Tridil (nitroglycerin) for acute attack (repeat in 3- to 5-minute intervals).
 - b. Buccal spray.
 - c. IV sodium Nipride (nitroprusside)—for heart failure decompensation combined with Depostat, Intropin (dopamine) or Dobutrex (dobutamine).
 - 2. Long acting.
 - a. Oral—Imdur, Ismo (isosorbide mononitrate).
 - b. Nitro-Dur (nitroglycerin), transdermal.
 - 3. Extended release—buccal tablets; capsules.
- ◆ D. Major side effects.
 - 1. Headache is a common side effect.
 - 2. Postural hypotension.
 - 3. Cyanide poisoning with sodium nitroprusside use.
- ◆ E. Nursing implementation.
 - 1. Development of tolerance minimized with intermittent therapy.
 - 2. Advise client to take drug, in short-acting doses, while sitting or lying down to prevent hypotension.
 - 3. Drug should be replaced in 3 months after opening bottle.
 - 4. Instruct client to notify physician if severe headache, weakness, blurry vision, irregular heartbeat, or dry mouth is experienced.

ACE Inhibitors

CAPOTEN (CAPTOPRIL), LOTENSIN (BENAZEPRIL), VASOTEC (ENALAPRIL), ZESTRIL (LISINOPRIL), UNIVASC (MOEXIPRIL), ETC.

- ◆ A. Action.
 - 1. Angiotensin-converting enzyme (ACE) inhibitor.
 - 2. Inhibits renin–angiotensin–aldosterone activity.
 - 3. Effective for heart failure (reduces mortality and improves cardiac function).
 - 4. Used as initial therapy for early CHF.
 - 5. Stimulates synthesis of nitric oxide and prostaglandin.
 - 6. Used postinfarction to reduce ventricular remodeling.

- ◆ B. Adverse side effects.
 - 1. Hypotension—especially with first dose.
 - 2. Dry, irritating cough is often present.
 - 3. Swelling of lips, tongue, or glottis may occur.
 - 4. Renal insufficiency.
- ◆ C. Nursing implementation.
 - 1. Instruct client to take medication at same time every day.
 - 2. Instruct client to move from lying to sitting to standing position slowly.
 - 3. Avoid salt substitutes that could lead to hyperkalemia.
 - 4. Notify physician if cough, fatigue, or nausea develop.

Beta-Adrenergic Blockers

INDERAL (PROPRANOLOL), LOPRESSOR (METOPROLOL), TENORMIN (ATENOLOL), SECTRAL (ACEBUTOLOL), ZEBETA (BISOPROLOL), COREG (CARVEDILOL), ETC.

- ◆ A. Action.
 - 1. Blocks cardiac response to sympathetic stimulation—slows heart, decreases blood pressure, slows AV conduction.
 - 2. Pure beta or beta₁-specific action.
 - 3. Coreg (carvedilol): alpha and beta blocker for heart failure.
- ◆ B. Uses.
 - 1. Prevent chronic angina; used in unstable angina.
 - 2. Slow heart rate, slow AV conduction, lower blood pressure.
 - 3. Prolong life in postinfarction clients.
 - 4. Prevent sudden death.
 - 5. Improve left ventricular function.
- C. Contraindications/major side effects.
 - 1. Bronchospasm (COPD), wheezing.
 - 2. Bradyarrhythmias.

Angiotensin Receptor Blockers

- A. Action: appropriate alternative for vasodilation if clients are intolerant to ACE inhibitors due to cough, edema, or rash.
- B. Example: Cozaar (losartan).

Cardiac Glycosides

LANOXIN (DIGOXIN), CRYSTODIGIN (DIGITOXIN)

- ◆ A. Action.
 - 1. Increases contractile force (pumping ability of heart positive inotropism), which increases cardiac output in systolic heart failure (ejection fraction < 40%).
 - 2. Slows heart rate.
 - a. Direct effect.
 - b. Increases vagal tone and decreases sympathetic tone.

3. Slows conduction through AV node.
 4. Increases nonpacemaker cell automaticity that may cause arrhythmias.
- ◆ B. Uses.
1. Systolic heart failure—increases contractility, reduces oxygen needs, increases cardiac efficiency, and reduces heart size.
 2. Supraventricular tachyarrhythmias—slows ventricular rate by slowing conduction of impulses through AV node.
- ◆ C. Dosage.
1. Individualized to client and clinical situation; loading dose, then maintenance dose (usually 0.25 mg daily).
 2. Monitor blood level with Lanoxin (normal is 0.9–2.0 mg/mL).
- ◆ D. Major side effects—signs of toxicity.
1. Cardiac.
 - a. Bradycardia.
 - b. Conduction disturbances (advanced AV block).
 - c. Arrhythmias, due to increased automaticity (premature ventricular beats).
 2. Gastrointestinal.
 - a. Anorexia.
 - b. Nausea and vomiting.
 - c. Diarrhea.
- ◆ E. Nursing implementation.
- ◆ 1. Monitor for toxic effects—incidence high.
 - a. Signs and symptoms: anorexia, nausea, vomiting, bradycardia.
 - b. Elderly are more sensitive to Lanoxin, so monitor carefully for toxicity.
 - ◆ 2. Check apical pulse before administering Lanoxin drugs.
 - a. If below 60, hold dose and notify physician.
 - b. If above 120, check for toxicity/arrhythmias.
 - 3. Client teaching.
 - a. Ensure that client understands drug action and dosage.
 - b. Monitor pulse before taking medication.
 - c. Report unusual effects (toxic symptoms).
 - d. Store in tightly covered, light-resistant containers.
 - ◆ 4. Precautions.
 - a. Hypokalemia—predisposes client to toxicity.
 - b. Renal failure—predisposition to Lanoxin toxicity.
 - c. Should not be given with advanced AV block.
 - d. Increased risk of toxicity when given with antiarrhythmics.

Calcium-Channel Blockers (Ion Antagonists)

CALAN, ISOPTIN (VERAPAMIL), CARDIZEM (DILTIAZEM), PROCARDIA (NIFEDIPINE), NORVASC (AMLODIPINE)

- ◆ A. Action.
1. Inhibits the influx of calcium ions across cell membrane.
 2. Decreases heart rate as conduction is slowed through SA and AV nodes.
 3. Reduces extension of non-Q MI. Increases myocardial oxygenation by causing coronary vasodilation (Isoptin, Cardizem).
 4. Decreases peripheral vascular resistance (especially Procardia)—dilates blood vessels.
- ◆ B. Uses.
1. Prescribed for angina—especially vasospastic angina.
 2. Slows ventricular response to atrial tachyarrhythmias.
 3. Antihypertensive agents.
- ◆ C. Major side effects.
1. Cardizem (diltiazem hydrochloride)—nausea, edema, bradycardia.
 2. Calan, Isoptin (verapamil hydrochloride)—hypotension, peripheral edema, vertigo, bradycardia.
 3. Procardia (nifedipine)—nausea, peripheral edema, headache, flushing, dyspnea, reflex tachycardia.
- ◆ D. Nursing implementation.
1. Cardizem: Observe for hypotension; report irregular heartbeats, or bradycardia; do not discontinue suddenly.
 2. Calan, Isoptin: Give on empty stomach; do not discontinue suddenly; monitor for bradycardia, constipation.
 3. Procardia: Give on empty stomach.
- Antiarrhythmic Drugs**
- QUINIDEX (QUINIDINE), PRONESTYL (PROCAINAMIDE HYDROCHLORIDE), XYLOCAINE (LIDOCAINE), CORDARONE (AMIODARONE)
- ◆ A. Action.
1. Increases recovery time of atrial and ventricular muscle; prolongs repolarization.
 2. Decreases myocardial excitability.
 3. Increases conduction in cardiac muscle, Purkinje fibers, and AV junction (exception: Xylocaine).
 4. Decreases contractility (exception: Xylocaine).
 5. Decreases automaticity.
- ◆ B. Uses.
1. Quinidex (quinidine) used for atrial fibrillation, atrial flutter, supraventricular tachycardia, premature systoles.

2. Pronestyl (procainamide hydrochloride) used for premature ventricular systoles.
3. Xylocaine (lidocaine) is drug of choice for short-term management of ventricular tachyarrhythmias associated with MI.
4. Cordarone (amiodarone) for life-threatening arrhythmias unresponsive to other agents.
- ◆ C. Major side effects.
1. Quinidex.
 - a. Cinchonism—nausea, vomiting, diarrhea, tinnitus, vertigo, visual disturbances.
 - b. Hypersensitivity, thrombocytopenia.
 - c. Conduction disturbances.
 - d. Potentiates Lanoxin toxicity.
 2. Pronestyl.
 - a. Anorexia, nausea, vomiting, diarrhea.
 - b. Systemic lupus erythematosus.
 - c. Agranulocytosis.
 - d. AV block.
 3. Xylocaine.
 - a. Central nervous system (CNS) disturbances—drowsiness, slurred speech, blurred vision, seizures, coma.
 - b. Cautious use in clients with liver disease or low cardiac output (metabolism of drug slowed).
 4. Cordarone.
 - a. Visual disturbances.
 - b. Bradycardia, hypotension.
 - c. Liver function abnormality.
 - d. Potentiates Lanoxin toxicity.
- ◆ D. Nursing implementation.
1. Monitor ECG and assess vital signs.
 2. Client teaching.
 - a. Observe for individual drug side effects. (See Major side effects.)
 - b. Notify physician if arrhythmia develops.
 3. Monitor blood levels as indicated.

Sympathomimetic Agents

- ◆ A. Action.
1. Adrenalin (epinephrine hydrochloride): beta and alpha stimulation—increases heart rate, contractility, and peripheral vascular resistance; bronchodilation.
 2. Levophed (norepinephrine).
 - a. Alpha-adrenergic stimulation—peripheral vasoconstriction.
 - b. Beta stimulation mild.
 3. Isuprel (isoproterenol hydrochloride): beta stimulation.
 - a. Increases heart rate, contractility, and oxygen consumption.
 - b. Decreases vascular resistance.
 - c. Bronchodilation.
- ◆ B. Uses.
1. Adrenalin: allergic states, anaphylactic shock.
 2. Levophed.
 - a. Elevates blood pressure.
 - b. Used for hypotension, cardiac arrest.
 3. Isuprel.
 - a. Cardiogenic shock with high peripheral vascular resistance.
 - b. AV block—increases pacemaker automaticity and improves AV conduction.
 4. Depostat, Intropin—precursor of norepinephrine.
 - a. Cardiogenic shock (hypotension).
 - b. Heart failure.
 5. Dobutrex.
 - a. Short term for heart failure.
 - b. Cardiac surgical procedures.
- ◆ C. Major side effects.
1. Adrenalin.
 - a. Chest pain, arrhythmias, tachycardia, hypertension.
 - b. Hyperglycemia.
 2. Levophed.
 - a. Anxiety (mimics physiological reaction to stress), headache.
 - b. Hypertension.
 - c. Arrhythmias.
 3. Isuprel.
 - a. Tachyarrhythmias, especially ventricular tachycardia.
 - b. Hypotension.
 - c. Headache, skin flushing, angina, dizziness, weakness.
 4. Depostat, Intropin.
 - a. Renal vasoconstriction with high dose.
 - b. Hypertension.
 - c. Tachycardia, arrhythmias.
 5. Dobutrex.
 - a. Arrhythmias, palpitations.
 - b. Angina, chest pain, shortness of breath.
- ◆ D. Nursing implementation.
1. Carefully monitor ECG and vital signs.
 2. Prevent IV infiltration of vasoconstricting agents—could cause tissue necrosis (central vein preferred).

3. Client teaching.
 - a. Recognition of side effects.
 - b. Diet—high fiber to reduce constipation.

Antihyperlipidemic Agents

- ◆ A. Action.
 1. Lowers low-density lipoprotein (LDL) cholesterol levels and triglycerides. Raises high-density lipoprotein (HDL) cholesterol.
 - a. Binds with bile acids in the intestine and excreted in feces, resulting in removal of LDL and cholesterol.
 - b. May interfere with absorption of Lanoxin, thiazides, beta-adrenergic blockers, fat-soluble vitamins, folic acid, and Vancocin (vancomycin).
- ◆ B. Uses and side effects.
 1. Bile acid sequestrants: Questran (cholestyramine).
 - a. Causes liver to produce bile acid from cholesterol.
 - b. Lowers LDL and total cholesterol.
 - c. May raise serum triglyceride level.
 - d. GI side effects (constipation, flatulence, nausea).
 2. HMG-CoA reductase inhibitors: Mevacor (lovastatin) or Zocor (simvastatin).
 - a. Blocks synthesis of cholesterol.
 - b. Lowers LDL cholesterol and triglycerides; raises HDL cholesterol.
 - c. May cause constipation, diarrhea, liver enzymes elevation, muscle aches.
 3. Fibrin acid derivatives: Atromid-S (clofibrate), Lopid (gemfibrozil), Tricor (fenofibrate).
 - a. Inhibit liver synthesis of triglycerides and very-low-density lipoprotein (VLDL).
 - b. Used for hypertriglyceridemia and type III hyperlipidemia.
 - c. GI side effects common; gallstones.
 - d. May increase effects of anticoagulants and hypoglycemics.
 4. Nicobid, Niacor (nicotinic acid [niacin]).
 - a. Inhibits VLDL production in liver.
 - b. Decreases low-density lipoprotein (LDL) level; raises high-density lipoprotein (HDL) level.
 - c. Used in mixed dyslipidemias.
 - d. Used in combination with other antihyperlipidemics.
 - e. May cause cutaneous flushing, pruritus, hepatitis.
- ◆ C. Nursing implementation.
 1. Review dietary restrictions (AHA diet).
 2. Encourage regular exercise program.
 3. Vitamin supplementation may be indicated.

4. HMG-CoA reductase inhibitors taken in evening.
5. Encourage smoking cessation.

Platelet Inhibitors

ASPIRIN (ACETYLSALICYLIC ACID; ASA), PERSANTINE (DIPYRIDAMOLE), TICLID (TICLOPIDINE)

- ◆ A. Action.
 1. Agents interfere with platelet adhesion or aggregation.
 2. Used to prevent venous thromboembolism and arterial thrombosis (cerebrovascular accident [CVA, MI]).
- ◆ B. Uses and side effects.
 1. Aspirin (acetylsalicylic acid).
 - a. Inhibits platelet formation of thromboxane A (reduces adhesiveness).
 - b. Low dose used in angina, acute coronary syndromes, MI, transient ischemic attack (TIA), postcardiac surgery, postcoronary artery interventional therapy.
 - c. Prolongs bleeding time; interacts with Coumadin (warfarin) to prolong prothrombin time (PT).
 - d. Monitor for GI bleeding; tinnitus.
 2. Persantine (dipyridamole).
 - a. Increases platelet cyclic adenosine monophosphate (AMP) levels.
 - b. Used for peripheral vascular disease, prosthetic heart valves, TIA.
 - c. May cause hypotension.
 3. Ticlid (ticlopidine).
 - a. Blocks platelet recruitment by binding to adenosine diphosphate (ADP) receptor on platelet.
 - b. Same indications as aspirin.
 - c. Used if unable to tolerate aspirin.
 - d. May cause bleeding, neutropenia, thrombocytopenia; may increase serum lipids.
 4. GPIIb/IIIa antagonists: Plavix (clopidogrel) oral; Reopro (abciximab) IV.
 - a. Inhibit platelet aggregation.
 - b. Used as adjunct to interventional coronary procedures (angioplasty, stent placement).
 - c. Used in unstable angina.
 - d. May cause hypotension, bradycardia, serious bleeding.
- ◆ C. Nursing implementation.
 1. Recommend appropriate safety precautions for bleeding.
 2. Discuss possible drug interactions (consult physician before taking OTC medications).
 3. Reinforce teaching of early signs of stroke, heart attack, DVT.

4. Monitor closely for bleeding (especially following interventional therapies).

Anticoagulant Therapy

- ◆ A. Action.
 - ◆ 1. Medications used to prevent intravascular thrombosis by decreasing blood coagulability.
 - a. Heparin IV, SUB Q.
 - b. Coumadin (warfarin sodium) PO.
 - c. Lovenox (enoxaparin) SUB Q.
 - ◆ 2. Pharmacological action.
 - a. Prevents fibrin deposits.
 - b. Prevents extension of a thrombus.
 - c. Prevents thromboembolic complications.
- B. Contraindications for use of drug.
 1. Blood dyscrasia.
 2. Liver and kidney disease.
 3. Peptic ulcer.
 4. Chronic ulcerative colitis.
 5. Active bleeding (except disseminated intravascular coagulation [DIC]).
 6. Spinal cord or brain injuries.
- ◆ C. Drugs and foods to avoid when on anticoagulant therapy.
 1. Leafy green vegetables (foods high in vitamin K) more than usual—antagonist.
 2. Salicylates/NSAIDs, Tylenol (acetaminophen), and steroids potentiate.
- ◆ D. Nursing implementation—safety precautions.
 - ◆ 1. Keep antagonist nearby; see Antagonist, next column.
 - ◆ 2. Observe for signs of bleeding (gums, ecchymosis, hematuria, melena).
 - 3. Avoid/prevent bleeding.
 - 4. Carry identification card (Coumadin [warfarin]).
 - 5. Keep appointments for blood work (PT).
 - 6. Teach first aid for bleeding.

Intravenous/Subcutaneous Anticoagulants

HEPARIN SODIUM, LOVENOX (ENOXAPARIN)

- ◆ A. Mode of administration: IV or SUB Q (inactivated orally).
- ◆ B. Action.
 1. Interferes with formation of thrombin from prothrombin.
 2. Prevents thrombin from converting fibrinogen to fibrin.
 3. Therapeutic dose by continuous infusion (e.g., 1000 U/hr) prolonged partial thromboplastin time (PTT).
 4. Dose lasts 3–4 hours if given IV intermittently (3500–5000 U q 8–12 hr) for prophylaxis.
- ◆ C. Lab findings.
 1. Prophylactic dose not monitored by PTT.

2. Therapeutic dose—weight-based dose adjusted to achieve desired PTT; values 1.5 to 2 times normal values.
- ◆ D. Antagonist.
 - 1. Discontinue infusion (short half-life).
 - ◆ 2. Protamine sulfate: 1 mg protamine sulfate for each 100 U of heparin in last dose if necessary.
- E. Used for treatment of various conditions.
 1. Quickly stops development of clots.
 2. Serious unstable angina.
 3. Certain strokes.
 4. Severe thrombophlebitis.
 5. Acute pulmonary edema.
- ◆ F. Nursing implementation.
 - ◆ 1. Check PTT or clotting time routinely for weight-based dosing per IV titration.
 - 2. Check patency of IV.
 - 3. Assess client for bleeding.
 - 4. Avoid aspirin during anticoagulant therapy.
 - 5. Instruct client to carry medical alert card.
 - ◆ 6. Take the following precautions when administering drug SUB Q into abdomen:
 - a. Use small needle (27 gauge).
 - b. Form pouch of skin on abdomen no closer than 5 cm around umbilicus—avoid extremities.
 - c. Administer injection at 90-degree angle SUB Q.
 - d. Do not aspirate needle or massage skin around injection site to prevent ecchymosis.

Oral Anticoagulants

DICUMAROL, COUMADIN (WARFARIN SODIUM), MIRADON (ANISINDIONE)

- ◆ A. Mode of administration: oral.
- ◆ B. Action.
 1. Prevents utilization of vitamin K by liver.
 2. Depresses hepatic synthesis of several clotting factors.
 3. Decreases prothrombin formation.
 4. Takes 24–72 hours for action to develop and continues for 24–72 hours after last dose.
- ◆ C. Antagonist.
 1. Vitamin K—AquaMephyton (phytonadione) IM or IV.
 2. Returns to hemostasis within 6 hours.
 3. Blocks action of Coumadin (warfarin) for 1 week.
- ◆ D. Nursing implementation.
 1. Check prothrombin or INR time before giving.
 - ◆ a. Keep prothrombin time at 18–30 seconds (normal is 12–14 seconds).
 - ◆ b. Keep INR between 2 and 3.5.

- 2. Give at same time each day.
- ◆ 3. Teach client to avoid usual intake of foods high in vitamin K (kale, spinach, collards, turnip greens, Swiss chard, parsley, and other dark leafy vegetables), grapefruit and grapefruit juice, alcohol, ASA, NSAIDs, Tylenol (acetaminophen).
- 4. Encourage client to wear Med-Alert bracelet.
- 5. Avoid invasive procedures (IM injection) and injury.
- 6. Check with physician before taking any OTC medications.

Thrombolytic Agents

- ◆ A. Action.
 - 1. Activates formation of plasmin, which digests fibrin and dissolves formed blood clots—limits infarct size.
 - 2. Stimulates conversion of plasminogen to plasmin (fibrinolysis).
 - 3. Prescribed for acute pulmonary emboli, deep vein thrombosis, arterial thrombosis, and coronary thrombosis.
 - 4. Greatest benefit if initiated in 1–3 hours.
- ◆ B. Agents infused.
 - 1. Streptase (streptokinase); Abbokinase (urokinase).
 - 2. Tissue plasminogen activator: Activase (alteplase).
 - 3. Eminase (anistreplase, APSAC).
 - 4. Retavase (reteplase).

- 5. TNKase (tenecteplase) was FDA approved in 2000.
 - a. Can be administered in one single injection to dissolve clots rather than 90-minute infusion.
 - b. Advantage over Activase is that TNKase is more specific for a clot in coronary artery.

- C. Major side effects.
 - ◆ 1. Serious bleeding (increased fibrinolytic activity).
 - 2. Fever up to 100°F/37.7°C.
 - 3. Allergic reactions; rash (Streptase).
 - 4. Reperfusion arrhythmias when used for coronary clots.
- D. Contraindications for use.
 - 1. Recent major surgery, GI bleed.
 - 2. History of CVA.
 - 3. Bleeding tendency.
 - 4. Uncontrolled hypertension.
 - 5. Pregnancy.
- ◆ E. Nursing implementation.
 - 1. Obtain PTT, PT, fibrinogen level, and platelet count.
 - 2. Monitor infusion of IV (use controller or pump).
 - 3. Monitor closely for signs of bleeding, blood pressure.
 - a. 24 hours for pulmonary embolism.
 - b. 24–72 hours for deep vein or arterial thrombosis.
 - 4. Avoid invasive procedures.

CARDIOVASCULAR SYSTEM REVIEW QUESTIONS

1. In assessing a client's history for a cardiac work-up, which of the following is the most important parameter to question?
 1. Amount of weight loss.
 2. Character of pain experienced.
 3. Respiratory rate and depth.
 4. Amount of coughing.
2. A 54-year-old client was put on Quinidex (quinidine) (a drug that decreases myocardial excitability) to prevent atrial fibrillation. He also has kidney disease. The nurse is aware that this drug, when given to a client with kidney disease, may
 1. Cause cardiac arrest.
 2. Cause hypotension.
 3. Produce mild bradycardia.
 4. Be very toxic even in small doses.
3. Thrombolytic therapy would be appropriate for which of the following conditions?
 1. Continual blood pressure above 200/120.
 2. History of diabetic retinopathy.
 3. History of significant kidney disease.
 4. Myocardial infarction.
4. When assessing an ECG, the nurse knows that the P-R interval represents the time it takes for the
 1. Impulse to begin atrial contraction.
 2. Impulse to traverse the atria to the AV node.
 3. SA node to discharge the impulse to begin atrial depolarization.
 4. Impulse to travel to the ventricles.
5. Monitoring a central venous pressure (CVP), the nurse understands that a normal reading is between
 1. 5 cm and 15 cm.
 2. 10 cm and 15 cm.
 3. 5 cm and 10 cm.
 4. 10 cm and 20 cm.
6. Following a treadmill test and cardiac catheterization, the client is found to have coronary artery disease. After discharge from the coronary care unit with a significant MI, the client is referred to the cardiac rehabilitation unit. During his first visit to the unit, he says that he doesn't understand why he needs to be there because there is nothing that can be done—and the damage is done. The best nursing response is
 1. "Cardiac rehabilitation is not a cure but can help restore you to many of your former activities."
 2. "Here we teach you to gradually change your lifestyle to accommodate your heart disease."
 3. "You are probably right but we can gradually increase your activities so that you can live a more active life."
 4. "Do you feel that you will have to make some changes in your life now?"
7. A client admitted with the diagnosis of cardiac disease tells the nurse he is afraid of dying from a heart attack. The most therapeutic response is
 1. "Perhaps you should discuss this with your physician."
 2. "Of course you aren't going to die."
 3. "What makes you think you will die?"
 4. "Tell me more about these fears of dying from a heart attack."
8. To evaluate a client's condition following cardiac catheterization, the priority intervention is to palpate the pulse
 1. In all extremities.
 2. At the insertion site.
 3. Distal to the catheter insertion.
 4. Above the catheter insertion.
9. While a client scheduled for a cardiac catheterization is being admitted, the client states to the nurse, "I always get a rash when I eat shellfish." Following safety protocol, the most appropriate initial nursing intervention is to
 1. Notify the physician.
 2. Place a note on the chart regarding this reaction.
 3. Ask the client if there are any other foods that cause such a reaction.
 4. Notify the dietitian of the reaction and request a "no shellfish" diet.
10. A client's physician orders nuclear cardiography and makes an appointment for a thallium scan. The purpose of injecting a radioisotope into the blood stream is to detect
 1. Normal versus abnormal tissue.
 2. Damage in areas of the heart.

3. Ventricular function.
 4. Myocardial scarring and perfusion.
- 11.** For a client who presents with a heart murmur, the nurse can best explain how a murmur manifests in the body by saying
1. “The systolic occurs between S1 and S2.”
 2. “The diastolic occurs between S2 and S1.”
 3. “It is determined by intensity over time.”
 4. “It is a measure of turbulence of blood flow through the valve.”
- 12.** When auscultating the apical pulse of a client who has atrial fibrillation, the nurse would expect to hear a rhythm that is characterized by
1. The presence of occasional coupled beats.
 2. Long pauses in an otherwise regular rhythm.
 3. A continuous and totally unpredictable irregularity.
 4. Slow but strong and regular beats.
- 13.** A client is experiencing tachycardia. The nurse's understanding of the physiological basis for this symptom is explained by which of the following statements?
1. The demand for oxygen is decreased because of pleural involvement.
 2. The inflammatory process causes the body to demand more oxygen to meet its needs.
 3. The heart has to pump faster to meet the demand for oxygen when there is lowered arterial oxygen tension.
 4. Respirations are labored.
- 14.** A client has the diagnosis of left ventricular failure and a high pulmonary capillary wedge pressure (PCWP). The physician orders Intropin (dopamine) to improve ventricular function. The nurse will know the medication is working if the client's
1. Blood pressure rises.
 2. Blood pressure decreases.
 3. Cardiac index falls.
 4. PCWP rises.
- 15.** A client is admitted with stable sinus tachycardia. The initial intervention will be based on
1. Elimination of the cause.
 2. Availability of cardioversion.
 3. Analysis of the P waves.
 4. Whether this is a defect or a physiological variant.
- 16.** A client is admitted, and the monitor shows an abnormal rhythm. A major sign of hemodynamic instability would be
1. Mild chest pain.
 2. Client complaining of anxiety.
 3. Shortness of breath.
 4. Heart rate of 80.
- 17.** A client has been admitted to the hospital with a diagnosis of suspected bacterial endocarditis. The complication that the nurse will constantly observe for is
1. Presence of a heart murmur.
 2. Systemic emboli.
 3. Fever.
 4. Congestive heart failure.
- 18.** For morning shift, you are assigned two clients, both on cardiac monitoring. Client 1, a 60-year-old, is on Lasix (furosemide) and Lanoxin (digoxin), has clear lungs, and has lost 4 pounds. Client 2 is a 70-year-old, with an MI 2 days ago; he requires close monitoring. The first nursing action is to
1. Assess Client 2 first because he is older and unstable.
 2. Obtain a rhythm strip for both clients and interpret them before intervening.
 3. Check the amount of fluid Client 1 is losing.
 4. Assess Client 1 first because of fluid loss.
- 19.** Thrombophlebitis is a common complication following vascular surgery. Which of the following signs indicates that a possible thrombus has occurred?
1. Kernig's sign.
 2. Homan's sign.
 3. Dull, aching calf pain.
 4. Soft, pliable calf muscle.
- 20.** In preparation for discharge of a client with arterial insufficiency and Raynaud's disease, client teaching instructions should include
1. Walking several times each day as part of an exercise routine.
 2. Keeping the heat up so that the environment is warm.
 3. Wearing TED hose during the day.
 4. Using hydrotherapy for increasing oxygenation.
- 21.** A 45-year-old male client with leg ulcers and arterial insufficiency is admitted to the hospital. The nurse understands that leg ulcers of this nature are usually caused by
1. Decreased arterial blood flow secondary to vasoconstriction.

2. Decreased arterial blood flow leading to hyperemia.
 3. Atherosclerotic obstruction of arteries.
 4. Trauma to the lower extremities.
- 22.** A client comes into the outpatient clinic and tells the nurse that he has leg pains that begin when he walks but cease when he stops walking. Which of the following conditions would the nurse assess for?
1. An acute obstruction in the vessels of the legs.
 2. Peripheral vascular problems in both legs.
 3. Diabetes.
 4. Calcium deficiency.
- 23.** A client who recently started taking a daily dose of the drug Aldomet (methyldopa) for hypertension complains of drowsiness and lethargy when the nurse makes a home visit. The nursing intervention would be to
1. Notify the physician of the negative side effects so the dose can be reduced.
 2. Ask the physician to prescribe another antihypertensive.
 3. Suggest that the client take the medication in the evening and reevaluate on the next visit.
4. Explain that these are expected side effects and he will have to live with them.
- 24.** Dyspnea associated with congestive heart failure is primarily due to
1. Blockage of a pulmonary artery by an embolus.
 2. Accumulation of fluid in the interstitial spaces and alveoli of the lungs.
 3. Blockage of bronchi by mucous secretions.
 4. Compression of lungs by the dilated heart.
- 25.** The client returns to the clinic a week after discharge following a leg fracture. The fracture was complicated by a clot in the left leg. The orders were to remain on Coumadin (warfarin). The client has a prothrombin time drawn. The results indicate that it is 24 seconds. The follow-up care plan for the client is based on the knowledge that these results are
1. Above normal and in the therapeutic range.
 2. Below normal and in the therapeutic range.
 3. Normal, within acceptable limits.
 4. Abnormal and test should be repeated.

CARDIOVASCULAR SYSTEM ANSWERS WITH RATIONALE

1. (2) The character of pain, including its location, duration, and intensity, is the most important for accurate diagnosis. Answers (3) and (4) should be included in the client's history, but are not as critical. Weight loss (1) is not relevant.

NP:A; CN:S; CA:M; CL:A

2. (1) Kidney disease interferes with metabolism and excretion of quinidine, resulting in higher drug concentrations in the body. Quinidex (quinidine) can depress myocardial excitability enough to cause cardiac arrest.

NP:E; CN:PH; CL:A

3. (4) For clients with an MI, thrombolytic therapy minimizes the infarct size through lysis of the clot in the occluded coronary artery. The patent artery then promotes perfusion of the heart muscle. The other three responses are all contraindications for the use of thrombolytic agents.

NP:AN; CN:PH; CL:C

4. (4) The P-R interval is measured on the ECG strip from the beginning of the P wave to the beginning of the QRS complex. It is the time it takes for the impulse to travel to the ventricle.

NP:AN; CN:PH; CL:K

5. (3) The normal CVP reading is between 5 cm and 10 cm. The rise and fall of CVP readings are more important than are pressure level readings, so it is necessary to observe a series of pressure readings.

NP:A; CN:PH; CL:C

6. (1) Such a response does not give false hope to the client but is positive and realistic. This answer tells the client what cardiac rehabilitation is and does not dwell upon his negativity about it.

NP:I; CN:H; CL:A

7. (4) This response opens up communication to allow the client to discuss his fears of dying. Referring to his physician (1) is nontherapeutic, as is answer (2), which is giving him false reassurance. Answer (3) questions his feelings and does not encourage him to express them.

NP:I; CN:PS; CL:A

8. (3) Palpating pulses distal to the insertion site is important to evaluate for thrombophlebitis and vessel occlusion. They should be bilateral and strong.

NP:E; CN:PH; CL:A

9. (1) Because the dye used during a cardiac catheterization contains iodine, the physician must be aware of this client's reaction to iodine (shellfish). The other interventions should be carried out, but they should follow notifying the physician.

NP:I; CN:PH; CL:A

10. (4) This scan detects myocardial damage and perfusion, an acute or chronic MI. It is a more specific answer than (1) or (2). Specific ventricular function is tested by a gated cardiac blood pool scan.

NP:AN; CN:PH; CL:K

11. (4) A murmur is heard as turbulence of blood flow through the valve. It is classified by timing, so answers (1) and (2) are correct, but they have to do with timing. Answer (3) has to do with pattern of flow.

NP:P; CN:PH; CA:M; CL:C

12. (3) In atrial fibrillation, multiple ectopic foci stimulate the atria to contract. The AV node is unable to transmit all of these impulses to the ventricles, resulting in a pattern of highly irregular ventricular contractions.

NP:AN; CN:PH; CL:C

13. (3) The arterial oxygen supply is lowered and the demand for oxygen is increased, which results in the heart's having to beat faster to meet body needs for oxygen.

NP:AN; CN:PH; CL:C

14. (1) If Intropin (dopamine) has a positive effect, it will cause vasoconstriction peripherally but increase renal perfusion, and the blood pressure will rise. The cardiac index will also rise and the PCWP should decrease.

NP:E; CN:PH; CL:AN

15. (1) With sinus tachycardia, determining the cause is critical, because the treatment depends on it. For example, if the client is in pain, pain relief will affect sinus tachycardia. If this condition is unstable, cardioversion would be the treatment of choice. Answers (3) and (4) are incorrect; P waves are normal, and a moderately fast heart rate may be a normal variant.

NP:I; CN:PH; CA: M; CL:A

16. (3) A major sign of hemodynamic instability is shortness of breath, in addition to ongoing chest pain and a heart rate over 150 per minute. Anxiety would be present, but is not a determining factor.

NP:A; CN:PH; CA:M; CL:C

17. (2) Emboli are the major problem; those arising in right heart chambers will terminate in the lungs, and left chamber emboli may travel anywhere in the arteries. Heart murmurs, fever, and night sweats may be present, but do not indicate a complication of emboli. Congestive heart failure may be a result, but this is not as dangerous an outcome as emboli. Emboli may occur in the spleen, kidneys, brain, lungs, and in the extremities.

NP:A; CN:PH; CL:AN

18. (2) The first nursing action is to interpret the two rhythm strips to identify any unanticipated complications. Answer (1) is incorrect because the nurse will need to assess the degree of instability and current status by interpreting the rhythm strip first. Fluid loss is expected with Lasix (furosemide) and is a positive sign of status change.

NP:I; CN:S; CA:M; CL:AN

19. (3) Dull, aching calf pain is a major sign of DVT. Homan's sign is now considered unreliable and may even mobilize the clot, so it is not used (2). Kernig's sign (1) indicates the presence of meningeal irritation. Rigidity in the muscle is found with DVT, not a soft and pliable muscle.

NP:A; CN:PH; CL:A

20. (2) The client's instructions should include keeping the environment warm to prevent vasoconstriction. Wearing gloves, warm clothes, and socks will also be useful in preventing vasoconstriction, but TED hose would not be therapeutic. Walking (1) will most likely increase pain.

NP:I; CN:H; CL:C

21. (1) Decreased arterial flow is a result of vasospasm. The etiology is unknown. It is more problematic in colder climates or when the person is under stress. Hyperemia occurs when the vasospasm is relieved.

NP:AN; CN:PH; CL:C

22. (2) Intermittent claudication is a condition that indicates vascular deficiencies in the peripheral vascular system. If an obstruction were present, the leg pain would persist when the client stops walking. Low calcium level may cause leg cramps but would not necessarily be related to walking.

NP:A; CN:PH; CL:A

23. (3) These side effects may be present with this medication, but may be alleviated by taking the drug in the evening. Often, taking one dose in the evening will minimize the sedation. The nurse needs to follow up with this client and report to the physician.

NP:I; CN:H; CL:AN

24. (2) Failure of the left ventricle to pump effectively causes damming of blood back into the pulmonary circuit, increasing pressure, and causing extravasation of fluid into interstitial spaces and alveoli.

NP:AN; CN:PH; CL:C

25. (1) Normal prothrombin time is 12 to 14 seconds, but for Coumadin (warfarin) therapy, the PT should be maintained between 18 and 28 seconds.

NP:P; CN:PH; CL:AN

RESPIRATORY SYSTEM

The respiratory system is the body process that accomplishes pulmonary ventilation. The act of breathing involves an osmotic and chemical process by which the body takes in oxygen from the atmosphere and gives off end products, mainly carbon dioxide, formed by oxidation in the alveolar tissues. The respiratory system also works in conjunction with the kidneys in regulating acid-base balance.

ANATOMY OF RESPIRATORY SYSTEM

Upper Airway

- A. Nasal passages.
 - 1. Filter the air.
 - 2. Warm the air.
 - 3. Humidify the air.
- B. Nasopharynx.
 - 1. Tonsils: filter and destroy microorganisms.
 - 2. Eustachian tube: opens during swallowing to equalize pressure in the middle ear.
- C. Oropharynx.
 - 1. Part of both the respiratory tract and the digestive tract.
 - 2. Swallowing reflex initiated here.
 - 3. Epiglottis closes entry to trachea as foodstuff passes en route to the stomach.

Lower Airway

- A. Larynx.
 - 1. Protects the tracheobronchial tree from aspiration of foreign materials.
 - 2. Cough reflex initiated here, whether voluntary or involuntary.
 - 3. Houses the vocal cords, which are considered to be the dividing point between the upper and lower airways.
- B. Trachea.
 - 1. Flexible cartilaginous tubular structure.
 - 2. Extends from the cricoid cartilage into the thorax, branching into the right and left mainstem bronchi.
- C. Right lung.
 - 1. Contains three distinct lobes: upper, middle, and lower.
 - 2. Lobes are divided by interlobar fissures.

- D. Left lung.
 - 1. Contains two lobes—upper and lower.
 - 2. Lingula is part of the upper lobe but is sometimes referred to as the middle lobe of the left lung.
 - 3. Lobes are divided by one interlobar fissure.
- E. Bronchi.
 - 1. Right mainstem bronchus (RMSB): shorter and wider than left bronchus; nearly vertical to trachea.
 - a. Most frequent route for aspirated materials.
 - b. Endotracheal tube might enter the RMSB if tube is passed too far.
 - 2. Left mainstem bronchus (LMSB): branches off the trachea at a 45-degree angle.
 - 3. The bronchi subdivide into bronchioles, terminal bronchioles, respiratory bronchioles, and alveoli.
- F. Alveoli.
 - 1. Air cells surrounded by pulmonary capillaries in which gas exchange takes place: oxygen, carbon dioxide.
 - 2. Contain a substance known as surfactant, which keeps the alveoli expanded. Without surfactant, the alveoli would collapse.
- G. Pleura.
 - 1. Each lung enclosed in double-walled membrane sac. The parietal pleura lines the chest cavity. The visceral pleura lines the lungs. Space between the pleural layers is the intrapleural space and is filled with pleural fluid.
 - 2. The pleural fluid is a thin film of fluid, encasing each lung, which allows for a smooth, gliding motion between the lung and the chest wall and facilitates expansion of lung during inspiration.

PRINCIPLES OF VENTILATION

Respiration

Definition: A process in which oxygen is transported from the atmosphere to the cells and carbon dioxide is carried from the cells to the atmosphere.

- A. Respiration is divided into four phases.
 - 1. Pulmonary ventilation—air movement caused by intrathoracic pressure changes in relation to the pressure at the airway opening.
 - 2. Diffusion of oxygen and carbon dioxide between alveoli and blood.

- 3. Transportation of oxygen and carbon dioxide in blood to and from cells.
- 4. Regulation of ventilation via respiratory center in medulla.
- B. Respiratory cycle.
 - 1. Inspiration (active process)—diaphragm descends and external intercostal muscles contract; alveolar pressure decreases, allowing air to flow into the lungs.
 - 2. Expiration (normally a passive process)—muscles relax, alveolar pressure increases, allowing air to flow from the lungs.

Respiratory Pressures

- A. At inspiration the intra-alveolar pressure is more negative than the atmospheric pressure.
- B. At expiration the intra-alveolar pressure is more positive, thereby pressing the air out of the lungs.
- C. A negative pressure exists in the intrapleural space and aids in keeping the visceral pleura of the lungs against the parietal pleura of the chest wall. Lung space enlarges as the chest wall expands.
- D. Recoil tendency of the lungs is due to the elastic fibers in the lungs and the surfactant.

Surfactant

- A. Surface-active material that lines the alveoli and changes the surface tension, depending on the area over which it is spread.
- ♦ B. Surfactant in the lungs allows the smaller alveoli to have lower surface tension than the larger alveoli.
 - 1. Results in equal pressures within both and prevents collapse.
 - 2. Production of surfactant depends on adequate blood supply.
- C. Conditions that decrease surfactant.
 - 1. Hypoxia.
 - 2. Oxygen toxicity.
 - 3. Aspiration.
 - 4. Atelectasis.
 - 5. Pulmonary edema.
 - 6. Pulmonary embolus.
 - 7. Mucolytic agents.
 - 8. Hyaline membrane disease.

Compliance

- A. Relationship between pressure and volume: elastic resistance.
 - 1. Measure of elasticity of lungs and thorax.
 - 2. When compliance is decreased, lungs are more difficult to inflate.
- ♦ B. Conditions that decrease chest wall compliance.
 - 1. Obesity—excess fatty tissue over chest wall and abdomen.

- 2. Kyphoscoliosis—marked resistance to expansion of the chest wall.
- 3. Scleroderma—expansion of the chest wall limited when the involved skin over the chest wall becomes stiff.
- 4. Chest wall injury—as in crushing chest wall injuries.
- 5. Diaphragmatic paralysis—as a result of surgical damage to the phrenic nerve, or disease process involving the diaphragm itself.
- C. Conditions that decrease lung compliance.
 - 1. Atelectasis—collapse of the alveoli as a result of obstruction or hypoventilation.
 - 2. Pneumonia—inflammatory process involving the lung tissue.
 - 3. Pulmonary edema—accumulation of fluid in the alveoli.
 - 4. Pleural effusion—accumulation of pleural fluid in the pleural space, compressing lung on the affected side.
 - 5. Pulmonary fibrosis—scar tissue replacing necrosed lung tissue as a result of infection.
 - 6. Pneumothorax—air present in the pleural cavity; lung is collapsed as volume of air increases.

Airway Resistance

- A. Opposition or counterforce. Resistance depends on the diameter and length of a given tube (respiratory tract).
 - 1. Flow may be laminar (smooth) or turbulent.
 - 2. Resistance equals pressure divided by flow (Poiseuille's law).
- B. Conditions that increase airway resistance.
 - 1. Secretions.
 - 2. Bronchial constriction.

♦ Lung Volumes

- A. Total lung capacity (TLC)—total volume of air that is present in the lungs after maximum inspiration.
- B. Vital capacity (VC)—volume of air that can be expelled following a maximum inspiration.
- C. Tidal volume (TV)—volume of air with each inspiration.
- D. Inspiratory reserve volume (IRV)—volume of air that can be inspired above the tidal volume.
- E. Inspiratory capacity (IC)—volume of air with maximum inspiration; comprises tidal volume and inspiratory reserve volume.
- F. Expiratory reserve volume (ERV)—volume of air that can be expelled following a resting expiration.
- G. Reserve volume (RV)—volume of air remaining in the lungs at the end of maximum expiration.

- H. Functional reserve capacity (FRC)—volume of air remaining in the lungs at the end of resting expiration; comprises ERV and RV.
- I. Forced expiratory volume (FEV1)—volume of air of the vital capacity that is expelled within the first second.

Alveolar Ventilation

Definition: The rate at which the alveolar air is renewed each minute by atmospheric air—the most important factor of the entire pulmonary ventilatory process.

- A. Rate of alveolar ventilation.
 - ◆ 1. Alveolar ventilation is one of the major factors determining the concentrations of oxygen and carbon dioxide in the alveoli.
 - 2. Alveolar ventilation per minute is the total volume of new air entering the alveoli each minute; equal to the respiratory rate times the amount of new air that enters the alveoli with each breath.
- B. Anatomic dead space.
 - 1. Dead space air is the air that fills the respiratory passages with each breath (nose to bronchioles).
 - 2. The volume of air that enters the alveoli with each breath is equal to the tidal volume minus the dead space volume; usually 150 mL in adults. Air is not available for gas exchange.
 - 3. Anatomical dead space refers to the volume of all spaces of the respiratory system besides the gas exchange areas (the alveoli and terminal ducts).
 - 4. Physiological dead space refers to alveolar dead space (occurring because of nonfunctioning or partially functioning alveoli); included in the total measurement of dead space.
 - 5. In the normal person, anatomical and physiological dead space are equal because all alveoli are functional.

Oxygen and Carbon Dioxide Diffusion and Transportation of Respiratory Gases

Ventilation

- A. The first phase in respiration is ventilation, which is the constant replenishment of air in the lungs.
- B. Composition of alveolar air.
 - ◆ 1. Alveolar air is only partially replenished by atmospheric air each inspiratory phase.
 - a. Approximately 350 mL of new air (tidal volume minus dead space) is exchanged with the functional residual capacity (FRC) volume each respiratory cycle (FRC = 2300 mL).

- b. Sudden changes in gaseous concentrations are prevented when alveolar air is replaced slowly.
- 2. Alveolar air contains more carbon dioxide and water vapor than atmospheric air.
- 3. Alveolar oxygen concentration depends on the rate of oxygen absorbed into the blood and the ability of the lungs to take in carbon dioxide.
- 4. Carbon dioxide content is likewise affected by the rate at which carbon dioxide is passed into the alveoli from the blood and the ability of the lungs to expire it.

Diffusion of Gases

- A. The next phase is movement of oxygen from the alveolar air to the blood and movement of carbon dioxide in the opposite direction.
- B. Movement of gases through the respiratory membrane depends on the following factors:
 - 1. Thickness of membrane.
 - 2. Permeability of membrane (diffusion coefficient).
 - 3. Surface area of the membrane.
 - 4. Differences in gas pressures in the alveolar and blood spaces.
 - 5. Rate of pulmonary circulation.
 - 6. The production of surfactant as it reduces the surface tension and aids in keeping the alveoli open.
- C. Blood low in carbon dioxide and high in oxygen leaves lungs.
- D. Throughout the body there again is exchange of respiratory gases in the capillary beds.
 - 1. Oxygen out of the blood and into the cells.
 - 2. Carbon dioxide from cells into the blood.

◆ **Oxygen Transport in the Blood**

- A. About 3% of the oxygen is carried in a dissolved state in the water of plasma and cells.
- B. About 97% is carried in chemical combination with hemoglobin in red blood cells (RBCs).
 - 1. The percentage of oxygen combined with each hemoglobin molecule depends on the partial pressure of oxygen (PO_2).
 - 2. The relationship is expressed as the oxygen–hemoglobin dissociation curve.
 - a. It shows the progressive increase in the percentage of hemoglobin that is bound with oxygen as the PO_2 increases.
 - b. When the PO_2 is high, oxygen binds with hemoglobin; when PO_2 is low (tissue capillaries), oxygen is released from hemoglobin.
 - c. This is the basis for oxygen transport from the lungs to the tissues.

3. Febrile states and acidosis permit less oxygen to bind with Hgb, thereby limiting the amount of oxygen available for the tissues.
 4. The amount of oxygen that is available to the tissues depends on the oxygen content of the blood and the cardiac output.
- C. Inadequate oxygen transport to the tissues—hypoxia.
1. Hypoxic hypoxia: low arterial PO₂.
 - a. Alveolar hypoventilation.
 - b. Ventilation–perfusion inequalities.
 - c. Diffusion defects.
 - d. Fraction of inspired oxygen (FIO₂) is less than atmosphere, such as in high altitudes.
 2. Anemic hypoxia: decreased oxygen-carrying capacity to the blood.
 - a. Anemia—less Hgb; therefore, less oxygen is able to combine with it.
 - b. Carbon monoxide poisoning—carbon monoxide combines with Hgb, preventing oxygen from combining with Hgb.
 3. Circulatory hypoxia: circulatory insufficiency.
 - a. Shock—decreased cardiac output.
 - b. Congestive heart failure.
 - c. Arterial vascular disease—localized obstruction to arterial blood flow.
 - d. Tissue need for oxygen surpasses supply available.
 4. Histotoxic hypoxia: prevents tissues from utilizing oxygen.

♦ Carbon Dioxide Transport in the Blood

- A. A small amount of carbon dioxide is dissolved in plasma and red blood cells in the form of bicarbonate.
- B. Inside the red blood cells, carbon dioxide combines with water to form carbonic acid.
 1. It is catalyzed by the enzyme called carbonic anhydrase.
 2. The enzyme accelerates the rate to a fraction of a second.
- C. In another fraction of a second, carbonic acid dissociates to form hydrogen ions and bicarbonate in the red cells.
- D. Carbon dioxide combines with the hemoglobin molecule.
 1. The hemoglobin molecule has given off its oxygen to the tissues, and carbon dioxide attaches itself.
 2. The venous system carries the combined carbon dioxide back to the lungs, where it is expired.

Regulation of Respiration

- A. Respiratory centers.
 1. Pons—two respiration areas: pneumotaxic and apneustic.
 2. Medulla oblongata—major brain area controlling rhythmicity of respiration.
 3. Spinal cord—facilitatory role in maintaining respiratory center.
 4. Hering Breuer reflexes—stretch receptors located in lung tissue that assist in maintaining respiratory rhythm and prevent overstretch of the lung. Afferent fibers are carried in the vagus nerve.
- B. Humoral regulation of respiration (chemical).
 1. Central chemoreceptors.
 - a. Directly stimulated by an increase in hydrogen ion concentration (acidity) in the cerebrospinal fluid.
 - b. An increase in arterial PCO₂ causes a rapid change in pH of the cerebrospinal fluid, increases the depth and rate of respiration, and decreases the PCO₂ level.
 - c. Changes in hydrogen ion and bicarbonate ion concentrations are not as quickly recognized as changes in the PCO₂ by the central chemoreceptors; therefore, responses to metabolic imbalances are slower.
 - d. Receptors are located in the medulla oblongata and adjacent structures.
 2. Peripheral chemoreceptors.
 - a. Receptor cells are located in the carotid body at the bifurcation of the common carotid arteries and at the aortic arch.
 - b. Impulses from the aortic arch are transmitted to the brain via the vagus nerve.
 - c. Impulses from the carotid body are transmitted to the brain via the glossopharyngeal nerve.
 - d. The peripheral chemoreceptors primarily respond quickly to a decreased PO₂ (below 50 mm Hg) and, to some extent, to alteration of the PCO₂ and hydrogen ion concentration in the arterial blood.

System Assessment

- ♦ A. Check for airway patency.
 1. Clear out secretions.
 2. Insert oral airway if necessary.
 3. Position client on side if there is no cervical spine injury.
 4. Place hand or cheek over nose and mouth of client to feel if client is ventilating.

- ◆ B. Listen to lung sounds.
 - 1. Absence of breath sounds: indicates lungs not expanding, due to either obstruction or deflation.
 - 2. Crackles (rales): Indicate vibrations of fluid in lungs.
 - 3. Rhonchi (coarse sounds): Indicate partial (fluid) obstruction of airway.
 - 4. Decreased breath sounds: Indicate poorly ventilated lungs.
 - 5. Detection of bronchial sounds that are deviated from normal position: Indicates mediastinal shift due to collapse of lung.
- ◆ D. Where breath sounds are heard.
 - a. Bronchovesicular—heard over mainstem bronchi.
 - b. Vesicular (normal)—heard over lung parenchyma.
 - c. Bronchial—heard over trachea above sternal notch.
- ◆ C. Determine level of consciousness; decreased sensorium can indicate hypoxia.
- D. Observe sputum or tracheal secretions; bloody sputum can indicate contusions of lung or injury to trachea and other anatomical structures.
- E. Evaluate vital signs for temperature, respiratory rate, pulse, and changes in skin color.
- F. Evaluate for tightness or fullness in chest.
- G. Determine degree of pain client is experiencing.
- H. Observe for PVCs if client is on monitor.
- I. Assess for respiratory complications.
 - 1. Breathing patterns.
 - 2. Evaluate cough.
 - a. Normally a protective mechanism utilized to keep the tracheobronchial tree free of secretions.
 - b. Common symptom of respiratory disease.
 - 3. Assess for bronchospasm.
 - a. Bronchi narrow and secretions may be retained.
 - b. Condition may lead to infection.
 - 4. Observe for hemoptysis—expectoration of blood or blood-tinged sputum.
- ◆ J. Assess for cyanosis—late sign of hypoxia, due to large amounts of reduced hemoglobin in the blood (PaO_2 of about 50 mm Hg).
- ◆ K. Assess for hypoxia (anoxia)—a deficiency of oxygen in the body tissues.
- ◆ L. Evaluate for hypercapnia.
 - a. Occurs when carbon dioxide is retained.
 - b. High levels of oxygen depress and/or paralyze the medullary respiratory center.
 - c. Peripheral chemoreceptors (sensitive to oxygen) become the stimuli for breathing.
- ◆ M. Assess for presence of respiratory alkalosis or acidosis.
- J. Assess for other system complications.
 - ◆ 1. Evaluate for polycythemia—increase in RBCs as a compensatory response to hypoxemia.
 - ◆ 2. Observe for clubbing of fingers. Pathogenesis is not well understood.
 - 3. Evaluate for cor pulmonale—enlargement of the right ventricle as a result of pulmonary arterial hypertension following respiratory pathology.
 - 4. Evaluate for chest pain.
 - 5. Assess for atelectasis.
 - 6. Check for abdominal distention.
 - 7. Assess for hypertension.
 - 8. Evaluate cardiac status: CHF, cerebral edema, arrhythmias.
 - 9. Assess for trauma to thorax.
- ◆ N. Assess oxygen concentration with noninvasive pulse oximetry.
 - 1. Sensor probe on earlobe, finger, or toe registers light passing through vascular bed.
 - 2. Allows continual monitoring of arterial oxygen saturation.
- L. Assess for conditions associated with respiratory failure.
 - 1. Infectious diseases: tuberculosis, pneumonia.
 - 2. Obstruction of airway: pulmonary embolism, chronic bronchitis, bronchiectasis, emphysema, asthma, cardiac disorders leading to pulmonary congestion.
 - 3. Restrictive lung disease: pleural effusion, pneumothorax, atelectasis, pulmonary tumors, obesity.
 - 4. CNS depression: drugs, head injury, CNS infection.
 - 5. Chest wall trauma: flail chest, neuromuscular disease, congenital deformities.

◆ ABNORMAL BREATHING PATTERNS

- Dyspnea—labored or difficult breathing.
- Hyperpnea—abnormal deep breathing.
- Hypopnea—reduced depth of breathing.
- Orthopnea—difficulty breathing in other than upright position.
- Tachypnea—rapid breathing.
- Stridor—noisy respirations as air is forced through a partially obstructed airway.

Diagnostic Procedures

Radiologic Studies

- A. Chest x-ray.
- B. Lung scintigraphy: measures concentration of gamma rays from lung after intake of isotope.

- C. Perfusion studies: outline pulmonary vascular structures after intake of radioactive isotopes IV. (Check for dye allergy.)
- D. Computed tomography (CT).
- E. Magnetic resonance imaging (MRI)—have client remove any metal before tests.

Bronchoscopy

- A. A flexible fiber-optic scope to visualize the interior of the tracheobronchial tree.
- B. Used as a therapeutic tool to remove foreign materials; and for diagnosis, biopsy, specimen collection.
- ◆ C. Nursing care.
 - 1. Keep client NPO 6–8 hours before procedure.
 - 2. Explain sedation and local anesthesia of nasal and oral pharynx.
 - 3. Postprocedure: check client's ability to control secretions. Keep NPO until gag reflex returns.
 - 4. Observe for potential complications of laryngospasm, laryngeal edema, anesthesia complications, subcutaneous emphysema.
 - 5. Client may expect hoarseness and sore throat.

Biopsy of Respiratory Tissue

- A. May be done by needle, via bronchoscope, or an open lung procedure biopsy.
- B. Nursing care: observe for hemothorax and/or pneumothorax.

Thoracentesis

- A. A needle puncture through the chest wall to remove air or fluid.
- B. Used for diagnostic and/or therapeutic purposes.
- ◆ C. Nursing care: observe for possible pneumothorax postprocedure (\uparrow pulse, pallor, chest pain, dyspnea, tachycardia).

Pulmonary Function Tests

- A. Measure of body's ability to mechanically ventilate and to effect gaseous exchange.
- B. Tests include spirometry, measurement of gas volume and airway resistance, diffusing capacity, and arterial blood gases. (See Lung Volumes under Principles of Ventilation, page 259.)
- C. Nursing care.
 - 1. Avoid scheduling immediately after meals.
 - 2. Hold bronchodilators (inhaled) for 6 hours prior to tests.

TB Tests

- ◆ A. Mantoux skin test for tuberculosis.
 - 1. The most reliable test to confirm infection.
 - 2. 0.1 mL tuberculin injected intradermally—PPD is standard-strength purified protein derivative.

- 3. Test read 48–72 hours postintradermal wheal production.
- 4. Erythema not important.
- 5. Area of induration is more than 10 mm: indicates positive reaction (client has had contact with the tubercle bacillus). For HIV or severely immune suppressed, test is positive if induration is 5 mm or greater.
- 6. When skin test is positive, chest x-ray and sputum cultures important to rule out active TB or old, resolved TB lesions.
- 7. Reactions of 5–9 mm require retest.
- B. Tine test not used.
- C. Interferon gamma release assay (IGRA)—TB blood test.
 - 1. This is a blood test used to determine if a person has been infected with TB bacteria.
 - 2. Two IGRA are approved by the U.S. Food and Drug Administration (FDA) and are available in the United States.
 - a. QuantiFERON®-TB Gold In-Tube test (QFT-GIT).
 - b. T-SPOT®.TB test (T-Spot).
 - 3. Positive IGRA: Means the person has been infected with TB bacteria. Additional tests are needed to determine if the person has latent TB infection or TB disease.
 - 4. Negative IGRA: This means that the person's blood did not react to the test and that latent TB infection or TB disease is not likely.

Arterial Blood Studies

- A. Arterial blood gases (ABGs).
 - ◆ 1. Indicate respiratory function by measuring:
 - a. Oxygen (PO_2).
 - b. Carbon dioxide (PCO_2).
 - c. pH.
 - d. Oxygen saturation.
 - e. Bicarbonate (HCO_3).
 - 2. Determine state of acid-base balance.
 - 3. Reveal the adequacy of the lungs to provide oxygen and to remove carbon dioxide.
 - 4. Assess degree to which kidneys can maintain a normal pH.
- ◆ B. Normal arterial values.
 - 1. Oxygen saturation: 93–98%.
 - 2. PaO_2 : 95 mm Hg.
 - 3. Arterial pH: 7.35–7.45 (7.4).
 - 4. PCO_2 : 35–45 mm Hg (40).
 - 5. HCO_3 content: 24–30 mEq (25).
 - 6. Base excess: –3 to +3 (0).

System Implementation

- ◆ A. Maintain patent airway.

- 1. Suction.
- 2. Intubation.
 - a. Oral airway.
 - b. Endotracheal intubation.
- B. Maintain adequate ventilation.
 - 1. Place in Fowler's position to facilitate lung expansion.
 - 2. Encourage coughing and breathing exercises.
 - 3. If client needs help breathing, a ventilator may be used.
 - a. Ventilator simulates breathing action usually provided by diaphragm and thoracic cage.
 - b. Type of ventilator depends on specific needs of client.
- C. Administer oxygen therapy using specific oxygen equipment according to the percentage of oxygen required by client with humidity therapy.
- D. Monitor blood gases to determine how well client's oxygen needs are being met.
- E. Maintain fluid and electrolyte balance.
 - ◆ 1. When blood and fluid loss are replaced, watch carefully for fluid overload, which can lead to pulmonary edema.
 - 2. Record intake and output.
- F. Maintain acid-base balance; make frequent blood gas determination as acid-base imbalances occur readily with compromised respirations or with mechanical ventilation.
- G. Provide for relief of pain.
 - ◆ 1. Analgesics should be used with caution as they depress respirations. (Demerol [meperidine] is the drug of choice.)
 - 2. Atropine, morphine sulfate, and barbiturates should be avoided.
 - 3. Nerve block may be used.
- H. Perform electrocardiogram to establish associated cardiac damage.
- I. Provide for incentive spirometry and chest physiotherapy.
- J. Maintain hydration status.
 - 1. Necessary to liquefy secretions or prevent formation of thick, tenacious secretions.
 - 2. Monitor oral intake of fluids, IV administration of fluids, or humidification to tracheobronchial tree.
- K. Administer appropriate drug therapy for respiratory condition.

- B. Assess client's vital signs.
- C. Observe existence of PVCs if client is on monitor.
- D. Observe client for any of the following signs. If these signs are evident, you may need to administer oxygen.
 - 1. Tachycardia.
 - 2. Gasping and/or irregular respirations (dyspnea).
 - 3. Restlessness.
 - 4. Flaring nostrils.
 - 5. Cyanosis.
 - 6. Substernal or intercostal retractions.
 - 7. Increased blood pressure followed by decreased blood pressure.
 - 8. Abnormal ABGs.
- ◆ E. Assess for side effects of oxygen therapy.
 - ◆ 1. Atelectasis.
 - a. Nitrogen is washed out of the lungs when a high FIO₂ is delivered to client.
 - b. In alveoli free of nitrogen, oxygen diffuses out of the alveoli into the blood faster than ventilation brings oxygen into the alveoli.
 - c. This results in a collapse (atelectasis) of the affected alveoli.
 - ◆ 2. Pulmonary oxygen toxicity.
 - a. High FIO₂ delivered over a long period of time (48 hours) results in destruction of the pulmonary capillaries and lung tissue.
 - b. The clinical picture resembles that of pulmonary edema.
 - ◆ 3. Retrolental fibroplasia.
 - a. Blindness resulting from high FIO₂ delivered to premature infants.
 - b. This condition is seen in prolonged FIO₂ of 100% when high levels of oxygen are not needed.
 - ◆ 4. Carbon dioxide narcosis.
 - a. Carbon dioxide narcosis can develop if hypoxic drive is removed by administering FIO₂ to return the arterial PO₂ to normal range.
 - b. Symptoms of carbon dioxide narcosis.
 - (1) Decreased mentation.
 - (2) Flushed, pink skin.
 - (3) Flaccid (sometimes twitching) extremities.
 - (4) Shallow breathing.
 - (5) Respiration arrest.
 - F. Evaluate client for clinical manifestations of COPD.
 - 1. Ventilatory drive is hypoxicemic.
 - 2. Oxygen administration requires critical observation. Start at 2 L/min.

Hypoxic Condition

◆ **Definition:** Oxygen deficiency—the primary indication for initiation of oxygen therapy.

◆ Assessment

- A. Check to see if client has a patent airway.

◆ STAGES OF HYPOXIA

Early symptoms

- Restlessness
- Headache, visual disturbances
- Slight confusion
- Hyperventilation
- Tachycardia
- Hypertension (mild)
- Dyspnea
- Decreased pulse oximetry

Late symptoms

- Hypotension
- Bradycardia
- Metabolic acidosis (production of lactic acid)
- Cyanosis

Chronic oxygen lack

- Polycythemia
- Clubbing of fingers and toes
- Thrombosis

Implementation

- A. Monitor lung sounds for adequate ventilation.
- B. Monitor client for signs of oxygen toxicity.
- C. Provide skin care for areas surrounding oxygen equipment.
- ♦ D. Administer oxygen at appropriate flow with specified equipment.
 1. Nasal prongs and cannula.
 - a. Easily tolerated by clients.
 - b. The FIO₂ will vary depending on the flow.
 - (1) FIO₂: 24–28%. Flow: 1–2 L.
 - (2) FIO₂: 30–35%. Flow: 3–4 L.
 - (3) FIO₂: 38–44%. Flow: 5–6 L.
 2. Simple face mask.
 - a. Requires fairly high flows to prevent rebreathing of carbon dioxide.
 - b. Accurate FIO₂ difficult to estimate.
 - c. FIO₂: 35–65%. Flow: 8–12 L.
 3. Mask with reservoir bag.
 - a. Higher FIO₂ is delivered because of the reservoir.
 - b. At flows less than 6 L/min, risk of rebreathing carbon dioxide increases.
 - (1) Partial rebreathing mask:
FIO₂: 40–60%. Flow: 6–10 L.
 - (2) Nonbreather:
FIO₂: 60–100%. Flow: 6–15 L.
 4. Venturi mask.
 - a. Delivers fixed or predicted FIO₂.
 - b. Utilized effectively in clients with COPD when accurate FIO₂ is necessary for proper treatment.
 - c. FIO₂: 24–50%.

5. Face tent.

- a. Well tolerated by clients but sometimes difficult to keep in place.
- b. Convenient for providing humidification with compressed air in conjunction with nasal prongs.
- c. FIO₂: 28–100%. Flow: 8–12 L.

6. Oxygen hood.

- a. Hood fits over child's head.
- b. Provides warm, humidified oxygen at high concentrations.
- c. FIO₂: 28–85%. Flow: 5–12 L.

7. Intratracheal oxygen device for long-term therapy.

INFECTIOUS DISEASES

Pulmonary Tuberculosis

♦ *Definition:* Airborne, infectious, communicable disease thought to be caused by *Mycobacterium tuberculosis*. May affect any part of the body, but is most common in the lungs. Disease may be acute or chronic.

- ♦ A. Tubercle bacilli is rod-shaped and gram-positive, acid fast.
- B. Diagnostic findings.
 1. Early AM sputum for smear and culture: positive acid-fast bacillus.
 2. Fiber-optic bronchoscopy and chest x-ray (to determine presence and extent of tuberculosis [TB]).
 3. Increased WBC and ESR.
 4. Positive Mantoux skin test.
- C. Most people infected do not develop clinical illness because the immune system brings infection under control.
- D. Persons at risk: persons with HIV, immunosuppressed, the elderly, certain minority groups, persons in close contact with infectious TB, persons who have live dormant bacilli from an initial infection acquired years before. Also, those with lowered resistance from alcoholism, those who take steroids, or those who are poorly nourished.
- E. Pathophysiology.
 1. Inhaled airborne droplets containing the bacteria infect the alveoli, which become the focus of infection—transmission requires close frequent or prolonged exposure.
 2. After entrance of tubercle bacilli, the body attempts to wall off the organism by phagocytosis and lymphocytosis.
 3. Macrophages surround the bacilli and form tubercles.

4. Tubercles go through the process of caseation—a necrotic process. (Cells become an amorphous cheese-like mass and may be encapsulated to form a nodule.)
5. Caseous nodule erodes, and sputum is released, leaving an air-filled cavity.
6. Initial lesion may disseminate by extension, via bloodstream or lymph system, and through bronchi.

♦ MANTOUX SKIN TEST

- Purified protein derivative (PPD) tuberculin antigen.
- PPD tuberculin injected intradermally to form wheal 5–10 mm.
- Test read 48–72 hours: positive induration is 10-mm diameter or more.
- Results mean client has had contact recently or in the past—does not signify active disease is present, or has recently been vaccinated with BCG (bacille Calmette–Guérin).
- BCG vaccine produces a greater resistance to developing TB—more commonly used in Europe than in United States.
- If false positive for Mantoux is suspected, chest x-ray and AFB (acid-fast bacilli) sputum done.

Assessment

- A. Evaluate pulmonary symptoms.
 1. Cough (at cavitation stage).
 2. Sputum production—initially dry, then purulent.
 3. Dyspnea.
 4. Hemoptysis.
 5. Pleuritic pain (with pleural involvement).
 6. Rales.
- B. Evaluate systemic symptoms.
 1. Fatigue, malaise.
 2. Night sweats, low-grade fever in afternoon.
 3. Weight loss.
 4. Anorexia.
 5. Irritability, lassitude.
 6. Tachycardia.
- C. Complete physical examination.
- D. Complete social and medical history.
- E. Examine sputum—takes 3–8 weeks for results.
- F. Check tuberculin test.

Implementation

- ♦ A. Maintain respiratory precautions.
 1. Client is not considered infectious 2–3 weeks after initiation of chemotherapy.
 2. Teach client methods to prevent spread of droplets when coughing.
- ♦ B. Monitor administration of medications—a combination of drugs are used to destroy variable microbial organisms.
- ♦ C. Sputum smears obtained every 2–4 weeks until negative (sputum cultures become negative in 3–5 months).
- ♦ D. Chemoprophylaxis.
 - ♦ 1. Laniazid, Nydrazid (isoniazid—INH) and vitamin B₆ therapy for 6 months given to those infected with tubercle bacillus without the disease, or to those at high risk for development of the disease.
 - ♦ 2. Evaluate for potential complications of INH therapy: Check for hepatitis (rare), excessive tiredness, weakness, loss of appetite, nausea, vomiting, dark yellow or brown urine, jaundice, diarrhea, vision problems, eye pain, numbness or tingling in hands and feet, rash, fever, swollen glands, joint pain, sore throat, stomach pains or right upper quadrant (RUQ) tenderness.
 - 3. Evaluate for potential complications of Rifadin (rifampin; RIF) therapy: hepatitis (rare), headache, muscle pain, bone pain, heartburn, nausea, vomiting, stomach cramps, chills, diarrhea, rash, sores on skin or in mouth, fever, jaundice. Urine, stools, saliva, sputum, sweat, and tears may turn red-orange.
 - 4. Evaluate for potential complications of pyrazinamide (PZA) therapy: hepatitis (rare), upset stomach, fatigue, rash, fever, vomiting, loss of appetite, jaundice, darkened urine, pain and swelling in joints, unusual bleeding or bruising, difficulty urinating.
 - 5. Evaluate for potential complications of Myambutol (ethambutol; EMB) therapy: blurred vision, sudden changes in vision, inability to see colors red and green, loss of appetite, upset stomach, vomiting, numbness and tingling in hands or feet, rash, itching.
 - 6. Encourage client to report for frequent prescribed liver function studies.
- ♦ E. Work with client to maintain compliance—the major problem in eliminating TB.
 1. Strict compliance to drug regimen.
 2. Monthly follow-up visits for sputum smear until conversion.
- F. Directly observed therapy (DOT).
 1. This therapy involves observing the ingestion of every dose of medicine the TB client is supposed to take.
 - a. This observation continues for the entire course of treatment.
 - b. Completing the course of therapy is essential; incomplete treatment can lead to reactivation of TB.
 2. The decision to implement DOT is based on risk factors evaluated by the nurse.

- ◆ G. Instruct client in ways to prevent spread of disease.
 1. Cover nose and mouth with a few layers of disposable tissue when sneezing or coughing.
 2. Expectorate into a disposable sputum container.
 3. Maintain adequate air ventilation.
- H. Decontaminate infected air by nonrecirculated air or ultraviolet rays.
- I. Provide well-balanced diet: high carbohydrate, high protein, high vitamin B₆.
- J. Provide frequent oral hygiene.
- K. Drug-resistant TB is beginning to appear in the United States.

TB MEDICATIONS

Drugs Used to Treat TB

The following drugs are recommended as initial treatment regimen for active TB. Treatment almost always consists of four antibiotics: Laniazid, Nydrazid (isoniazid—INH), Rifadin, Rimactane (rifampin—RIF), pyrazinamide—PZA, and Myambutol (ethambutol—EMB).

First-line TB drugs: 2 months of isoniazid (INH), rifampin (RIF), and pyrazinamide (PZA); followed by 4 months of INH and RIF.

- ◆ • Streptomycin or ethambutol will be added for 1–3 weeks until sensitivity results and then discontinued if organisms are sensitive to other drugs in the regimen.
 - a. Daily alcohol intake and antacids containing aluminum interfere with metabolism and absorption, respectively.
 - b. Monitor kidney function if client is taking streptomycin.
- Priftin (rifapentine) was a new drug approved in 1998—first new TB drug in 10 years.
 - a. As effective as rifampin, but with a longer half-life.
 - b. Clients need to take it less often, so compliance is increased.
- Drug regimen varies with age, number of bacilli in client's smear, and susceptibility to drug therapy and compliance.
- **Adverse effects:** Relatively common, especially during the first few weeks of therapy, but clients should not discontinue treatment because of minor side effects. If more serious side effects—particularly drug-induced hepatitis—develop, isoniazid, rifampin, and pyrazinamide should be stopped immediately and then restarted one-by-one to determine which drug was causing the problem. (Ethambutol does not damage the liver.)

Second-line drugs—used for resistant clients: Capastat (capreomycin), Kantrex (kanamycin), para-aminosalicylic acid, Seromycin (cycloserine), Levoquin (levofloxacin), Floxin (ofloxacin), and Cipro (ciprofloxacin).

- Drugs are more effective when administered in single daily dose.
- Drug resistance is a problem, especially in certain populations: poor compliance, previously treated for TB.
- Corticosteroids may be used in severe cases, together with antituberculosis agents, to reduce symptoms.
- Clients with latent TB are sometimes prescribed drug therapy—typically isoniazid once daily for 6 months to a year—to prevent the disease from progressing to active TB.

Pneumonia

Definition: An acute inflammatory process of the lung parenchyma, resulting in lung consolidation as the alveoli and bronchioles fill with exudate. Can be caused by bacteria, viruses, fungi, chemicals.

Assessment

- A. Assess for type of pneumonia (classification).
 1. Community-acquired pneumonia (CAP)—acquired outside the hospital; lower respiratory tract infection.
 - a. Typical.
 - (1) *Streptococcus pneumoniae* is the most common bacterial organism, followed by *Haemophilus influenzae*.
 - (2) Communicable disease.
 - (3) Young males most affected.
 - (4) Clinical manifestations.
 - (a) Rapid onset, severe chills, high temperature (103–106°F/39.4–41.1°C).
 - (b) Tachypnea, rapid pulse.
 - (c) Productive cough with purulent sputum.
 - (d) Pleuritic pain.
 - (e) Anxiety.
 - (f) Dyspnea.
 - (g) Bronchial breath sounds, crackles.
 - b. Atypical.
 - (1) *Legionella*, *Mycoplasma*, and *Chlamydia* are the common organisms causing infections.
 - (2) More gradual onset.
 - (3) Dry cough.
 - (4) Headache, fatigue, sore throat.
 - (5) Nausea, vomiting.
 - (6) Crackles.
 2. Hospital-acquired pneumonia (HAP)—leading cause of mortality stemming from healthcare-associated infections (HAI). Occurs 48 hours after hospitalization.
 - a. Common organisms include *Pseudomonas*, *Enterobacter*, *Staphylococcus aureus*, and *Streptococcus pneumoniae*, which enter lungs after aspiration of particles from client's own pharynx.
 - b. Risk factors.
 - (1) Aspiration.
 - (2) Abdominal surgery.
 - (3) Immunosuppressant therapy.
 - (4) Prolonged mechanical ventilation.
 - (5) Structural lung disease.
 - c. Clinical manifestations—may represent other disease processes like tuberculosis, heart failure.
 - (1) Fever, chills, diaphoresis.

- (2) Wheezing, inspiratory rales.
 - (3) Productive cough, increased pulmonary secretions.
 - (4) Fatigue, pallor, malaise.
 - (5) Tachypnea, tachycardia.
3. Aspiration pneumonia—aspiration of material in mouth into trachea and lungs. Dependent areas of lung most often affected. Aspirate can be food, water, vomitus, chemicals.
- Secondary to other conditions such as age, debilitation, stasis, loss of consciousness.
 - Onset insidious—initial manifestation may be airway obstruction.
4. Opportunistic pneumonia—clients with altered immune response very susceptible to respiratory infections.
- At-risk individuals include those with malnutrition, HIV/AIDS, transplants, cancer, immune deficiencies.
 - Most common organisms involved are *Pneumocystis jiroveci* pneumonia (PJP), cytomegalovirus, and fungi.
 - Clinical manifestations: fever, chills, dry nonproductive cough, malaise, fatigue.
- B. Assess for exacerbation of chronic obstructive pulmonary disease as respiratory infections precipitate this condition.
- C. Observe for an increase in the amount of sputum.
- Change in the character of sputum (particularly color—yellow to green).
 - Onset of malaise or fever may indicate infection.

Implementation

- ♦ A. If possible, keep client ambulatory or change position frequently.
- B. Elevate head of bed 30 degrees.
- C. Encourage fluids to 3000 mL or more to provide hydration.
- D. Observe and record type and amount of sputum.
- E. Administer antibiotics as ordered.
 - Given for a period of 10–14 days.
 - Antibiotics most commonly used are penicillin G IV, ampicillin, Bactrim (sulfamethoxazole and trimethoprim), Vancocin (vancomycin) (staph pneumonia), and cephalosporins.
- F. Provide physiotherapy as ordered (cough, deep-breathe, incentive spirometry).
- G. Obtain throat sputum and blood cultures for specific organisms.
- H. Determine O₂ need according to O₂ saturation and ABGs. Administer O₂ as indicated.
- I. Administer antipyretic drugs and analgesics as needed.

Legionnaires' Disease

♦ *Definition:* An acute respiratory infection caused by gram-negative bacteria. The name was derived from an outbreak of the disease in Philadelphia in 1973 when members of the American Legion were attending a convention.

Assessment

- ♦ A. Assess the lungs, the organs most targeted by the bacteria.
 - Primary entry into the body is through the lungs.
 - The organisms are in infected water, usually transmitted via air conditioners and cooling towers.
 - Disease is not transmitted person to person.
- B. Early symptoms.
 - Malaise.
 - Mild headache.
 - Dry cough.
- C. Later symptoms.
 - Fever and chills—unremitting until therapy.
 - Other symptoms may be pleuritic pain, confusion, and impaired renal function.

Implementation

- A. Diagnosis made from specific serum antibodies or by culture.
- B. Monitor antibiotic therapy—erythromycin is drug of choice.
- C. Nursing care is the same as for pneumonia.

Emerging Viruses

See Chapter 6, Infection Control.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Definition: A functional category applied to respiratory disorders that obstruct the pathway of normal alveolar ventilation either by spasm of the airways, mucus secretions, or changes in the airway and/or alveoli.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) PRECAUTIONS

- Oxygen must be given via a low-flow controlled system. Usually nasal cannula for chronic obstructive pulmonary disease (COPD) client at low liter flow (½ to 1 LPM).
- The Venturi mask provides O₂ at 24–40%.
- ABG measurements—important to maintain PaO₂ of 60–90 mm Hg. (If less than 55 mm Hg, client may require oxygen.)

Chronic Bronchitis

♦ **Definition:** A long-term inflammation of the mucous membranes of the bronchial tubes with recurrent cough and sputum production for 3 months or more in 2 consecutive years.

Characteristics

- A. Cigarette smoking is probably the biggest culprit, inhibiting the ciliary activity of the bronchi, and resulting in increased stimulation of the mucous glands to secrete mucus.
- B. Immunological factors and familial predisposition may also be implicated for those individuals who do not smoke.

Assessment

- A. Assess for bronchoconstriction.
- B. Evaluate malaise.
- C. Check for exertional dyspnea.
- D. Assess for hemoptysis.
- E. Evaluate cough—may not be productive but may be purulent.
- F. Assess for hypoxia.
- G. Evaluate lung fields for the following: atelectasis, percussion—hyperresonant, tactile fremitus decreased, prolonged expiratory phase, expansion decreased, trachea midline, wheezes, rales.

♦ Implementation

- A. Administer antibiotics when infection occurs.
- B. Administer bronchodilators (drug of choice) to relieve bronchospasm and facilitate mucus expectoration.
- C. Steroid therapy may be used, but it is still controversial.
- D. Encourage fluids to 3000 mL daily to dilute secretions.
- E. Provide chest physiotherapy.
- ♦ F. Monitor oxygen therapy.
- ♦ G. Teaching principles.
 1. Stop smoking—this is the major irritant to the lungs and the major cause of death from cancer.
 2. Avoid irritants or allergens and pollutants when possible.
 3. Avoid high altitudes (where there is less oxygen).
 4. Teach pursed-lip breathing (helps to open airway and stretching exercises).
 5. Monitor edema in legs and ankles, which may signify right-sided heart failure.
 6. Yearly flu and pneumococcal vaccines.

Bronchiectasis

♦ **Definition:** Thought to develop following airway obstruction or atelectasis. Characterized by permanent,

abnormal dilation of one or more large bronchi, leading to destruction of elastic and muscular structures of bronchial wall. Most often associated with bacterial infections such as pneumonia or TB.

Assessment

- A. Evaluate for frequent, severe paroxysms of coughing.
- B. Assess for hemoptysis.
- C. Check for fetid breath.
- D. Assess for thick, profuse sputum.
- E. Observe for breathlessness, fatigue.
- F. Assess for profuse night sweats.
- G. Assess for weight loss, anorexia.
- ♦ H. Evaluate lung fields and chest for the following:
 1. Trachea deviates to the affected side.
 2. Decreased expansion.
 3. Percussion—dull.
 4. Vocal fremitus and breath sounds absent if bronchus occluded.
 5. Vocal fremitus increased; bronchovesicular/bronchial breath sounds if bronchus open.
 6. Rales, rhonchi.

♦ Implementation

- A. Administer antibiotics as ordered. Usually given for 7–10 days—may be long term.
- B. Provide chest physiotherapy—postural drainage.
- C. Administer bronchodilators and aerosolized nebulizer treatments to assist in removal of secretions.
- D. Monitor oxygen therapy if hypoxia occurs.
- E. Prepare client for surgery if severe hemoptysis occurs.
- F. Encourage client to rest by providing quiet environment.
- G. Provide high-protein diet with increased fluid intake.
- H. Provide frequent mouth care.

Emphysema

Definition: The permanent overdistention of the alveoli with resulting destruction of the alveolar walls. (*Emphysema* is a Greek word meaning “overinflated.”)

♦ Assessment

- A. Alpha-antitrypsin deficiency causes condition to develop at a young age.
- B. Individual usually has a history of smoking, chronic cough, wheezing, and shortness of breath.
- C. Observe for dyspnea—chief complaint.
- D. Assess sputum production.
- E. Observe for weight loss.
- F. Assess for hypoxia, hypercapnia.
- G. Observe physical characteristics of chest.
 1. Barrel chest.
 2. Expansion decreased.

- 3. Flat diaphragm.
- 4. Accessory muscles of respiration used.
- H. Assess for decreased tactile fremitus.
- I. Percuss for hyperresonance.
- J. Auscultate for distant breath sounds.
- K. Assess for prolonged expiratory phase.
- L. Assess for wheezes, forced expiratory rhonchi.
- M. Assess for complications.
 - 1. Pulmonary hypertension.
 - 2. Right-sided heart failure.
 - 3. Spontaneous pneumothorax.
 - 4. Acute respiratory failure.
 - 5. Peptic ulcer disease, gastroesophageal reflux disease (GERD).

Implementation

- A. Monitor for signs of impending hypoxia.
- B. Monitor for alterations in lung sounds.
- C. Instruct on pursed lip breathing exercises.
- ◆ D. Administer low-concentration oxygen.
 - 1. Usually 2 L/min.
 - 2. Raise PaO₂ to 65–80 mm Hg.
- E. Monitor for signs of carbon dioxide narcosis.
- ◆ F. Monitor medications.
 - 1. Inhaled bronchodilators: beta agonists: Proventil, Ventolin (albuterol); Alupent (meta-proterenol)—to improve gas exchange by stimulating beta receptors in the lungs.
 - 2. Systemic corticosteroids: controversial—used when bronchodilators are unsuccessful or during an acute attack.
 - 3. Inhaled corticosteroids: Azmacort (triamcinolone), Beclovent (beclomethasone), AeroBid (flunisolide)—affect lungs with no systemic effects.
 - 4. Antibiotics—to combat infection.
- G. Provide hydration.
 - 1. Necessary to liquefy secretions present, or to prevent formation of thick, tenacious secretions in clients with pulmonary disease.
 - 2. Modalities.
 - a. Oral intake of fluids.
 - b. IV administration of fluids.
 - c. Humidification to tracheobronchial tree.
- ◆ H. Monitor humidification and aerosol therapy—an important part of treatment plan.
 - 1. Humidification can be delivered through humidifier or nebulizer.
 - 2. Metered-dose inhaler (MDI) therapy, nebulizer.
 - a. Corticosteroids, beta₂-adrenergic agonists (isoproterenol), and anticholinergic agents may be administered alone or in combination.
 - b. Nebulizers deliver aerosols.

- 3. Clinical implications.
 - a. Relief of bronchospasm and mucosal edema.
 - b. Mobilization of secretions.
 - c. Humidification of the tracheobronchial tree.

◆ I. Provide for chest physiotherapy.

- 1. Postural drainage.
 - a. Positions are utilized to promote gravitational drainage and mobilization of secretions of affected lung segments.
 - b. Allows the client to expectorate secretions.
 - c. Secretions may be aspirated through a sterile suctioning procedure.
- ◆ 2. Percussion and vibration.
 - a. Valuable and necessary adjunct to postural drainage. Cupped-hand position used in percussion.
 - b. Vibration of the chest is performed only during the expiratory phase of respiration.
- ◆ 3. Deep breathing and coughing.
 - a. Should be encouraged often.
 - b. Clients with COPD should be taught the mechanics of an effective cough.
 - (1) Contract intercostal muscles.
 - (2) Contract diaphragm.
 - (3) Fill lungs with air.
- ◆ 4. Breathing exercises or exercise regimen—an integral part in the management of clients with coronary disease.
 - ◆ a. Diaphragmatic breathing.
 - (1) Breathe in via nose.
 - (2) Exhale through slightly pursed lips.
 - (3) Contract abdominal muscles while exhaling.
 - (4) Chest should not move, but abdomen should do the moving. (Abdomen contracts at expiration.)
 - (5) Exercises can be learned with client flat on back and then done in other positions.
 - b. Accelerated diaphragmatic breathing.
 - c. Chest expansion—apical, lateral (unilateral, bilateral), basal.
 - d. Controlled breathing with daily activities and graded exercises to improve general physical fitness.
 - e. Relaxation and stretching.
 - f. General relaxation.
- 5. Pressure ventilation options.
 - a. PEP (positive expiratory pressure).
 - b. NIPPV (noninvasive positive-pressure ventilation).

- c. IPV (intrapulmonary percussive ventilation).
- d. Intermittent positive pressure breathing (IPPB) use is very controversial and is not treatment of choice.
- J. Monitor carefully for complications of right-sided (cor pulmonale) and left-sided heart failure.

◆ POSITIONS FOR CHEST PHYSIOTHERAPY

- To affect RUL and LUL, place client in upright position.
- To affect RML, position client on left side with head slanted down, right shoulder one-quarter turn onto pillow. Cup anteriorly over right nipple.
- To affect lingula LL, position client on right side with head slanted down, left shoulder one-quarter turn onto pillow. Cup anteriorly over left nipple.
- To affect RLL and LLL, place client in Trendelenburg position, alternating sides, or prone.

RUL = right upper lobe; LUL = left upper lobe;

RML = right middle lobe; LL = left lung;

RLL = right lower lobe; LLL = left lower lobe.

Asthma

Definition: An obstructive chronic inflammatory disorder of the airways manifested by narrowing of the airways and characterized by generalized bronchoconstriction, excess mucus secretion, and mucosal edema. More than 14.6 million people have asthma in the United States.

Assessment

- ◆ A. Assess classification of asthma.
 - 1. Mild intermittent.
 - 2. Mild persistent.
 - 3. Moderate persistent.
 - 4. Severe persistent.
- B. Evaluate for precipitating factors and triggers, which may include emotions, infection, seasonal changes, occupational exposure to dusts or chemical irritants, certain drugs, exercise.
- C. Evaluate for respiratory problems.
 - 1. Cough may be nonproductive or very purulent.
 - 2. Air hunger, dyspnea.
 - 3. Wheezing.
 - 4. Tachypnea.
 - 5. Prolonged expiratory phase.
 - 6. Tachycardia.
 - 7. Hypoxia, cyanosis, hypercapnia.
 - 8. Assess physical signs.
 - a. Retraction of intercostal and sternal muscles.
 - b. Percussion—hyperresonant.
 - c. Distant breath sounds.
 - d. Rhonchi, wheezes, rales.

- ◆ 9. Ominous signs.
 - a. Diminished breath sounds.
 - b. No wheezing (quiet chest).
 - c. Increased respiratory rate.

Implementation

- A. Provide supportive respiratory care.
- B. Identify and avoid known triggers for asthma.
- C. Avoid aspirin, NSAIDS.
- D. Teach peak-flow monitoring.
- E. Administer drug therapy.
 - 1. Beta agonists: Adrenaline (epinephrine), Proventil, Ventolin (albuterol), Bricanyl, Brethine (terbutaline), Bronkosol (isoetharine).
 - 2. Methylxanthines: Truphylline (aminophylline and derivatives).
 - 3. Corticosteroids.
 - 4. Anticholinergics (atropine).
 - 5. Mast cell inhibitors: Nasalcrom (cromolyn sodium).
- ◆ F. Current treatment approach for asthma attack.
 - 1. During attack, bronchial mucosa releases histamine and slow-reacting substances of anaphylaxis (SRS-A) bronchoconstrictors.
 - 2. SRS-A are leukotrienes that cause airway inflammation, edema, and mucus secretion.
 - 3. New drugs that antagonize leukotrienes and reduce symptoms are available.
 - 4. Anti-inflammatory drugs taken orally are Accolate (zafirlukast), Zyrlo (zileuton), and Singulair (montelukast).
- G. Sedatives and narcotics should be used with caution.
- H. Administer oxygen via nasal cannula.
- ◆ I. Encourage fluids to 3000 mL daily.
- J. Breathing exercises, postural drainage.
- ◆ K. Metered-dose inhaler (MDI) therapy has advantages over nebulized medications.
 - 1. Teach client to coordinate puff of drug with breath, hold for 10 seconds, one puff at a time.
 - 2. Use of holding chambers attached to MDI mouthpiece (spacers) enhance effectiveness.

RESTRICTIVE RESPIRATORY DISORDERS

Pleural Effusion

- ◆ **Definition:** A collection of nonpurulent fluid in the pleural space. Many pathological processes can irritate the pleurae and cause effusion, but in older clients cancer is a common cause. Empyema is a pleural effusion that contains pus.

TYPES OF PNEUMOTHORAX CONDITIONS

- **Tension pneumothorax—a medical emergency**
 - a. The mediastinum shifts away from the side of the pneumothorax, compressing the unaffected lung.
 - b. A large-bore needle introduced into the pleural cavity to release the pressure will change a tension pneumothorax into a simple pneumothorax.
 - c. A tube thoracostomy is then performed.
- **Spontaneous (or closed) pneumothorax**
 - a. Occurs suddenly when lung is weakened—air moves from lung to intrapleural space, causing collapse.
 - b. If the pneumothorax is large or increasing in size, closed tube thoracostomy is performed.
 - c. Chest tubes attached to water seal are utilized to reexpand the lung.
 - d. A small pneumothorax may reabsorb on its own.
- **Hemothorax (blood in the thoracic cavity)**
 - a. Hemothorax occurs with pneumothorax, especially if trauma is the causative factor.
 - b. Treatment: evacuate the blood through chest tube insertion.

♦ Assessment

- A. Assess for dyspnea.
- B. Check fatigue level, malaise.
- C. Assess for elevated temperature.
- D. Assess for dry cough.
- E. Assess for pleural pain.
- F. Check for tachycardia.
- G. Assess physical signs.
 1. Absence of movement on side of effusion.
 2. Percussion—dull.
 3. Decreased breath sounds.
 4. Pleural friction rub occurs in dry pleurisy; as effusion develops, friction rub disappears.
 5. Collapse of lung—when fluid increases in amount.
 6. Mediastinal structures shift position.
 7. Cardiac tamponade.

Implementation

- ♦ A. Assist with thoracentesis, which is used to aid in diagnosis and to relieve pressure by draining excess fluid.
 1. Explain procedure to client.
 2. Instruct client to tell you any compromising symptoms such as difficulty in breathing or discomfort.
 3. Give client reassurance during procedure.
- B. Monitor vital signs.

- C. Following removal of fluid, observe for bradycardia, hypotension, pain, pulmonary edema, or pneumothorax.
- D. Monitor administration of drugs if ordered for empyema.
- E. Administer oxygen as ordered; high-Fowler's position.
- F. Teach deep-breathing exercises to increase lung expansion and coughing.
- G. Monitor chest tubes and drainage.
- H. Encourage intake of fluids.

Pneumothorax

♦ *Definition:* A collection of air in the pleural cavity. As the air collects in the pleural space, the lung collapses and respiratory distress ensues. This condition occurs as a result of chest wall penetration by surgery or injury or when a disease process interrupts the internal structure of the lung.

♦ Assessment

- A. Assess for sharp, sudden chest pain.
- B. Assess for gasping respirations, dyspnea.
- C. Check anxiety, vertigo.
- D. Assess for hypotension.
- E. Look for pallor.
- F. Evaluate cough.
- G. Check tachycardia.
- H. Evaluate elevated temperature, diaphoresis.
- I. Assess for hypoxia, hypercapnia.
- J. Assess for physical signs.
 1. Paradoxical or diminished movement on the affected side.
 2. Percussion—hyperresonant.
 3. Absent breath sounds.
 4. Tactile fremitus decreased.

Implementation

- A. Monitor vital signs frequently for impending shock.
- B. Auscultate lungs frequently.
- C. Monitor for respiratory distress.
- D. Assist client to semi- or high-Fowler's position—maintain bed rest initially.
- E. Reassure client, who will be anxious.
- F. Prepare for possible thoracentesis and/or chest tube placement.

Acute Respiratory Distress Syndrome

Definition: Inflammatory syndrome marked by disruption of the alveolar-capillary membrane. Sudden, progressive form of acute respiratory failure from damaged alveolar-capillary membranes, with increased permeability to intravascular fluid. Mortality rate approximately 50%.

Characteristics

- A. Conditions predisposing to acute respiratory distress syndrome (ARDS).
 - 1. Aspiration.
 - 2. Pneumonia.
 - 3. Chest trauma.
 - 4. Oxygen toxicity.
 - 5. Embolism.
- B. Manifestations.
 - 1. Dyspnea, cough, restlessness, scattered crackles (early).
 - 2. Severe dyspnea, retractions.
 - 3. Hypoxemia, hypercapnia.
 - 4. Crackles, rhonchi, pulmonary edema.
 - 5. Decreased lung compliance.
 - 6. Mental status changes.

Assessment

- A. Assess for cyanosis.
- B. Assess for shallow, increased respirations, restlessness and anxiety.
- C. Evaluate use of accessory muscles for breathing.
- D. Assess for decreased breath sounds.
- E. X-ray shows bilateral patchy infiltrates.

Implementation

- A. Monitor oxygen therapy—leading to intubation and ventilation.
- B. Use prone positioning to increase PaO₂.
- C. Monitor ABGs.
- D. Monitor pulmonary artery catheter for pressure monitoring.
- E. Maintain fluid balance.

Cancer of the Lung

Definition: Pulmonary tumors are either primary or metastatic and interrupt the normal physiological internal structures of the lung.

Characteristics

- ◆ A. Classification of lung cancer is designated by anatomic location or by histological pattern.
 - 1. Anatomic classification.
 - a. Central lesions involve the tracheobronchial tube up to the distal bronchi.
 - b. Peripheral lesions extend from the distal bronchi and include the bronchioles.
 - 2. Four histologic types.
 - a. Squamous cell (epidermoid).
 - (1) Most frequent lung lesions.
 - (2) Affects more men than women.
 - (3) Associated with cigarette smoking.

- (4) Lesion usually starts in bronchial area and extends.
- (5) Metastasis not usually a rapid process.

- b. Adenocarcinoma.
 - (1) Usually develops in peripheral tissue (smaller bronchi).
 - (2) Metastasizes by blood route.
 - (3) May be associated with focal lung scars.
 - (4) Affects more women than men.
 - (5) Bronchiole—alveolar cell and bronchogenic are two types.
- c. Small-cell anaplastic or oat cell carcinoma.
 - (1) Aggressive and spreads bilaterally.
 - (2) Considered metastatic because usually spreads to distant sites.
- d. Large-cell (undifferentiated) carcinoma—usually spreads through the bloodstream; high correlation with smoking.
- B. Detection—pulmonary lesions are not usually detected by physical exam, and symptoms do not occur until process is extensive. Chest x-ray is very helpful in diagnosis; also CT scan and MRI.

♦ **Assessment**

- A. Assess for pulmonary symptoms.
 - 1. Persistent cough that changes in character (most common sign).
 - 2. Dyspnea.
 - 3. Bloody sputum.
 - 4. Long-term pulmonary infection.
 - 5. Atelectasis.
 - 6. Bronchiectasis.
 - 7. Chest pain.
 - 8. Chills, fever.
- B. Assess for systemic symptoms.
 - 1. Weakness.
 - 2. Weight loss.
 - 3. Anemia.
 - 4. Anorexia.
 - 5. Metabolic syndromes.
 - a. Hypercalcemia.
 - b. Inappropriate antidiuretic hormone (ADH).
 - c. Cushing's syndrome.
 - d. Gynecomastia.
 - 6. Neuromuscular changes.
 - a. Peripheral neuropathy.
 - b. Corticocerebellar degeneration.
 - 7. Connective tissue abnormalities.
 - a. Clubbing.
 - b. Arthralgias.
 - 8. Dermatologic abnormalities.
 - 9. Vascular changes.

MEDICAL IMPLICATIONS**Diagnostic Evaluation**

- Chest x-ray—a negative film does not rule out cancer.
- Cytologic examination of sputum—to detect malignant cells.
- Bronchoscopy—view of tracheobronchial tree; to stage cancer.
- Percutaneous fine-needle aspiration—tissue for diagnosis.
- Bone scan or bone marrow for metastasis; computed tomography may show primary tumor and metastasis.
- Mediastinoscopy—examination of lymph nodes through a small incision over sternal notch.

Management

- Surgery for localized tumors (Stage I and II).
- Radiation therapy.
- Chemotherapy with multiple drugs: Platinol (*cisplatin*) and topoisomerase inhibitors.

Implementation

- A. Comprehensive supportive care of client in the preoperative and postoperative state. (See section on care of the operative client.)
- ◆ B. Nursing care for common lung cancer symptoms.
 - 1. Cough.
 - a. Encourage fluid intake.
 - b. Monitor amount, type, and change of color of sputum.
 - c. Avoid lung irritants.
 - d. Give antitussives as ordered.
 - 2. Dyspnea.
 - a. Teach coughing, deep breathing, and pursed-lip breathing.
 - b. Administer humidified oxygen as ordered.
 - c. Suction to remove secretions as needed.
 - d. Position for comfort—high-Fowler's leaning over a cushion may help.
 - e. Administer medications: bronchodilators, anxiolytic agents.
 - 3. Hemoptysis.
 - a. Administer antibiotics as needed.
 - b. Mild symptoms may resolve; instruct client to notify physician if bleeding continues or worsens.
 - 4. Fatigue.
 - a. Monitor blood count.
 - b. Teach client to pace activities, rest frequently, and ask for help.
 - 5. Pain.
 - a. Develop a plan for analgesia administration.
 - b. Teach alternative techniques for managing pain: relaxation, biofeedback.
 - 6. Weight loss.
 - a. Consult with nutritionist for planning—use nutritional supplements.

- b. Request appetite stimulant from physician.
- c. Encourage client to rest before and after meals.

- C. Give appropriate information to client to allay anxiety and clarify expectations.
- D. Instruct client in postoperative procedures to minimize complications.
- E. Give psychological support.

See Chapter 9, Oncology Nursing.

THORACIC TRAUMA**Trauma Assessment**

- ♦ A. Check for airway patency.
 - 1. Clear out secretions.
 - 2. Insert oral airway if necessary.
 - 3. Position client on side if there is no cervical spine injury.
 - 4. Place hand or cheek over nose and mouth of client to feel if client is breathing.
- ♦ B. Inspect thoracic cage for injury.
 - 1. Inspect for contusions, abrasions, and symmetry of chest movement.
 - 2. If open wound of chest, cover with a nonporous dressing, taped on three sides to allow vent and prevent tension pneumothorax.
 - 3. Watch for symmetrical movement of chest. Asymmetrical movement indicates
 - a. Flail chest.
 - b. Tension pneumothorax.
 - c. Hemothorax.
 - d. Fractured ribs.
 - 4. Observe color; cyanosis indicates decreased oxygenation.
 - 5. Observe type of breathing; stertorous breathing usually indicates obstructed respiration.
- ♦ C. Auscultate lung sounds.
 - 1. Absence of breath sounds: indicates lungs not expanding, due to either obstruction or deflation.
 - 2. Rales or crackles (crackling sounds): indicate vibrations of fluid in lungs.
 - 3. Rhonchi (coarse sounds): indicate partial obstruction of airway.
 - 4. Decreased breath sounds: indicate poorly ventilated lungs.
 - 5. Detection of bronchial sounds that are deviated from normal position: indicates mediastinal shift due to collapse of lung.
- D. Determine level of consciousness; decreased sensorium can indicate hypoxia.
- E. Observe sputum or tracheal secretions; bloody sputum can indicate contusions of lung or injury to trachea and other anatomical structures.

Trauma Implementation

- A. Take history from client if feasible or family member, witness to trauma, or emergency personnel to aid in total evaluation of client's condition.
- B. Administer electrocardiogram to establish if there is associated cardiac damage.
- ♦ C. Maintain patent airway.
 - 1. Suction.
 - 2. Intubation.
 - a. Oral airway.
 - b. Endotracheal intubation.
- D. Maintain adequate ventilation.
- E. Maintain fluid and electrolyte balance.
 - 1. When blood and fluid loss is replaced, watch carefully for fluid overload, which can lead to pulmonary edema.
 - 2. Record intake and output.
- F. Maintain acid-base balance; make frequent blood gas determinations, as acid-base imbalances occur readily with compromised respirations or with mechanical ventilation.
- G. Provide relief of pain.
 - 1. Analgesics should be used with caution because they depress respirations. (Demerol [meperidine] is rarely used now due to its CNS neurotoxic effects.)
 - 2. Morphine sulfate and other opioids can be used with careful monitoring.
 - 3. Nerve block may be used.

THORACIC INJURIES

Definition: Thoracic injuries involve trauma to the chest wall, lungs, heart, great vessels, and esophagus. Injuries occur as a result of blunt trauma (e.g., crush injury) or penetrating trauma (e.g., gunshot wound).

♦ Hemothorax or Pneumothorax

♦ *Definition:* *Hemothorax* refers to blood in pleural space. *Pneumothorax* refers to air in pleural space. As air or fluid accumulates in pleural space, positive pressure builds up, collapsing the lung.

Assessment

- A. Evaluate pain.
- B. Auscultate for decreased breath sounds.
- C. Observe for tracheal shift to unaffected side.
- D. Observe for dyspnea and respiratory embarrassment.
- E. Observe for hypovolemic shock, hypotension.
- F. Inspect chest for asymmetrical expansion.

Implementation

- ♦ A. Assist with the insertion of a large-bore needle into the second intercostal space, midclavicular line,

- followed by aspiration of the fluid or air by means of thoracentesis.
- B. Assist with insertion of chest tubes and connection to closed-chest drainage.
- C. Continuously observe vital signs for complications such as shock and cardiac failure.
- D. See Restrictive Respiratory Disorders: Pneumothorax.

♦ Open Wounds of the Chest

♦ Assessment

- A. Assess for air entering and leaving the wound during inspiration and expiration.
- B. Evaluate if intrapleural negative pressure is lost, thereby embarrassing respirations, leading to hypoxia. Death can occur if not corrected promptly.

♦ Implementation

- A. Cover with occlusive dressing taped on three sides and vented to allow air to escape and decrease risk of tension pneumothorax.
- B. Place client on assisted ventilation if necessary.
- C. Prepare for insertion of chest tubes.
- D. Place client in high-Fowler's position (unless contraindicated) to assist in adequate ventilation.

Fractured Ribs

Assessment

- A. Evaluate pain and tenderness over fracture area, especially on inspiration.
- B. Observe for bruising at injury site.
- C. Evaluate respiratory embarrassment occurring from splinters puncturing lung and causing pneumothorax.
- D. Observe client for splinting of chest causing shallow respirations. Splinting causes a reduction in lung compliance as well as respiratory acidosis.

Implementation

- ♦ A. Decrease pain to promote good chest expansion. Narcotics drug therapy used with caution due to respiratory depression.
- B. Encourage deep breathing and coughing to prevent respiratory complications such as atelectasis and pneumonia.
- C. Observe for signs of hemorrhage and shock.
- D. Assist with intercostal nerve block if necessary to decrease pain.

Flail Chest

Definition: Multiple rib fractures that result in an unstable chest wall, with subsequent respiratory impairment causing

flail area to move paradoxically to intact portion of chest during respiration.

Assessment

- A. Evaluate for severe chest pain.
- B. Observe for dyspnea leading to cyanosis.
- C. Assess for tachypnea with shallow respirations.
- ♦ D. Assess if detached portion of flail chest is moving in opposition to other areas of chest cage and lung.
 - 1. On inspiration, the affected chest area is depressed; on expiration, it is bulging outward.
 - 2. This causes poor expansion of lungs, which results in carbon dioxide retention and respiratory acidosis.
- ♦ E. Evaluate ability to cough effectively. Inability leads to accumulation of fluids and respiratory complications such as pneumonia and atelectasis.
- F. Assess for signs of cardiac failure due to impaired filling of right side of heart. This condition results from high venous pressure caused by paradoxical breathing.
- G. Observe for rapid, shallow, and noisy respirations and accessory muscle breathing.

♦ Implementation

- A. Progressive respiratory failure is treated with intubation and mechanical ventilation.
- B. Positive end-expiratory pressure (PEEP) used to improve oxygenation.
- C. Suction as needed to maintain airway patency.
- D. Pain medications as ordered.
- E. Observe for signs of shock and hemorrhage.
- F. For client on ventilator, use nasogastric tube to prevent abdominal distention and emesis, which can lead to aspiration.
- G. For client with mild to moderate chest injuries when client is not on mechanical ventilator:
 - 1. Encourage turning, coughing, and hyperventilating every hour.
 - 2. Administer oxygen.
 - 3. Incentive spirometry.
 - 4. Suction as needed.

Cardiac Tamponade

♦ *Definition:* Acute accumulation of blood or fluid in the pericardial sac (interferes with diastolic filling, which causes decreased cardiac output, myocardial hypoxia and cardiac failure). Can occur from blunt or penetrating wounds.

♦ Assessment

- A. Assess for Beck's triad: increased CVP with neck vein distention, muffled heart sounds, and pulsus paradoxus.

- B. Assess for decreased blood pressure.
- C. Assess for narrowed pulse pressure.
- ♦ D. Evaluate paradoxical pulse (pulse disappears on inspiration and is weak on expiration because of changed intrathoracic pressure).
 - 1. Paradoxical pulse is an exaggeration of the normal fall in arterial BP on inspiration.
 - 2. Defined as a fall in systolic arterial BP of 10–20 mm Hg or more on inspiration.
- E. Observe for agitation.
- F. Observe for cyanosis.
- G. Chest pain.

Implementation

- A. Assist with pericardiocentesis. Large-bore needle (16–18 gauge) is inserted by physician into pericardium, and blood is withdrawn.
- B. Maintain cardiac monitoring to observe for arrhythmias due to myocardial irritability.
- C. Have cardiac defibrillator and emergency drugs available to treat cardiac arrhythmias.
- D. Monitor vital signs and watch for shock.

TREATMENT FOR TRAUMATIC INJURY

Chest Tube

Definition: Chest tubes remove air and fluid from lungs and restore normal intrapleural pressure so lungs can reexpand.

Assessment

- A. Before insertion.
 - 1. Complete client procedure verification.
 - 2. Obtain consent after physician explains procedure.
 - 3. Perform baseline cardiopulmonary assessment.
 - 4. Monitor vital signs (VS) and pulse oximetry.
 - 5. Observe chest excursion.
 - 6. Assess changes in level of consciousness (LOC).
 - 7. Obtain a preprocedure chest x-ray if ordered.
 - 8. Assess anxiety and medicate 30 minutes prior to insertion.
 - 9. Prepare necessary equipment and supplies, including two rubber-tipped hemostats for each chest tube at bedside and to travel with client should he or she leave the unit.
 - 10. Position client according to physician's specifications.
- B. During insertion.
 - 1. Evaluate client's safety while tubes inserted.
 - 2. Assess patency of chest tubes.

3. Observe for mediastinal shift.
4. Auscultate breath sounds for air flow.
5. Observe for bilateral chest expansion.
6. Evaluate chest drainage, color and amount.

♦ **Implementation**

- A. Purpose: To reestablish negative pressure in pleural space by the evacuation of air and fluid.
 1. Uses: Used for pleural effusions, pneumothorax and hemothorax.
 2. Safety measure: Always keep rubber-tipped Kelly clamps and Vaseline gauze at bedside. There should be two Kelly clamps per chest tube.
- B. Assist physician in placement of tubes.
 1. Tubes placed in pleural cavity following thoracic surgery.
 2. Provides for removal of air and serosanguinous fluid from pleural space.
- C. Attach to water-seal suction—maintains closed system.
 1. Tape all connectors.
 2. Ensure that all stoppers in bottles are tight fitting.
- D. Apply suction.
 1. Keep unit below level of bed.
 2. Keep suction level where ordered (be sure that bubbling is not excessive in the pressure-regulating chamber).
 3. Maintain water level in chamber.
- E. Nursing care immediately following procedure.
 1. Obtain repeat chest x-ray.
 2. Assess respirations.
 3. Assess integrity of the system.
 4. Assess drainage.
 5. Assess for fluctuation in tubing during respirations.
- F. Follow-up nursing care (hourly initially, once stabilized q 2 hours).
 1. Respiratory rate and effort.
 2. Bilateral lung sounds.
 3. Symmetrical chest excursion.
 4. Assess and medicate for pain.
 5. Check integrity of dressing.
 6. Subcutaneous emphysema (should ↓ unless air leak).
 7. Tidaling with inspiration.
 8. Water seal—no bubbling unless leak (client or system).
- G. Facilitating drainage.
 1. Keep tubing looped on bed—avoid dependent drainage.
 2. Reposition every 2 hours or as ordered.
 3. Encourage client to cough and deep-breathe.
 4. Use gentle wall suction if ordered.

5. Monitor drainage (color, amount), initially every hour, when < 100 mL/hr, monitor q 2 hours. Document every 4 hours.
6. Drainage should be no more than 100 mL/hr or 500 mL in 8 hours.
- H. Maintain integrity of system.
 1. Keep water seal filled to the 2-cm level.
 2. Keep suction control chamber to ordered level (usually 20 cm and check for evaporation of water q shift) or dry suction to ordered level.
 3. Keep system below level of chest.
 4. Tape all connections.
 5. Secure drainage system to bed or floor.
 6. If transporting, secure drainage system to stretcher or wheelchair (W/C).
 7. Position system for safety prior to raising or lowering bed.
 8. Never clamp unless ordered.
 - ♦ 9. Milking of chest tubes is not done unless specifically ordered by physician.
 - a. With specific physician's orders, milk every 30–60 minutes.
 - b. Milk away from client toward the drainage receptacle (Pleur-evac or bottles).
 - c. Pinch tubing close to the chest with one hand as the other hand milks the tube. Continue going down the tube in this method until drainage receptacle is reached.
 - d. Milking may be ordered—stripping should be avoided unless specifically ordered.
- I. Change drainage system.
 1. Prepare new drainage system.
 2. Fill under water seal.
 3. Fill suction control to desired level (if ordered).
 4. Clamp and disconnect chest tube.
 5. Attach to new drainage system.
 6. Retape all tubing connections.
 7. Open clamp.
- J. Nursing care following removal of chest tubes.
 1. Explain procedure to client.
 2. Medicate 30 minutes prior to removal.
 3. Prepare necessary equipment and supplies.
 4. Postprocedure chest x-ray as ordered.
 5. Perform baseline cardiopulmonary assessment.
 6. Monitor VS and pulse oximetry.
 7. Observe chest excursion.
 8. Monitor insertion site.
 9. Encourage cough, deep breathing, position change.

Chest Drainage Systems

Characteristics

- A. The disposable water-seal drainage system is most commonly used.

- ◆ B. General principles.
 1. Used after some intrathoracic procedures.
 2. Chest tubes placed intrapleurally.
 3. Breathing mechanism operates on principle of negative pressure (pressure in chest cavity is lower than pressure of atmosphere, causing air to rush into chest cavity when injury such as stab wound occurs).
 4. When chest has been opened, vacuum must be applied to chest to reestablish negative pressure.
 5. Closed water-seal drainage is method of reestablishing negative pressure.
 - a. Water acts as a seal and keeps the air from being drawn back into pleural space.
 - b. Open drainage system would allow air to be sucked back into chest cavity and collapse lung.
 6. Closed drainage is established by placing catheter into pleural space and allowing it to drain under water.
 - a. The end of the drainage tube is always kept under water.
 - b. Air will not be drawn up through catheter into pleural space when tube is under water.

Assessment

- A. Assess client's respiratory rate, rhythm, and breath sounds for signs of respiratory distress.
- B. Check that all connections on tubing are airtight and suction control is connected.
- C. Examine system to see if it is set up and functioning properly.
- D. Identify any malfunctions in system (e.g., air leaks, negative pressure, or obstructions).

Implementation

- A. Maintain chest drainage system.
- B. Most pleural drainage systems have three basic compartments (see **Figure 8-11**).
 1. Collection chamber (1). Fluid and air from chest cavity drain into chamber. Air in this chamber is vented to the second chamber.
 2. Water-seal chamber (2). Acts as one-way valve so air drains from the chest cavity, but can't return to the client. Air bubbles out into water. Water level fluctuates as intrapleural pressure changes.
 3. Suction-control chamber (3). Amount of suction applied regulated by amount of water in chamber or depth of tubing in water, not by the amount of suction applied.
 4. When drainage system pressure becomes too low, outside air is sucked into the system. Results in constant bubbling in the pressure regulator bottle.
 5. Whenever suction is off, drainage system must be open (vented) to the atmosphere.
 - a. Intrapleural air can escape from the system.

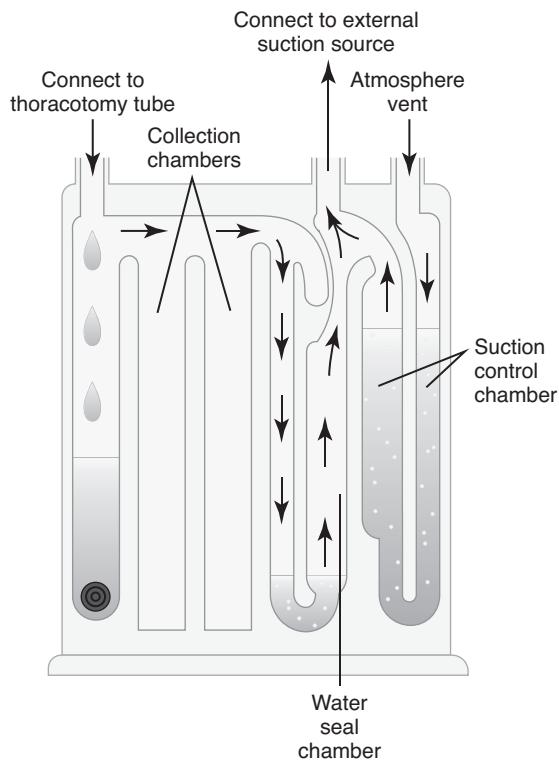


Figure 8-11 Disposable water-seal system

- b. Detach the third chamber tubing from the suction motor to provide the air vent.
- C. A flutter or Heimlich valve may be used.
 1. This is a one-way flutter valve within a rigid plastic tube with an attached drainage bag.
 2. It is attached to the end of the chest tube.
 3. Valve opens whenever pressure is greater than atmospheric pressure.
 4. Can be used for emergency transport with small to moderate pneumothorax.
 5. Allows for client mobility.
 6. Can be hidden under clothes.
 7. Clients can return home with Heimlich valves in place.

CHECKPOINTS FOR CHEST TUBE AIR LEAKS

- *Insertion site:* pinch tube at chest insertion site—bubbling stops in water-seal chamber if there is an air leak at insertion site.
- *Tubing:* pinch rubber connecting tube—bubbling stops if there is a leak at chest tube connector site.
- *Water-seal drainage system:* pinch rubber connecting tubing—bubbling continues if there is a leak in water-seal connection.
- *Water-seal chamber:* there should not be excessive continuous bubbling present; when client exhales or coughs and air is forced out of pleural space; or when lung has reexpanded, bubbling occurs.
- *Continuous bubbling:* if found in water-seal chamber, indicates an air leak.

Mechanical Ventilation

Assessment

- A. Assess respiratory status for need to use mechanical ventilation.
- B. Identify type of mechanical ventilation needed.
 - 1. Negative-pressure ventilator.
 - a. Helpful in problems of a neuromuscular nature, spinal cord injuries.
 - b. Not effective in the treatment of increased airway resistance.
 - ◆ c. Types—full body, chest, and chest–abdomen. Employs intermittent negative pressure around chest wall to pull wall out and decrease intrathoracic pressure.
 - 2. Positive-pressure ventilator.
 - a. Uses positive pressure (pressure greater than atmospheric) to inflate lungs. Primary use in acutely ill clients.
 - b. Types.
 - (1) Pressure cycle.
 - (a) Pressure ranges from 10 to 30 cm of water pressure.
 - (b) Air is actively forced into lungs.
 - (c) Expiration is passive.
 - (2) Volume cycle.
 - (a) Uses physiological limits.
 - (b) Predetermined total volume is delivered irrespective of airway pressure.
 - (c) Positive end-expiratory pressure (PEEP) utilized to maintain positive pressure between expiration and beginning of inspiration.
 - C. Assess for complications of positive-pressure therapy.
 - 1. Respiratory alkalosis.
 - 2. Gastric distention and paralytic ileus.
 - 3. Gastrointestinal bleeding.
 - 4. Diffuse atelectasis.
 - 5. Infection.
 - 6. Circulatory collapse.
 - 7. Pneumothorax.
 - 8. Sudden ventricular fibrillation.
 - 9. Ventilator-associated pneumonia (VAP).

Implementation

- A. Monitor client for complications.
- B. Suction client or check for kinks in tubing when pressure alarm sounds.
- C. Monitor blood gas values frequently.
- D. Maintain fluid therapy.
 - 1. IV route.
 - 2. Oral route if client able to swallow.

- E. Monitor intake and output.
- F. Follow VAP bundle protocol for prevention.
 - 1. Proper hand washing technique.
 - 2. Frequent and careful oral hygiene with chlorhexidine oral rinse.
 - 3. Elevate head of bed 30–45 degrees.
 - 4. Suction above the cuff.
 - 5. Proper cuff inflation 25 to 30 cm H₂O: use of minimal occlusion pressure.
 - 6. Daily sedation vacations and assessment of readiness to extubate.
 - 7. Stress ulcer prophylaxis.
 - 8. DVT prophylaxis.
 - 9. Increase use of noninvasive ventilation (NIV) (continuous positive airway pressure [CPAP], bilevel positive airway pressure [BiPAP]).
 - 10. Insure assessment/performance of daily spontaneous breathing trial (SBT).
 - 11. Use MDIs instead of small-volume nebulizer (SVN).
 - 12. Orotracheal instead of nasotracheal intubation.

Thoracic Surgical Procedures

Assessment

- ◆ A. Identify type of procedure done.
 - 1. Exploratory thoracotomy: incision of the thoracic wall; performed to locate bleeding, injuries, tumors.
 - 2. Thoracoplasty: removal of ribs or portions of ribs to reduce the size of the thoracic space.
 - 3. Pneumonectomy: removal of entire lung.
 - 4. Lobectomy: removal of a lobe of the lung (three lobes on right side, two on the left).
 - 5. Segmented resection: removal of one or more segments of the lung (right lung has ten segments and left lung has eight).
 - 6. Wedge resection: removal of a small, localized area of disease near the surface of the lung.
- B. Assess for postoperative client care needs.

Implementation

- ◆ A. Provide postoperative nursing management.
 - 1. Closed chest drainage is employed in all but pneumonectomy. In pneumonectomy, there is no lung to reexpand, so it is desirable that the fluid accumulate in empty thoracic space. Eventually the thoracic space fills with serous exudate, which consolidates to prevent extensive mediastinal shifts.
 - 2. Maintain patent chest tube drainage by chest tube milking—milk away from client toward drainage bottle, *only* with physician's orders.

- ◆ 3. Maintain respiratory function.
 - a. Have client turn, cough, and deep-breathe.
 - b. Suction if necessary.
 - c. Provide oxygen therapy.
 - d. Provide incentive spirometry.
 - e. Ventilate mechanically if necessary.
 - f. Auscultate lungs.
 - g. Observe for complications.
- ◆ 4. Ambulate early to encourage adequate ventilation and prevent postoperative complications. (Ambulate clients with pneumonectomies in 2 or 3 days to facilitate cardiopulmonary adjustment.)
- 5. Provide range-of-motion exercises to all extremities to promote adequate circulation.
- 6. Monitor central venous pressure with vital signs—watch for indications of impaired venous return to heart.
- ◆ 7. Position client correctly to maximize ventilation.
 - a. Use semi-Fowler's position when vital signs are stable to facilitate lung expansion.
 - b. Turn every 1–2 hours.
 - c. Pneumonectomy.
 - (1) No chest tubes inserted (no lung to reinflate). Fluid left in space to consolidate.
 - (2) Position on operative side to maximize ventilation.
 - (3) Some physicians will allow positioning on either side after 24 hours.
 - d. Segmental resection or wedge resection: Position on back or unoperative side (aids in expanding remaining pulmonary tissue).
 - e. Lobectomy: Turn to either side (can expand lung tissue on both sides).
- 8. Maintain fluid intake as tolerated. Watch for overload in pneumonectomy clients.
- 9. Provide arm and shoulder postoperative exercises—prevent adhesion formation.
 - a. Put affected arm through both active and passive range of motion every four hours.
 - b. Start exercises within 4 hours after client has returned to room following surgery.
- B. Monitor postoperative complications.
 - ◆ 1. Respiratory complications.
 - a. Causes of inadequate ventilation
 - (1) Airway obstruction due to secretion accumulation.
 - (2) Atelectasis due to underexpansion of lungs and anesthetic agents during surgery.
 - (3) Hypoventilation and carbon dioxide buildup due to incisional splinting because of pain.
 - (4) Depression of CNS from overuse of medications.
 - b. Tension pneumothorax
 - (1) Caused by air leak through pleural incision lines.
 - (2) Can cause mediastinal shift.
 - c. Pulmonary embolism.
 - d. Bronchopleural fistula.
 - (1) Air escapes into pleural space and is forced into subcutaneous tissue around incision, causing subcutaneous emphysema.
 - (2) Caused by inadequate closure of bronchus when resection is done.
 - (3) Another cause is alveolar or bronchiolar tears in surface of lung (particularly following pneumonectomy).
 - e. Atelectasis and/or pneumonia: caused by airway obstruction or as result of anesthesia.
 - f. Respiratory arrest can occur.
- ◆ 2. Circulatory complications.
 - a. Hypovolemia: due to fluid or blood loss.
 - b. Arrhythmias: due to underlying myocardial disease.
 - c. Cardiac arrest: can occur from either of these conditions.
 - d. Pulmonary edema: can occur due to fluid overload of circulatory system.

Tracheostomy

Characteristics

- A. Bypasses upper airway obstruction.
- B. Facilitates removal of secretions.
- C. Permits long-term mechanical ventilation.

Assessment

- A. Determine need for tracheostomy as compared to less intrusive methods of providing patent airway.
- B. Assess client's level of consciousness to determine client's ability to understand explanation and instructions.
- C. Observe client's respiratory status: shortness of breath, severe dyspnea, tachypnea, or tachycardia.
- D. Auscultate for presence and forced expiration of rhonchi, rales, or wheezes.
- E. Observe for dried or moist secretions surrounding cannula or on tracheal dressing.
- F. Observe for excessive expectoration of secretions.
- G. Assess result of routine tracheal care to determine if routine care is adequate for this client.
- H. Observe client's ability to sustain respiratory function by ability to breathe through normal airway.
- I. Assess respiratory status: breath sounds, respiratory rate, use of accessory muscles for

breathing while tracheal tube is plugged (must be a fenestrated tube).

- J. Assess for labored breathing, flaring of nares, retractions, and color of nail beds.

Implementation

- A. Provide tracheal suction as ordered or PRN. (See Suctioning.)
 - ◆ 1. Always wear sterile gloves for these procedures.
 - 2. Always apply oral or nasal suction first so that when cuff is deflated, secretions will not fall into lung from area above cuff.
 - 3. Catheter must be changed before doing tracheal suctioning as a sterile technique.
- B. Provide humidity by using tracheostomy mist mask, if client is not on ventilator.
- C. Monitor for hemorrhage around tracheostomy site.
- D. Change dressings (nonraveling type) and cleanse surrounding area with hydrogen peroxide at least every 4 hours.
- E. Provide care for client with a cuffed tracheostomy tube.
 - ◆ 1. Hyperoxygenate client before and after cuff is deflated with Ambu bag.
 - 2. Deflate tracheal cuff (no longer a routine procedure).
 - a. Suction airway before deflating cuff.
 - b. Attach 10-mL syringe to distal end of inflatable cuff, making sure seal is tight.
 - c. Slowly withdraw 5 mL of air. Amount of air withdrawn is determined by type of cuff used and whether air leak is utilized.
 - d. Keep syringe attached to end of cuff.
 - e. Suction if cough reflex stimulated.
 - f. Assess respirations; if labored, reinflate cuff.
 - ◆ g. If high-volume/low-pressure cuff is used, cuff is not routinely deflated. (In fact, deflating cuff does not help tracheal lining. The pooled secretions above the tracheal cuff are the problem.)
 - ◆ 3. Inflate cuff.
 - a. Suction airway before inflating cuff.
 - ◆ b. Inflate prescribed amount of air to create leak-free system. *Cuff is inflated correctly when you cannot hear the client's voice or any air movement from nose or mouth.*
 - c. Remove syringe and apply rubber-tipped forceps to maintain air in cuff if there is no self-sealing.
 - d. If high-volume/low-pressure cuff is used, cuff is not routinely deflated.
- ◆ F. Administer inner cannula tracheal cleaning.
 - 1. Suction before cleaning tracheal tube.
 - 2. Unlock the inner cannula by turning the lock to the right about 90 degrees and secure the

outer cannula of the neck plate with your left index finger and thumb.

- 3. Gently pull the inner cannula slightly upward and out toward you.
- 4. Wash cannula thoroughly with cool, sterile water, saline, or hydrogen peroxide to remove secretions. (Tap water may be used if hospital policy allows.) Soak the cannula in a hydrogen peroxide-filled sterile bowl to further remove dried secretions.
- 5. Rinse cannula thoroughly with sterile water or saline, and gently shake to dry.
- 6. Replace the inner cannula carefully by grasping the outer flange of the cannula with your left hand as you insert the cannula. Lock the inner cannula by turning the lock to the left so that it is in an upright position.
- 7. Cleanse around the incision site with applicator sticks soaked in normal saline and/or hydrogen peroxide (one-half strength).
- 8. Apply tracheostomy dressing around insertion site, and change tracheostomy ties if needed.
- 9. If tracheostomy ties are to be changed, ask another person to hold the tracheal tube in place while you change the ties. This procedure prevents accidental extubation if the client coughs.
- 10. Repeat care TID and as needed.
- 11. Keep obturator at bedside for emergency use if tube is dislodged.
- ◆ G. Current research advises against instilling saline into airway—increases chance of infection and causes hypoxemia.
- ◆ H. Provide tracheostomy plugging.
 - 1. Suction nasopharynx if cuffed tube is in place using clean technique.
 - 2. Deflate tracheal cuff; if tracheostomy tube is plugged and cuff is not deflated, client has no airway.
 - 3. Place tracheal plug in either the inner cannula or the outer cannula with inner cannula removed.
 - 4. Observe client for respiratory distress.

Suctioning

Assessment

- A. Determine need for suctioning.
 - 1. Ineffective cough.
 - 2. Thick, tenacious mucus.
 - 3. Impaired pulmonary function.
 - 4. Repressed level of consciousness.
 - 5. Restlessness.
- B. Observe vital signs for increases in pulse and respirations, and for changes in skin color.

- C. Auscultate sounds to evaluate lung field.
- D. Determine level of consciousness to assess hypoxia.

Implementation

- A. Provide nasotracheal suction.
 - 1. Gather equipment.
 - a. Sterile suction catheter, usually no. 14 or no. 16 French.
 - b. Sterile saline.
 - c. Suction machine.
 - d. Gloves.
 - ◆ 2. Complete suctioning procedure.
 - a. Hyperoxygenate (100% oxygen) before suctioning.
 - b. Lubricate catheter with normal saline.
 - c. Insert catheter into nose for 15–20 cm (clean technique is used when catheter does not extend to lower airway).
 - d. Do not apply suction while introducing catheter.
 - e. When advanced as far as possible, begin suctioning by withdrawing catheter slowly; if single-eyed catheter, rotate it with pressure applied. (Usually, a whistle-tip catheter or Y connector tube is used to apply pressure.)
 - f. Withdraw catheter slightly if cough reflex is stimulated.
 - ◆ g. Remember that hypoxia can occur if suctioning is done incorrectly.
 - (1) More than 10 seconds of suctioning—oxygen will be decreased in respiratory tree.
 - (2) Causes chemoreceptors to respond by increasing ventilation rate.
 - h. Postoxygenate after suctioning.
 - ◆ B. Closed suction system.
 - 1. Suction catheter attached directly to ventilator tubing presents advantages over open system.
 - 2. More effective—no need to disconnect client from ventilator; thus, oxygenation is better.
 - 3. Safer—catheter is enclosed in plastic sheath (a closed system) so risk of infection is decreased for both client and nurse.

Passy-Muir Speaking Valve

Characteristics

- A. Used to help clients speak more normally.
- B. One-way valve attaches to the outside opening of the tracheostomy tube.
- C. Allows air to pass into the tracheostomy, *but not out* through it.
- D. Valve opens when the client breathes in.

- E. Valve closes when the client breathes out and air flows around the tracheostomy tube, up through the vocal cords, allowing sounds to be made.
- F. The client breathes out through the mouth and nose instead of the tracheostomy.

Assessment

- A. Assess as for tracheostomy.
- B. Pay particular attention to client secretions.
- C. If the client has a lot of secretions or very thick secretions, you may not be able to use the valve.

Implementation

- A. Suction the tracheostomy tube as needed before placing the valve.
- B. If the tracheostomy tube has a cuff, deflate it before placing the valve.
- C. Suction the client's mouth and nose as needed before deflating the cuff so that secretions do not trickle into the trachea (windpipe) and bronchi.
- D. Attach the valve to the top of the tracheostomy tube with a twisting motion to the right (clockwise) approximately $\frac{1}{4}$ turn. This will prevent it from popping off with coughing.
- E. To remove the valve, twist off to the left (counter clockwise).

Special Considerations

- A. Humidity can be used with the valve in place.
- B. Oxygen can be given with the valve in place.
- C. Remove the valve during aerosol treatments. If left on, remove it and rinse it after treatment to remove any medications that could cause the valve to stick or not work well.

Care of the Valve

- A. Wash the valve daily with mild soapy water.
- B. Rinse thoroughly with cool to warm water. Hot water may damage the valve.
- C. Let the valve air dry completely before using it again.
- D. Do not use a brush, vinegar, peroxide, bleach, or alcohol on the valve.
- E. Replace the valve when it becomes sticky, noisy, or vibrates.

Safety Precautions

- A. Clients must not use the valve while sleeping.
- B. The valve should only be used under direct supervision of caregivers who know how it works and how to correctly use it.
- C. Remove the valve immediately if the client has difficulty breathing.
- D. Suction and/or change the tracheostomy tube if needed.
- E. The valve must not be used on tracheostomies that have the cuff inflated.

PULMONARY MEDICATIONS

♦ Sympathomimetic (Adrenergic) Bronchodilators

Definition: Relax smooth muscle and increase respirations by effect on beta-adrenergic receptor in bronchus.

- A. Adrenalin (epinephrine).
 1. Beta and alpha stimulant; relaxes bronchial smooth muscle.
 2. Routes: SUB Q, IV, MDI.
 3. Used to treat severe bronchial attacks and for anaphylaxis.
 4. May cause arrhythmias, increased BP, urinary retention, increased blood sugar, headache.
- B. Ephedrine (ephedrine sulfate.)
 1. Relaxes smooth muscle of the tracheobronchial tree.
 2. Route: PO.
 3. Used for mild bronchospasm.
 4. Similar side effects as epinephrine.
- C. Isuprel (isoproterenol).
 1. Pure beta agonist; relaxes smooth muscle of tracheobronchial tree; relieves bronchospasms.
 2. Routes: IV, MDI.
 3. May cause marked tachycardia, arrhythmias, angina, palpitations.
- D. Proventil, Ventolin (albuterol).
 1. Very selective beta₂ agonist with rapid onset of action.
 2. Routes: PO, MDI (two to three puffs every 4–6 hours).
 3. Minimal cardiovascular side effects.
- E. Bronkosol, Bronkometer (isoetharine).
 1. More beta₂-specific than Isuprel; relaxes smooth muscle of the tracheobronchial tree; less potent.
 2. Route: nebulized solution or MDI.
 3. Side effects similar to Isuprel, but appear less frequently; may cause tachycardia.
 4. Tolerance to bronchodilating effect may develop with too-frequent use of medication.
- F. Alupent (metaproterenol).
 1. Relieves bronchospasm, has rapid onset.
 2. Routes: PO, MDI (two to three puffs every 4–6 hours).
 3. Side effects same as isoetharine.
- G. Bricanyl, Brethine, Brethaire (terbutaline).
 1. Beta-adrenergic receptor agonist; bronchodilator; relieves bronchospasms associated with COPD, asthma. Slow onset with PO, MDI.
 2. Routes: SUB Q, PO, Brethaire by MDI (two to three puffs every 4–6 hours).
 3. May cause nervousness, palpitations; nausea if taken on an empty stomach.

♦ Anticholinergic Bronchodilators

Definition: Agents that prevent bronchospasm caused by acetylcholine.

- A. Atrovent (ipratropium bromide).
 1. Greater bronchodilating effect than conventional beta agonists. Primarily local and site specific; more potent than sympathomimetics in COPD. Also used for severe acute asthma.
 2. Route: MDI (two to three puffs every 4–6 hours).
 3. Minimal side effects, dry mouth, cough.
- B. Atropine.
 1. Prevents bronchospasm associated with asthma, bronchitis, and COPD.
 2. Routes: nebulizer three to four times/day.
 3. Monitor for tachycardia and hypertension.

♦ Methylxanthine Bronchodilators

Definition: Relaxes smooth muscle of tracheobronchial tree. Less effective than inhaled beta agonists. Used later in treatment regimen, as an additional bronchodilator.

- A. Truphylline (aminophylline).
 1. Relaxes smooth muscle of the tracheobronchial tree; bronchodilator.
 2. Routes: PO, IV, rectal suppository.
 3. Therapeutic serum level 8–20 µg/mL.
 4. May cause tachycardia, hypotension, arrhythmias, GI distress, tremors, anxiety, headache.
 5. Toxic levels cause arrhythmias, seizures.
- B. Theo-Dur, Slo-Bid, Uni-Dur (theophylline).
 1. Long-acting bronchodilator—relaxes smooth muscle of the bronchi and pulmonary vessels.
 2. Routes: PO, rectally.
 3. Therapeutic serum level 10–20 µg/mL.
 4. Side effects similar to Truphylline.
- C. Choledyl (oxtriphylline).
 1. Similar to other bronchodilators.
 2. Route: PO.
 3. Less GI irritation than Truphylline.

♦ Leukotriene Inhibitors/Receptor Antagonists

Definition: Inhibit formation of leukotrienes, which cause airway inflammation, edema, bronchoconstriction, and mucus secretion.

- A. Accolate (zafirlukast), Zyflo (zileuton), and Singulair (montelukast sodium).
 1. Basic action is anti-inflammatory.
 2. Taken orally (not through MDI) so compliance is improved for long-term control, not for acute asthma episode.

- B. Side effects: headache, nausea, diarrhea, dizziness, fever, and myalgia.

♦ Antimediators (Mast Cell Stabilizers)/

Anti-Inflammatory Agents

Definition: Mast cell stabilizers inhibit release of histamine; glucocorticoids reduce inflammation and act as bronchodilators.

- A. Intal, Nalcrom (cromolyn sodium).
 - 1. Decreases airway inflammation and irritation—used for younger clients with asthma.
 - 2. Route: MDI, nebulizer, nasal spray.
 - 3. Prevents bronchospasm when used before exercise or exposure to cold air.
 - 4. Can cause throat irritation.
- B. Glucocorticoids: Beclovent, Vanceril, Beconase (beclomethasone dipropionate).
 - 1. Used in conjunction with bronchodilators for treatment of bronchospasms; anti-inflammatory effects, decrease mucus secretion. Aerosol use prevents systemic side effects of steroids.
 - 2. Routes.
 - a. Deltasone (prednisone) PO.
 - b. Medrol (methylprednisolone) PO, IV, Cortef (hydrocortisone) IV.
 - c. Beclovent, Vanceril (beclomethasone dipropionate) MDI.
 - d. Azmacort (triamcinolone) MDI.
 - 3. Instruct client to rinse mouth after MDI use to prevent oral candidiasis.
 - 4. Side effects include increased appetite, sore throat, cough, thrush, Cushing-like appearance.

♦ Mucokinetic Agents

Definition: Reduce the viscosity of respiratory secretions by breaking down mucoproteins.

- A. Mucomyst (acetylcysteine).
 - 1. Used to loosen secretions; reduces viscosity.
 - 2. Routes: inhaled or instilled.

- 3. May cause bronchospasm, nausea.
- 4. Instruct client to rinse mouth after use.
- B. Mucinex (guaifenesin).
 - 1. Commonly used expectorant.
 - 2. Route: PO.
- C. Iodide preparations: SSKI, Organidin (guaifenesin).
 - 1. Expectorant liquefies tenacious bronchial secretions.
 - 2. Route PO; bitter taste, give with juice or milk.
 - 3. Do not administer if allergic to iodine or hyperthyroid.

♦ Antiprotozoal Drugs

Definition: Interferes with biosynthesis of deoxyribonucleic acid, ribonucleic acid, phospholipids, and proteins in susceptible organisms.

- A. NebuPent, Pentam 300 (pentamidine) for prevention.
 - 1. Prevention of *Pneumocystis jiroveci* pneumonia (PJP).
 - 2. Routes: nebulizer (300 mg every 4 weeks).
 - 3. If client experiences fatigue, dizziness, or anxiety during inhalation, stop treatment and allow client to rest. Well tolerated, expensive. No systemic protection. Least effective form of prophylaxis.
- B. NebuPent, Pentam 300 for treatment.
 - 1. Treatment of PJP.
 - 2. Route: IV or IM (4 mg/kg daily for 14–21 days). IV used for those clients who do not tolerate Bactrim, Septa (trimethoprim-sulfamethoxazole).
 - 3. Closely monitor for hypotension—place client in supine position for IV administration.
 - 4. Nephrotoxic; can cause hyperglycemia, pancreatitis.
 - 5. Screen for active TB before treating moderate to severe PCP.

RESPIRATORY SYSTEM REVIEW QUESTIONS

1. A client is on a disposable water-seal system with chest tubes in place. The RN assigns the LVN to position the chest tubes to maintain patency. The RN monitors that the first LVN action is to
 1. Secure the chest tubes near the client without any dependent drainage loops.
 2. Check that the physician has written orders to milk the chest tubes.
 3. Tell the charge nurse that this assignment is not appropriate for LVNs.
 4. Complete the assignment and chart the intervention in the client's record.
2. A female client comes to the emergency department complaining of shortness of breath and pain in the lung area. She states that she started taking birth control pills 3 weeks ago and that she smokes. Her vital signs are as follows: BP 140/80, P 110, R 40. The physician orders ABGs; results are as follows:

pH	7.50
PaCO ₂	29 mm Hg
PaO ₂	60 mm Hg
HCO ₃	24 mEq/L
SaO ₂	86%

Considering these results, the first intervention is to

 1. Begin mechanical ventilation.
 2. Place the client on oxygen.
 3. Give the client sodium bicarbonate.
 4. Monitor for pulmonary embolism.
3. Basilar crackles are present in a client's lungs on auscultation. The nurse knows that these discrete, noncontinuous sounds are
 1. Caused by the sudden opening of alveoli.
 2. Usually more prominent during expiration.
 3. Produced by air flow across passages narrowed by secretions.
 4. Found primarily in the pleura.
4. A client's condition requires that a bronchoscopy procedure be done. Due to his physical condition, he will be awake during the procedure. As part of the pretest teaching, the nurse will instruct him that before the scope insertion, his neck will be positioned so that it is
 1. In a flexed position.
 2. In an extended position.
 3. In a neutral position.
 4. Hyperextended.
5. A cyanotic client with an unknown diagnosis is admitted to the emergency room. In relation to oxygen, the first nursing action would be to
 1. Wait until the client's lab work is done.
 2. Not administer oxygen unless ordered by the physician.
 3. Administer oxygen at 2 L flow per minute.
 4. Administer oxygen at 10 L flow per minute and check the client's nail beds.
6. A client with tuberculosis is given the drug Tebrazid (pyrazinamide). Which one of these diagnostic tests should be conducted while the client is receiving the drug?
 1. Liver function tests.
 2. Gallbladder studies.
 3. Thyroid function studies.
 4. Blood glucose.
7. Care for a client following a bronchoscopy will include
 1. Withholding food and liquids until the gag reflex returns.
 2. Providing throat irrigations every 4 hours.
 3. Having the client refrain from talking for several days.
 4. Suctioning frequently, as ordered.
8. Immediately following a thoracentesis, which clinical manifestations indicate that a complication has occurred and the physician should be notified?
 1. Serosanguineous drainage from the puncture site.
 2. Increased temperature and blood pressure.
 3. Increased pulse and pallor.
 4. Hypotension and hypothermia.
9. If a client continues to hypoventilate, the nurse will continually assess for a complication of
 1. Respiratory acidosis.

2. Respiratory alkalosis.
 3. Metabolic acidosis.
 4. Metabolic alkalosis.
- 10.** A client is admitted to the hospital for acute bronchitis. While taking the client's vital signs, the nurse notices he has an irregular pulse. The nurse understands that cardiac arrhythmias in chronic respiratory diseases are usually the result of
1. Respiratory acidosis.
 2. A buildup of carbon dioxide.
 3. A buildup of oxygen without adequate expelling of carbon dioxide.
 4. An acute respiratory infection.
- 11.** Select the most effective nursing intervention for a client experiencing adult respiratory distress syndrome (ARDS).
1. Maintain low-flow oxygen via nasal cannula.
 2. Encourage oral intake of at least 3000 mL fluids per day.
 3. Ask open-ended questions to promote expression of anxiety.
 4. Position in semi- to high-Fowler's with support to the back.
- 12.** Which one of the following principles is incorrect when discussing the water-seal chest drainage system?
1. When the chest has been opened, a vacuum must be applied to reestablish positive pressure.
 2. Water acts as a seal to prevent air from being drawn into the pleural space.
 3. Air drawn into the chest cavity collapses the lung.
 4. Water-seal mechanisms operate on a negative-pressure principle.
- 13.** Your client is unable to use the incentive spirometer device. In counseling the client, the first advice would be to
1. Start slowly and gradually increase volume over several sessions.
 2. Give up and do regular deep breathing.
 3. Obtain another device because this one is obviously faulty.
 4. Be much more vigorous in increasing increments.
- 14.** Auscultation of a client's lungs reveals rales (crackles) in the left posterior base. The nursing intervention is to
1. Repeat auscultation after asking the client to deep-breathe and cough.
 2. Instruct the client to limit fluid intake to less than 2000 mL/day.
3. Inspect the client's ankles and sacrum for the presence of edema.
 4. Place the client on bed rest in a semi-Fowler's position.
- 15.** The exercise that would be most beneficial for a client with COPD is
1. Controlled coughing.
 2. Whistling while exhaling.
 3. Deep breathing.
 4. Use of the incentive spirometer.
- 16.** The most reliable index to determine the respiratory status of a client is to
1. Observe the chest rising and falling.
 2. Observe the skin and mucous membrane color.
 3. Listen to and feel the air movement.
 4. Determine the presence of a femoral pulse.
- 17.** A client with COPD has developed secondary polycythemia. Which nursing diagnosis would be included in the care plan because of the polycythemia?
1. Fluid volume deficit related to blood loss.
 2. Impaired tissue perfusion related to thrombosis.
 3. Activity intolerance related to dyspnea.
 4. Risk for infection related to suppressed immune response.
- 18.** The nurse is assigned to care for a 20-year-old client who has just had chest tubes inserted. The priority nursing action is to
1. Place a hemostat nearby in case of an air leak.
 2. Check the chest tubes every 2 hours for air leaks.
 3. Coil the tubes carefully to prevent kinking, which could result in an air leak.
 4. Keep the client flat to avoid leaks in the tubing.
- 19.** The physician has scheduled a client for a left pneumonectomy. The position that will most likely be ordered postoperatively for him is the
1. Unoperative side or back.
 2. Operative side or back.
 3. Back only.
 4. Back or either side.
- 20.** Assessing a client who has developed atelectasis postoperatively, the nurse will most likely find
1. A flushed face.
 2. Dyspnea and pain.
 3. Decreased temperature.
 4. Severe cough with no pain.

- 21.** A client who has had a lobectomy for cancer of the left lower lobe of the lung is complaining of severe pain on inspiration. The drug the nurse expects the physician to order to relieve the pain is
1. Codeine sulfate.
 2. Demerol (meperidine).
 3. Morphine sulfate.
 4. Tylenol (acetaminophen) with codeine.
- 22.** A 50-year-old client has a tracheostomy and requires tracheal suctioning. The first intervention in completing this procedure would be to
1. Change the tracheostomy dressing.
 2. Provide humidity with a tracheostomy mask.
 3. Apply oral or nasal suction.
 4. Deflate the tracheal cuff.
- 23.** A client has been diagnosed with a pulmonary embolism. The nurse would anticipate medical orders for the immediate administration of
1. Coumadin (warfarin sodium).
 2. Decadron (dexamethasone).
 3. Heparin.
 4. Protamine sulfate.
- 24.** When a client asks the nurse why the physician says he “thinks” he has tuberculosis, the nurse explains to him that diagnosis of tuberculosis can take several weeks to confirm. Which of the following statements supports this answer?
1. A positive reaction to a tuberculosis skin test indicates that the client has active tuberculosis, even if one negative sputum is obtained.
 2. A positive sputum culture takes at least 3 weeks, due to the slow reproduction of the bacillus.
 3. Because small lesions are hard to detect on chest x-rays, x-rays usually need to be repeated during several consecutive weeks.
 4. A client with a positive smear must have a positive culture to confirm the diagnosis.
- 25.** The nurse would assess that a client is experiencing Cheyne–Stokes respiration when he has
1. Periods of hyperpnea alternating with periods of apnea.
 2. Periods of tachypnea alternating with periods of apnea.
 3. An increase in both rate and depth of respirations.
 4. Deep, regular, sighing respirations.

RESPIRATORY SYSTEM ANSWERS WITH RATIONALE

1. (2) Preventing dependent loops in the tubing from the chest tube facilitates drainage and promotes lung expansion.

NP:I; CN:S; CL:AN

2. (2) The pH (7.50) reflects alkalosis, and the low PaCO₂ indicates that the lungs are involved. The client should immediately be placed on oxygen via mask, so that the SaO₂ is brought up to 95%. Encourage slow, regular breathing to decrease the amount of CO₂ she is losing. This client may have pulmonary embolism, so she should be monitored for this condition (4), but it is not the first intervention. Sodium bicarbonate (3) would be given to reverse acidosis; mechanical ventilation (1) may be ordered for acute respiratory acidosis.

NP:I; CN:PH; CL:AN

3. (1) Basilar crackles are usually heard during inspiration and are caused by sudden opening of alveoli.

NP:AN; CN:PH; CL:K

4. (4) Hyperextension brings the pharynx into alignment with the trachea and allows the scope to be inserted without trauma.

NP:I; CN:PH; CL:A

5. (3) Administer oxygen at 2 L/min and no more. If the client is emphysemic and receives too high a level of oxygen, he will develop CO₂ narcosis and the respiratory system will cease to function.

NP:I; CN:PH; CL:A

6. (1) Liver function tests can be elevated in clients taking pyrazinamide. This drug is used when primary and secondary antitubercular drugs are not effective. Urate levels may be increased, and there is a chemical interference with urine ketone levels if these tests are done while the client is on the drug.

NP:E; CN:PH; CL:A

7. (1) Until the gag reflex returns, the client cannot handle foods or liquids and may aspirate. Suctioning (4) is not usually ordered. The client does not require throat irrigations (2) and can talk (3) whenever he or she is ready.

NP:E; CN:PH; CL:A

8. (3) Increased pulse and pallor are symptoms associated with shock. A compromised venous return may occur if there is a mediastinal shift as a result of excessive fluid removal. Usually no more than 1 L of fluid is removed at one time to prevent this from occurring.

NP:E; CN:PH; CL:AN

9. (1) Respiratory acidosis represents an increase in the acid component, carbon dioxide, and an increase in the hydrogen ion concentration (decreased pH) of the arterial blood. It differs from metabolic acidosis (3) in that it is caused by defective functioning of the lungs.

NP:A; CN:PH; CL:A

10. (2) The arrhythmias are caused by a buildup of carbon dioxide and not enough oxygen so that the heart is in a constant state of hypoxia.

NP:AN; CN:PH; CL:C

11. (4) ARDS produces severe dyspnea and life-threatening abnormalities of blood gases; therefore, maintaining an upright position will promote gas exchange and help relieve dyspnea. The client with ARDS requires high concentrations of oxygen, usually by mask or ventilator. Diuretics and fluid restrictions are used to combat the pulmonary edema, which is part of ARDS. Closed questions are used because of the client's dyspnea; the expected anxiety needs to be addressed through interventions other than verbalization.

NP:P; CN:PH; CL:A

12. (1) A seal must be established to prevent atmospheric air from entering the pleural space and to reestablish

negative, not positive, pressure. The other options are correct.

NP:E; CN:PH; CL:A

- 13.** (1) The best advice is to have the client start very slowly and gradually increase the volume. The device is not at fault; it is usually the inability of the client to expand the lungs. Deep breathing is an alternative only if the client is totally unable to use the device.

NP:I; CN:PH; CL:A

- 14.** (1) Although crackles often indicate fluid in the alveoli, they may also be related to hypoventilation and will clear after a deep breath or a cough. It is, therefore, premature to impose fluid (2) or activity (4) restrictions. Inspection for edema (3) would be appropriate after reauscultation.

NP:I; CN:PH; CL:A

- 15.** (2) Whistling while exhaling or pursed-lip breathing prevents the bronchi from collapsing, thereby permitting more effective exhalation of trapped carbon dioxide. The other exercises do not foster exhalation of carbon dioxide.

NP:P; CN:PH; CL:A

- 16.** (3) To check for breathing, the nurse places her ear and cheek next to client's mouth and nose to listen and feel for air movement. The chest rising and falling (1) is not conclusive of a patent airway. Observing skin color (2) is not an accurate assessment of respiratory status, nor is checking the femoral pulse (4).

NP:A; CN:PH; CL:C

- 17.** (2) Chronic hypoxia associated with COPD may stimulate excessive RBC production (polycythemia). This results in increased blood viscosity and the risk of thrombosis. The other nursing diagnoses are not applicable in this situation.

NP:AN; CN:PH; CL:A

- 18.** (1) The most important safety measure is to tape a hemostat nearby to use in case of an air leak. Chest tubes should be checked periodically, but not necessarily every 2 hours (2). The client should be in semi-Fowler's position to increase lung expansion.

NP:I; CN:PH; CL:A

- 19.** (2) Positioning the client on the operative side facilitates the accumulation of serosanguineous fluid. The

fluid forms a solid mass, which prevents the remaining lung from being drawn into the space.

NP:P; CN:PH; CL:C

- 20.** (2) Atelectasis is a collapse of the alveoli due to obstruction or hypoventilation. Clients become short of breath, have a high temperature, and usually experience severe pain but do not have a severe cough (4). The shortness of breath is a result of decreased oxygen–carbon dioxide exchange at the alveolar level.

NP:A; CN:PH; CL:C

- 21.** (3) Morphine sulfate (3) is the drug of choice, but due to its depressing action on respirations, clients need to be closely monitored. Codeine (1) and Tylenol (acetaminophen) (4) are usually not sufficient pain relievers; therefore, the use of these drugs could interfere with other nursing interventions, such as deep breathing and coughing. Demerol (meperidine) is not commonly used today.

NP:P; CN:PH; CL:C

- 22.** (3) Before deflating the tracheal cuff (4), the nurse will apply oral or nasal suction to the airway to prevent secretions from falling into the lung. Dressing change (1) and humidity (2) do not relate to suctioning.

NP:I; CN:PH; CL:A

- 23.** (3) Heparin acts rapidly to prevent extension of emboli and the formation of thrombi. Coumadin (warfarin) (1) is a slow-acting anticoagulant. Protamine sulfate (4) inactivates heparin. Decadron (dexamethasone) (2), a corticosteroid, is not indicated for the immediate treatment of pulmonary embolism.

NP:P; CN:PH; CL:C

- 24.** (2) The culture takes 3 weeks to grow. Usually, even very small lesions can be seen on x-rays due to the natural contrast of the air in the lungs; therefore, chest x-rays do not need to be repeated frequently (3). Clients may have positive smears but negative cultures if they have been on medication (4). A positive skin test indicates the person has been infected with tuberculosis but may not necessarily have active disease (1).

NP:AN; CN:H; CL:K

- 25.** (1) Periods of hyperpnea alternating with apnea is a breathing pattern that is easily missed if the client's respirations are not observed for a few minutes. It may indicate disorders of cerebral circulation, increased cerebral pressure, and/or injury to the brain tissue.

NP:A; CN:PH; CL:C

GASTROINTESTINAL SYSTEM

The alimentary tract's primary function is to provide the body with a continual supply of nutrients, fluids, and electrolytes for tissue nourishment. This system has three components: a tract for ingestion and movement of food and fluids; secretion of digestive juices for breaking down the nutrients; and absorption mechanisms for the utilization of foods, water, and electrolytes for continued growth and repair of body tissues.

ANATOMY AND PHYSIOLOGY

Main Organs

Description: The main organs of the gastrointestinal (GI) system include the mouth, pharynx, esophagus, stomach, small intestine, and large intestine.

Functions

- Normally, the GI system is the only source of intake for the body.
- Provides the body with fluids, nutrients, and electrolytes.
- Provides means of disposal for waste residues.

Activities

- Secretion of enzymes and electrolytes are used to break down the raw materials ingested.
- Movement of ingested products through the system.
- Complete digestion of ingested nutrients.
- Absorption of the end products of digestion into the blood.

Coats of Tissue Walls

- Mucous lining.
 - Rugae and microscopic gastric and hydrochloric acid glands in the stomach.
 - Villi, intestinal gland Peyer's patches, and lymph nodes.
 - Intestinal glands.
- Submucous coat of connective tissue, in which the main blood vessels are located.
- Muscular coat.
 - Digestive organs have circular and longitudinal muscle fibers.
 - The stomach has oblique fibers in addition to circular and longitudinal fibers.
- Fibroserous coat, the outer coat.
 - In the stomach, the omentum hangs from the lower edge of the stomach, over the intestines.
 - In the intestines, it forms the visceral peritoneum.

The Mouth, Pharynx, and Esophagus

- The buccal cavity.
 - Cheeks.
 - Hard and soft palates.
 - Muscles.
 - Maxillary bones.
 - Tongue.
- The pharynx.
 - Tubelike structure that extends from the base of the skull to the esophagus.
 - Compound of muscle lined with mucous membrane, composed of the nasopharynx, the oropharynx, and the laryngopharynx.
 - Functions include serving as a pathway for the respiratory and digestive tracts, and playing an important role in phonation.
- The esophagus begins at the lower end of the pharynx and is a collapsible muscular tube about 10 inches (25 cm) long.
 - It leads to the abdominal portion of the digestive tract.
 - The main portion is lined with many simple mucous glands; complex mucous glands are located at the esophagogastric juncture.

The Stomach

- Elongated pouch lying in the epigastric and left hypochondriac portions of the abdominal cavity (approximately 10 inches [25 cm]).
- Divisions are the fundus, the body, and the pylorus (the constricted lower portion).
- Curvatures are the lesser curvature and the greater curvature.
- Sphincters.
 - Cardiac sphincter—at the opening of the esophagus into the stomach.
 - Pyloric sphincter—guards the opening of the pylorus into the duodenum.
- Regions.
 - Cardiac.
 - Fundus.
 - Body.
 - Pylorus.
- Coats.
 - The mucous coat allows for distention and contains microscopic glands: gastric, hydrochloric acid, and mucus.
 - The muscle coat contains three layers.
 - Circular—forms the two sphincters.
 - Longitudinal.
 - Oblique.
 - The fibroserous coat forms the visceral peritoneum; the omentum hangs in a double fold over the intestines.

- G. Glands.
1. Mucous glands—secrete mucus to provide protection from gastric juice.
 2. Goblet cells—secrete viscid mucus.
 3. Gastric glands.
 - a. Parietal—secrete hydrochloric acid and intrinsic factor.
 - b. Chief cells—secrete pepsin, lipase, amylase, and renin.
- ♦ H. Function: mechanical and chemical digestion.
1. Mechanical.
 - a. A storage reservoir for food.
 - b. Churning provides for forward and backward movement.
 - c. Peristalsis moves material through the stomach and, at intervals with relaxation of the pyloric sphincter, squirts chyme into the duodenum.
 2. Chemical.
 - a. Hydrochloric acid provides the proper medium for action of pepsin and aids in the coagulation of milk in adults.
 - b. Pepsin splits protein into proteoses and peptones.
 - c. Lipase is a fat-splitting enzyme with limited action.
 - d. Renin coagulates or curdles the protein of milk.
 - e. Intrinsic factor acts on certain components of food to form the antianemic factor.
 - f. Mixes food with gastric juices into a thick fluid called chyme.
- The Small Intestine**
- A. Approximately 21 feet (6 m).
 - ♦ B. Divisions.
 1. The duodenum (about 10 inches [25 cm]) includes the Brunner's glands (the duodenal mucous digestive glands) and the openings for the bile and pancreatic ducts.
 2. The jejunum is approximately 8 feet (2.4 m) long; the ileum is approximately 12 feet (3.6 m) long. Both have deep circular folds that increase their absorptive surfaces.
 - a. The mucous lining has numerous villi, each of which has an arteriole, venule and lymph vessel that serve as structures for the absorption of digested food.
 - b. The small intestine terminates by opening into the cecum (the opening is guarded by the ileocecal valve).
 - C. Intestinal digestion.
 1. Intestinal juice has an alkaline reaction and contains a large number of enzymes.

2. Enzymes.
 - a. Peptidase.
 - b. Amylase.
 - c. Maltase.
 - d. Lactase.
 - e. Sucrase.
 - f. Nuclease.
 - g. Enterokinase.

The Large Intestine (Colon)

- A. Approximately 5 feet (1.5 m) long, with a relatively smooth mucous membrane surface. The only secretion is mucus.
- B. Muscle coats pucker the wall of the colon into a series of pouches (haustra) and contain the internal and the external anal sphincters.
- ♦ C. Divisions.
 1. The cecum (the first part of the large intestine) is guarded by the ileocecal valve.
 - a. Prevents regurgitation of the cecal contents into the ileum.
 - b. 3 L of fluid passes through the small bowel but only 500 mL passes through the ileocecal valve.
 2. The appendix is attached to its surface as an extension. The appendix is a twisted structure that may accumulate bacteria and become inflamed.
 3. Colon.
 - a. Ascending.
 - b. Transverse.
 - c. Descending.
 - d. Sigmoid.
 - e. Rectum.
 - f. Anus—a hairless, darker-skinned area at the end of the digestive tract. It has an internal involuntary sphincter and an external voluntary sphincter.
- D. Functions.
 1. Absorption and elimination of wastes.
 - ♦ 2. Formation of vitamins: K, B₁₂, riboflavin, and thiamine.
 3. Mechanical digestion: churning, peristalsis, and defecation.
 4. Absorption of water from fecal mass.

Accessory Organs

Description: The accessory organs of the gastrointestinal system include the teeth, tongue, salivary glands, pancreas, liver, gallbladder, and appendix.

Tongue

- A. A skeletal muscle covered with a mucous membrane that aids in chewing, swallowing, and speaking.

- B. Papillae on the surface of the tongue contain taste buds.
- C. The frenulum is a fold of mucous membrane that helps to anchor the tongue to the floor of the mouth.
- D. The tongue mixes food with saliva to form a mass called a bolus.

Salivary Glands

- A. Three pairs—the submaxillary, the sublingual, and the parotid glands.
- B. Secretion.
 - 1. Saliva is secreted by the glands when sensory nerve endings are stimulated mechanically, thermally, or chemically.
 - 2. pH ranges: 6.0–7.9.
 - 3. Contains amylase, an enzyme that hydrolyzes starch.

Teeth

- A. Deciduous teeth (20 in the set) and permanent teeth (32 in the set).
- B. The functions are mastication and mixing saliva with food.

Liver

- A. Location and size.
 - 1. Located in the right hypochondrium and part of the epigastrium.
 - 2. It is the largest gland in the body, weighing about 3 pounds (1.3 kg).
 - 3. It is protected by the lower ribs and is in contact with the undersurface of the dome of the diaphragm.
- B. Lobes—right lobes (include the right lobe proper, the caudate, and the quadrate) and left lobe.
 - 1. Lobes are divided into lobules by blood vessels and fibrous partitions.
 - 2. The lobule is the basic structure of the liver and contains hepatic cells and capillaries.
- C. Ducts include the hepatic duct from the liver, the cystic duct from the gallbladder, and the common bile duct (the union of the hepatic and cystic ducts).

♦ Functions of the Liver

- A. Metabolism of carbohydrates.
 - 1. Converts glucose to glycogen and stores glycogen.
 - 2. Converts glycogen to glucose.
 - 3. Glycogenolysis—the supply of carbohydrates released into bloodstream.
- B. Metabolism of fats.
 - 1. Oxidation of fatty acids and formation of acetoacetic acid.
 - 2. Formation of lipoproteins, cholesterol, and phospholipids.

- 3. Conversion of carbohydrates and protein into fat.
- C. Metabolism of proteins.
 - 1. Deamination of amino acids.
 - 2. Formation of urea.
 - 3. Formation of plasma proteins.
 - 4. Interconversions among amino acid and other compounds.
- D. Vascular functions for storage and filtration of blood.
 - 1. Blood (200–400 mL) can be stored by the liver.
 - 2. Fat-soluble vitamins (A, D, E, and K), B₁₂, copper, and iron are stored in the liver.
 - 3. Detoxifies harmful substances in the blood.
 - 4. Breaks down worn-out blood cells.
 - 5. Filters blood as it comes through the portal system.
 - 6. Synthesizes prothrombin, fibrinogen, and factors I, II, VII, IX, and X, which are necessary for blood clotting.
- E. Secretory functions.
 - 1. Constant secretion (500–1000 mL in 24 hours) of bile, which is stored in the gallbladder.
 - 2. Bile is a yellow-brown viscous fluid, alkaline in reaction, and consists of bile salts, bile pigments, cholesterol, and inorganic salts.
 - 3. Bile emulsifies fats.
 - 4. Red blood cell destruction releases hemoglobin, which changes to bilirubin; bilirubin unites with plasma proteins and is removed by the liver and excreted in the bile.
 - 5. The bile pigment bilirubin is converted by bacterial action into urobilin and to urobilinogen (appears in urine and gives feces brown color).
- F. Hepatic reticuloendothelial functions.
 - 1. Inner surface of the liver sinusoids contains Kupffer cells.
 - 2. Kupffer cells are phagocytic and are capable of removing bacteria in the portal venous blood.
- G. Sex hormone and aldosterone metabolism.

The Gallbladder

- ♦ A. Small sac of smooth muscle located in a depression at the edge of the visceral surface of the liver, which functions as a reservoir for bile.
 - 1. Cystic duct—the duct of the gallbladder joins the hepatic duct, which descends from the liver, to form the common bile duct.
 - 2. The common bile duct is joined by the duct of the pancreas (Wirsung's duct) as it enters the duodenum.
 - 3. The sphincter of Oddi guards the common entrance.

- B. Secretion—the presence of fatty materials in the duodenum stimulates the liberation of cholecystokinin, which causes contraction of the gallbladder and relaxation of the sphincter of Oddi.

The Pancreas

- A. A soft, pink-white organ, 15 cm long and 2.5 cm wide (5.9 in long and .98 wide), which adheres to the middle portion of the duodenum.
- B. Divided into lobes and lobules.
 - 1. Exocrine portion secretes digestive enzymes, which are carried to the duodenum by Wirsung's duct.
 - 2. Endocrine secretion is produced by the islets of Langerhans; insulin is secreted into the bloodstream and plays an important role in carbohydrate metabolism.
- ◆ C. Pancreatic juices contain enzymes for digesting proteins, carbohydrates, and fats.
 - 1. Enzymes are secreted as inactive precursors, which do not become active until secreted into the intestine (otherwise they would digest the gland).
 - 2. Actions.
 - a. Converts trypsinogen to trypsin to act on proteins, producing peptones, peptides and amino acids.
 - b. Pancreatic amylase acts on carbohydrates, producing disaccharides.
 - c. Pancreatic lipase acts on fats, producing glycerol and fatty acids.
- D. Two regulatory mechanisms of pancreatic secretion.
 - 1. Nervous regulation—distention of the intestine.
 - 2. Hormonal regulation.
 - a. Chyme in the intestinal mucosa causes the release of secretin (which stimulates the pancreas to secrete large quantities of fluid) and pancreozymin.
 - b. Pancreozymin passes by way of the blood to the pancreas and causes secretion of large quantities of digestive enzymes.

See Chapter 4, Nutritional Management, Assimilation of Nutrients section, Gastrointestinal Tract subsection.

System Assessment

- A. Evaluate client's history regarding reported signs and symptoms.
- B. Assess overall condition of client, including vital signs and level of consciousness.
- C. Evaluate condition of mouth, teeth, gums, and tongue.
 - 1. Foul odor to breath may indicate diseased teeth, gums, or poor assimilation along gastrointestinal tract.

- 2. Coated tongue may indicate chemical imbalance in system.
- D. Check for presence of gag reflex.
- E. Assess general contour of abdomen with client lying flat.
- F. Assess for bowel sounds: hyperactive or hypoactive.
 - 1. Hypoactive bowel sounds may be due to peritonitis, paralytic ileus, or no obvious cause.
 - 2. Absent bowel sounds may be due to bowel obstruction or systemic illness.
- G. Check bowel habits and/or alterations in bowel elimination.
- H. Palpate abdominal muscles for tenderness or rigidity; evaluate all quadrants of abdomen.
- I. Assess bowel motility.
 - 1. Hypermotility may be result of irritation of autonomic nervous system or inflammatory process.
 - 2. Hypomotility may be result of blockage, intestinal muscle weakness, or chemical agents.
- J. Check for amount of flatulence client reports, which indicates malfunction of system or dietary indiscretion.
- K. Assess stool specimen.
 - 1. Check for presence of blood.
 - 2. Check for presence of mucus.
 - 3. Evaluate consistency, color, and odor of stool.
- L. Assess for parasites.
- M. Assess fluid intake per day.
- N. Evaluate dietary program (e.g., type of foods, amount).
- O. Evaluate laboratory tests.
- P. Note presence or absence of hemorrhoids.
- Q. Assess the degree of sphincter control by the client's reports of his or her ability to control and regulate bowel movements.
- R. Assess for presence of pain along gastrointestinal tract and in accessory organs.
 - 1. Assess nonverbal signs, such as flinching, grimacing, etc.
 - 2. Evaluate onset, location, intensity, duration, and aggravating factors.
- S. Palpate for rebound tenderness of spleen.
- T. Check skin color for yellow tinge, pallor, or heavy flushing.
- U. Assess for signs of shock following trauma to abdomen.
- V. Assess client's knowledge of diagnostic tests or surgical interventions.
- W. Assess sclerae for jaundice.

Diagnostic Procedures

Roentgenography of the Gastrointestinal Tract

- A. The gastrointestinal tract cannot be visualized unless a contrast medium is ingested or instilled into it.
- B. Barium sulfate—a white, chalky radiopaque substance that can be flavored—is normally used as a contrast medium.
- C. For an upper GI tract study, the client ingests an aqueous suspension of barium. The progression of barium is followed by the fluoroscope.
- D. Roentgenography of the upper tract reveals
 - 1. Structure and function of the esophagus.
 - 2. Size and shape of the right atrium.
 - 3. Esophageal varices.
 - 4. Thickness of gastric wall.
 - 5. Motility of the stomach.
 - 6. Ulcerations, tumor formations, and anatomic abnormalities of the stomach.
 - 7. Pyloric valve patency.
 - 8. Emptying time of the stomach.
 - 9. Structural abnormalities of the small intestine.
- E. X-rays are taken for permanent records.
- F. Preparation of client for an upper GI roentgenograph.
 - 1. Maintain NPO after midnight, prior to the test.
 - 2. Withhold medication.
 - 3. Explain procedure.
- G. The lower GI roentgenograph involves rectal instillation of barium, which is viewed with the fluoroscope. Then, permanent x-rays are taken.
- H. The lower GI roentgenograph reveals the following information:
 - 1. Abnormalities in the structure of the colon.
 - 2. Contour and motility of the cecum and appendix.
- ♦ I. Preparation of client for a lower GI roentgenograph.
 - 1. Empty intestinal tract by giving an enema, laxatives, or suppositories as ordered.
 - 2. Maintain NPO after midnight, prior to the examination.
 - 3. Explain procedure to client.
 - 4. Increase fluid intake and administer laxative, if needed, following procedure.

Endoscopy

- A. Visualization of the inside of a body cavity by means of a lighted tube.
- B. Flexible scopes are used for these examinations; scopes may be equipped with a camera.
- C. Purposes.
 - 1. Direct visualization of mucosa to detect pathologic lesions.

- 2. Obtaining biopsy specimens.
- 3. Securing washings for cytologic examination.
- D. Organs capable of being scoped: esophagus, stomach, duodenum, rectum, sigmoid colon, transverse colon, and right colon.
- ♦ E. Nursing implementation.
 - 1. Explain procedure to client.
 - 2. Ensure that a signed consent for the procedure is present in the chart. Endoscopy is an invasive procedure and requires an informed consent.
 - 3. Have client fast prior to the examination.
 - 4. Prepare the lower bowel with laxatives, enemas, or suppositories as ordered.
 - 5. Remove dentures and check for loose teeth prior to the procedure.
 - 6. Prior to gastroscopy, conscious sedation and a local anesthetic may be used in the posterior pharynx. Withhold fluids and food after the procedure until the gag reflex has returned.
 - 7. Support client during the procedure. The muscles of the GI tract tend to go into spasm with the passage of the scope, causing pain.
 - ♦ 8. Following the endoscopy.
 - a. Observe for hemorrhage, swelling, or dysfunction of the involved area.
 - b. Monitor vital signs.
 - c. Evaluate client for evidence of complications (bleeding, dyspnea, fever, abdominal pain).
 - d. For upper GI, withhold all food and fluids until gag and swallow reflexes have returned.
 - e. Inform client that a sore throat, hoarseness, abdominal bloating, belching, and flatulence are common.
 - f. Ensure that client is not discharged alone until sedation is completely worn off.
 - g. Instruct client to inform physician immediately if the following occur: persistent difficulty swallowing; epigastric, substernal, or shoulder pain; vomiting blood; black, tarry stools; or fever.

Analysis of Secretions

- A. Contents of the GI tract may be examined for the presence or absence of digestive juices, bacteria, parasites, and malignant cells.
- B. Stomach contents may be aspirated and analyzed for volume and free and total acid.
- ♦ C. *Gastric analysis*, performed by means of a nasogastric tube.
 - 1. Maintain NPO 6–8 hours prior to the test.
 - 2. Pass nasogastric tube, verify its presence in the stomach, tape to client's nose.

3. Collect fasting specimens.
 4. Administer agents, such as alcohol, caffeine, histamine (0.2 mg subcutaneous), as ordered, to stimulate the flow of gastric acid.
 - a. Watch for side effects of histamine, including flushing, headache, and hypotension.
 - b. Do not give drug to clients with a history of asthma or other allergic conditions.
 5. Collect specimens as ordered, usually at 10- to 20-minute intervals.
 6. Label specimens and send to laboratory.
 7. Withdraw nasogastric tube, offer oral hygiene, make client comfortable.
 8. Gastric acid is high in the presence of duodenal ulcers and low in pernicious anemia.
- ◆ D. *Gastric washings for acid-fast bacilli.*
1. Have client fast 6–8 hours prior to the procedure.
 2. Insert nasogastric tube and secure to client's nose.
 3. Send specimens to the laboratory to determine the presence of acid-fast bacilli.
 4. Wash your hands carefully, wear gloves, and protect yourself from direct contact with specimens.
 5. This procedure is performed on suspected cases of active pulmonary tuberculosis when it is difficult to secure sputum for analysis and clients have swallowed sputum.
- ◆ E. *Analysis of stools.*
1. Stool specimens are examined for amount, consistency, color, shape, blood, fecal urobilinogen, fat, nitrogen, parasites, food residue, and other substances.
 2. Stool cultures are also done for bacteria and viruses.
 3. Some foods and medicines can affect stool color: spinach, green; cocoa, dark red; senna, yellow; iron, black; upper GI bleeding, tarry black; lower GI bleeding, bright red.
 4. Stool abnormalities.
 - a. Steatorrhea: bulky, greasy and foamy, foul odor.
 - b. Biliary obstruction: light gray or clay-colored.
 - c. Ulcerative colitis: loose stools, with copious amounts of mucus or pus.
 - d. Constipation or obstruction: small, hard masses.
 5. Specimen collection.
 - a. Specimens for detection of ova and parasites should be sent to the laboratory while the stool is still warm and fresh.

- b. Examination for guaiac (occult blood) is performed on a small sample that is sent to the lab, or, a sample is placed on a commercially prepared card. A positive result indicates blood in the stool.
- c. Stools for chemical analysis are usually examined for the total quantity expelled, so the complete stool is sent to the laboratory.

Biopsy and Cytology

- A. Specimens for microscopic examination are secured by endoscopy examination, cell scrapings, and needle aspiration.
- B. Specimens are examined, and the laboratory then determines their origin, structure, and functions, and the presence of malignant cells.

Radionuclide Uptake

- A. Radionuclides are used for diagnosis by measuring the localization of the substance, such as radio-iodine in the thyroid, and the excretion of the material.
- B. Various substances are studied, such as vitamin B₁₂, iron, and fat, and major organs can be scanned.
- C. Substances are tagged with radioactive isotopes to assess the degree of absorption.

Blood Examinations

- A. Hematologic studies and electrolyte determinations reveal information about the general status of the client.
- B. Results of these examinations in conjunction with other assessment procedures and clinical symptoms help to localize the disorder.

System Implementation

- A. Monitor vital signs.
- B. Check for signs of dehydration.
 1. Dry mucous membranes.
 2. Poor skin turgor.
 3. Decreased urination.
 4. Increased pulse.
- C. Monitor fluid intake or intravenous (IV) administration if ordered.
- D. Monitor dietary intake or NPO status as ordered.
- E. Check and record stool pattern, consistency, color, odor, presence of blood or pus, etc.
- F. Evaluate laboratory results of stool culture.
- G. Observe skin tone, color, and changes.
- H. Administer enema if ordered.
- I. Promote bowel regulation through client teaching of dietary information.
- J. Perform and teach colostomy or ileostomy care to client.

- K. Place or assist physician in placing Miller-Abbott tube for relief of distention if ordered.
- L. Instruct client on diagnostic tests.
- M. Instruct client in preoperative and postoperative care.

GENERAL GASTROINTESTINAL CONDITIONS

Definition: General symptoms of the gastrointestinal tract that may occur singly or concurrently and may be due to a wide variety of causes.

Anorexia

Definition: Loss of appetite.

Assessment

- A. Assess for physiological basis for anorexia.
 - 1. Most illnesses, especially active stages of infections and disorders of the digestive organs, cause anorexia.
 - 2. Physical discomfort.
 - 3. Constipation.
 - 4. Fluid and electrolyte imbalances.
 - 5. Oral sepsis.
 - 6. Intestinal obstruction.
- B. Assess for psychological source of anorexia.
 - 1. Fear and anxiety.
 - 2. Depression.
 - 3. Anorexia nervosa.
- C. Assess for mechanical problems resulting in anorexia.
 - 1. Improperly fitting dentures.
 - 2. Excessive amounts of food.

Implementation

- A. Be aware of client's eating habits, food likes and dislikes, and cultural and religious beliefs regarding food.
- B. Permit choices of food when possible.
- C. Show interest, but do not force client to eat.
- D. Provide a pleasant environment.
- E. Serve small, attractive portions of food.

Nausea and Vomiting

Definitions: *Nausea* is a feeling of revulsion for food, accompanied by salivation, sweating, and tachycardia. *Vomiting* is the contraction of the expiratory muscles of the chest, spasm of the diaphragm with contraction of the abdominal muscles, and subsequent relaxation of the stomach, allowing the gastric contents to be forced out through the mouth.

Characteristics

- A. Accompanying symptoms: decreased blood pressure, increased salivation, sweating, weakness, faintness, paleness, vertigo, headache, and tachycardia.
- B. Vomiting centers.
 - 1. Chemoreceptor emetic trigger zone.
 - 2. Vomiting center in the medulla.
- C. Stimulation of vomiting centers.
 - 1. Impulses arising in the gastrointestinal tract.
 - 2. Impulses from cerebral centers.
 - 3. Chemicals via the bloodstream to the centers.
 - 4. Increased intracranial pressure.

Assessment

- A. Assess for cerebromedullary causes.
 - 1. Stress, fear, and depression.
 - 2. Neuroses and psychoses.
 - 3. Shock.
 - 4. Pain.
 - 5. Hypoxemia.
 - 6. Increased intracranial pressure.
 - 7. Anesthesia.
- ♦ B. Assess for toxic causes.
 - 1. Drugs ingested.
 - a. Direct action on the brain.
 - b. Irritant effects on the stomach or the small bowel.
 - 2. Food poisoning—ask about foods recently ingested.
 - 3. Acute febrile disease—evaluate temperature.
- C. Evaluate possible visceral causes.
 - 1. Allergy.
 - 2. Intestinal obstruction—evaluate bowel sounds.
 - 3. Constipation.
 - 4. Diseases of the stomach.
 - 5. Acute inflammatory disease of the abdominal and pelvic organs.
 - 6. Pregnancy.
 - 7. Cardiovascular diseases.
 - 8. Visceral disease.
 - 9. Motion sickness.
- D. Check for severe hypovitaminosis, especially B vitamins.
- E. Assess for eating patterns—fasting or starvation.
- F. Check for endocrine disorders, such as hypothyroidism and Addison's disease.
- G. Observe character and quantity of emesis.
- H. Evaluate hydration status and fluid and electrolyte balance.
- I. Check daily weights.
- J. Assess for complications—alkalosis, convulsions or tetany, atelectasis, or pneumonitis.

Implementation

- A. Administer drugs: antiemetics, antihistamines, phenothiazines.
- B. Monitor parenteral fluid and electrolyte replacements.
- C. Perform gastric decompression.
- D. Closely monitor prolonged vomiting, as hemorrhage could result.
- E. Monitor hydration status, as dehydration will result in electrolyte imbalance leading to alkalosis.
- F. Monitor for aspiration of vomitus, which may cause asphyxia, atelectasis, or pneumonitis.
- G. Protect the client from unpleasant sights, sounds, and smells.
- H. Promptly remove used emesis basin and equipment.
- I. Promptly change soiled linens and dressings.
- J. Ventilate room and use unscented air fresheners.

Constipation and Diarrhea

Definitions: **Diarrhea** is a condition characterized by loose, watery stools resulting from hypermotility of the bowel (not determined by frequency). **Constipation** is the undue delay in the evacuation of feces, with passage of hard and dry fecal material.

Assessment

- A. Assess all other systems of the body to determine causal factors.
- ◆ B. Assess for constipation.
 - 1. Lack of regularity.
 - 2. Psychogenic causes.
 - 3. Drugs such as narcotics.
 - 4. Inadequate fluid and bulk intake.
 - 5. Mechanical obstruction.
- ◆ C. Assess for diarrhea.
 - 1. Fecal impaction.
 - 2. Ulcerative colitis.
 - 3. Intestinal infections.
 - 4. Drugs such as antibiotics.
 - 5. Neuroses.
- ◆ D. Evaluate hydration status.
- E. Assess for presence of metabolic acidosis.
- F. Assess for fecal impaction—pain.
- G. Observe the condition of the stool, such as color, odor, shape, consistency, amount, and any unusual features, such as mucus, blood, or pus.

Implementation

- A. Administer drugs—laxatives and cathartics.
 - ◆ 1. Laxative may be used temporarily to relieve constipation, but regular use will cause loss of bowel tone.
 - a. Bulk-forming/fiber (Metamucil, psyllium seed, bran) stimulates peristalsis.

- b. Milk of magnesia alters stool consistency to stimulate peristalsis.
- c. Lubricants, such as mineral oil, soften stool.
- d. Dulcolax (bisacodyl) stimulates colon; cascara, castor oil.
- e. Stool softener; Colace, Surfak (docusate).
- f. Miralax (polyethylene glycol an osmotic laxative).
- ◆ 2. Antidiarrheals, such as absorbents, astringents, and antispasmodics, may relieve symptoms.
 - a. Mild diarrhea: Oral fluids replace lost fluids.
 - b. Moderate diarrhea: drugs that decrease motility (Lomotil [diphenoxylate/atropine] and Imodium [loperamide]).
 - c. Severe diarrhea caused by infectious agent: antimicrobials and fluid replacement.
 - d. Anticholinergics (atropine) reduce bowel spasticity. Used to treat irritable bowel and diarrhea caused by peptic ulcer disease.
- ◆ B. Provide fluid and electrolyte replacement therapy to correct imbalances—IV therapy may be necessary to replace fluids.
- C. Diet high in nutrients and calories—give supplements of vitamins (especially fat-soluble A, D, E, and K).
- D. Prevent skin excoriation with emollients, powder, and cleanliness.
- E. Change soiled linens and dressings.
- F. Ventilate room.

DISORDERS OF THE UPPER GASTROINTESTINAL TRACT**Oral Infections**

Definition: Stomatitis is an inflammation of the mouth; glossitis is an inflammation of the tongue; and gingivitis is an inflammation of the gums.

Characteristics

- A. Causes may be mechanical, chemical, or infectious.
- B. Types.
 - ◆ 1. Herpes simplex—a group of vesicles on an erythematous base.
 - a. Usually located at the mucocutaneous junction of the lips and face.
 - b. Caused by a virus that may be activated by sunlight, heat, fever, digestive disturbances, and menses.
 - c. Antimicrobial treatment is not effective unless there is secondary bacterial infection. Treated with Zovirax (acyclovir).
 - d. Treated symptomatically.

2. Vincent's angina (trench mouth)—purplish-red gums covered by pseudomembrane.
 - a. Caused by fusiform bacteria and spirochetes.
 - b. Symptoms include fever, anorexia, enlarged cervical glands, and foul breath.
 - c. May be acute, subacute, or chronic.
3. Aphthous ulcers (canker sores).
 - a. Unknown etiology.
 - b. Usually less than 1 cm in diameter.
 - c. Duration—lasts weeks to months.
 - d. Very painful, shallow erosions of the mucous membranes.
 - e. Well circumscribed with a white or yellow center, encircled by a red ring.

Assessment

- A. Assess for anorexia.
- B. Evaluate excessive salivation.
- C. Check for foul breath.
- D. Evaluate condition of gums and tongue.
- E. Assess for jagged teeth or mouth breathing.
- F. Check for foods or drinks that result in allergies.
- G. Assess for presence of infection.

Implementation

- A. Remove cause.
- B. Provide frequent, soothing oral hygiene.
- C. Administer topical medications or systemic antibiotics.
- D. Provide a soft, bland diet.
- E. Administer pain medications as needed.
- F. Avoid alcohol-based mouthwashes.

Disorder of the Salivary Glands

♦ *Definition:* Salivary gland infection is an inflammation (parotitis or surgical mumps) usually caused by *Staphylococcus aureus*.

Assessment

- A. Assess for pain.
- B. Check temperature.
- C. Assess for enlargement of glands.
- D. Assess for dysphagia.

Implementation

- A. Administer preventive measures.
 1. Keep the glands active; calculus or calculi (stones) form when the gland is inactive.
 2. Provide adequate fluids.
 3. Give oral hygiene.
- B. Provide warm packs.
- C. Administer antibiotics.
- D. Monitor hydration.

- E. Care for incision.
- F. Observe for drainage.

Malignant Tumors of the Mouth

Definition: Cancer of the mouth is a malignant tumor (squamous cell carcinoma) and usually affects the lips, the lateral border of the tongue, or the floor of the mouth.

Assessment

- ♦ A. Assess for lesions that tend to be painless and hard and ulcerate easily.
- B. Assess for poor oral hygiene.
- C. Check for chronic irritation.
- D. Evaluate for chemical and thermal trauma (tobacco, alcohol, and hot, spicy foods).
- E. Assess for metastasis by local extension.
 1. Cause symptoms by occupying space and exerting pressure.
 2. Usually fibromas, lipomas, or neurofibromas.

Implementation

- A. Provide postsurgical interventions.
- B. Monitor for complications.

Radical Neck Dissection

Definition: Removal of lateral lymph nodes and tissue, submandibular gland, jugular vein, sternocleidomastoid muscle, spinal accessory nerve, and surrounding tissue of neck.

♦ Assessment

- A. Assess for patent airway.
 1. Observe for airway obstruction (wheezing, stridor, retraction).
 2. Observe for respiratory distress, stertorous, labored breathing, increased respirations, and cyanosis.
- B. Observe for edema that could constrict trachea.
- C. Watch for difficulty in swallowing if allowed oral fluids. Difficulty may indicate nerve damage. If radical procedure, client will probably be fed through either nasogastric (NG) tube, gastrostomy, or IV therapy.
- D. Observe dressings for hemorrhage, which could lead to respiratory embarrassment.
- E. Assess vital signs for indications of bleeding and infection.
- F. Assess for infection; increase in temperature, foul odor to dressings.

- G. Observe for carotid rupture or chylous fistula—milky drainage.
- H. Assess catheter drainage and suture lines.
- I. Evaluate wound healing.
- J. Observe for lower facial paralysis indicating facial nerve injury.
- K. Assess mental state for depression, damage to self-image, feelings of loss, etc.

Implementation

- ◆ A. Maintain adequate respiratory function.
 - 1. Place in high-Fowler's position.
 - 2. Monitor for respiratory distress.
- ◆ B. Suction to prevent aspiration and pneumonia.
- C. Administer oxygen as needed.
- D. Encourage intake of fluids, which is necessary to thin secretions.
- E. Provide care for laryngectomy (frequently performed with radical neck dissection).
 - 1. Use mist mask.
 - 2. Clean laryngectomy tube as you would tracheostomy tube.
- F. Change dressings frequently to prevent infection.
 - 1. Drains are frequently placed in surgical site; Hemovac is the drain most commonly used.
 - 2. Observe for drainage (amount, type, odor, color).
- G. Give oral hygiene every 2–4 hours.
- ◆ H. Develop means to communicate, as client will not be able to talk postoperatively if laryngectomy was also performed.
 - 1. Provide method of writing for the first few days.
 - 2. Explain to client that hoarseness is usual for the first few weeks.
 - 3. Provide bell or readily accessible means of communication for client to decrease anxiety following surgery. Answer bell or call light immediately.
- I. Provide privacy for client.
- J. Develop nurse-client relationship, as client may be depressed, may suffer feelings of loss, and may need to verbalize concerns about self-image.
- K. Teach or follow through with rehabilitation exercises for head and shoulder.
 - 1. Rotate neck, tilt head to both sides, and drop chin to chest.
 - 2. Swing arm on operated side in arc to extend range of motion.
- L. Provide general postoperative care.

MEDICAL IMPLICATIONS

Diagnosis

- Laryngoscopic exam reveals nodes on or near the vocal cords.
- Biopsy reveals cancer cells.
- Assess involvement of the vocal cords.

Radiation

- Excellent result when only one cord is affected.
- Usually retains normal voice.
- May be used preoperatively to reduce tumor size.
- May not be a lasting cure.

Surgery

Cancer of the Larynx

Definition: Cancer of the voice box and other surrounding structures.

Characteristics

- A. Factors that increase risk.
 - 1. Age—occurs most often in people older than age 55.
 - 2. Gender—men are four times more likely than women.
 - 3. Race—increased in African Americans.
 - 4. Smoking.
 - 5. Alcohol.
 - 6. Personal history of head and neck cancer.
 - 7. Occupational—workers exposed to sulfuric acid mist, nickel, or asbestos have increased risk of disease.
- B. Clinical manifestations.
 - 1. Hoarseness.
 - 2. Burning while drinking hot or acidic food.
 - 3. Dysphagia.
 - 4. Foul breath.
 - 5. Enlarged cervical nodes.
 - 6. Weight loss.
 - 7. Malaise.
 - 8. Pain radiating to the ear.

Laryngectomy

Definition: Removal of the voice box and other surrounding structures. May be partial or complete, which depends on the location and involvement of the tumor.

Characteristics

- A. Total laryngectomy and radical neck dissection—procedure of choice for cancer under following circumstances:

1. If tumor does not extend more than 5 mm up base of tongue or below upper edge of cricoarytenoid muscle.
2. If there is no evidence of distant metastasis.
- B. Epiglottis, thyroid cartilage, hyoid bone, cricoid cartilage, and part of trachea are removed.
- C. Stump of trachea is brought out to neck and sutured to skin. The pharyngeal portion is closed, and breathing through nose is eliminated.
- D. Accompanied by radical neck dissection if neck tissue and lymph nodes are involved.

Assessment

- A. Assess drainage from wound suction for amount, type, color, and odor.
- B. Assess for carotid artery hemorrhage.
- C. Evaluate lung fluids for atelectasis and pneumonia.
- D. Monitor for complications.
 1. Mucus plug.
 2. Bleeding from stoma or incision.
 3. Infection at incision site.
 4. Respiratory infection.

♦ Implementation

- A. Observe for hypoxia.
 1. Early signs: increased respirations and pulse, apprehension, restlessness.
 2. Late signs: cyanosis, dyspnea, swallowing difficulties.
- B. Position in semi-Fowler's position or higher. Prevent forward flexion on the neck to reduce edema and help to keep airway open.
- C. Suction frequently using sterile technique until area has healed; then use clean technique.
- D. Place pressure on neck wound for hemorrhage around site.
- E. Instruct client regarding means for communication, as he or she will not be able to speak immediately postoperatively.
- F. Speech rehabilitation is utilized after surgical area has healed.
- G. Nutrition.
 1. NPO 7 days.
 2. NG or gastrostomy tube and total parenteral nutrition (TPN).
 3. Thick fluids introduced first. Have suction available.
 4. Avoid sweet foods as they increase salivation and can decrease appetite.
 5. Rinse mouth with warm water or brush teeth after eating.

H. Teaching.

1. Teach ways to handle increased mucus production.
2. Keep stoma clear of excess mucus.
3. Wear a nonrestricting bib to conceal mucus.
4. Cleanse peristomal skin BID.
5. Use nebulizer or humidifier.
6. Assure that taste and smell will adapt over time.
7. Cover stoma while showering.
8. Avoid swimming.
9. Avoid powders and aerosols.
10. Carry medical alert information.

Gastroesophageal Reflux Disease

Definition: Backward flow (reflux) of gastric contents into the esophagus; suffered by 15–20% of adults.

Assessment

- A. Assess for heartburn after meals.
- B. Check for regurgitation of material into the mouth.
- C. Assess for difficulty or pain in swallowing—pain may be severe.

♦ Implementation

- A. Monitor antacids (Maalox) for mild or moderate conditions.
- B. Explain use of histamine₂ receptor blockers (Tagamet [cimetidine], Zantac [ranitidine]) to reduce acid production.
- C. Monitor use of proton-pump inhibitors (PPIs) such as Prilosec (omeprazole) or Prevacid (lansoprazole) to reduce gastric secretions and relieve symptoms.
- D. Suggest dietary changes such as reduction in fat, coffee, and spicy foods, and cessation in smoking (which increases acidity).

Esophageal Varices

♦ Definition: Tortuous, dilated veins in the submucosa of the lower esophagus, possibly extending into the fundus of the stomach or upward into the esophagus; caused by portal hypertension and often associated with cirrhosis of the liver.

Assessment

- A. Assess for bleeding.
- B. Check for hypotension.
- C. Evaluate neck veins for distention.

- D. Assess for nutritional status.
- E. Evaluate indications that lead to suspected varices.
 - 1. Hematemesis.
 - 2. Hematochezia (rectal bleeding).
 - 3. History of alcoholism.
- F. Observe for strain of coughing or vomiting, which could result in esophageal rupture.

◆ **Implementation**

- ◆ A. Carefully observe vital signs, watching for hemorrhage and shock. (Goal is to restore hemodynamic status.)
- B. Maintain prescribed pressure levels in balloon tamponade (infrequently used today, kept in place for 12 hours or less depending on other definitive therapies used).
 - 1. Provide frequent oral hygiene and aspiration of the mouth and throat because the client cannot swallow saliva with the balloons in place.
 - 2. Prevent esophageal erosion by deflating the balloons (only with physician's order).
- ◆ 3. Safety measure: Keep scissors at bedside. If tube dislodges and causes obstruction, cut tube to deflate balloons.
- 4. Prevent nasal breakdown.
 - a. Keep nostrils lubricated and clean.
 - b. Provide foam rubber padding to reduce pressure at nares.
- 5. Observe for sudden respiratory crisis, which may occur with aspiration or upward displacement of the balloons.
- C. Maintain fluid and nutritional balance.
- ◆ D. Observe for complications of active bleeding varices.
 - 1. Hypovolemia.
 - 2. Hepatic encephalopathy due to increased ammonia production as blood protein is metabolized.
 - 3. Metabolic imbalances due to acid-base and electrolyte disturbances.
- E. Comfort family and client.
 - 1. Explain procedures and utilize nursing comfort measures.
 - 2. Use sedatives and narcotics judiciously because the liver is usually impaired in its ability to detoxify.

MEDICAL IMPLICATIONS

- ◆ A. Upper endoscopy evaluates and treats condition.
 - I. Gastric lavage with normal saline to visualize varices.
 - 2. Varices may be banded or sclerosed.
 - a. Varices are ligated with small rubber bands that occlude blood flow.
 - b. Sclerosing agent injected into varices to induce inflammation and thrombosis.
- ◆ B. Balloon tamponade: Sengstaken–Blakemore triple-lumen tube for pressure application against varices.
 - I. May be used if endoscopy is unavailable or if vasoconstriction cannot control bleeding.
 - 2. Tube has three openings.
 - a. One opening to gastric balloon.
 - b. Second opening to esophageal balloon.
 - c. Pressure in both balloons is 25–30 mm Hg.
 - d. Third opening for aspiration of gastric contents.
 - 3. Traction with a 0.75- to 1.5-lb weight used to prevent downward movement.
 - 4. Iced saline irrigations may be used to vasoconstrict the small collaterals.
- ◆ C. Transjugular intrahepatic portosystemic shunt (TIPS): Used for portal hypertension and varices.
 - I. A needle inserted transcutaneously in which a stent that carries blood into hepatic vein is inserted, bypassing the damaged liver.
 - 2. Shunt relieves pressure in varices and increases perfusion of the liver and impaired ammonia metabolism.
- ◆ D. Restoration of clotting factors.
 - I. Vitamin K replacement.
 - 2. Platelet replacement (destroyed by damaged spleen).
 - 3. Fresh frozen plasma.
- ◆ E. Surgical repairs.
 - 1. Direct ligation of varices.
 - 2. Portasystemic shunts.
 - a. Portacaval.
 - (1) End to side.
 - (2) Side to side.
 - b. Splenorenal.
 - (1) End to side.
 - (2) Side to side.
 - c. Mesocaval.
 - (1) End to side.
 - (2) Use of synthetic graft.
 - 3. Esophageal transection and devascularization.

Esophageal Hernia (Hiatal Hernia)

Definition: In esophageal hernia, a portion of the stomach herniates through the diaphragm and into the thorax (also called diaphragmatic hernia).

Characteristics

- A. Congenital weakness.
- B. Trauma.
- C. Relaxation of muscles.
- D. Increased intra-abdominal pressure.
- E. Manifestations range from none to acutely severe manifestations.

Assessment

- A. Assess for heartburn and substernal discomfort or pain.
- B. Assess for dysphagia.
- C. Check for vomiting pattern.
- D. Reflux.
- E. Indigestion or feeling of fullness.
- F. Assess for complications.
 - 1. Ulceration.
 - 2. Hemorrhage.
 - 3. Regurgitation and aspiration of gastric contents.
 - 4. Incarceration of stomach in the chest, with possible necrosis, peritonitis, and mediastinitis.
- G. Diagnostic tests.
 - 1. Esophagogastroduodenoscopy (EGD).
 - 2. Barium swallow.

Implementation

- ◆ A. Provide small, frequent meals, avoiding highly seasoned foods.
- ◆ B. Maintain upright position during and after meals.
- C. Give antacids after meals and at bedtime.
- D. Elevate head of bed to avoid regurgitation while eating and for 30 minutes after meal.
- E. Avoid anticholinergic drugs, which delay emptying of the stomach.
- F. Prevent constricting clothing around the waist and sharp, forward bending.
- G. Monitor medical treatment.
 - 1. Reduction of stomach distention.
 - 2. Reduction of stomach acidity.
 - 3. Reduction of increased levels of intra-abdominal pressure.
- ◆ H. Give postoperative care for surgical reduction of hernia, via a thoracic or abdominal approach.
 - 1. Surgery is indicated when the risk of complications or reflux is severe.
 - 2. Surgical approach reinforces the lower esophageal sphincter (LES) to restore sphincter competence and prevent reflux. A portion of the stomach fundus is wrapped around the distal esophagus to anchor it and reinforce the LES.

Esophageal Lesions**Characteristics**

- A. Benign lesions.
 - 1. Leiomyoma most common type.
 - 2. Asymptomatic.
- B. Malignant lesions.
 - 1. Usually occur in lower two-thirds of esophagus.
 - 2. Mainly affect men over age 50.
 - ◆ 3. Smoking and alcohol are risk factors.
 - a. Poor prognosis (< 5 years survival) due to early lymphatic spread and late development of symptoms.
 - b. Dysphagia is the most common symptom.
 - c. Diagnosis made by barium swallow, esophagoscopy, biopsy.
- C. Treatment.
 - 1. Surgical excision.
 - 2. Radiation therapy (fistulas may be a complication).

Assessment

- A. Assess for extent of lesions.
- B. Evaluate vital signs.
- C. Observe for poor nutritional status.
- D. Observe for complications of ulceration and hemorrhage, fistula formation, and pneumothorax in end-stage disease.

Implementation

- A. Maintain fluid and electrolyte balance.
- B. Manage nutrition needs (hyperalimentation therapy may be used).
- C. Administer gastrostomy tube feedings, if ordered.
- D. Monitor client's ability to handle secretions.
- E. Provide emotional support.

GASTRIC DISORDERS**Dyspepsia Indigestion**

Definition: Indigestion is caused by diseases of the gastrointestinal system, eating too rapidly, emotional problems, inadequate chewing, eating improperly cooked foods, systemic diseases, food allergies, and altered gastric secretion or motility.

Assessment

- A. Assess for heartburn.
- B. Assess for flatulence.
- C. Observe for nausea.
- D. Observe for eructations.
- E. Identify feeling of fullness.

Implementation

- A. Based on the cause of the disorder.
- B. Antacids and bland diets.
- C. Antispasmodics and tranquilizers.
- D. Altered eating habits.

Anorexia Nervosa

♦ *Definition:* Underlying emotional disorders cause psychogenic aversion to food, with resulting emaciation. Usually occurs in females during the late teens or early twenties. Onset is often associated with a stressful life event. Client often has fear of obesity, body-image distortion, and disturbed self-concept. This eating disorder may be life-threatening. Death can occur from starvation or electrolyte imbalance.

Assessment

- ♦ A. Assess weight—loss of one-fourth to one-half or more of the body weight occurs with this disorder.
- ♦ B. Check for amenorrhea for at least three consecutive periods.
- C. Observe for vomiting when food is forced.
- D. Assess for hypotension, decreased temperature and pulse.
- E. Evaluate for anemia.
- F. Assess for hypoproteinemia.
- G. Compulsive exercising.
- H. Loss of appetite or refusal to eat.
 - I. Perfectionism and overachievement.
 - J. Self-administered enemas or self-induced vomiting.
 - K. Dry and scaly skin.
 - L. Sleep disturbances.
- M. Gastrointestinal upsets.
- N. Deterioration of gums and teeth.
- O. Degeneration of bone.

Implementation

- A. Give supportive care.
- B. Administer tube feedings if necessary.
- ♦ C. Monitor psychiatric treatment. (See Chapter 14, Psychiatric Nursing, for more detailed information.)
 - 1. Set firm limits.
 - 2. Monitor eating patterns.

Acute Gastritis

Definition: An inflammation of the stomach by a local irritant.

Characteristics

- A. Ingestion of an infectious, corrosive, or erosive substance (such as alcohol, aspirin, or food poisoning).

- B. Acute systemic infections.
- C. Radiotherapy or chemotherapy.

♦ Assessment

- A. Assess for pain.
- B. Evaluate nausea and vomiting pattern.
- C. Check for malaise.
- D. Observe for hemorrhage.
- E. Assess for anorexia.
- F. Check for headache.
- G. Assess for dehydration.

Implementation

- A. Remove cause and treat symptomatically.
- B. Monitor drugs that include antacids and phenothiazines.
- ♦ C. Correct fluid and electrolyte balance; NPO during acute phase, then graduate to bland diet with fluid replacement.

Chronic Gastritis

Definition: Unrelated to acute gastritis, a nondescript, upper abdominal distress with vague symptoms. Other causes should be explored.

♦ Characteristics

- A. Type A: autoimmune component affecting people of Northern European heritage.
 - 1. Antibodies destroy gastric mucosal cells—results in tissue atrophy, loss of hydrochloric acid (HCl) and pepsin.
 - 2. Intrinsic factor not present, so low absorption of B₁₂ leads to pernicious anemia.
- B. Type B: more common, with incidence increasing with age.
 - 1. Caused by chronic infection of gastric mucosa by *Helicobacter pylori*.
 - 2. Infection is associated with increased risk of peptic ulcer disease.

Assessment

- A. Assess for dyspepsia, anorexia, and eructations.
- B. Check for foul taste in mouth.
- C. Assess for nausea and vomiting.
- D. Assess for pain and mild epigastric tenderness.
- E. Observe for complications.
 - 1. Hemorrhage.
 - 2. Scarring of mucosa.
 - 3. Ulcer formation.
 - 4. Malnutrition.

Implementation

The same as for peptic ulcer disease (PUD).

Peptic Ulcer Disease

◆ **Definition:** An ulceration in the mucosal wall of the stomach, pylorus, or duodenum, occurring in portions that are accessible to gastric secretions. Erosion may extend through the muscle to the peritoneum.

Characteristics

- ◆ A. Pathophysiology.
 1. Any condition that upsets the balance between digestion and protection.
 - a. No longer thought to be only caused by excess stomach acid. It can contribute to ulcer formation if too much acid is secreted.
 - ◆ b. Bacterial invasion of mucosa caused by *Helicobacter pylori* bacterium (*H. pylori*).
 - c. Ingestion of certain drugs such as steroids, aspirin (ASA), and nonsteroidal anti-inflammatory drugs (NSAIDs).
 - d. Smoking is a risk factor.
 - ◆ 2. Ulcers tend to occur in lesser curvature of stomach near the pylorus (15%).
 - 3. Duodenal ulcers account for 80% of peptic ulcers. (See **Table 8-1**.)
- B. Diagnostic evaluation.
1. Medical history and symptoms.
 2. Key test is endoscopy to locate ulcer.
 3. Gastric biopsy to detect *H. pylori*.

Assessment

- A. Assess pain.
1. Location and intensity—duodenal ulcer symptoms usually occur 1–3 hours after eating, worse at end of day and during the night.
 2. Duration.
 3. Aggravating factors.

- B. Evaluate vital signs to establish a baseline to monitor for bleeding.
- C. Evaluate laboratory results.
- D. Check stool for blood.
- ◆ E. Observe for hemorrhage.
 1. Dark, granular (coffee ground) emesis is a result of acid digestion of blood in the stomach.
 2. Tarry, black stools result when blood is completely digested.
 3. Hematemesis (vomiting of bright red blood).
 4. Bright red blood from rectum. Occurs when bleeding originates from high in the gastrointestinal tract and there is concurrent, rapid gastrointestinal motility.

Implementation

- A. Administer and monitor medications.
- ◆ 1. Antimicrobial therapy—antibiotics (Amoxil [amoxicillin]), tetracycline.
 - a. One course of therapy treats ulcers caused by *H. pylori* infection.
 - b. Combined with proton-pump inhibitor, bismuth preparations, traditional antacids, H₂ antagonists, and Flagyl (metronidazole) results in a full cure with fewer complications.
 - c. Levaquin (levofloxacin)-based triple therapy is treatment of choice for persistent *H. pylori* infection.
 - ◆ 2. Antacids.
 - a. Action: Reduces gastric acidity; given for pain.
 - b. Taken 1 hour after meals; effects last longer.

Table 8-1 COMPARISON OF DUODENAL AND GASTRIC ULCER

	Chronic Duodenal Ulcer	Chronic Gastric Ulcer
Age	Usually 30 to 55	Usually 55 and older
Sex	Male:female-2-3:1	Male:female-1:1
Blood group	Most frequently type O	Blood group A
Social class	Executives, competitive leaders	Lower socioeconomic class
Incidence	80%	20%
General nourishment	Well nourished	Malnourished
Acid production in stomach	Hypersecretion	Normal to hyposecretion
Location	Within 3 cm of pylorus	Lesser curvature
Pain	2–3 hours after meals, and 50–80% have pain at night on an empty stomach or shortly after the meal Usually absent before breakfast—worsens as day progresses Rarely is there pain at night as day progresses	Ingestion of food, antacids, or vomiting relieves There is pain at night in about 30–40% of patients Relieved by antacids or vomiting
Vomiting	Uncommon	Common
Hemorrhage	Melena more common than hematemesis	Hematemesis more common than melena
Malignancy possibility	None	Usually less than 10%

- c. Side effects: diarrhea and constipation.
- d. Types of nonabsorbable antacids.
 - (1) Calcium carbonate is most effective but may cause hypercalcemia, hypercalciuria (high urine calcium), and constipation.
 - (2) Magnesium oxide is more potent than either magnesium trisilicate or magnesium carbonate.
 - (3) Aluminum hydroxide: high sodium (Na) content and constipation are disadvantages.
 - (4) Sodium bicarbonate is absorbed and should be avoided to prevent systemic alkalosis.
- ◆ 3. Histamine H₂-receptor antagonists.
 - a. Tagamet (cimetidine), Zantac (ranitidine), Pepcid (famotidine), and Axicid (nizatidine), PO or IV.
 - b. Action: Blocking action reduces production of gastric acid and allows ulcers to heal.
 - c. Drugs were 90% effective when taken PO for 8 weeks; now often replaced by antibiotics.
 - d. Minimal side effects: headache and skin rash.
- ◆ 4. Carafate (sucralfate).
 - a. Action: Adheres to ulcer surface, stimulates release of prostaglandins; reinforces mucosal barrier.
 - b. Duration is 5 hours; administer 1 hour before or after meals and at bedtime on an empty stomach.
 - c. Prescribed when drug interactions or side effects negate use of H₂ antagonists.
 - d. Side effects: constipation, nausea, and vomiting.
- 5. Anticholinergic drugs.
 - a. Used only for clients with severe pain in the early morning.
 - b. Drug action increases risk of gastric outlet syndrome.
- ◆ 6. Proton-pump inhibitors block release of HCl from parietal cells—very effective result with over 90% healing in 4 weeks.
 - a. Prilosec (omeprazole).
 - b. Prevacid (lansoprazole).
- 7. Synthetic prostaglandin.
 - a. Cytotec (misoprostol).
 - b. Particularly useful for persons using long-term NSAIDs.
- c. Protects stomach lining from erosive action of gastric acid. (This drug may induce abortions.)
- ◆ B. Provide dietary control of symptoms until ulcer is cured.
 - 1. Ensure three nutritious meals.
 - 2. Avoid black pepper, foods that cause distress until ulcer is cured (e.g., highly seasoned, rough, greasy, gas-forming, or fried).
 - 3. Avoid prolonged use of milk and cream, as they stimulate acid production.
 - 4. Avoid alcohol, as it releases gastrin, stimulates the parietal cells, and may damage the mucosa.
 - 5. Avoid tea, coffee, and cola, because caffeine stimulates gastric secretion.
 - 6. Do not provide any snacks, even at bedtime (stimulates acid secretion).
 - 7. Provide iron and ascorbic acid to promote healing.
- ◆ C. Reduce stressful situations if client is hospitalized.
 - 1. Allow client to care for important business obligations.
 - 2. Eliminate visitors or duties that increase stress.
 - 3. Teach autogenic methods of stress reduction, relaxation, tension-releasing activities.
- D. Promote rest.
 - 1. Adequate sleep is strongly advised.
 - 2. Business and social responsibilities should be curtailed during acute phase.
 - 3. Hospitalization may be required if therapy is not effective in 1 week.
 - 4. Sedatives and tranquilizers may be helpful for the anxious, tense client.
- ◆ E. Provide client and family teaching regarding diet, activity level, medications, risk factors (smoking), and potential complications.
- ◆ F. Observe for complications.
 - 1. Hemorrhage, ranging from slight blood loss (revealed by occult blood in stool) to massive blood loss, which may lead to shock.
 - a. Promote bed rest.
 - b. Observe vital signs.
 - c. Observe consistency, color, and volume of vomitus and stools.
 - d. Provide nasogastric suction to empty the stomach of clots and blood, and to watch the rate of bleeding.
 - e. Monitor blood, plasma, or IV fluids to support blood volume.
 - f. Administer narcotics and/or tranquilizers to reduce restlessness and to relieve pain.
 - g. Gavage with ice water to increase vasoconstriction.

2. Perforation: Occurs almost exclusively in males 25–40 years of age.
 - a. Monitor acute onset of severe, persistent pain that increases in intensity and can be referred to the shoulder.
 - b. Examine for tender, boardlike rigidity of the abdomen.
3. Pyloric obstruction caused by scarring, edema, or inflammation at the pylorus.
 - a. Monitor for the following signs: nausea and vomiting, pain, weight loss, and constipation.
 - b. Be aware that persistent vomiting can lead to alkalosis.
- G. For surgical interventions, see Surgical Implications under Gastric Cancer.

SURGICAL INTERVENTION

Gastric Cancer

Definition: Carcinoma of the stomach is a common cancer of the digestive tract.

Characteristics

- A. A significant cause of death because of low cure rate.
- B. Occurs twice as often in males as in females, and more often in African Americans than in other races.
- C. Found frequently in conjunction with pernicious anemia and atrophic gastritis.
- D. Worldwide incidence varies.
- E. Early carcinoma causes no symptoms.

♦ SURGICAL IMPLICATIONS

- ♦A. Vagotomy and gastroenterostomy or pyloroplasty.
 1. Vagus nerve is cut.
 2. Drainage of stomach.
 - a. Drainage operation necessary because vagotomy is often followed by gastric retention.
 - b. Vagus nerve provides the motor impulses to the gastric musculature, whose division is often followed by gastric atony.
 3. The pyloroplasty or gastroenterostomy also reduces the stimulation of gastric acid by reducing the formation of gastrin produced in the antral area of the stomach.
- B. Vagotomy and antrectomy.
 1. Decrease production of acid to point where ulcers will not recur.
 2. Remove acid-stimulating mechanism of stomach (i.e., divide vagus nerve and remove antral portion of stomach).
- C. Partial gastrectomy and possible vagotomy.
 1. Billroth I—partial gastrectomy with remaining segment of stomach anastomosed to duodenum.
 2. Billroth II—remaining segment of stomach is anastomosed to jejunum (usually for duodenal ulcer).

Assessment

- A. Assess for weight loss and anorexia.
- B. Check for feeling of vague fullness and sensation of pressure.
- C. Assess for anemia from blood loss.
- D. Examine stools for occult blood.
- E. Assess vomiting if pylorus becomes obstructed.
- F. Observe for late symptoms: ascites, palpable mass, and pain from metastasis.
- G. Evaluate for metastasis.
 1. Occurs by direct extension into surrounding tissue.
 2. Spreads through lymphatic and hematogenous systems.

Implementation

- A. Provide postoperative care for surgical resection.
- B. Monitor chemotherapy—response has not been consistent; may shorten life span if toxic effects occur.

Postoperative Period

Assessment

- A. Observe color, amount, and consistency of nasogastric drainage.
- B. Evaluate patency of nasogastric tube.
- C. Evaluate type and severity of pain.
- D. Evaluate client's ability to deep-breathe and cough.
- E. Assess intravenous site for possible complications.
- F. Listen for bowel sounds.
- G. Assess all systems for possible complications.

Implementation

- ♦ A. After anesthesia recovery, place in modified Fowler's position for comfort and easy stomach drainage.
- ♦ B. Prevent pulmonary complications—medicate before turning, coughing, or hyperventilating.
- ♦ C. Institute nasogastric suction; drainage contains some blood for the first 12 hours, then colored brown to dark green.
 1. Physician inserts tube.
 2. Keep patent by irrigating with sodium chloride.
- ♦ D. See that client is NPO (no peristalsis).
- E. Give intravenous fluids as ordered.
- ♦ F. After nasogastric tube is out, give small sips of water. (Do not use a straw.)
 1. Do not give cold fluids (cause distress); give warm, weak tea.
 2. Offer bland foods so that client eats six small meals a day and drinks 120 mL fluid between meals.
- G. Promote ambulation on first postoperative day unless contraindicated by physician.

- H. Check drainage tubes if inserted. (Serosanguineous drainage is normal.)
- ◆ I. Observe for postoperative complications.
 - 1. Shock (from hypovolemia).
 - 2. Vomiting—usually due to blood left in stomach. (Patent nasogastric tube prevents vomiting.)
 - 3. Hemorrhage.
 - 4. Pulmonary complications.
 - 5. Large fluid and electrolyte losses.
 - 6. Dumping syndrome.
 - 7. Diarrhea—complication of vagotomy (use Kapectate).
- ◆ 8. Vitamin B₁₂ deficiency.
 - a. Production of “intrinsic factor” is halted. (The gastric secretion is required for the absorption of vitamin B₁₂ from the gastrointestinal tract.)
 - b. Unless supplied by parenteral injection throughout life, client suffers vitamin B₁₂ deficiency.

INFLAMMATORY BOWEL DISEASE

Regional Enteritis (Regional Ileitis, Crohn's Disease)

◆ *Definition:* An inflammatory disease of the small intestine that is chronic and relapsing. It results in thickening, scarring, and granulomas of intestinal tissues, which causes narrow lumen, fistulas, ulcerations, and abscesses. The etiology is unknown but may be related to altered immunologic reactivity.

Characteristics

- A. Occurs at all ages.
- B. Usually observed in second and third decades of life.
- C. High incidence of familial occurrence.
- D. High incidence in those of Jewish descent; low incidence in African Americans.

◆ **Assessment**

- A. Continuous or episodic diarrhea and cramplike pain after meals.
- B. Evaluate for weight loss.
- C. Check for malnutrition.
- D. Assess for secondary anemia.
- E. Check for abdominal pain and tenderness.
- F. Evaluate temperature.
- G. Assess for complications: acute perforation, generalized peritonitis, and massive melena, which are sometimes present at onset.
- H. Fever.
- I. Electrolyte imbalance.

Implementation

- ◆ A. Provide appropriate diet: high calorie, high protein, low residue, bland, with iron and vitamin supplements (including B₁₂); elimination of all milk and milk products.
- ◆ B. Administer medications.
 - 1. Anti-inflammatory drugs to reduce swollen membranes (corticosteroids, Azulfidine [sulfasalazine]).
 - 2. Antidiarrheal agents to control diarrhea.
 - 3. Sedatives and narcotics to reduce apprehension and pain.
 - 4. Antibiotics such as Flagyl (metronidazole) may be given to control infection.
 - 5. Oral aminosalicylates (Asacol).
 - 6. Immunosuppressives to prevent relapses.
 - 7. Total parenteral nutrition (TPN) to maintain nutritional status is often prescribed.
- C. Provide postoperative care for surgical intervention (ileostomy).

Ulcerative Colitis

◆ *Definition:* A chronic ulcerative and inflammatory disease that affects the mucosa and submucosa of the colon and rectum; commonly begins in the rectum and sigmoid colon and spreads upward. The disease is characterized by periods of exacerbations and remissions.

Characteristics

- A. Cause unknown, but theories include autoimmune factor, allergic reaction, specific vulnerability of the colon, emotional instability, and bacterial infection.
- B. Most common in young adulthood and middle life. More prevalent among those of Jewish descent; less common in African Americans than in Caucasians.

◆ **Assessment**

- A. Assess for gradual onset.
 - 1. Malaise.
 - 2. Early—vague abdominal discomfort.
 - 3. Later—cramplike abdominal pain.
 - 4. Bowel evacuation—pus, mucus, and blood.
 - 5. Stools scanty and hard.
 - 6. Painful straining with defecation.
- B. Assess for abrupt onset.
 - 1. Severe diarrhea (15–20 watery stools a day that may contain blood and mucus).
 - 2. Fever.
 - 3. Anorexia.
 - 4. Weight loss.
 - 5. Abdominal tenderness.
 - 6. Rectal and anal spasticity.
 - 7. Consistency of stools varies with areas of colon involved.

- ◆ C. Assess for complications.
 1. Dehydration.
 2. Magnesium and calcium imbalances.
 3. Anemia and malnutrition—malabsorption and iron and vitamin K deficiency.
 4. Perforation, peritonitis, and hemorrhage.
 5. Abscesses and strictures.
 6. Carcinomatous degeneration (if more than 10 years' duration).
 7. Toxic megacolon and colon perforation.
 8. Bleeding tendency.
- D. Evaluate results of client's history and diagnostic tests.
 1. Medical history.
 2. Clinical manifestations.
 3. Lower GI series.
 4. Stool and blood examinations.
 5. Sigmoidoscopy.

Implementation

- A. Major objective—prevent acute episodes and/or manage complications.
- ◆ B. Maintain nutritional status.
 1. High-protein, high-calorie, high-fiber diet.
 2. Avoid certain spices (pepper), gas-forming foods, and milk products (client may be lactose intolerant).
 3. All foods should be cooked to reduce cramping and diarrhea.
 4. Vitamins (A and E), minerals (zinc, calcium, and magnesium), and iron supplements.
 5. Eating may increase diarrhea and anorexia.
 6. Total parenteral nutrition (TPN) may be indicated.
- ◆ C. Replace fluid and electrolytes lost due to diarrhea.
 1. 3–4 L/day.
 2. Potassium chloride may need to be added.
- D. Manage psychological disturbances.
 1. Allow client to ventilate feelings; accept client as he or she is.
 2. Help client live with chronic disease (a change in lifestyle may be necessary).
 3. Avoid emotional probing during periods of acute illness.
 4. Provide client and family with instructions about pathology of the disease and rationale for treatment.
- ◆ E. Administer drugs as ordered.
 1. Steroid therapy for inflammation, toxicity, and emotional symptoms.
 - a. Induces remissions.
 - b. Given IV in acute episode.
 - c. Given rectally for long term.
 2. Anti-infectives.
 - a. Routine sulfonamides to reduce severity of attack.

- b. Antibiotic therapy for secondary bowel inflammation and systemic infections.
- 3. Immunosuppressives to prevent relapses.
- 4. Oral aminosalicylates have proven very effective (used with caution in clients with renal dysfunction).
- 5. Tranquilizers (e.g., Luminal [phenobarbital]) to relieve anxiety and decrease peristalsis.
- 6. Anticholinergics.
 - a. Relieve abdominal cramps.
 - b. Assist in controlling diarrhea.
- 7. In acute stages cathartics contraindicated, as they may lead to megacolon or perforation.
- F. Maintain bed rest during acute phase.
- G. Prepare client for surgery, if necessary.
(See **Table 8-2**.)

INTESTINAL DISORDERS**Malignant Tumors of the Intestine****Characteristics**

- ◆ A. Adenocarcinoma of the duodenum is the most common lesion of the small intestines.
 1. In the United States, less than 1% of gastrointestinal tract cancers (CA) arise in the small bowel.
 2. Occurs in younger age group; twice as common in men.
- ◆ B. Malignant tumors of large intestine are second most frequent cause of death from cancer.
 1. Men and women equally affected.
 2. CA colon more common in women; CA rectum more common in men.
 3. Metastasis is by direct extension, usually to stomach from transverse colon, bladder, and bowel.

Assessment

- A. Assess for abnormal stools, malabsorption, intestinal bleeding.
- B. Assess for weight loss, malaise, anemia.
- C. Check for anorexia.
- D. Check for vomiting.
- E. Evaluate cramplike pain.
- F. Assess for intestinal obstruction or biliary obstruction.

Implementation

- ◆ A. Provide postoperative care for surgical intervention.
 1. Large intestine tumors may result in a colostomy.
 2. Instruct client in colostomy procedure and care.
 3. Refer client to ostomy club.

Table 8-2 SURGICAL CORRECTIONS FOR THE COLON**Colostomy**

- A. Indications for surgery.
 - 1. Cancer of colon—permanent colostomy.
 - 2. Traumatic or congenital disruption of intestinal tract (permanent or temporary).
 - 3. Diverticulitis (double barrel)—can be reversed after inflammatory process is healed.
- B. Procedure—portion of colon brought through abdominal wall.
- C. Preoperative care.
 - 1. Provide high-calorie, high-protein, high-carbohydrate, low-residue diet for several days prior to surgery. At 24–48 hours prior to surgery, patient may be changed to full liquids or clear liquids.
 - 2. Administer intestinal antibiotics as ordered. These may include Kantrex (kanamycin), Cipro (ciprofloxacin), Keflex (cephalexin), erythromycin, and neomycin (PO) to decrease bacterial content of colon and to soften and decrease bulk of contents of colon.
 - 3. Cleanse bowel by administering laxatives and enemas.
 - 4. Provide adequate fluids and electrolytes.
- D. Postoperative care.
 - 1. Depends on which part of colon involved; contents are liquid to formed.
 - 2. Client has no voluntary control of bowel evacuation.
 - 3. Ascending colostomy is hard to train for evacuation.
 - 4. Evacuate bowel every 24–48 hours.
 - a. May irrigate with 200–500 mL at first, but irrigation not commonly done today.
 - b. Empty colostomy bag when $\frac{1}{3}$ – $\frac{1}{2}$ full.
 - 5. Control with diet.
 - 6. Maintain skin care around stoma; use skin barrier.
 - 7. Assure proper fit and placement of appliance— $\frac{1}{8}$ inch from stoma.
 - 8. Normal fluid intake.
 - 9. Instruct client in colostomy self-care.
 - 10. Suppositories may be given via colostomy.

Ileostomy

- A. Indications for surgery.
 - 1. Ulcerative colitis.
 - 2. Crohn's disease (regional ileitis).
 - 3. Distal obstruction.
- B. Procedure.
 - 1. Total colectomy and ileostomy (anything less gives only temporary relief).
 - 2. Portion of ileum brought through abdominal wall.
- C. Preoperative care.
 - 1. Provide intensified fluid, blood, and protein replacement.
 - 2. Administer chemotherapy and intestinal antibiotics, as ordered. These may include Kantrex, Cipro, Keflex, erythromycin, and neomycin (PO) to decrease bacterial content of colon and to soften and decrease bulk of contents of colon.
 - 3. If on steroids, maintain therapy after surgery and then gradually decrease.
 - 4. Provide low-residue diet in small, frequent feedings.
 - 5. Administer neomycin enemas.
- D. Postoperative care.
 - 1. Contents always liquid (from small intestine).
 - 2. More chance of excoriation of skin around stoma.
 - 3. Provide increased fluids because of excessive fluid loss through stoma.
 - 4. Provide a low-residue, high-calorie diet until client is accustomed to new arrangement for bowel evacuation; give vitamin B₁₂.
 - 5. Do not give suppositories via ileostomy.

Continent Ileostomy

- A. Internal reservoir created by short segment of small intestines.
- B. Nipple valve is formed from terminal ileum.
- C. As reservoir fills, fecal pressure closes valve.
- D. Client catheterizes stoma 2–4 times a day.
- E. Appliance may be needed if leaking occurs.

- B. Monitor cytotoxic drug therapy following surgery.
- C. Provide psychological support.
- D. Maintain low-residue or liquid diet.
- E. Administer antibiotics if ordered.

- F. Assess for abdominal distention and, if ruptured, paralytic ileus.
- G. Check diagnostic tests: elevated white blood cells (WBC), urinalysis, abdominal x-rays and ultrasound.

Implementation

- ◆ A. Place in semi-Fowler's position to relieve abdominal strain.
- ◆ B. Give nothing by mouth until bowel sounds present. IV fluids may be given to maintain vascular volume.
- C. Give antibiotics (third-generation cephalosporin) as ordered.
- D. Insert nasogastric tube as required; rectal tube for flatus.
- E. Client should not receive laxatives or enemas because these may perforate the appendix.
- F. Follow routine postoperative nursing care for any abdominal surgery (return of bowel sounds).
- G. Surgery may be laparoscopic.

Appendicitis

Definition: An inflammation of the appendix due to infection; can be classified as simple, gangrenous, or perforated.

♦ Assessment

- ♦ A. Assess for generalized, severe upper abdominal or periumbilical pain that localizes in the right lower quadrant.
- ♦ B. Check for rebound tenderness or flatus.
- C. Check for anorexia.
- D. Evaluate slightly increased temperature.
- E. Assess for nausea and vomiting.

Intestinal Obstruction

Definition: An impairment of the forward flow of intestinal contents caused by partial or complete stoppage.

Characteristics

- ◆ A. Mechanical type of obstruction.
 1. Adhesions—fibrous bands of scar tissue, following abdominal surgery, may become looped over a portion of the bowel.
 2. Hernias—incarcerated or strangulated.
 3. Volvulus—twisting of the bowel.
 4. Intussusception—telescoping of the bowel upon itself.
 5. Tumors.
 6. Hematoma.
 7. Fecal impaction.
 8. Intraluminal obstruction.
- ◆ B. Neurogenic type of obstruction.
 1. Paralytic, adynamic ileus.
 2. Ineffective peristalsis due to toxic or traumatic disturbance of the autonomic nervous system.
- C. Vascular type of obstruction.
 1. Occlusion of the arterial blood supply to the bowel.
 2. Mesenteric thrombosis.
 3. Abdominal angina.
- D. Pathophysiology.
 1. Fluids and air collect proximal to the obstruction.
 - a. Peristalsis increases as the bowel attempts to force material through.
 - b. Peristalsis ends and the bowel becomes blocked.
 2. Pressure increases in the bowel and decreases the absorptive ability.
 3. Circulating blood volume is reduced and shock may develop.
 4. Location of the obstruction determines the symptoms and progression of the clinical course.

Assessment

- ◆ A. Assess for small bowel obstruction (mortality is 10%) by evaluating following symptoms:
 1. Cramplike, colicky pain in midabdomen may be intermittent.
 2. Nausea and early severe vomiting.
 3. Reverse peristalsis.
 4. Dehydration; signs of fluid and electrolyte imbalance.
 5. Abdominal distention.
 6. Shock and death.

- ◆ B. Assess for large bowel obstruction by evaluating following symptoms:
 1. Progression of symptoms is slower than with small bowel obstruction.
 2. Constipation.
 3. Abdominal distention.
 4. Cramplike pain in lower abdomen.
 5. If ileocecal valve is incompetent, relief of colonic pressure occurs by reflux into the ileum.
- ◆ C. Assess for paralytic ileus by evaluating following symptoms:
 1. Dull, diffused pain.
 2. Gaseous distention.
 3. Bowel sounds diminished or absent.
 4. Vomiting after eating.
- D. Observe and report the nature, duration, and character of pain.
- E. Assess the presence and progression of distention and the absence of flatus and stool.
- F. Observe for signs and symptoms of fluid and electrolyte imbalance.
- G. Note lab test results: elevated hematocrit, blood urea nitrogen (BUN) and blood glucose, and low potassium.

Implementation

- A. Assist in placement of a long intestinal tube with weighted or balloon tip for intestinal decompression to remove gas and fluid.
- B. Monitor parenteral fluids to replace fluids and electrolytes.
 1. Sodium, potassium, and chloride.
 2. Dextrose and water.
- C. Administer antibiotics to prevent secondary infections (especially peritonitis).
- D. Measure and record vital signs, intake and output (urinary output hourly—keep at 30 mL/hr or more), and emesis.
- E. Save stool for testing.
- F. Prepare client for surgery, if indicated.

Herniorrhaphy

Definition: A hernia is a protrusion of the intestine through an opening in the abdominal wall.

Characteristics

- A. Femoral—below groin.
- B. Umbilical—around umbilicus, due to failure of orifice to close after birth.
- C. Incisional—due to weakness in incisional area from infection or poor healing.
- D. Inguinal—weakness in abdominal wall where round ligament is located in female and where spermatic cord emerges in male.

Assessment

- A. Assess for possible wound healing at incision site.
- B. Assess for edematous scrotum for inguinal hernia.
- C. Check for constipation.
- D. Assess for abdominal distention.

Implementation

- ◆ A. Treatment.
 - 1. Reducing hernia—place an appliance over hernia area to prevent abdominal contents from entering hernia area and strangulating.
 - 2. Surgical intervention.
- B. Postoperative care.
 - 1. Maintain routine postoperative care.
 - 2. Ambulate day of surgery or next morning.
 - 3. Provide ice pack or scrotal support if inguinal hernia in male.
 - 4. Prevent urine retention.
 - 5. Report any abdominal distention.

Diverticulosis and Diverticulitis

◆ *Definition:* Diverticulum is the outpouching of intestinal mucosa, which may occur at any point in the gastrointestinal tract but more commonly in the sigmoid colon. It is caused by congenital weakness and increased pressure in the lumen. *Diverticulosis* is the presence of multiple diverticula. *Diverticulitis* is inflammation of diverticula.

Characteristics

- A. No symptoms unless complications develop.
- B. Large bowel diverticula are more apt to develop complications.
- C. Complications are perforation, hemorrhage, inflammation, fistulas, and abscess.

Assessment

- A. Assess for cramplike pain (usually left-sided).
- B. Check for flatulence.
- C. Assess for nausea and vomiting.
- D. Evaluate patterns of irregularity, irritability, and spasticity of the intestine.
- E. Assess for fever.
- F. Examine for dysuria associated with bladder involvement.

Implementation

- ◆ A. Provide care during acute phase.
 - 1. Intravenous fluids with electrolytes.
 - 2. Bed rest.
 - 3. Nothing by mouth (NPO).
 - 4. Nasogastric decompression.
 - 5. Drugs: antibiotics, analgesics, antispasmodics, and bulk former (Metamucil).

- ◆ B. Monitor appropriate diet.
 - ◆ 1. Current studies indicate a high-fiber diet to increase stool bulk and reduce spasms. (Use bran fiber for diverticulosis.)
 - ◆ 2. Bowel rest and low-fiber regimen for severe inflammatory phase of diverticulitis.
 - 3. Provide vitamin and iron supplements.
- C. Instruct client and family in pathology and rationale for treatment.
- D. Provide pain medication (Talwin [pentazocine]) rather than morphine sulfate (MS) or Demerol (pethidine), which increase colonic pressure.
- E. Monitor stool normalization: bowel lubricant nightly, stool softener, bulk preparation daily, evacuant suppository, vegetable oil, unprocessed bran, and fruit juice daily.
- F. Prepare client for surgery if indicated. (See Table 8-2.)

Hemorrhoids

Definition: Dilated varicose veins of the anal canal that may be internal or external.

Characteristic

- A. Types.
 - 1. Internal hemorrhoids (occur above the internal sphincter)—covered by mucous membrane.
 - 2. External hemorrhoids (occur outside the external sphincter)—covered by anal skin.
 - 3. Thrombosed hemorrhoids are infected and clotted.
- ◆ B. Causes.
 - 1. Portal hypertension.
 - 2. Straining from constipation.
 - 3. Irritation and diarrhea.
 - 4. Increased venous pressure from congestive heart failure.
 - 5. Increased abdominal pressure as from pregnancy.

Assessment

- A. Assess for itching.
- B. Assess for pain.
- C. Check for bleeding.
- D. Assess for complications: hemorrhage, strangulation, thrombosis, and prolapse.

Implementation

- ◆ A. Treat constipation with diet, stool softeners, and laxatives.
- ◆ B. Maintain diet low in roughage and high in fiber.
- C. Provide suppositories, ointments, and systemic analgesics.
- D. Administer hot sitz baths.

- ◆ E. Surgical treatment.
 1. Internal hemorrhoids ligated with rubber bands—tissue becomes necrotic and drops off.
 2. Cryosurgical hemorrhoidectomy may be done.
- F. Nonsurgical treatment.
 1. Infrared photocoagulation and laser therapy.
 2. Methods affix mucosa to underlying muscle.

Anorectal Surgery

Characteristics

- A. Pilonidal cyst—cyst located on lower sacrum with hair protruding from sinus opening.
- B. Anal fissure—crack in the anal canal.
- C. Anal fistula—abnormal opening near the anus and continuing into the anal canal.

♦ Implementation

- A. Give routine postoperative care.
- B. Keep perineal and rectal area clean by providing sitz baths three to four times/day (after first day) or irrigations.
- C. Apply spray analgesics when needed to ease pain.
- D. Medicate for pain but avoid codeine preparations as they are constipating.
- E. Place in prone position or side-lying position for at least 4 hours postop to prevent hemorrhage.
- F. Prevent urinary retention.
 1. Keep accurate intake and output.
 2. Observe for frequent, small voidings.
- G. Clients usually have packing inserted with pressure dressing applied.
 1. Reinforce dressing as needed to apply pressure.
 2. Keep area clean.
- H. Apply ice packs over rectal dressing immediately postoperatively.
 1. Prevents edema formation.
 2. Provides vasoconstriction.
- I. When client is able to ambulate, encourage small steps; increase activity gradually.
- J. When client is sitting in chair, use flotation pads, not rubber rings; limit sitting to short periods of time.
- K. Force fluids to aid in keeping bowel movements soft.
- L. Administer stool softeners and laxatives every day.
- M. On second day, before first bowel movement, enemas are sometimes ordered.
 1. Medicate for pain.
 2. Administer an enema with a pliable, soft, well-lubricated tube.
 3. Place in sitz bath after expelling enema (will relieve excessive pain by relaxing anal area).

DISORDERS OF LIVER, BILIARY, AND PANCREATIC FUNCTION

Diagnostic Evaluation Studies

(See Table 8-3.)

Physical Examination

- A. Palpation of the abdomen to determine tenderness, size, and shape of liver and spleen.
- B. Visual inspection for ascites, venous networks, and jaundice.

♦ Radiologic Techniques

- A. Cholecystogram—to visualize the gallbladder for detection of gallstones, and to determine the ability of the gallbladder to fill, concentrate, contract, and empty normally. Used only if ultrasound is not conclusive as in acalculous cholecystitis.
 1. Organic radiopaque dye may be given by mouth 10–12 hours before x-ray, or intravenously 10 minutes before x-ray.
 2. Dyes taken orally (e.g., Telepaque [iopanoic acid], Priodax [iodoaliphonic acid], Oragrafin [sodium ipodate]) are given one at a time at 3- to 5-minute intervals with at least 240 mL of water. A low-fat evening meal precedes the dye ingestion. Clients are NPO until after examination. An enema is given before the test.
- B. Cholangiography—radiopaque dye is injected directly into the biliary tree.
 1. May be injected into the common duct drain during surgery or postoperatively.
 2. Gallbladder disease is indicated by poor or absent visualization of the gallbladder.
 3. Stones will appear as shadows within the opaque medium.
- C. Scanning of the liver—¹³¹-iodine or other like substances are administered intravenously; then a scintillation detector is passed over the area.
 1. Lesions appear as filling defects.
 2. The isotopes are concentrated in functioning tissue.
- D. Other procedures with contrast media: celiac angiography, hepatopertigraphy, splenoportography, and pancreatic angiography.
 1. With all of these procedures, organic iodine dye is injected into the vessel, flowing to and outlining the desired area.
 2. Reveals the patency of the vessels and the lesions that distort the vasculature.

♦ Liver Biopsy

- A. Sampling of liver tissues by needle aspiration through abdominal wall to determine anatomic tissue changes and to facilitate diagnosis.

Table 8-3 LABORATORY/RADIOGRAPHIC/DIAGNOSTIC ASSESSMENT FOR LIVER DISEASE

Test	Comments
Serum enzymes	Elevated during hepatic inflammation. As the liver deteriorates, hepatocytes may be unable to create an inflammatory response. AST and ALT may be normal.
↑ ALP	Enzyme found in the liver, bones, placenta, obstructive jaundice, hepatic metastasis.
↑ ALT/SGPT	Enzyme found primarily in liver cells, hepatitis, or hepatic cell destruction.
↑ AST/SGOT	Enzyme found in liver and other areas of the body; most specific indicator of hepatitis or hepatic cell destruction.
↑ LDH	Enzyme found in the liver.
GGTP/GGT	Enzyme found in the liver, pancreas, and kidneys.
Bilirubin	A waste product formed by the breakdown of RBCs.
↑ Total bilirubin	Hepatic cell disease.
↑ Serum direct conjugated bilirubin	Hepatitis, liver metastasis.
↑ Serum indirect conjugated bilirubin	Cirrhosis.
↑ Urine bilirubin	Hepatocellular obstruction, viral or toxic liver disease.
↑ Urine urobilinogen	Hepatic dysfunction.
↓ Fecal urobilinogen	Obstructive liver disease.
Serum proteins	Nutrients normally broken by the liver and its enzymes.
↑ Serum total protein	Acute liver disease.
↓ Serum total protein	Chronic liver disease, ↓ synthesis in the liver.
↓ Albumin	A protein synthesized by the liver, ↓ synthesis in the liver.
↑ Serum globulin	Immune response to liver disease.
Other Tests	
Total cholesterol	A substance stored in the liver.
↑ (Prolonged) Prothrombin time or INR	Hepatic cell damage, ↓ synthesis of prothrombin.
↑ Serum ammonia	Advanced liver disease or portal-systemic encephalopathy (PSE).
↓ Platelet count	Results in thrombocytopenia.
↑ Serum creatinine	Deteriorating kidney function.
X-ray	Show hepatomegaly, splenomegaly, or massive ascites.
Liver biopsy	Percutaneous—risk of bleeding, may thread through jugular to hepatic artery.
MRI	Reveals masses or lesions, helps to determine if condition is benign or malignant.
Arteriography	Portal vein thrombosis.
Ultrasound	Show hepatomegaly, splenomegaly, massive ascites, biliary stones, duct obstructions, portal vein thrombosis. Evaluation of portal blow flow—normal is from portal vein into liver, reverse blood flow is abnormal.

B. Nursing implementation prior to procedure.

- ◆ 1. Verify test results of prothrombin times (PT) and blood typing; high PT may indicate deficiency in prothrombin, fibrinogen, or factor V, VII, or X. Administer vitamin K as ordered.
- ◆ 2. Obtain baseline vital signs and consent form.
- 3. Keep NPO and provide sedation as ordered.
- 4. Assemble equipment, have client empty bladder, place client in supine position on right side of bed.
- 5. Support client; let client verbalize fears.

C. Nursing implementation following procedure.

1. Position client on right side over biopsy site to prevent hemorrhage.
2. Measure and record vital signs.
3. Watch for shock.

4. Observe for complications: hemorrhage, puncture of the bile duct, peritonitis, and pneumothorax.

See Chapter 11, Laboratory Tests, Liver Function Tests.

Jaundice

Definition: A symptom of a disease that results in yellow pigmentation of the skin due to accumulation of bilirubin pigment. Jaundice is usually first observed in the sclera of the eye.

◆ Characteristics

- A. Hemolytic.
 1. Results from the rapid rate of red blood cell destruction, which releases excessive amounts of unconjugated bilirubin.

2. Caused by hemolytic transfusion reactions, erythroblastosis fetalis, and other hemolytic disorders.
- B. Hepatocellular.
 1. Results from the inability of the diseased liver cells to clear the normal amount of bilirubin from the blood.
 2. Caused by viral liver cell necrosis or cirrhosis of the liver.
- C. Obstructive.
 1. Caused by intrahepatic obstruction due to inflammation, tumors, or cholestatic agents.
 2. Bile is dammed into the liver substance and reabsorbed into the blood.
 3. Deep-orange, foamy urine; white- or clay-colored stools; and severe itching (pruritus).

Assessment

- A. Evaluate laboratory findings indicating hemolytic jaundice.
 1. Increased indirect (unconjugated) serum bilirubin.
 2. Absence of bilirubin in urine.
 3. Increased urobilinogen levels.
- ◆ B. Evaluate laboratory findings indicating hepatocellular jaundice.
 1. Increased bilirubin.
 2. Increased serum glutamic-oxaloacetic transaminase (SGOT).
 3. Increased serum glutamic pyruvic transaminase (SGPT).
 4. Increased alkaline phosphatase.
 5. Urobilinogen in urine.
 6. Increased PT.
 7. Decreased albumin.
- C. Evaluate laboratory findings indicating obstructive jaundice.
 1. Increased bilirubin.
 2. Increased alkaline phosphatase.
 3. Decreased stool urobilinogen.

Implementation

- ◆ A. Control pruritus.
 1. Starch or baking soda baths.
 2. Soothing lotions, such as calamine.
 3. Antihistamines, tranquilizers, and sedatives.
 4. Questran (cholestyramine)—binds bile salt.
- B. Provide emotional support.
 1. Allow client to ventilate feelings of altered body image.
 2. Notify family and visitors of client's appearance.
- C. Provide dietary plan for anorexia and liver involvement.

Viral Hepatitis

Definition: An inflammation of the liver; the most common infection of the liver, often becoming a major health problem in crowded living conditions. Through vaccination, types A (two vaccines—Havrix and Vaqta) and B can be prevented.

Characteristics

- ◆ A. Hepatitis A (HAV); formerly infectious hepatitis.
 1. Transmission.
 - a. Oral-anal route, especially in conditions of poor hygiene.
 - b. Blood transfusion with infected serum or plasma.
 - c. Contaminated equipment, such as syringes and needles.
 - d. Contaminated milk, water, and food (uncooked clams and oysters).
 - e. Respiratory route is possible, but not yet established.
 - f. Antibodies persist in serum.
 - g. Intimate contact with carriers of the virus.
 2. Prevention.
 - a. Good hand washing and good personal hygiene.
 - b. Do not eat uncooked shellfish (clams, oysters).
 - c. Control and screening of food handlers.
 - d. Passive immunization.
 - (1) Immune serum globulin (ISG) to exposed individuals.
 - (2) ISG for prophylaxis for travelers to developing countries.
 3. Incubation period: 20–50 days (short incubation period).
 4. Incidence.
 - a. More common in fall and winter months.
 - b. Usually found in children and young adults.
 - c. Client is infectious 3 weeks prior to and 1 week after developing jaundice.
 5. Clinical recovery: 3–16 weeks.
- ◆ B. Hepatitis B (HBV); formerly serum hepatitis (SH) virus.
 1. Transmission.
 - a. Oral or parenteral route with infusion, ingestion, or inhalation of the blood of an infected person.
 - b. Contaminated equipment such as needles, syringes, and dental instruments.
 - c. Oral or sexual contact.
 - d. Infected people can become carriers.
 - e. Infected by filterable virus—Australian antigen.

- f. High-risk individuals include homosexuals, IV drug abusers, medical workers.
2. Prevention.
- Screen blood donors for HB₃Ag.
 - Use disposable needles and syringes.
 - Registration of all carriers.
 - Passive immunization: ISG for exposure and hepatitis B immunoglobulin (HBIG) for finger stick, contact with mucous membrane secretions.
 - Active immunization: Heptavax (hepatitis B vaccine) and formalin-treated hepatitis B vaccine—purified antigen given in three doses (initial dose, 1 month, then 6 months).
3. Incubation: 45–180 days.
- ◆ C. Hepatitis C (HCV); formerly non-A, non-B.
- Transmission.
 - Transmitted primarily by contact with contaminated blood.
 - Incidence noted following injection of prophylactic gamma globulin.
 - Increased incidence in population using drugs.
 - Usual incubation period 14–180 days.
 - May not show clinical jaundice—only 30–40% of clients have symptoms.
- ◆ D. Hepatitis D (delta agent).
- Transmission.
 - Same as hepatitis B.
 - Only clients with hepatitis B are at risk for hepatitis D because it requires B surface antigen for replication.
 - Infections occur as coinfection with HBV or superinfection in HBV carrier.
 - Incubation period: 45–180 days.
- E. Hepatitis E.
- ◆ 1. Rare in United States but epidemic in areas of India.
2. Transmitted through oral-fecal route by contaminated foods or water.
3. Course of illness resembles hepatitis A.
4. Incubation period: 15–60 days.
- F. Hepatitis G—newly discovered, believed to be transmitted by infected blood. May exist only as a coinfection with HCV.
- Assessment**
- A. Perform general assessment; keep in mind that client is not immediately sick after being infected; onset depends on incubation period and degree of infection.
- ◆ B. Assess preicteric phase.
- Signs are generally systemic.
 - Lethargy and malaise.
- b. Anorexia, nausea and vomiting.
- c. Headache.
- d. Abdominal tenderness and pain.
- e. Diarrhea or constipation.
- f. Low-grade fever.
- g. Myalgia and polyarthritis.
2. Aforementioned symptoms may precede jaundice or it may never appear.
- C. In anicteric hepatitis, client has symptoms of disease and altered lab tests, but no jaundice.
- ◆ D. Assess icteric phase.
- Dark urine and clay-colored stools generally occur a few days prior to jaundice.
 - Jaundice is first observable in the eyes.
 - Pruritus—usually transient and mild.
 - Enlarged liver with tenderness.
 - Nausea may continue with dyspepsia and flatulence.
- E. Assess posticteric phase.
- Jaundice disappears.
 - The absence of clay-colored stools is an indication of resolution.
 - Fatigue and malaise continue.
 - Enlarged liver continues for several weeks.
- Implementation**
- ◆ A. Type A.
- ◆ 1. Wash your hands carefully, always wear gloves, and take precautions during stool and needle procedures.
2. Use disposable equipment or sterilized reusable equipment.
- ◆ 3. Provide diet.
 - High-calorie, well-balanced diet; modified servings according to client response.
 - Protein decreased if signs of coma.
 - 10% glucose IV if not taking oral foods.
 - Vitamin K supplements if prothrombin time is abnormally long.
 - Promote adequate fluid intake.
4. Instruct client and family.
 - Stress the importance of follow-up care.
 - Stress the restricted use of alcohol.
 - Stress that client never offers to be a blood donor.
 - Encourage gamma globulin for close contacts.
 - Advise correction if any unsanitary condition exists in the home.
- ◆ 5. Bed rest during acute phase with bathroom privileges; reasonable activity level during subsequent phases.
- ◆ B. Type B.
- ◆ 1. Maintain bed rest until symptoms have decreased.

- a. Activities restricted while liver is enlarged.
 - b. Activities discouraged until serum bilirubin is normal.
 - ◆ 2. Alpha-interferon daily injections for 4 months induce remission in one-third of clients.
 - ◆ 3. Provide well-balanced diet supplemented with vitamins. Protein may be restricted.
 - 4. Administer antacids for gastric acidity and soporifics for rest and relaxation.
 - 5. Instruct client and family in pathology of the disease and rationale for treatment.
 - 6. Counsel client to abstain from sexual activity during communicable period.
- C. Other types of hepatitis follow the treatment principles for HAV and HBV.

Cirrhosis

Definition: Cirrhosis is a progressive disease of the liver characterized by diffuse damage to the cells with fibrosis and nodular regeneration.

Characteristics

- ◆ A. Types.
 - 1. Alcoholic or Laënnec's cirrhosis.
 - a. Most common in the United States.
 - b. Scar tissue surrounds the portal areas.
 - c. Characterized by destruction of hepatic tissue, increased fibrous tissue, and disorganized regeneration.
 - 2. Posthepatitis cirrhosis—a sequela to viral hepatitis in which there are broad bands of scar tissue. Results from chronic hepatitis B or C or unknown cause.
 - 3. Biliary cirrhosis.
 - a. Pericholangitic scarring as a result of chronic biliary obstruction and infection.
 - b. Least encountered of the three types.
- B. Causes.
 - 1. Repeated destruction of hepatic cells, replacement with scar tissue, and regeneration of liver cells.
 - 2. Insidious onset with progression over a period of years.
 - 3. Occurs twice as often in males; primarily affects 40- to 60-year-old age group.
- ◆ C. Clinical progression.
 - 1. Early in the disease process, the liver becomes enlarged due to fat accumulation in the cells; accompanying this are gastrointestinal problems and fever.
 - 2. Subsequent symptoms are usually anorexia, weight loss, fatigue, and jaundice. (Jaundice is not always present in the active stage.)

- 3. Continued structural changes in the liver result in obstruction of portal circulation. Collateral circulation increases to compensate for increased portal pressure.
 - a. Obstruction of portal circulation results in portal hypertension, which in turn leads to esophageal varices and changes in bowel functioning with chronic dyspepsia.
 - b. Liver function deteriorates; leads to peripheral edema and ascites, accompanied by hormone imbalance, weakness, depression, and potential bleeding.
- 4. As the liver is unable to synthesize protein, plasma albumin is reduced; leads to edema and contributes to ascites.
 - a. Ascites, accumulation of serous fluid in the peritoneal cavity, increases as pressure in the liver increases.
 - b. In addition, estrogen-androgen imbalance causes increased sodium and water to be retained.
- 5. Hepatic coma results from the incomplete metabolism of nitrogenous compounds, particularly ammonia, by the incompetent liver.
- 6. When the liver cannot detoxify this product, it remains in the systemic circulation, and hepatic encephalopathy ensues.

Assessment

- A. Evaluate client's history of failing health, weakness, gastrointestinal distress, fatigue, weight loss, and low resistance to infections.
- ◆ B. Assess for emaciation and ascites due to malnutrition, portal hypertension, and hypoalbuminemia.
- C. Check for hematemesis.
- ◆ D. Assess for lower leg edema from ascites obstructing venous return from legs.
- E. Palpate liver.
- F. Assess for prominent abdominal wall veins from collateral vessel bypass.
- G. Assess for esophageal varices and hemorrhoids from portal hypertension.
- H. Evaluate skin manifestations: spider angiomas, telangiectasia, vitamin deficiency, and alterations.
- ◆ I. Evaluate laboratory tests.
 - 1. Impaired hepatocellular function; elevated bilirubin, aspartate aminotransferase (AST) (SGOT), alanine transaminase (ALT) (SGPT), and lactate dehydrogenase (LDH); reduced bromosulfophthalein (BSP); reduced albumin; elevated PT.
 - 2. Increased WBC, decreased red blood cells (RBC), coagulation abnormalities, increased gamma globulin, and proteinuria.

- J. Assess for precoma state: tremor, delirium, and dysarthria.

Implementation

- ◆ A. Assist in maximizing liver function.
 1. Diet: ample protein to build tissue; carbohydrates to sustain weight and provide energy.
 2. With edema, restrict salt and fluids. With low Na, unrestricted fluids could lead to low serum Na and electrolyte imbalance.
 3. Multivitamin supplement (especially B complex).
 4. Diuretics (spironolactones) potassium-sparing to decrease ascites.
 5. Antacids decrease gastric distress and minimize possibility of bleeding.
- ◆ B. Eliminate hepatotoxin intake (aldosterone antagonist).
 - ◆ 1. Completely restrict use of alcohol.
 - 2. Lower the dosage of drugs metabolized by the liver.
 - 3. Avoid sedatives and opiates.
 - 4. Avoid all known hepatotoxic drugs (Thorazine [chlorpromazine], Fluothane [halothane]).
 - 5. Colchicine (anti-inflammatory drug to treat gout) has been shown to increase survival time.
- C. Prevent infection by adequate rest, diet, and environmental control.
- D. Administer plasma proteins as ordered.
- E. Maintain adequate rest during acute phase to reduce demand on the liver.

- F. Monitor intake and output due to fluid restriction.
- G. Provide good skin care and control pruritus.
- H. Evaluate client's response to diet therapy.
- I. Measure, record, and compare vital signs.
 1. Character of pain.
 2. Progression of edema.
 3. Character of emesis and stools.
- J. Evaluate level of consciousness, personality changes, and signs of increasing stupor.
- K. Instruct client and family in disease process and rationale for treatment.
- L. Prevent and control complications: ascites, bleeding esophageal varices, hepatic encephalopathy, and anemia.
- M. Provide postoperative care if peritoneovenous shunt is placed for intractable or circulatory failure. (See Table 8-4.)

COMPLICATIONS

Portal Hypertension

Definition: The result of altered liver structure that impedes normal hepatic blood flow and increases portal pressure.

◆ Characteristics

- A. Obstruction of portal circulation causes portal hypertension and congestion of the spleen, pancreas, and gastrointestinal tract.
- B. As the body compensates for increased pressure in the hepatic system, collateral circulation increases.

Table 8-4 MEDICATIONS FOR LIVER DISEASE

Medication	Purpose
Antacids: Mylanta, Maalox Vitamins: B ₁ , B ₆ , B ₁₂ , folic acid Diuretics: Lasix, spironolactone	Relief of dyspepsia Correct the deficiency seen in cirrhosis Treat ascites, reduce fluid accumulation, prevent cardiac and respiratory impairment
Laxatives: Dulcolax, milk of magnesia Colchicine	Treat constipation An inhibitor of collagen synthesis, for primary biliary cirrhosis—anti-inflammatory ↓ BP and help control bleeding
Propranolol Steroids: prednisone Recombinant factor (Recombinate) Milkweed thistle	For autoimmune causes Bleeding problems, adjusts for coagulation problems Protects the liver from damage caused by viruses, toxins, alcohol, and certain drugs such as acetaminophen
Lactulose Hepatitis A vaccine: Havrix;VAQTA	To reduce ammonia levels in encephalopathy For active immunization of persons 12 months and older against disease caused by hepatitis A virus (HAV)
Hepatitis B vaccine (active immunity): Engerix-B, Recombivax HB	Immunization against infection caused by all known subtypes of hepatitis B virus (HBV)
Hepatitis B vaccine (passive immunity): Hepatitis B immune globulin (HBIG) Hepatitis C vaccine: C-PEG-alpha interferon and ribavirin	Postexposure prophylaxis Treatment of patients with chronic hepatitis C virus (HCV) infection

Assessment

- A. Two major conditions result from portal hypertension.
 - 1. Evidence of increased collateral circulation: hemorrhoids, veins observable on abdomen, esophageal varices that bleed easily.
 - 2. Weight gain and abdominal distention from ascites.
- B. Assess for respiratory complications due to severe ascites.
- C. Assess for abdominal pain (may be indication of infection or bleeding).

Implementation

- A. Provide general nursing care for cirrhosis
- ◆ B. Provide specific care for management of edema.
 - 1. Skin care to prevent breakdown.
 - a. Use lanolin-based products to soften skin.
 - b. Guard against cutting or scratching skin.
 - 2. Dietary control: negative sodium balance to reduce fluid retention, diuretics (Lasix [furosemide], Edecrin [ethacrynic acid]) with potassium supplements, vitamin supplements of B complex, C, folate, and K.
 - 3. Monitor intake and output; weigh daily.
- C. Provide care for ascites.
 - 1. Prevent complications associated with ascites (e.g., respiratory impairment, infection).
 - 2. Restrict fluids and sodium intake.
 - ◆ 3. Position client in high-Fowler's to maximize respiratory capability.
 - 4. Weigh daily and measure abdominal girth to estimate status of fluid accumulation.
 - 5. Monitor use of diuretics (used with sodium restriction); is successful in 90% of clients with ascites.
 - ◆ 6. Assist with paracentesis (will be avoided as long as possible due to the danger of precipitating shock, hypovolemia, or hepatic coma).
 - a. Removal of fluid will relieve pressure on the diaphragm, stomach, or umbilical hernia.
 - b. Because of high protein concentration in the ascitic fluid, IV infusion of salt-poor albumin may be administered over 24 hours.

Esophageal Varices

See page 300.

Hepatic Encephalopathy

Definition: Results from brain cell alterations caused by buildup of ammonia levels.

Characteristics

- ◆ A. Increased blood ammonia levels.
 - 1. Normally, ammonia is formed in the intestines from the breakdown of protein and is converted by the liver to urea.
 - 2. In liver failure, ammonia is not converted into urea, and blood ammonia concentrations increase.
- ◆ B. Any process that increases protein in the intestine, such as gastrointestinal hemorrhage and high protein intake, will cause elevated blood ammonia.
- ◆ C. Other factors involved in high ammonia levels.
 - 1. Electrolyte and acid-base imbalances. Alkalosis increases toxicity of NH₃.
 - 2. Constipation.
 - 3. Infectious diseases.
 - 4. Medications: sedatives, narcotic analgesics, central nervous system depressants.
 - 5. Shunting of blood into systemic circulation without passing through the hepatic sinusoids.

Assessment

- ◆ A. Assess for mental changes as blood ammonia level increases.
 - 1. Impaired memory, decreased attention, concentration, and rate of response.
 - 2. Personality changes: untidiness, confusion, and inappropriate behavior.
- ◆ B. Assess for depressed level of consciousness and flapping tremor (liver flap) upon dorsiflexion of hand; also called asterixis (involuntary hand flapping), constructional apraxia (inability to reproduce simple two- or three-dimensional figures).
- ◆ C. Evaluate disorientation and eventual coma.

Implementation

- ◆ A. Temporarily decrease protein from diet because ammonia cannot be converted to urea for excretion.
 - 1. Protein is restricted to 60–80 g/day.
 - 2. Sodium intake may be restricted to less than 2 g/day to decrease fluid retention, especially ascites
 - 3. High-calorie, moderate-fat diet recommended.
- ◆ B. Give client bile salts to assist with the absorption of vitamin A. Vitamin K may be given to reduce risk of bleeding.
- ◆ C. Give folic acid and ferrous sulfate (iron) to treat anemia.
- ◆ D. Administer antibiotics (Neomycin) to destroy intestinal bacteria and to reduce the amount of ammonia.
- ◆ E. Administer lactulose to reduce blood ammonia—acidifies colon contents, resulting in retention

- of ammonium ion and decreased ammonia absorption.
- ◆ 1. Two or three stools/day indicates lactulose is working.
 - 2. Watery diarrhea indicates drug overdose.
 - ◆ F. Give enemas and/or cathartics to empty bowel and to reduce ammonia absorption.
 - G. Give salt-poor albumin to maintain osmotic pressure by increasing serum protein.
 - H. Use cation-exchange resins to remove toxic substances from the bowel.
 - I. Correct fluid and electrolyte imbalances.
 - J. Weigh daily to monitor for ascites and edema.
 - K. Measure and record intake and output.
 - L. Observe, measure, and record neurologic status daily.
 - 1. Test ability to perform mental tasks.
 - 2. Keep samples of handwriting.
 - M. Avoid depressants, which must be detoxified by the liver. Use agents, such as a benzodiazepine, that are excreted through the kidneys.
 - N. Prevent complications—pressure ulcers, thrombo-phlebitis, or pneumonia.
 - O. With coma, utilize same nursing skills as with the unconscious client.

Cholecystitis and Cholelithiasis

◆ *Definition:* *Cholecystitis*, either acute or chronic, is an inflammation of the gallbladder; *cholelithiasis* refers to stones in the gallbladder, formed of cholesterol (the most common) or pigment; *choledocholithiasis* refers to stones in the common bile duct.

Characteristics

- A. Risk factors: cholesterol gallstones—age, race or ethnicity, obesity, estrogen, rapid weight loss, genetic predisposition, cholesterol-lowering drugs, and bile acid malabsorption; pigment gallstones—chronic liver disease, obstruction, or biliary infection.
- B. Diagnostic procedures.
 - 1. Serum bilirubin is elevated.
 - 2. Gallbladder x-ray test.
 - 3. IV cholangiogram.
 - 4. Ultrasound determines gallstones.
 - 5. Complete blood count (CBC); if WBC elevated, indicates infection or inflammation.

Assessment

- ◆ A. Laboratory values.
 - 1. Serum amylase elevated—may indicate pancreatic involvement of stones in common bile duct; alkaline phosphatase, bilirubin increased.
- 2. WBC count elevated—indicates inflammation and/or infection.
- ◆ B. Differentiate between cholecystitis and cholelithiasis.
- ◆ C. Assess for cholecystitis.
 - 1. Epigastric distress—eructation after eating.
 - 2. Pain—localized in right upper quadrant because of somatic sensory nerves.
 - a. Murphy's sign: Client cannot take a deep inspiration when assessor's fingers are pressed below hepatic margin.
 - b. Pain begins 2–4 hours after eating fried or fatty foods and persists 12–18 hours.
 - 3. Nausea, vomiting, and anorexia.
 - 4. Low-grade fever.
 - 5. Jaundice due to hepatocellular damage (seen in 25% of clients).
 - 6. Weight loss.
 - 7. Elevated serum bilirubin and alkaline phosphatase.
- ◆ D. Assess for cholelithiasis.
 - 1. Pain—excruciating, upper right quadrant—radiates to right shoulder (biliary colic).
 - 2. Pain is sudden, intense, and paroxysmal—occurs with contraction of gallbladder. Lasts 30 minutes to 5 hours.
 - 3. Nausea and vomiting.
 - 4. Jaundice due to obstruction and/or hepatocellular damage.
 - 5. Intolerance to fat-containing foods.
- E. Observe for biliary obstruction.
 - 1. Jaundice—yellow sclera.
 - 2. Urine—dark orange and foamy.
 - 3. Feces—clay-colored.
 - 4. Pruritus.

Implementation

- ◆ A. Provide relief from vomiting.
 - 1. Position nasogastric tube and attach to low suction. Tube reduces distention and eliminates gastric juices that stimulate cholecystokinin.
 - 2. Provide good oral and nasal care; assure patency and flow of gastric secretions.
- B. Maintain fluid and electrolyte balance.
 - 1. Monitor intravenous fluids; record intake and output (I&O).
 - 2. Observe serum electrolyte levels; watch for signs of imbalance.
- ◆ C. Monitor drug therapy.
 - 1. Administer broad-spectrum antibiotics in presence of positive culture.
 - ◆ 2. Chenodeoxycholic acid—bile acid dissolves cholesterol calculi (60% of stones).

3. Actigal (ursodiol) and Chenix (chenodiol) reduce cholesterol content of stones, so they gradually dissolve; disadvantages are cost and long duration.
4. Nitroglycerin or papaverine to reduce spasms of duct.
- ◆ 5. Synthetic narcotics (Demerol, Dolophine [methadone]) to relieve pain. Morphine sulfate may cause spasm of sphincter of Oddi and increase pain.
6. Questran/Benadryl (diphenhydramine) to relieve pruritus.
- ◆ D. Provide low-fat diet to decrease gallbladder stimulation; avoid alcohol and gas-forming foods.
- E. Maintain bed rest.

Nonsurgical Management

- ◆ A. Extracorporeal shock-wave lithotripsy: shock waves that disintegrate stones in the biliary system.
 1. Ultrasound is used for stone localization before the lithotripter sends waves through a water bag upon which the client is lying.
 2. Analgesics and sedatives are given to reduce pain during procedure.
 3. Oral-dissolution medication follows to dissolve stone fragments.
 4. Postprocedure—monitor for biliary colic, results from gallbladder contractions.
- ◆ B. Cholesterol stones removed through dissolution therapy. For high-risk clients—oral medications to decrease size or dissolve stones.
- C. Stone removal by instrumentation.

Surgical Management

- A. Laparoscopic cholecystectomy is treatment of choice: removal of gallbladder through small puncture hole in abdomen.
 1. Laser dissects gallbladder.
 2. Discharged day of surgery—normal activities resumed in 2–3 days.
- ◆ B. Cholecystectomy: removal of gallbladder after ligation of the cystic duct and vessels.
 1. Common bile duct may be explored.
 2. A Penrose drain is usually inserted for drainage following procedure.
- ◆ C. Choledochostomy: opening into the common bile duct for removal of stones.
 1. T-tube inserted to maintain patency of the duct; connected to drainage bottle to collect excess bile.
 2. Purpose is to decompress biliary tree and allow for postoperative cholangiogram.

Implementation

- ◆ A. Position client in low- to semi-Fowler's to facilitate bile drainage
- ◆ B. Maintain skin integrity following surgery.
 1. Change position frequently; relieve pressure points.
 2. Protect skin around incision site from bile seepage.
 - a. Change dressings frequently.
 - b. Use skin protectant or drainage pouches to prevent bile drainage from skin contact.
- ◆ C. Prevent respiratory complications (the most common postoperative complication).
 1. Turn, cough, and deep-breathe every 2 hours.
 2. Use incentive spirometer every 2 hours.
 3. Auscultate for abnormal breath sounds.
 4. Observe for signs of respiratory distress.
 5. Ambulate and activate as early as allowed.
- ◆ D. If nasogastric tube was inserted to relieve distention and increase peristalsis, irrigate tube every 4 hours and PRN.
- ◆ E. If T-tube inserted.
 1. Place client in Fowler's position to facilitate drainage.
 2. Keep tube below level of wound to promote bile flow and prevent backflow.
 3. Measure amount and record character and color of drainage (may be up to 500 mL for first 24 hours).
 4. Clamp tube before eating.
 5. Protect skin around incision and cleanse surrounding area.
- F. Prevent wound infections; clients tend to be obese—healing is often delayed.
- G. Prevent thrombophlebitis.
 1. Encourage range of motion.
 2. Ambulate early.
 3. Provide antiembolic stockings.
- H. Provide diet: low fat, high carbohydrate, and high protein.
 1. Instruct client to maintain diet for at least 2 or 3 months postoperatively.
 2. May require continued use of vitamin K as dietary supplement.
- I. Prepare client for T-tube removal.
 1. As T-tube is clamped, observe for
 - a. Abdominal discomfort and distention.
 - b. Chills and fever; nausea.
 2. Unclamp tube if any nausea or vomiting.

Acute Pancreatitis

Definition: An inflammation of the pancreas with associated escape of pancreatic enzymes into surrounding tissue.

Characteristics

- A. Etiology.
 - ◆ 1. Inflammation is caused by the digestion of the organ from the very enzymes it produces—trypsin, elastase, and lipase.
 - ◆ 2. The most common precipitating factor in the United States is alcoholic indulgence.
 - ◆ 3. Eighty percent of clients with pancreatitis have biliary tract disease with blocking of ampulla of Vater by gallstones.
 - 4. May be caused as a result of Deltasone (prednisone) or thiazide therapy.
 - 5. May be a complication of viral or bacterial disease, peptic ulcer, trauma, etc.
- B. Pathology.
 - 1. Cholecystitis with reflux of bile components into the pancreatic duct.
 - 2. Spasm and edema of ampulla of Vater following inflammation of the duodenum.

Assessment

- ◆ A. Assess for acute interstitial pancreatitis.
 - 1. Constant epigastric abdominal pain radiating to the back and flank. More intense in supine position. Aggravated by fatty meal, alcohol, or lying in the recumbent position.
 - 2. Nausea, vomiting, abdominal distention, paralytic ileus, and weight loss.
 - 3. Low-grade fever.
 - 4. Severe perspiration; anxiety.
 - 5. Possible jaundice.
- ◆ B. Laboratory values.
 - 1. Elevation of WBC—20,000 to 50,000.
 - 2. Elevated serum lipase (rises within 2–12 hours) and amylase (5–40 times); bilirubin and alkaline phosphatase elevated (due to compression of common duct) and transient elevation in glucose.
 - 3. Urine amylase elevated.
 - 4. Abnormal low serum levels in calcium, sodium, and magnesium—due to dehydration, binding of calcium in areas of fat necrosis.
- ◆ C. Assess for acute hemorrhagic pancreatitis.
 - 1. Pancreatic enzymes erode major blood vessels, causing hemorrhage into the pancreas and retroperitoneal tissues.
 - a. Cullen's sign: gray-blue discoloration of the abdominal area may be seen in intra-abdominal hemorrhage.
 - b. Turner's sign: bruising of the skin of the loin.
 - 2. Enzymatic digestion of the pancreas.
 - 3. Severe abdominal, back, and flank pain.
 - 4. Ascites.
 - 5. Shock.

Implementation

- ◆ A. Assess pain (using a standard pain scale) and take actions to alleviate pain.
 - 1. Give analgesic medication as ordered (pain and anxiety increase pancreatic secretions).
 - 2. Avoid opiates (morphine), which may cause spasms of sphincter of Oddi.
 - 3. Give anticholinergic medication—atropine, to decrease vagal stimulation.
- ◆ B. Reduce pancreatic stimulus.
 - ◆ 1. Client is NPO to eliminate chief stimulus to enzyme release. TNA may be initiated.
 - 2. Nasogastric tube to low suction to remove gastric secretions and air if nausea, vomiting, or ileus present.
 - ◆ 3. Drugs to reduce pancreatic secretion.
 - a. Sodium bicarbonate to reverse metabolic acidosis. Histamine H₂ antagonists may be used to neutralize hydrochloric acid secretion.
 - b. Diamox (acetazolamide) to prevent carbonic anhydrase from catalyzing secretion of bicarbonate into pancreatic juice.
 - c. Regular insulin to treat hyperglycemia.
 - ◆ 4. Diet to avoid pancreatic secretion: low fat, low protein, high carbohydrate; no spicy foods, alcohol, or caffeine; parenteral feedings if NPO.
- C. Take vital signs every 15–30 minutes during acute phase; assess cardiovascular status.
- D. Prevent or treat infection (and possible sepsis) with broad-spectrum antibiotics.
- ◆ E. Replace and maintain fluids and electrolytes.
 - ◆ 1. Treat hypocalcemia with neuromuscular irritability with calcium gluconate IV. (Signs—nausea, vomiting, tetany, abdominal pain, positive Chvostek's sign.)
 - ◆ 2. Treat hypokalemia—potassium is a major component in pancreatic juice. (Signs—muscle weakness, hyporeflexia, hypotension, apathy or irritability, arrhythmias.)
 - ◆ 3. Treat hypomagnesemia (less than 1.4 mg/dL)—can be life-threatening.
 - 4. Blood and plasma administration may be necessary to maintain circulatory volume.
- F. Aggressive respiratory care to prevent acute respiratory distress syndrome (ARDS).
 - 1. Atelectasis, effusion may be caused by elevation of the diaphragm.
 - 2. Hypoxemia may occur.
 - 3. Monitor arterial blood gases or ventilator if ordered.
- G. Reduce body metabolism.
 - ◆ 1. Oxygen for labored breathing.

- ◆ 2. Bed rest; Fowler's position for maximum chest expansion.
- 3. Cool, quiet environment.
- H. Provide client and family instruction.
 1. Discuss pathology of disease.
 2. Give rationale for treatment.
 3. Instruct client to avoid alcohol, coffee, heavy meals, and spicy foods.
 4. Stress importance of follow-up with physician.

Chronic Pancreatitis

Definition: Chronic fibrosis of the pancreatic gland—an irreversible process of obstruction of ducts and destruction of secreting cells, following repeated attacks of acute pancreatitis.

Etiology

- A. Alcohol abuse most common.
- B. Other causes: hyperparathyroidism, malnutrition, and trauma.

Assessment

- ◆ A. Assess for pain—persistent epigastric and left upper quadrant pain radiating to upper left lumbar region.
- ◆ B. Check for anorexia, nausea, vomiting, constipation, and flatulence.
- C. Evaluate disturbances of protein and fat digestion.
 1. Malnutrition.
 2. Weight loss from decreased intake due to fear of pain.
 3. Abdominal distention with flatus and paralytic ileus.
 4. Foul, fatty stools (steatorrhea) caused by a decrease in pancreatic enzyme secretion.
- ◆ D. Laboratory values.
 1. Elevated serum amylase and lipase (indicates decreased pancreatic enzyme excretion).
 2. Increased glucose and lipids.

- 3. Decreased calcium, potassium.
- E. Assess for hyperglycemia with symptoms of diabetes.
- F. Evaluate fecal fat in stool specimens; x-ray often shows pancreatolithiasis and mild ileus, indicating fibrous tissue and calcification.

Implementation

- ◆ A. Provide low-protein, low-fat, high-carbohydrate diet. Suggest bland and low-gas-forming foods in small, frequent feedings.
- ◆ B. Administer drug therapy.
 1. Antacids (Maalox) to neutralize acid secretions.
 2. Histamine antagonists Zantac and Tagamet to decrease hydrochloric acid production so pancreatic enzymes are not activated.
 3. Proton-pump inhibitors (Prilosec) may be given to neutralize or decrease gastric secretions.
 4. Anticholinergics (atropine, Pro-Banthine [propantheline bromide]) to decrease vagal stimulation, GI motility, and inhibit pancreatic enzymes.
 5. Administer pancreatic enzyme replacements, such as Viokase (pancreatin) and Cotazym (pancrelipase), with meals or snacks to aid digestion. Dose depends on degree of malabsorption or maldigestion. Monitor for side effects.
 6. Narcotic analgesics (such as morphine sulfate) are used to control pain.
- ◆ C. Report diabetic symptoms—insulin or oral hypoglycemic agents will be administered; monitor blood glucose levels to control hyperglycemia and prevent insulin shock.
- D. Monitor for potential complications: pseudocyst, ascites, or pleural effusion, GI hemorrhage, biliary tract obstruction. Surgical treatment is done for specific complications and to relieve constant pain.

GASTROINTESTINAL SYSTEM REVIEW QUESTIONS

1. The nurse is completing the initial morning assessment on the client. Which physical examination technique would be used first when assessing the abdomen?
 1. Inspection.
 2. Light palpation.
 3. Auscultation.
 4. Percussion.

2. The client has orders for a nasogastric (NG) tube insertion. During the procedure, instructions that will assist in insertion would be
 1. Instruct the client to tilt his head back for insertion into the nostril, then flex his neck forward and swallow for final insertion.
 2. After insertion into the nostril, instruct the client to extend his neck.
 3. Introduce the tube with the client's head tilted back, and then instruct him to keep his head upright for final insertion.
 4. Instruct the client to hold his chin down, then back for insertion of the tube.

3. The most important pathophysiologic factor contributing to the formation of esophageal varices is
 1. Decreased prothrombin formation.
 2. Decreased albumin formation by the liver.
 3. Portal hypertension.
 4. Increased central venous pressure.

4. The nurse analyzes the results of the blood chemistry tests done on a client with acute pancreatitis. Which of the following results would the nurse expect to find?
 1. Low glucose.
 2. Low alkaline phosphatase.
 3. Elevated amylase.
 4. Elevated creatinine.

5. A client being treated for esophageal varices has a Sengstaken-Blakemore tube inserted to control the bleeding. The most important assessment is for the nurse to
 1. Check that a hemostat is at the bedside.
 2. Monitor IV fluids for the shift.
 3. Regularly assess respiratory status.
 4. Check that the balloon is deflated on a regular basis.

6. A female client complains of gnawing midepigastric pain for a few hours after meals. At times, when the pain is severe, vomiting occurs. Specific tests are indicated to rule out
 1. Cancer of the stomach.
 2. Peptic ulcer disease.
 3. Chronic gastritis.
 4. Pylorospasm.

7. When a client has peptic ulcer disease, the nurse would expect a priority intervention to be
 1. Assisting in inserting a Miller-Abbott tube.
 2. Assisting in inserting an arterial pressure line.
 3. Inserting a nasogastric tube.
 4. Inserting an IV.

8. A 40-year-old male client has been hospitalized with peptic ulcer disease. He is being treated with a histamine-receptor antagonist (cimetidine), antacids, and diet. The nurse doing discharge planning will teach him that the action of cimetidine is to
 1. Reduce gastric acid output.
 2. Protect the ulcer surface.
 3. Inhibit the production of hydrochloric acid (HCl).
 4. Inhibit vagus nerve stimulation.

9. The nurse is admitting a client with Crohn's disease who is scheduled for intestinal surgery. Which surgical procedure would the nurse anticipate for the treatment of this condition?
 1. Ileostomy with total colectomy.
 2. Sigmoid colostomy with mucous fistula.
 3. Intestinal resection with end-to-end anastomosis.
 4. Colonoscopy with biopsy and polypectomy.

10. A client who has just returned home following ileostomy surgery will need a diet that is supplemented with
 1. Potassium.
 2. Vitamin B₁₂.
 3. Sodium.
 4. Fiber.

11. A client is scheduled for colostomy surgery. An appropriate preoperative diet will include which of the following foods? List all that apply.
 1. Ground hamburger.
 2. Baked potato.

3. Broiled fish.
4. Rice.
5. Salad.
6. Winter squash or apple sauce.
- 12.** As the nurse is completing evening care for a client, he observes that the client is upset, quiet, and withdrawn. The nurse knows that the client is scheduled for diagnostic tests the following day. An important assessment question to ask the client is
1. "Would you like to go to the dayroom to watch TV?"
 2. "Are you prepared for the test tomorrow?"
 3. "Have you talked with anyone about the test tomorrow?"
 4. "Have you asked your physician to give you a sleeping pill tonight?"
- 13.** Following abdominal surgery, a client complaining of "gas pains" will have a rectal tube inserted. The client should be positioned on his
1. Left side, recumbent.
 2. Left side, Sims' position.
 3. Right side, semi-Fowler's.
 4. Left side, semi-Fowler's.
- 14.** If a colostomy irrigation was ordered, the appropriate instruction a homecare nurse would give a client would be to use
1. The solution temperature at 100°F.
 2. 1000 mL of solution for the irrigation.
 3. The solution container placed 10 inches above the stoma.
 4. The irrigation cone in an upward direction in relation to the stoma.
- 15.** The nurse is teaching a client with a new colostomy how to apply an appliance to a colostomy. The client leaves $\frac{1}{2}$ inch of skin exposed between the stoma and the ring of the appliance. What teaching is indicated here?
1. Telling the client this is too much skin exposed to fecal drainage.
 2. No teaching—this is a correct procedure.
 3. Telling the client that exposed skin should be between $\frac{3}{4}$ and 1 inch.
 4. Asking the client how much skin should be exposed before teaching.
- 16.** Following a liver biopsy, the highest-priority assessment of the client's condition is to check for
1. Pulmonary edema.
 2. Uneven respiratory pattern.
3. Hemorrhage.
4. Pain.
- 17.** A client has a bile duct obstruction and is jaundiced. Which intervention will be most effective in controlling the itching associated with his jaundice?
1. Keep the client's nails clean and short.
 2. Maintain the client's room temperature at 72 to 75°F.
 3. Provide tepid water for bathing.
 4. Use alcohol for back rubs.
- 18.** When a client is in liver failure, which of the following behavioral changes is the most important assessment to report?
1. Shortness of breath.
 2. Lethargy.
 3. Fatigue.
 4. Nausea.
- 19.** A client with a history of cholecystitis is now being admitted to the hospital for possible surgical intervention. The orders include NPO, IV therapy, and bed rest. In addition to assessing for nausea, vomiting, and anorexia, the nurse should observe for pain
1. In the right lower quadrant.
 2. After ingesting food.
 3. Radiating to the left shoulder.
 4. In the right upper quadrant.
- 20.** The nurse taking a nursing history from a newly admitted client learns that he has a peritoneovenous shunt. This suggests that he has a history of
1. Hydrocephalus.
 2. Renal failure.
 3. Peripheral occlusive disease.
 4. Cirrhosis.
- 21.** A female client had a laparoscopic cholecystectomy this morning. She is now complaining of right shoulder pain. The nurse would explain to the client this symptom is
1. Common following this operation.
 2. Expected after general anesthesia.
 3. Unusual and will be reported to the surgeon.
 4. Indicative of a need to use the incentive spirometer.
- 22.** For a client with the diagnosis of acute pancreatitis, the nurse would plan for which critical component of his care?
1. Testing for Homan's sign.
 2. Measuring the abdominal girth.
 3. Performing a glucometer test.
 4. Straining the urine.

- 23.** After having a fecal impaction removed, the client complains of feeling light-headed, and the pulse rate is 44. The priority intervention is to
1. Monitor vital signs.
 2. Place in shock position.
 3. Call the physician.
 4. Begin CPR.
- 24.** Peritoneal reaction to acute pancreatitis results in a shift of fluid from the vascular space into the peritoneal cavity. If this occurs, the nurse would evaluate for
1. Decreased serum albumin.
 2. Abdominal pain.
- 25.** The assessment finding that should be reported immediately should it develop in the client with acute pancreatitis is
1. Nausea and vomiting.
 2. Abdominal pain.
 3. Decreased bowel sounds.
 4. Shortness of breath.

GASTROINTESTINAL SYSTEM ANSWERS WITH RATIONALE

- 1.** (1) Visual inspection is the first step in assessing the abdomen. Auscultation (3) is next because palpation (2) or percussion (4) can alter bowel motility, thereby producing inaccurate findings.

NP:A; CN:PH; CL:C

- 2.** (1) NG insertion technique is to have the client first tilt his head back for insertion into the nostril, then to flex his neck forward and swallow. Extension of the neck (2) will impede NG tube insertion.

NP:I; CN:PH; CL:C

- 3.** (3) As the liver cells become fatty and degenerate, they are no longer able to accommodate the large amount of blood necessary for homeostasis. The pressure in the liver increases and causes increased pressure in the venous system. As the portal pressure increases, fluid exudes into the abdominal cavity. This is called ascites.

NP:AN; CN:PH; CL:K

- 4.** (3) Amylase is produced by the pancreas. An inflamed pancreas is unable to adequately secrete the amylase into the intestinal tract producing elevated levels of amylase in the blood. Glucose (1) and alkaline phosphatase (2) are also likely to be elevated in acute pancreatitis. Creatinine (4) is unaffected by acute pancreatitis.

NP:AN; CN:PH; CL:C

- 5.** (3) The respiratory system can become occluded if the balloon slips and moves up the esophagus, putting pressure on the trachea. This would result in respiratory distress and should be assessed frequently. Scissors should be kept at the bedside to cut the tube if distress occurs. This is a safety intervention.

NP:A; CN:PH; CL:A

- 6.** (2) Peptic ulcer disease is characteristically gnawing epigastric pain that may radiate to the back. Vomiting

usually reflects pyloric spasm from muscular spasm or obstruction. Cancer (1) would not evidence pain or vomiting unless the pylorus was obstructed.

NP:AN; CN:PH; CL:C

- 7.** (3) An NG tube insertion is the most appropriate intervention because it will determine the presence of active gastrointestinal bleeding. A Miller–Abbott tube (1) is a weighted, mercury-filled, ballooned tube used to resolve bowel obstructions. There is no evidence of shock or fluid overload in the client; therefore, an arterial line (2) is not appropriate at this time and an IV (4) is optional.

NP:I; CN:PH; CL:C

- 8.** (1) These drugs inhibit action of histamine on the H₂ receptors of the parietal cells, thus reducing gastric acid output. Answer (2) refers to a cytoprotective drug; (3) to an antisecretory drug; and (4) to an anticholinergic drug.

NP:P; CN:H; CL:C

- 9.** (3) Crohn's disease is characterized by inflammation of the small and/or large intestine in a segmental pattern with diseased areas separated by areas of normal intestine. If surgery becomes necessary to treat the condition, a diseased area can be resected with a reanastomosis of the intestine. Ileostomy with colectomy (1) may be needed by clients with ulcerative colitis.

NP:P; CN:PH; CL:C

- 10.** (1) Potassium is lost through the liquid effluent, so it must be taken as a supplement. This surgery requires a low-residue diet that reduces fiber and fecal material. Vitamin B₁₂ (2) is supplemented when the intrinsic factor is missing.

NP:P; CN:PH; CL:C

- 11.** The answer is 2 3 4 6. The client's diet should be low residue and high calorie. Foods high in carbohydrates

are usually low residue; chicken is acceptable without skin. Any salad, fresh vegetables, or grains would be considered high residue.

NP:P; CN:H; CL:C

- 12.** (3) An important assessment question is to find out how the client feels about the tests to be performed. Learning if he has talked with anyone about his concerns or fears will help the nurse assess the client's resources for emotional support and whether the client needs to talk about his fears or feelings.

NP:A; CN:PS; CL:A

- 13.** (1) The left-side position facilitates easy insertion of the rectal tube due to the anatomical position of the rectum. A recumbent position will be more comfortable for the client.

NP:I; CN:PH; CL:C

- 14.** (2) With the exception of the first irrigation, which is 500 mL, the amount of irrigating solution for a colostomy irrigation is 1000 mL. The temperature should be between 105° and 110°F. When the client is sitting up, the container is at shoulder level.

NP:P; CN:PH; CL:K

- 15.** (1) A colostomy appliance should be cut to fit the stoma so that there is a minimum amount of skin exposed to fecal drainage. Leaving $\frac{1}{8}$ inch of skin exposed conforms to these criteria. Asking the client first is not necessary because he needs exact information, then clarification.

NP:P; CN:PH; CL:K

- 16.** (3) It is important to evaluate the client's condition for hemorrhage every hour for 12 hours, because this is a danger following a liver biopsy. Pulmonary edema (1) and respiratory problems (2) are not usually a concern.

NP:A; CN:PH; CL:A

- 17.** (3) Itching is made worse by vasodilation. Tepid water prevents excessive vasodilation. Warm environmental temperatures promote vasodilation. Alcohol not only produces vasodilation but also is drying to the skin, which further compounds the problem of itching. Keeping the nails clean and short will help prevent skin irritation and infection if the client scratches, but will not prevent the itching from occurring.

NP:P; CN:PH; CL:C

- 18.** (2) Lethargy may indicate impending encephalopathy and dictate the need for client safety measures. Fatigue is expected due to anemia, shortness of breath due to

ascites, and nausea due to GI vascular congestion, but these are not as grave as lethargy.

NP:A; CN:PH; CL:A

- 19.** (4) Pain occurs 2–4 hours after eating fatty foods and is located either in the epigastric region or in the upper right quadrant of the abdomen.

NP:A; CN:PH; CL:C

- 20.** (4) The peritoneovenous shunt used in the treatment of clients who have cirrhosis with ascites. The shunt diverts ascitic fluid from the abdomen into the jugular vein or the vena cava.

NP:AN; CN:PH; CL:C

- 21.** (1) Carbon dioxide is insufflated into the abdomen during a laparoscopic cholecystectomy. It may irritate the diaphragm and cause referred shoulder pain. This client's complaint is a common response to this operation, so telling the client will be reassuring.

NP:I; CN:PH; CL:C

- 22.** (3) Hyperglycemia is a common finding in acute pancreatitis because the islet cells may not be able to produce adequate amounts of insulin. An important component of the treatment is to administer regular insulin to treat the hyperglycemia.

NP:P; CN:PH; CL:AN

- 23.** (2) The client requires treatment for shock. Vital signs are monitored (1) after placing the client in shock position. The physician is then called (3) for further orders.

NP:I; CN:PH; CL:A

- 24.** (3) Oliguria, with accompanying hypovolemic shock, is a dangerous complication of acute pancreatitis. This condition may necessitate large volumes of parenteral fluids to maintain vascular volume; a central venous pressure (CVP) catheter is often inserted for monitoring fluid needs.

NP:E; CN:PH; CL:A

- 25.** (4) Adult respiratory distress syndrome is a grave complication of pancreatitis. Pulmonary edema due to administration of large volumes of IV fluids and direct extension of inflammation resulting in pleural effusion are also seen. Pulmonary complications are associated with a poor prognosis. The other distractors are the more common presenting symptoms of pancreatitis.

NP:A; CN:PH; CL:A

GENITOURINARY SYSTEM

The genitourinary (GU) system—the kidneys and their drainage channels—is essential for the maintenance of life. This system is responsible for excreting the end products of metabolism as well as regulating water and electrolyte concentrations of body fluids. The genitalia are the organs of reproduction.

ANATOMY AND PHYSIOLOGY

Kidney Structure

- A. Paired organs located to the right and left of midline lateral to lower thoracic vertebrae.
- ◆ B. Kidneys perform two major functions.
 - 1. Excrete most of the end products of body metabolism.
 - 2. Control the concentrations of most of the constituents of body fluids.
- C. Composed of structural units, each of which functions the same as the total kidney and is capable of forming urine by itself.
- ◆ D. The functional renal unit is called the nephron. Each nephron is composed of
 - 1. A glomerulus (a network of many capillaries) that filters fluid out of the blood. It is encased by Bowman's capsule.
 - 2. Tubules (proximal, Henle's loop, distal) in which fluid is converted to urine as it goes to the pelvis of the kidneys.
- E. Fluid from Bowman's capsule moves through the proximal tubule located in the cortex.
- F. Fluid then flows through Henle's loop and collecting duct located in medulla of the kidney.
- G. Fluid flows from the loop to the collecting tubule.
- H. After flowing through many convolutions, the fluid goes into a collecting sac called the pelvis of the kidney.
- I. From the pelvis, fluid flows through the ureter and empties into the bladder.

Kidney Function

- A. Urine production.
 - ◆ 1. As the fluid filtrate flows through the proximal tubules, 80% of the water and solutes are reabsorbed into tubular capillaries.
 - 2. The water and solutes that are not reabsorbed become urine.

- 3. The amount of fluid and solutes excreted is determined through selective reabsorption.

◆ B. Nephron function.

- 1. The basic function is to rid the body of unwanted substances, the end products of metabolism (fluid and electrolytes).
- 2. The nephron filters much of the plasma through the glomerular membrane into the tubules.
- 3. The tubules filter the wanted elements of the blood (e.g., water and electrolytes) from the unwanted elements and reabsorb them into the plasma through the peritubular capillaries.
- 4. Reabsorption and secretion take place by both active and passive transport.

◆ C. Tubular reabsorption and secretion.

- 1. Tubular secretion—passage of a substance by capillary action through tubular cells into tubular lumen.
- 2. Three substances filtered at glomerulus.
 - a. Electrolytes: Na^+ , K^+ , Ca^{++} , Mg^{++} , HCO_3^- , Cl^- , and HPO_4^{--} .
 - b. Nonelectrolytes: glucose, amino acids, urea, uric acid, creatinine.
 - c. Water.
- 3. Proximal tubule reabsorption.
 - a. Eighty percent of filtrate reabsorbed actively through obligatory reabsorption.
 - b. H_2O , Na^+ , and Cl^- continue through loop of Henle, where Cl^- is actively transported out of ascending loop, followed passively by Na^+ .

◆ D. Glomerular filtration.

- 1. Glomerular membrane is semipermeable (proteins and glucose do not cross the membrane).
- 2. Amount of filtration is determined by hydrostatic pressure. Normal glomerular filtration rate is 120–125 mL/min in adults.
- 3. A decrease in blood pressure leads to a decrease in glomerular filtration rate (GFR) and, therefore, a decrease in urine output.
- 4. Approximately 1000–2000 mL blood flows through kidneys each minute to produce 60 mL urine output per hour.

◆ E. Concentrating and diluting mechanisms.

- 1. Countercurrent flow of blood and tubular fluid increase concentration of NaCl and, therefore, H_2O reabsorption.
- 2. ADH (antidiuretic hormone) released by posterior pituitary gland controls H_2O reabsorption at distal tubule.
 - a. Concentrated urine leads to increased ADH secretion.
 - b. Dilute urine leads to decreased ADH secretion.

3. Distal tubule and collecting duct.
 - a. Secretion and reabsorption completed—reabsorption of Na^+ and H_2O takes place.
 - b. Distal tubule—final regulation of H_2O and acid–base balance.
 - c. Uric acid and K^+ secreted into distal tubules and excreted in urine.
4. Hormonal regulation.
 - a. H_2O reabsorption depends on ADH.
 - b. Na^+ and K^+ reabsorption influenced by aldosterone.
 - (1) Increased aldosterone causes increased Na^+ reabsorption and increased K^+ secretion.
 - (2) Decreased aldosterone exhibits opposite effect.
 - c. Ca^{++} and HPO_4^{--} reabsorption regulated by parathyroid hormone.
 - (1) Increased parathyroid hormone leads to increased Ca^{++} reabsorption and increased HPO_4^{--} excretion.
 - (2) Decreased parathyroid hormone exhibits opposite effect.
5. Water balance maintained through homeostasis—all functions of kidney must be maintained.
6. Acid–base regulation.
 - a. Distal tubule maintains pH of extracellular fluid (ECF) within 7.35–7.45.
 - b. Other actions: reabsorption, conservation of most of the bicarbonate and secretion of excess H^+ ions.
- ♦ F. Blood pressure regulation.
 1. Regulation occurs through release of renin from juxtaglomerular cells in response to low blood volume or ischemia.
 2. Renin stimulates conversion of angiotensinogen to angiotensin I in liver.
 3. Angiotensin I changed to angiotensin II in pulmonary capillary bed.
 4. Angiotensin II increases blood pressure by vasoconstriction of peripheral arterioles and secretion of aldosterone.
 5. Increased aldosterone stimulates Na^+ reabsorption.
 6. Increased Na^+ reabsorption causes increased H_2O retention and plasma volume, which leads to increased blood pressure.
- G. Additional functions.
 1. Production of erythropoietin in response to hypoxia and decreased blood flow; stimulates production of red blood cells (RBCs) in bone marrow.
 2. Renal failure leads to vitamin D deficiency, which leads to altered calcium and phosphate balance.

♦ Characteristics of Urine

- A. Components of urine include organic and inorganic materials in urine solution.
- B. Cloudy urine is of little significance and is usually the result of urates or phosphates that precipitate out.
- C. Red blood cells in the urine or hematuria are significant and indicate the presence of some disease or disorder in the body.
 1. Acute nephritis or exacerbation of chronic nephritis.
 2. Neoplasms, vascular accidents, or infections.
 3. Renal stones.
 4. Renal tuberculosis.
 5. Trauma to the urinary tract.
 6. A manifestation of thrombocytopenia.
 7. May be the result of problems along the genitourinary tract, such as the ureter, the bladder, or the prostate gland.
- D. The source of blood cells in urine must be determined.
 1. Blood during the initial period of voiding may be from the anterior urethra or prostate.
 2. Blood mixed with the total volume of urine may be from kidneys, ureters, or bladder.

RENAL REGULATION OF FLUID AND ELECTROLYTES

Composition of the Body

Body Fluids

Definition: Total body water represents the largest constituent (45–80%) of the total body weight, depending on the amount of fat present.

- ♦ A. Intracellular—represents 40% of total body fluid; contained inside the cell; includes the red blood cells.
- ♦ B. Extracellular—represents 20% of total body fluid; includes remaining fluid not contained within the cell.
 1. Intravascular (plasma)—liquid in which the blood cells are suspended (5%).
 2. Interstitial—liquid surrounding tissue cells (15%).
 3. Percent varies with age and amount of fat.
 - a. Infant—70–80% of baby's weight is water.
 - b. Elderly clients—45–55% of body weight is water.
 - c. Thin person has more water.
 - d. Men—greater percentage of body weight is water, more lean body mass than women.

Electrolytes

Definition: Electrolytes are compounds that dissolve in a solution to form ions; each particle then carries either a positive or negative electrical charge.

- ◆ A. Types.
 1. Cations—positive charge (Na^+ , K^+ , Ca^{++} , Mg^{++}).
 2. Anions—negative charge (Cl^- , HCO_3^- , HPO_4^{--} , SO_4^{--}).
 3. Equal number of cations and anions (154 each).
- ◆ B. Concentration in solution is expressed in mEq/L. Total number of cations (mEq) plus total number of anions (mEq) will be the same in both intracellular fluid and extracellular fluid, thereby rendering the body's fluid composition electrically neutral.
- ◆ C. Compartment composition.
 1. Extracellular—large quantities of sodium, chloride, and bicarbonate ions.
 2. Intracellular—large quantities of potassium, phosphate, and proteins.

Dynamics of Intercompartmental Fluid Transfer

◆ Transport of Fluids and Electrolytes

- A. Diffusion—movement of solutes (substances that are dissolved in a solution) or gases from an area of higher concentration to an area of lower concentration; a passive transport system.
- B. Filtration—passage of fluids through a semipermeable membrane as a result of a difference in hydrostatic pressures (pressure exerted by a fluid within a closed system). The semipermeable membrane prevents movement of solute particles.
- C. Osmosis—passage of water or solvent through a semipermeable membrane from an area of lesser concentration to an area of greater concentration of solute; a passive transport system.
- D. Facilitated diffusion—transport of molecules that are too large or insoluble across the membrane by means of a carrier molecule, creating a complex that is soluble in the membrane.
- E. Active transport—transport (requiring external energy—adenosine triphosphate [ATP]) of substances across a membrane from an area of low concentration to an area of high concentration.
 1. Molecules move from an area of high concentration to one of low concentration. Glucose transport into cell is an example.
 2. Active transport is used for sodium moving out of the cell and potassium moving into the cell.

- F. Oncotic pressure—osmotic pressure that results from dispersed colloid particles (the largest being proteins) in the blood capillaries; the pressure draws water back into the vascular system, thereby maintaining blood volume.
- G. Lymphatics—vessels responsible for returning the large molecules that have escaped from the blood capillaries (including protein molecules) to the bloodstream, returning them from the interstitial fluid and the gastrointestinal (GI) tract.

Balance of Body Fluid

- A. Intake.
 1. Ingestion of foodstuff and water. Usual intake of fluid is 2000–3000 mL/day.
 2. Oxidation of foodstuff.
- B. Output.
 1. Skin and lungs.
 - a. Water is lost through vaporization from the skin surface and through expired air from the lungs.
 - b. The amount lost increases as metabolism increases.
 - c. About 900 mL loss/day.
 2. Gastrointestinal tract.
 - a. Routes include saliva, gastric secretions, bile, pancreatic juices, and intestinal mucosa.
 - b. A volume in excess of 7 L is transferred from the ECF into the gastrointestinal tract, only to be reabsorbed, excepting some 200 mL that is passed with feces.
 - ◆ 3. Kidneys.
 - a. Carry the heaviest load.
 - b. Through glomerular filtration and tubular reabsorption, the kidneys maintain homeostasis.
 - c. Hormones influence the kidneys in terms of fluid balance.
 - (1) Antidiuretic.
 - (2) Aldosterone.

Fluid Imbalances

Assessment

- ◆ A. Assess for dehydration (extracellular fluid volume deficit).
 1. Evaluate possible causes.
 - a. Vomiting, diarrhea.
 - b. Increased urine output.
 - c. Diuretics.
 - d. Excessive loss through respiration.
 - e. Insufficient IV replacement.
 - f. GI loss.
 - g. Hemorrhage.
 - h. Excessive perspiration.

- 2. Assess skin.
 - a. Loss of skin turgor (after being pinched and lightly pulled upward, skin returns to normal very slowly).
 - b. Dry, warm skin.
 - 3. Assess febrile state (usually means there is fluid loss through perspiration).
 - 4. Observe cracked lips, dry mucous membranes.
 - 5. Assess decreased urinary output (normal output is > 30 mL/hr).
 - 6. Concentrated urine—dark amber color and odorous.
 - 7. Weight loss.
 - 8. Low central venous pressure.
 - 9. Increased respiration.
- ◆ B. Assess for circulatory overload (extracellular fluid volume excess).
- 1. Evaluate possible causes.
 - a. Excessive intravenous (IV) fluids.
 - b. Inadequate kidney function.
 - c. Cushing's syndrome.
 - d. Chronic liver disease.
 - 2. Assess for headache.
 - 3. Observe flushed skin.
 - 4. Assess tachycardia.
 - 5. Assess for venous distention, particularly neck veins.
 - 6. Evaluate increased blood pressure and central venous pressure (CVP).
 - 7. Assess tachypnea (increased respiratory rate), coughing, dyspnea (shortness of breath), cyanosis, and pulmonary edema.

Implementation

- ◆ A. Take central venous pressure to determine fluid balance if CVP catheter is in place. The CVP reflects the competency of the heart (particularly the right side) to handle the volume of blood returning to it.
- 1. CVP indicates the comparison of the pumping capacity of the heart and the volume of the circulating blood.
 - 2. Normal CVP reading: 5–10 cm H₂O.
 - 3. Increased CVP (above 15 cm H₂O) can be indicative of congestive heart failure or circulatory overload.
 - 4. Decreased CVP (below 5 cm H₂O) is indicative of hypovolemia (decreased fluid volume) whether from blood loss or other fluid losses.
- B. Monitor client's condition.
- 1. Check condition of skin.
 - a. Dry, warm, cracked lips.
 - b. Elasticity.
 - 2. Check body temperature—fever suggests loss of body fluids.

- 3. Check for venous distention, increased pulse rate, and increasing blood pressure.
- 4. Ask client about unusual related symptoms, if possible, such as headache, shortness of breath.
- 5. Monitor fluid intake.
- 6. Check urine output at least every 8 hours for maintenance IV therapy, or as often as every hour for replacement fluid administration.
- 7. Check specific gravity (over 1.025 indicates dehydration; less than 1.010 indicates overhydration).
- 8. Check for symptoms of electrolyte disturbances at least every 4 hours.
- 9. Weigh client daily and watch for weight gain.

ELECTROLYTE IMBALANCES

Potassium Imbalance

See also Serum Electrolyte Levels in Chapter 11.

- ◆ A. Normal serum level is 3.5–5.0 mEq/L.
- B. Potassium deficiency and excess is a common problem in fluid and electrolyte imbalance.
- C. Major cell cation.
- ◆ D. General nursing management related to potassium imbalances.
- 1. Observe electrocardiogram (ECG) tracings for change in T wave, ST segment, or QRS complex.
 - 2. Measure intake and output (I&O) accurately.
 - 3. Draw frequent blood specimens for potassium level.
 - 4. Observe for signs of metabolic acidosis and alkalosis.

Hypokalemia

Definition: Hypokalemia is a very low concentration of potassium ions in extracellular fluid (serum level below 3.5 mEq/L).

- ◆ A. Signs and symptoms of hypokalemia.
- 1. Muscle weakness, muscle pain, leg cramps, hyporeflexia, fatigue.
 - 2. Hypotension, shallow respiration.
 - 3. Arrhythmias—premature ventricular contractions (PVCs) particularly.
 - 4. Nausea, vomiting, diarrhea.
 - 5. Apathy, drowsiness leading to coma.
 - 6. ECG changes include peaked P wave, flat T wave, depressed ST segment, and elevated U waves.
 - 7. Paralytic ileus.
- ◆ B. Causes of hypokalemia.

1. Renal loss most common (usually caused by use of diuretics).
 2. Insufficient potassium intake.
 3. Loss from gastrointestinal tract via nasogastric (NG) tube placement without replacement electrolyte solution, or from vomiting or diarrhea.
- ◆ C. Nursing management of hypokalemia.
1. Maintain IVs with potassium chloride (KCl) added.
 2. Replace K⁺ when excess loss occurs (NG tubes, diarrhea, etc.).
 3. Replace no more than 20 mEq of KCl in 1 hour; observe ECG monitor if possible.
 4. Dilute KCl in 30–50 mL IV fluid and administer with an IV pump.
 5. Observe for adequate urine output.

Hyperkalemia

Definition: Hyperkalemia is an excess of potassium in extracellular fluid (serum level greater than 5.0 mEq/L).

- ◆ A. Signs and symptoms of hyperkalemia.
1. Weakness, muscle cramp, flaccid paralysis, irritability.
 2. Hyperreflexia proceeding to paralysis.
 3. Bradycardia, arrhythmias.
 4. Ventricular fibrillation.
 5. ECG changes depict elevated or tented T wave, widened QRS complex, prolonged P-R interval, and flattened P wave with depressed ST segment.
 6. Oliguria.
 7. Diarrhea, nausea.
- ◆ B. Causes of hyperkalemia.
1. Usually renal disease (cannot excrete potassium).
 2. Burns (due to cellular destruction releasing potassium from cells into extracellular space).
 3. Crushing injuries (due to cellular breakage releasing potassium from cells).
 4. Adrenal insufficiency.
 5. Respiratory or metabolic acidosis.
 6. Excess potassium administration.
- ◆ C. Nursing management of hyperkalemia.
1. Administer diuretics if kidney function is adequate.
 2. Administer hypertonic IV glucose with insulin.
 3. Provide exchange resins through NG or enema (Kayexalate [sodium polystyrene sulfonate]).
 4. Provide calcium IV to stimulate heart if depressed action.

5. Administer sodium bicarbonate if client is acidotic.
6. Withhold food and medications with high potassium levels.

Sodium Imbalance

- ◆ A. Normal serum level is 135–145 mEq/L.
- B. Sodium deficiency and excess are common problems in fluid and electrolyte imbalance.
- C. General nursing management.
1. Observe skin condition.
 2. Measure intake and output.
 3. Auscultate lung sounds.
 4. Observe urine for specific gravity and color.

Hyponatremia

Definition: Hyponatremia is caused by a very low concentration of sodium in extracellular fluid (serum level below 135 mEq/L).

- ◆ A. Signs and symptoms of hyponatremia.
1. Signs and symptoms are the same as those for extracellular fluid deficiency.
 - a. Weakness.
 - b. Restlessness.
 - c. Delirium, irritability, confusion.
 - d. Hyperpnea.
 - e. Oliguria.
 - f. Increased temperature and pulse.
 - g. Flushed skin, dry mucous membranes.
 - h. Abdominal cramps.
 - i. Convulsions.
 - j. Nausea, anorexia.
 2. If sodium is lost but fluid is not, the following signs and symptoms will be present (similar to those of water excess):
 - a. Mental confusion, restlessness.
 - b. Headache.
 - c. Muscle twitching and weakness.
 - d. Coma.
 - e. Convulsions.
 - f. Oliguria.
- ◆ B. Causes of hyponatremia.
1. Excessive perspiration.
 2. Use of diuretics.
 3. Gastrointestinal losses—severe diarrhea, vomiting, pancreatic and biliary fistulas.
 4. Lack of sodium in diet.
 5. Burns, fibrocystic disease.
 6. Excessive IV administration without sodium chloride (NaCl).
 7. Diabetic acidosis.
 8. Adrenal insufficiency.
- C. Nursing management of hyponatremia.
1. Administer IV fluids with sodium.
 2. Maintain accurate intake and output.

Hypernatremia

Definition: Hypernatremia is caused by a very high concentration of sodium in extracellular fluid (serum level above 145 mEq/L).

- ◆ A. Signs and symptoms of hypernatremia.
 1. Signs and symptoms are the same as for extracellular fluid excesses.
 - a. Pitting edema.
 - b. Excessive weight gain.
 - c. Increased blood pressure.
 - d. Dyspnea.
 2. If hypernatremia is due to dehydration, in which a loss of fluid increases the number of ions, the signs and symptoms include
 - a. Concentrated urine and oliguria.
 - b. Dry mucous membranes, dry swollen tongue.
 - c. Thirst.
 - d. Flushed skin.
 - e. Increased temperature.
 - f. Tachycardia, hypertension.
 - g. Seizures, coma.
- ◆ B. Causes of hypernatremia.
 1. Severe diarrhea.
 2. Decreased water intake.
 3. Febrile states.
 4. Ingestion of sodium chloride.
 5. Excessive loss of water through rapid and deep respiration.
 6. Renal failure.
 7. Diabetes insipidus.
- ◆ C. Nursing management of hypernatremia.
 1. Record intake and output.
 2. Restrict sodium in diet.
 3. Weigh daily.
 4. Observe vital signs (VS).
 5. Administer fluids orally or IV.

Calcium Imbalance

- ◆ A. Normal serum level is 4.3–5.3 mEq/L; 9–11 mg/dL.
- B. Mineral plays major role in blood coagulation, cardiac muscle function, and muscle and nerve function.

Hypocalcemia

Definition: Hypocalcemia results from a deficit of calcium in the extracellular fluid (serum level below 8.5 mg/dL).

- ◆ A. Signs and symptoms of hypocalcemia.
 1. Abdominal cramps, muscle cramps, spasms of larynx and bronchus.
 2. Tetany, carpopedal spasms.
 3. Circumoral tingling, especially in fingers.
 4. Convulsions.

5. Confusion, anxiety, and moodiness.

6. ECG changes, prolonged QT interval, ventricular tachycardia.

- ◆ B. Causes of hypocalcemia.
 1. Acute pancreatitis.
 2. Chronic renal insufficiency.
 3. Burns.
 4. Removal of parathyroid glands.
 5. Massive transfusion (over 2000 mL of blood) requires calcium supplement.
 6. Malabsorption syndrome.
 7. Vitamin D deficiency.
- ◆ C. Nursing management of hypocalcemia.
 1. Calcium gluconate IV, followed by oral calcium supplements.
 2. Serum albumin if condition is due to low serum albumin concentration.
 3. Monitor for hypocalcemia.
 - a. Troussseau's test positive.
 - b. Chvostek's test positive.
 4. Monitor for signs of hypercalcemia and dysrhythmias.

Hypercalcemia

Definition: Hypercalcemia results from an excess of calcium in the extracellular fluid (serum level above 5.3 mEq/L).

- ◆ A. Signs and symptoms of hypercalcemia.
 1. Anorexia, nausea, vomiting.
 2. Lethargy, weight loss, polydipsia, polyuria, dehydration.
 3. Flank pain, bone pain, decreased muscle tone, pathologic fractures.
 4. Stupor, coma.
 5. ECG changes, shortened QT segment, ventricular arrhythmia.
- ◆ B. Causes of hypercalcemia.
 1. Excessive intake of vitamin D (milk) or calcium supplements.
 2. Hyperparathyroidism, neoplasm of parathyroids.
 3. Thyrotoxicosis.
 4. Immobilization.
 5. Paget's disease.
- ◆ C. Nursing management of hypercalcemia.
 1. Treat the underlying cause of the high serum calcium level.
 2. Immediate reversal—sodium salts IV and diuretics (Lasix [furosemide]).

Magnesium Imbalance

- ◆ A. Normal serum magnesium level is 1.3–2.1 mEq/L.
- B. Fifty percent of magnesium is in the bones and remaining 45% in intracellular compartment.

Hypomagnesemia

Definition: Deficit of magnesium due to chronic alcoholism, starvation, malabsorption, or vigorous diuresis (serum level below 1.3 mEq/L).

- ◆ A. Signs and symptoms of hypomagnesemia.
 - 1. Neuromuscular irritability.
 - a. Jerks, twitches.
 - b. Hyperactive reflexes.
 - c. Convulsions, hallucinations, coma.
 - ◆ d. Tetany.
 - 2. Cardiovascular changes.
 - a. Tachycardia, ventricular dysrhythmias.
 - b. Hypotension.
 - c. ECG changes: prolonged PR and QT segments.
- ◆ B. Causes of hypomagnesemia.
 - 1. Low intake.
 - 2. Abnormal loss—chronic diarrhea.
 - 3. Chronic nephritis.
 - 4. Diuretic phase of renal failure.
 - 5. Alcoholism.
 - 6. Pancreatitis.
 - 7. Toxemia of pregnancy.
 - 8. Cancer chemotherapy.
- ◆ C. Nursing management of hypomagnesemia.
 - 1. Magnesium sulfate.
 - a. Administer IV or intramuscular (IM) slowly.
 - b. Observe for adequate urine output.
 - ◆ c. Antidote: calcium gluconate.
 - 2. Monitor cardiac rhythm.
 - 3. Institute seizure precautions.

Hypermagnesemia

Definition: An excess of magnesium as a result of renal insufficiency or inability to excrete magnesium absorbed from food (serum level above 2.1 mEq/L).

- ◆ A. Causes of hypermagnesemia.
 - 1. Renal insufficiency.
 - 2. Overdose of magnesium.
 - 3. Severe dehydration, oliguria.
 - 4. Overuse of antacids with magnesium (Gelusil).
- ◆ B. Signs and symptoms of hypermagnesemia.
 - 1. Hypotension, decreased respirations.
 - 2. Curare-like paralysis.
 - 3. Sedation.
 - 4. Hypoactive deep tendon reflex.
 - 5. Cardiac arrhythmias, bradycardia.
 - 6. Warm sensation in body.
- ◆ C. Nursing management of hypermagnesemia.
 - 1. Administer calcium gluconate IV slowly.
 - 2. Give in peripheral veins (not CVP line).
 - 3. Monitor vital signs and neurological status.

ACID-BASE REGULATION

Principles of Acid-Base Balance

- ◆ A. Acid-base balance is the ratio of acids and bases in the body necessary to maintain a chemical balance conducive to life.
- ◆ B. Acid-base ratio is 20 parts base to 1 part acid.
- ◆ C. Acid-base balance is measured by arterial blood samples and recorded as blood pH. Range is 7.35–7.45.
- D. Acids are hydrogen ion donors. They release hydrogen ions to neutralize or decrease the strength of the base.
- E. Bases are hydrogen ion acceptors. They accept hydrogen ions to convert strong acids to weak acids (for example, hydrochloric acid is converted to carbonic acid).

Regulatory Mechanisms

- A. The body controls the pH balance by use of
 - 1. Chemical buffers.
 - 2. Lungs.
 - 3. Cells.
 - 4. Kidneys.
- ◆ B. The chemical buffer system works fastest, but other regulatory mechanisms provide more reliable protection against acid-base imbalance.
 - 1. A buffer is a substance that reacts to keep pH within normal limits. It functions only when excessive base or acid is present.
 - 2. Chemical buffers are paired (for example, weakly ionized acid or base is balanced with a fully ionized salt).
 - a. Pairing prevents excessive changes in normal acid-base balance.
 - b. The buffers release or absorb hydrogen ions when needed.
 - 3. The buffer systems in the extracellular fluid react quickly with acids and bases to minimize changes in pH.
 - a. Once they react, they are used up.
 - b. If further stress occurs, the body is less able to cope.
 - ◆ 4. There are four primary buffer systems.
 - a. Carbonic acid-bicarbonate—maintains blood pH at 7.4 with ratio of 20 parts bicarbonate to 1 part carbonic acid.
 - b. Intracellular and plasma proteins—vary the amounts of hydrogen ions in the chemical structure of the protein (along with liver). They can both attract and release hydrogen ions.

- c. Hemoglobin—maintains the balance by the chloride shift. Chloride shifts in and out of red blood cells according to the level of oxygen in the blood plasma. Each chloride ion that leaves the cell is replaced by a bicarbonate ion.
 - d. Phosphate buffer system—composed of sodium and other cations in association with HPO_4^{2-} and H_2PO_4^- ; acts like bicarbonate system.
- ♦ C. Lungs.
1. Next to react are the lungs.
 2. It takes 10–30 minutes for lungs to inactivate hydrogen molecules by converting them to water molecules.
 3. The carbonic acid that was formed by neutralizing bicarbonate is taken to lungs.
 - a. There it is reduced to carbon dioxide and water and exhaled.
 - b. When there is excessive acid in the body, the respiratory rate increases to blow off the excessive carbon dioxide and water.
 4. When there is too much bicarbonate or base in the body, respirations become deeper and slower.
 - a. This process builds up the level of carbonic acid.
 - b. The result is that the strength of the excessive bicarbonate is neutralized.
 5. Lungs can inactivate only the hydrogen ions carried by carbonic acid. The other ions must be excreted by the kidneys.
- ♦ D. Cells.
1. They absorb or release extra hydrogen ions.
 2. They react in 2–4 hours.
- ♦ E. Kidneys.
1. Most efficient regulatory mechanism.
 2. Begin to function within hours to days as integral part of buffering system.
 3. Blood pH is maintained by balance of 20 parts bicarbonate to 1 part carbonic acid.
 4. Four processes are involved in acid–base regulation.
 - a. Dissociation of H^+ from H_2CO_3 (H^+ and HCO_3^-).
 - b. Reabsorption of Na^+ from urine filtrate (Na^+ and H^+ change places).
 - c. Formation and conservation of NaHCO_3 (Na^+ and HCO_3^-).
 - d. NH_3 from metabolic process (Krebs cycle) enters kidney's tubular cell and adds an H^+ ion and then exchanges as ammonium with Na^+ (Na^+ and NH_4^+).
 5. Hydrogen and potassium compete with each other in exchange for Na^+ in the tubular urine.

NORMAL BLOOD GASES

- pH: 7.35–7.45
- PCO_2 : 35–45 mm Hg
- HCO_3 : 22–26 mEq/L

- a. In acidosis, the H^+ ion concentration is increased, and K^+ ion must wait to be excreted because hydrogen has preference.
- b. In alkalosis, the H^+ ion is low and K^+ is excreted in larger amounts.

ACID–BASE IMBALANCES

Metabolic Acidosis

♦ *Definition:* Metabolic acidosis occurs when there is a deficit of bases or an accumulation of fixed acids.

- A. Changes in pH and serum HCO_3 .
 1. The pH will become acidotic as a result of insufficient base.
 - a. It falls below 7.35.
 - b. There are either more hydrogen ions or fewer bicarbonate ions present in the blood.
 2. The serum CO_2 level will be below 22 mEq/L (normal range of CO_2 is 26–28 mEq/L).
 - a. Serum CO_2 measures the amount of circulating bicarbonate.
 - b. Serum CO_2 acts as a bicarbonate (HCO_3) determinant. When serum CO_2 is low, HCO_3 is lost and acidosis results.
- B. Compensatory mechanisms.
 1. When compensating for metabolic acidosis, the one clinical manifestation usually observed is the “blowing off” of excessive acids. This can be noted by a respiratory rate increase.
 2. The lungs are the fastest mechanism used to compensate for metabolic acidosis.
 - a. If the lungs are involved, as in respiratory acidosis, they cannot function as a compensatory mechanism.
 - b. Therefore, the kidneys must take over and the process is much slower.
 3. Renal excretion of acid occurs.
- C. Laboratory values.
 1. The partial pressure of the blood gas carbon dioxide (PCO_2) decreases below 35 mm of pressure when the client is compensating. (Normal values: 35–45 mm Hg.)
 2. The partial pressure of oxygen (PO_2) is usually increased due to increased respiratory rate. (Normal values PO_2 : 80–100 mm Hg.)

3. The serum potassium level is increased with acidosis, due primarily to the cause of the acidosis.
 - a. For example, clients can go into metabolic acidosis from severe diarrhea.
 - b. When this condition is present, the potassium moves out of the cell and into the extravascular space due to the dehydration process.
 4. Sodium and chloride levels may be decreased. Again, this is usually due to excessive loss through urine or gastrointestinal disorders.
 5. Laboratory values when a client is in metabolic acidosis.
 - a. pH: < 7.35 (decreased).
 - b. HCO₃: < 22 mEq/L (decreased).
 - c. PCO₂: 38–40 mm Hg (normal).
- ◆ D. Causes of metabolic acidosis (seen particularly in the surgical client).
1. Diabetes—diabetic ketoacidosis.
 - a. When insufficient insulin is produced or administered to metabolize carbohydrates, increased fat metabolism results, thus producing excess accumulations of ketones and other acids.
 - b. This is the most common problem associated with metabolic acidosis in the surgical client.
 2. Renal insufficiency—kidneys lose their ability to reabsorb bicarbonate and secrete hydrogen ions.
 3. Diarrhea—excessive amounts of base are lost from the intestines and pancreas, resulting in acidosis.
- E. Clinical manifestations.
1. Headache, mental dullness.
 2. Drowsiness, confusion.
 3. Nausea, vomiting, diarrhea.
 4. Coma, twitching, convulsions (late changes).
 5. Kussmaul's respiration (increased respiratory rate due to compensation).
 6. Fruity breath (as evidenced in diabetic ketoacidosis as a result of improper fat metabolism).
- F. Nursing management.
- ◆ 1. Administer sodium bicarbonate intravenously to alkalinize the client and return client to normal acid-base balance as quickly as possible.
- a. Usual dosage: one to three ampules of 50 mEq bicarbonate/ampule.
 - b. This is usually the immediate treatment rendered for metabolic acidosis.
- ◆ 2. Administer sodium lactate solution to increase the base level.
- a. Sodium lactate is converted to bicarbonate by the liver.

- b. Lactated Ringer's IV solution may be used.
3. Administer insulin in ketoacidosis. Insulin moves glucose out of the blood serum and into the cell, thereby decreasing ketosis. Insulin decreases ketones by decreasing the release of fatty acids from fat cells.
4. Monitor laboratory values closely while managing metabolic acidosis.
5. Watch for signs of hyperkalemia and dehydration in the client (oliguria, vital sign changes, etc.).
6. Record intake and output.

Metabolic Alkalosis

◆ *Definition:* Metabolic alkalosis is a malfunction of metabolism, causing an increase in blood base or a reduction of available acids in the serum.

- A. Changes in pH and serum bicarbonate (HCO₃).
 1. The pH will become more alkaline; therefore, it will be above 7.45.
 2. Bicarbonate will increase above 26 mEq/L. CO₂ measures the amount of circulating bicarbonate or the base portion of the plasma. (A good way to remember these acid-base values is to recall that as the pH increases, so does the HCO₃ [and CO₂]. The reverse is true for acidosis.)
 3. The PCO₂ will not change unless the lungs attempt to compensate.
 4. Serum potassium and chloride levels decrease, due to the basic cause of the alkalosis, whether it be excessive vomiting or the use of diuretics.
 - B. Compensatory mechanisms.
 1. The lungs attempt to hold on to the carbonic acid in an effort to neutralize the base state; therefore, the rate of respiration decreases.
 2. When the lungs are compensating for the alkalotic state, the PCO₂ will increase above 45 mEq/L.
 3. Renal excretion of bicarbonate occurs.
- ◆ C. Laboratory values when client is in metabolic alkalosis
1. pH: > 7.45 (increased).
 2. HCO₃: > 26 mEq/L (increased).
 3. PCO₂: 38–40 mm Hg (normal).
- D. Causes of metabolic alkalosis.
1. Ingestion of excessive soda bicarbonate (used by individuals for acid indigestion).
 2. Excessive vomiting, which results in the loss of hydrochloric acid and potassium.
 3. Placement of NG tubes that causes a depletion of both hydrochloric acid and potassium.
 4. Use of potent diuretics, particularly by cardiac clients. They tend to lose not only potassium

- but also hydrogen and chloride ions, causing an increase in the bicarbonate level of the serum.
5. Excessive intake of mineralocorticoids.
- E. Clinical manifestations.
1. Confusion, dizziness.
 2. Nausea, vomiting, diarrhea.
 3. Restlessness, irritability, agitation, nervousness.
 4. Twitching of extremities, coma, convulsions (late signs).
 5. Numbness or tingling of fingers and toes.
 6. ECG changes indicate tachycardia, with the T wave running into the P wave.
- ◆ F. Nursing management.
1. Give Diamox (acetazolamide) to promote kidney excretion of bicarbonate.
 2. Administer IV solution of added electrolytes.
 - a. Estimate the potassium loss from gastric fluid at 5–10 mEq for each liter lost.
 - b. In many institutions, the gastric fluid loss is replaced mL for mL every 2–4 hours.
 - c. In other institutions, the approximate electrolyte loss is calculated and this amount is added to the 24-hour IV solution.
 - d. Chloride replacement enables renal absorption of NA^+ with Cl^- and renal excretion of excessive HCO_3^- .
 3. Maintain diet of foods high in potassium and chloride (bananas, apricots, dried peaches, Brazil nuts, dried figs, oranges).
 4. Administer potassium chloride maintenance doses to clients on long-term diuretics.
 5. Give ammonium chloride to increase the amount of available hydrogen ions, thereby increasing the availability of acids in the blood.
 6. Check laboratory values frequently to watch for electrolyte imbalance.
 7. Watch client for physical signs indicative of hypokalemia or metabolic alkalosis.
 8. Keep accurate records of intake and output and vital signs.

Respiratory Acidosis

◆ *Definition:* Respiratory acidosis refers to increased carbonic acid concentration (accumulated CO_2 that has combined with water) caused by retention of carbon dioxide through hypoventilation. Differs from metabolic acidosis in that it results from altered alveolar ventilation.

- A. Changes in pH, PCO_2 , and PO_2 .
1. With an increased acidic state, the pH will fall below 7.35.
 2. The PCO_2 will be increased above 45–50 mm Hg.
 3. The PO_2 will be normal (80–100 mm Hg), or it can be decreased as hypoxia increases.

4. The HCO_3^- will be normal if respiratory acidosis is uncompensated.
- B. Compensatory mechanisms.
1. Because the basic problem in respiratory acidosis is a defect in the lungs, the kidneys must be the major compensatory mechanism.
 - a. The kidneys work more slowly than the lungs.
 - b. Therefore, it will take from hours to days for the compensation to take place.
 2. The kidneys will retain bicarbonate and return it to the extracellular fluid compartment.
 3. The bicarbonate level will be elevated with partial or complete compensation.
- ◆ C. Laboratory values when client is in respiratory acidosis and compensated acidosis.
1. pH: < 7.35 (decreased).
 2. PCO_2 : > 45 mm Hg (increased).
 3. HCO_3^- : 24 mEq/L (normal or increased).
- D. Causes of respiratory acidosis.
1. Sedatives.
 2. Oversedation with narcotics in postoperative period.
 3. A chronic pulmonary disorder such as emphysema, asthma, bronchitis, or pneumonia, leading to
 - a. Difficulty in the expiratory phase of respiration, leading to retention of carbon dioxide.
 - b. Airway obstruction.
 4. Poor gaseous exchange during surgery.
- E. Clinical manifestations.
1. Dyspnea after exertion, tachycardia.
 2. Visual disturbances.
 3. Hyperventilation when at rest.
 4. Headache, vertigo, tremors, confusion.
 5. Sensorium changes—drowsiness leading to coma (late changes).
 6. Carbon dioxide narcosis.
 - a. When body has adjusted to higher carbon dioxide levels, the respiratory center loses its sensitivity to elevated carbon dioxide.
 - b. Medulla fails to respond to high levels of carbon dioxide.
 - c. Client is forced to depend on anoxia for respiratory stimulus.
 - d. If a high level of oxygen is administered, client will cease breathing.
- ◆ F. Nursing management.
1. Turn, cough, and deep-breathe client at least every 2–4 hours as part of general postoperative care. Use oropharyngeal suction if necessary. Maintain semi-Fowler's position.
 2. Encourage the use of the incentive spirometer.
 3. When pulmonary complications present a threat, do postural drainage, percussion, and vibration, followed by suctioning.

4. Keep client well hydrated (2–3 L) to facilitate removal of secretions. If client is dehydrated, secretions become thick and more difficult to expectorate.
5. Monitor vital signs carefully, particularly rate and depth of respirations.
6. Monitor arterial blood gases (ABGs) for changes in pH and CO₂.
7. Teach pursed-lip breathing to chronic respiratory clients.
8. If oxygen is administered, watch carefully for signs of carbon dioxide narcosis. Usually O₂ at 2 L is started.
9. Place client on mechanical ventilation if necessary.
10. Administer aerosol medications through nebulizer treatment.
 - a. Bronchodilators (aminophylline)—relieve bronchospasms.
 - b. Detergents (Tergemist)—liquefy tenacious mucus.
 - c. Antibiotics specific to causative agent.
11. Administer drug therapy.
 - a. Sodium bicarbonate IV (0.25 g/kg body weight).
 - b. Sodium lactate IV.
 - c. Ringer's lactate IV to replace electrolyte loss.
 - d. Potassium to maintain serum levels.

Respiratory Alkalosis

♦ **Definition:** Respiratory alkalosis occurs when an excessive amount of carbon dioxide is exhaled, usually caused by hyperventilation. The loss of carbon dioxide results in a decrease in H⁺ concentration along with a decrease in PCO₂ and an increase in the ratio of bicarbonate to carbonic acid. The result is an increase in the pH level.

- A. Changes in pH, PCO₂, and PO₂.
 1. With an increased alkalotic state, the pH will increase above 7.45, indicating there is a decreased amount of carbonic acid in the serum.
 2. The PCO₂ will be normal to low, as this measures the acid portion of the acid–base system (30–45 mm Hg).
 3. The PO₂ should be unchanged.
 4. The bicarbonate level (HCO₃ or CO₂ content) should be normal unless the client is compensating.
- B. Compensatory mechanisms.
 1. Because the basic problem is related to the respiratory system, the kidneys compensate by excreting more bicarbonate ions and retaining hydrogen ions.

2. This process returns the acid–base balance to a normal ratio.
- ♦ C. Laboratory values when client is in respiratory alkalosis.
1. pH: > 7.45 (increased).
 2. PCO₂: 35 mm Hg (decreased).
 3. HCO₃: < 22 mEq/L.
- D. Causes of respiratory alkalosis.
1. Hysteria or acute anxiety: Client hyperventilates and exhales excessive amounts of carbon dioxide.
 2. Hypoxia: Stimulates client to breathe more vigorously.
 3. Following head injuries or intracranial surgery.
 4. Increased temperature.
 5. Overventilation with mechanical ventilator.
 6. Salicylate poisoning.
 - a. Stimulation of respiration causes alkalosis through hyperventilation.
 - b. Acidosis may occur from excessive salicylates in the blood.
- E. Clinical manifestations—increased neuromuscular irritability.
1. Lightheadedness, vertigo, tinnitus, palpitations.
 2. Hyperreflexia.
 3. Numbness of fingers and toes, tetany.
 4. Muscular twitching, convulsions (late changes).
- ♦ F. Nursing management.
1. Eliminate cause of hyperventilation, instruct client to breathe slowly to decrease CO₂ loss.
 2. Remain with client and be supportive to reduce anxiety.
 3. Use rebreathing bag to return client's carbon dioxide to self (paper bag works just as well).
 4. Provide sedation as ordered.
 5. Monitor lab values, especially K⁺ and HCO₃⁻.

SOLVING THE PUZZLE: IS IT RESPIRATORY OR METABOLIC ACIDOSIS OR ALKALOSIS?

When pH is in same column as

- PCO₂ = a respiratory problem
- HCO₃ = a metabolic problem

If third component is in opposite column = partial compensation.

If third component is in normal column = no compensation.

If pH is normal (7.40) = full compensation.

	Acidosis	Normal	Alkalosis
pH	< 7.35	7.35–7.45	> 7.45
PCO ₂	> 45	35–45	< 35
HCO ₃	< 22	22–26	> 26

System Assessment

- A. Take history to determine presence of renal or urologic problems.
- B. Determine use of prescriptions, over-the-counter drugs, and herbs. Many drugs are nephrotoxic.
- C. Evaluate urinalysis findings to determine presence of infection, bleeding, or signs of renal failure.
- D. Assess (palpate) for kidney pain between last thoracic and third lumbar vertebrae.
 - 1. Severe pain or discomfort may indicate kidney infection, stone, or kidney disease.
 - 2. Kidney enlargement may indicate neoplasm or polycystic disease.
- ◆ E. Assess pain for location, intensity, and precipitating factors.
 - 1. Arterial pain is related to obstruction and is usually an acute manifestation.
 - a. Site of obstruction may be found by tracing the location of radiation of pain.
 - b. Pain may be severe and usually radiates down ureter into scrotum or vulva and to the inner thigh.
 - 2. Bladder pain is due to infection and overdistention of the bladder in urinary retention.
 - 3. Testicular pain is caused by inflammation or trauma, and is acute and severe.
 - 4. Pain in the lower back and leg may be caused by prostate cancer with metastasis to pelvic bones.
 - 5. Pain caused by renal disease.
 - a. Dull ache in flank, radiating to lower abdomen and upper thigh.
 - b. Pain may be absent if there is no sudden distention of kidney capsules.
- ◆ F. Assess bladder for distention.
- G. Examine the urinary catheter drainage for abnormal findings.
- H. Evaluate intake and output values; dehydration can lead to infection, calculi formation, and renal failure.
- I. Measure vital signs to determine presence of complications.
- J. Assess patency of shunts.
- K. Assess all body systems for potential alterations as a result of kidney problems.
 - 1. Peripheral edema.
 - 2. Hypertension.
 - 3. Eye disorders.
 - 4. Anemia.
 - 5. Lethargic or irritable condition.
 - 6. Congestive heart failure.
- L. Observe for signs and symptoms of fluid and electrolyte imbalances.

- M. Evaluate urinary test results for signs of renal abnormalities.
- N. Assess client's feelings about body image.
- O. Assess for type of imbalance.

DIAGNOSTIC PROCEDURES

Renal Function Tests

- ◆ A. Renal concentration tests.
 - 1. Underlying principles.
 - a. Evaluate the ability of the kidney to concentrate urine.
 - b. As kidney disease progresses, renal function decreases. Concentration tests evaluate this process.
 - c. Renal concentration is measured by specific gravity readings (normal range 1.010–1.030).
 - d. If specific gravity is 1.018 or greater, it may be assumed that the kidney is functioning within normal limits.
 - e. Specific gravity that stabilizes at 1.010 indicates kidney has lost ability to concentrate or dilute.
 - 2. Common tests.
 - a. Urine osmolality—used to evaluate clients with renal disease (e.g., SIADH [syndrome of inappropriate antiidiuretic hormone] and diabetes insipidus).
 - b. Urinary sodium—24-hour test that determines amount of sodium excretion in urine. Used to determine clients with fluid volume deficits, acute renal failure, and acid-base imbalances.
 - 3. Concentration and dilution tests.
- B. Glomerular filtration test (endogenous creatinine clearance).
 - 1. Kidney function is assessed by clearing a substance from the blood (filtration in the glomerulus).
 - 2. Common test is the amount of blood cleared of urea per minute.
 - 3. Test done on 12-hour or 24-hour urine specimen.
 - 4. Normal range is approximately 100–120 mL/min (1.67–2.0 mL/sec).
 - 5. Blood urea nitrogen (BUN).
 - a. Normal 10:1 ratio for BUN to creatinine.
 - b. High BUN indicates severe catabolic state, GI bleeding, or use of corticosteroids.
- C. Electrolyte tests.
 - 1. Kidney function is essential to maintain fluid and electrolyte balance.

2. Tests for electrolytes (sodium, potassium, chloride, and bicarbonate) measure the ability of the kidney to filter, reabsorb, or excrete these substances.
3. Impaired filtration leads to retention, and impaired reabsorption leads to loss of electrolytes.
4. Tests are performed on blood serum, so venous blood is required.

Analysis of Urine

- A. Urinalysis is a critical test for total evaluation of the renal system and for indication of renal disease.
- B. Specific gravity shows the degree of concentration in urine.
 1. Indicates the ability of the kidney to concentrate or dilute urine.
 2. Change from normal range indicates diabetes mellitus (> 1.030) or kidney damage (< 1.010).
 3. Renal failure—specific gravity constant at 1.010.
- C. Analysis of the pH of urine—normal urine pH is 6–7. Lower than 6 is acidic urine, and higher than 7 is alkaline urine.
- D. Urinary sodium—random sample used to identify renal failure.

See also Urine Analysis in Chapter 11, Laboratory Tests.

Renal Imaging

- A. Flat plate of abdomen without contrast dye.
 1. Outlines size of kidney.
 2. Outlines stone formation.
- B. Intravenous pyelogram (IVP).
 1. Contrast dye identifies changes in kidney structure.
 2. Identifies presence of stones.
 3. Outlines ureteral obstructions.
- C. Voiding cystourethrogram (VCUG) x-ray (XR).
 1. Contrast dye inserted through catheter into bladder.
 2. Determines reflux, cancer on wall of bladder, and increased residual volume.
- D. Retrograde pyelogram (XR).
 1. Contrast inserted into ureters retrograde from bladder.
 2. Visualizes collecting system.
- E. Renal ultrasound.
 1. Noninvasive and useful in identifying kidney size, hydronephrosis, and obstructions.
 2. Used to guide percutaneous needle biopsies of kidneys.

GU Examination

Male Examination

- ◆ A. Testicular self-exam (TSE).
 1. Instruct client to perform monthly following warm bath or shower. (Between ages 15 and 25, third highest cause of cancer deaths in men.)
 2. Stand before mirror and check for swelling on skin and scrotum.
 3. Rotate each testicle between thumb and forefinger, feeling for a firm surface.
 4. If painless lump is felt (not the epididymis), notify physician immediately.
- ◆ B. Prostate evaluation.
 1. Rectal exam annually beginning at age 40.
 2. Blood chemistry for cancer.
 - a. Prostatic acid phosphate (PAP)—elevated.
 - b. Prostate-specific antigen (PSA)—elevated. Most sensitive tumor marker.
 - c. May be false-positive readings.
 3. Ultrasound with biopsy if indicated.

Female Examination

- A. Pelvic examination.
 1. Inspection of external genitalia for signs of inflammation, bleeding, discharge, and epithelial cell changes.
 2. Visualization of vagina and cervix.
 3. Bimanual examination.
 4. Rectal examination.
- ◆ B. Papanicolaou (Pap) smear.
 1. Diagnosis for cervical cancer.
 2. Vaginal secretions and secretions from posterior fornix are smeared on a glass slide.
 - ◆ 3. Pathological classifications.
 - a. Class I: No abnormal or atypical cells present.
 - b. Class II: Abnormal or atypical cells present but no malignancy found; repeat Pap smear and follow-up if necessary.
 - c. Class III: Cytology suggests malignancy; additional procedures: biopsy, dilation and curettage (D&C).
 - d. Class IV: Cytology strongly suggests malignancy; additional procedures: biopsy, D&C.
 - e. Class V: Cytology conclusive of malignancy.
- ◆ C. Breast self-examination (BSE).
 1. Perform 5–7 days after menses, counting first day of menses as day 1. Less fluid is retained.
 2. Instruct female client to place pillow under the shoulder and, using three fingers, compress

- breast tissue in a circular motion, beginning at outer edge and moving toward nipple.
- Examine entire breast including nipple area.
 - Move pillow to other shoulder and repeat examination.
 - Remind client to immediately report any lump, irregularity, edema, skin changes, discharge, nipple changes, changes in contour of breasts.
- D. Mammography.
- X-ray of soft tissue to detect nonpalpable mass.
 - Baseline (one time) age 35–39; yearly after age 40.

Cystoscopy

Definition: The direct visualization of the bladder and urethra by means of a cystoscope.

Purpose

- Inspect bladder and urethra for stones, etc.
- Evaluate results of tissue examination obtained from biopsy.
- Treat lesions of the bladder, urethra, and prostate.

Implementation

- Measure vital signs.
- Observe for urethral bleeding.
- Chart intake and output, and consistency of urine.
- Monitor for signs of infection.
 - Frequency.
 - Urgency.
 - Burning during urination.
- Monitor for perforation of bladder.
 - Sharp abdominal pain.
 - Anuria.
 - Boardlike abdomen.
- Maintain client on bed rest for 4–6 hours if indicated; then ambulate if no complications. (Many procedures are outpatient and the client is released 1–2 hours after test if no complications.)
- Monitor vital signs for shock and infection.

System Implementation

- ♦ A. Monitor fluid intake at least every shift for clients with renal dysfunction.
 - Encourage fluids.
 - Urinary tract infection.
 - Cystitis.
 - Pyelonephritis.
 - Urolithiasis.
 - Restrict fluids.
 - Glomerulonephritis.

- b. Renal failure.
- c. Nephrotic syndrome.
- ♦ B. Provide appropriate diet for renal dysfunction.
 - Pyelonephritis—high calorie, vitamins, and protein; if oliguria is present, change diet to low protein.
 - Glomerulonephritis—low saturated fat, 0.8 g/kg/day protein, low sodium.
 - Nephrotic syndrome—0.8 g/kg/day protein, high calorie, low sodium, liberal potassium.
 - Renal failure—restricted protein to 40–60 mEq/day; low in nitrogen, potassium; 2 g/day sodium, phosphate, and sulfate.
- C. Monitor client for complications associated with renal dysfunction, especially congestive heart failure, pulmonary edema, and hypertension.
- D. Provide good skin care; edematous areas are easily broken down.
- E. Encourage bed rest for clients in an acute stage of the disease.
- F. Administer medications on time to keep blood levels stable and in therapeutic range.
- G. Monitor vital signs for early detection of changes in client status.
- H. Provide shunt care to maintain patency and prevent infection.
 - Instruct client on diet, fluid alteration, and shunt care as needed.
 - Encourage client to express feelings and concerns with altered body image.

RENAL DISORDERS

Injuries to the Kidney

Definition: Injury to the kidney includes any trauma that bruises, lacerates, or ruptures any part of the kidney organ.

Assessment

- Assess for hematuria.
- Assess for shock, if hemorrhage has occurred.
- Evaluate pain over costovertebral area.
- Observe for gastrointestinal symptoms of nausea and vomiting.

Implementation

- Promote bed rest.
- Monitor vital signs frequently for possible hemorrhage.
- Monitor blood work and laboratory examination of urine to assess for hematuria.
- Prevent infection.
- Frequently monitor the total status of the client following injury.
 - Observe for pain and tenderness.
 - Observe any sudden change in status.

- F. Prepare for surgery (nephrectomy) if health status deteriorates (shock indicating severe hemorrhage).

Urinary Tract Infections

♦ **Definition:** A term that refers to a wide variety of conditions affecting the urinary tract in which the common denominator is the presence of microorganisms. Classified as infections involving the upper or lower urinary tract. Most common healthcare problem in United States. More common in women.

♦ Characteristics

- A. Urine is sterile until it reaches the distal urethra.
- B. Any bacteria can be introduced into the urinary tract, resulting in infection, which may then spread to any other part of the tract. *Escherichia coli* is most frequent organism causing about 80% of all cases; 5–15% are caused by *Staphylococcus*.
- C. The most important factor influencing ascending infection is obstruction of free urine flow.
 - 1. Free flow, large urine output, and pH are antibacterial defenses.
 - 2. If defenses break down, the result may be an invasion of the tract by bacteria.
- D. Microscopic examination is completed for an accurate identification of the organism (especially important in chronic infections).

Assessment

- A. Determine location of infection.
 - 1. Lower urinary tract infection (UTI)—cystitis, urethritis, or prostatitis.
 - 2. Upper UTI—pyelonephritis, interstitial nephritis.
- B. Evaluate urine cultures and chemical tests to determine presence and number of bacteria.
- C. Evaluate urine colony count. Colony count over 100,000/mL indicates urinary tract infection.
- D. Assess for location, type, and precipitating factors leading to pain.
- E. Observe urine for color, consistency, specific gravity.
- F. Assess for frequency, urgency, nocturia, incontinence, and suprapubic or pelvic pain.
- G. Blood or urine test to rule out sexually transmitted diseases (STDs), which produce similar symptoms.

Implementation

- ♦ A. Encourage fluids to 3000 mL provided there are no cardiac or renal contraindications.
- ♦ B. Administer urinary antimicrobials as ordered.
 - 1. Standard treatment—therapy for lower tract infection.
 - a. Single-dose therapy effective in 80% of cases (Monurol [fosfomycin]

antibiotics—one packet of granules dissolved into 90–120 mL of water [not hot]. May be taken with or without meals.)

- b. Primsol (trimethoprim), sulfamethoxazole, Bactrim, Septra (sulfamethoxazole and trimethoprim), or quinolones (Cipro [ciprofloxacin] or Noroxin [norfloxacin]) may be used.
- 2. Short-course therapy—3 or 4 days, more commonly prescribed.
- 3. Longer course—10–14 days, for upper tract infections.
 - a. Antibacterial may be prescribed with single-dose therapy.
 - b. Urinary antiseptics may be used with antimicrobials.
- 4. Action of antimicrobials—inhibits cell-wall mucopeptide synthesis; interferes with enzyme needed for bacterial metabolism.
- 5. Adverse effects—hypersensitivity, nausea, vomiting, diarrhea, rash.
- ♦ C. Administer antiseptics—interfere with vital processes of the bacteria.
 - 1. Medications: Furadantin (nitrofurantoin); Hipres, Urised (methenamine salts).
 - 2. Adverse effects—anorexia, nausea, vomiting.
 - 3. Avoid foods that increase urinary pH.
- D. Antispasmodics and analgesics may be used to relieve pain, frequency, urgency, and burning.
- ♦ E. Encourage client to void every 2 to 3 hours and to empty bladder—reduces urinary stasis and risk of reinfection.
 - F. Avoid beverages that irritate bladder—alcohol, coffee, carbonated beverages.
- ♦ G. Teach women hygiene measures to prevent reoccurrence (wipe front to back, keep perineum clean and dry, do not douche, and avoid tight-fitting pants; also, voiding after sexual intercourse helps).

Cystitis

♦ **Definition:** Inflammation of the bladder from infection or obstruction of the urethra is the most common cause.

Assessment

- ♦ A. Observe for frequency, urgency, and burning sensation on urination.
- B. Evaluate lower abdominal discomfort.
- C. Observe for dark and odorous urine (often a manifestation), hematuria.
- D. Assess laboratory findings for presence of bacteria and hematuria.
- E. Bacterial counts exceeding 10^5 colonies/mL of urine indicate infection using clean catch technique for urine sample.

Implementation

- A. Assist physician in identifying and removing the cause of the condition (infection, obstruction, etc.).
- ◆ B. Administer antibiotics on time. Drugs usually administered—Bactrim, Septra (sulfamethoxazole with trimethoprim) are drugs of choice. May use Macrodantin (nitrofurantoin macrocrystals).
- C. Instruct client on how to prevent infection. Empty bladder completely and frequently.
- D. Instruct client on measures for symptomatic relief of chronic conditions. Antispasmodics are used for pain and bladder irritability.
- E. Collect an uncontaminated urine specimen (midstream specimen) for laboratory test.
- ◆ F. Maintain adequate fluid intake.
 - 1. Force fluids only if specifically ordered.
 - 2. Check and record intake and output.
- G. Encourage bed rest or a decrease in activity during the acute stage.
- H. Avoid urinary tract irritants—coffee, tea, citrus.

Pyelonephritis

◆ *Definition:* An acute or chronic infection and inflammation of one or both kidneys that usually begins in the renal pelvis. Women are more commonly affected. Gram-negative organisms are most often responsible, especially *Escherichia coli*.

Assessment

- ◆ A. Observe for attacks of chills, fever, malaise, gastrointestinal upsets.
- ◆ B. Evaluate for tenderness and dull, aching pain in back.
- C. Assess for fatigue, headache, poor appetite, excessive thirst, and weight loss.
- ◆ D. Identify frequent and burning urination (more common in lower tract involvement).
- E. Evaluate pus and bacteria in urine.
- F. Evaluate renal function. May have normal renal function except for inability to concentrate urine.
- G. Evaluate for renal insufficiency.
 - 1. Progressive destruction of renal tubules and glomeruli.
 - 2. Inability of kidneys to excrete large amounts of electrolytes.
 - 3. Ultrasound or computed tomography (CT) scan is used to locate any obstruction in urinary tract.
- H. Assess for hypertension in presence of bacterial pyelonephritis.
- I. Identify if overt symptoms disappear in a few days but urine is still infected.

Implementation

- ◆ A. Administer and monitor drug therapy.

1. Antibiotic therapy usually for 2 weeks (organism-specific for infection).
2. Usual drugs—Bactrim, Septra (trimethoprim and sulfamethoxazole), Cipro (ciprofloxacin), Garamycin (gentamicin), or a third-generation cephalosporin.
3. Analgesics and sedatives as needed.
4. May be on antibiotics up to 6 months.
- B. Maintain bed rest until asymptomatic.
- ◆ C. Force fluids to flush kidneys and maintain urine output of 1500 mL/day (3–4 L/day).
- D. Continue monitoring for presence of bacteria.
- E. Instruct client in methods to prevent chronic renal insufficiency.
- F. Monitor urinalysis.
 1. Check urine concentration (specific gravity), blood, protein.
 2. Check electrolytes.
- G. Provide diet high in calories and vitamins, and low in protein if oliguria is present.
- H. Monitor temperature every 4 hours.
- I. Instruct to empty bladder regularly.
- J. Observe for edema and signs of renal failure.
- K. Instruct client in good hygiene to prevent further infections.

Glomerulonephritis

◆ *Definition:* A group of kidney diseases caused by inflammation of the capillary loops in the glomeruli of the kidney.

Characteristics

- A. The kidney's glomeruli are affected by an immunological disorder.
- ◆ B. Most frequently follows infections with group A beta-hemolytic *Streptococcus*.
- C. Upper respiratory infections, skin infections, other autoimmune processes (systemic lupus), and acute infections predispose to glomerulonephritis.
- D. Glomerulonephritis symptoms appear 2–3 weeks after original infection.

Assessment

- A. Initially, symptoms may be mild—assess for pharyngitis as it can occur after a strep infection, fever, malaise.
- B. Assess urine.
 1. Evaluate for hematuria—first symptom.
 2. Urine may be dark, smoky, cola-colored.
 3. Assess urine for persistent and excessive foam caused by protein.
 4. Assess specific gravity for high values.
 5. Observe for oliguria, anuria.

- 6. Observe for hypoalbuminemia due to increased loss via urine. (Proteinuria 2–8 g daily.)
- C. Observe for weakness, anorexia, mild anemia.
- D. Evaluate edema—leg, face, or generalized.
- E. Assess abdominal pain, nausea, vomiting.
- F. Flank pain.
- G. Identify if hypertension, headache, or convulsions are present.
- H. Assess for congestive heart failure.
- I. Evaluate presence of increased BUN and creatinine.
- J. Reduced visual acuity.
- K. Observe for signs of encephalopathy.

♦ Implementation

- ◆ A. Administer penicillin for residual infection.
- B. Administer loop diuretics and antihypertensives if necessary.
- C. Administer corticosteroids and immunosuppressive agents if disease is progressing rapidly.
- ◆ D. Provide appropriate diet.
 - 1. Protein restriction if oliguria is severe; otherwise, protein allowed at low normal range (normal 40–60 g/day).
 - 2. BUN level watched for protein determination.
 - 3. Protein should be of the complete type (milk, eggs, meat, fish, poultry).
 - ◆ 4. High carbohydrate to provide energy and spare protein.
 - ◆ 5. Potassium usually restricted.
 - 6. Sodium restriction for hypertension, edema, and congestive heart failure (CHF). If diuresis is great, sodium replacement may be necessary.
 - 7. Fluid restriction: Replacement is based on insensible loss plus measured sensible loss of previous day or hour.
 - 8. Vitamin replacement.
- ◆ E. Prolonged bed rest is of little value and does not improve long-term outcomes.
- F. Monitor vital signs continuously.
- G. Allow client to verbalize feelings on body image changes (due to edema), loss of health, fear of death.
- H. Monitor fluid intake.
 - 1. Measure fluids according to urinary output.
 - 2. Record intake and output.
 - 3. Weigh daily.
- I. Monitor for signs of overhydration.
- J. Take blood pressure frequently and observe for hypertension, signs of congestive failure, and pulmonary edema.

- K. Evaluate for symptoms of renal failure.
 - 1. Oliguria.
 - 2. Azotemia.
 - 3. Acidosis.

Nephrotic Syndrome

Definition: A term that refers to renal disease characterized by massive edema and albuminuria, high cholesterol, and low-density lipoproteins. Considered a disease of childhood.

Characteristics

- ◆ A. The syndrome is seen in any renal condition that has damaged glomerular capillary membrane: glomerulonephritis, lipid nephrosis, syphilitic nephritis, amyloidosis, or systemic lupus erythematosus.
- B. There is a loss of plasma proteins, especially albumin, in the urine.
- C. A specific form of intercapillary glomerulosclerosis is associated with diabetes mellitus (Kimmelstiel-Wilson syndrome).
- D. Occurrence thought to be related to thyroid function.

Assessment

- ◆ A. Evaluate edema (at first, dependent; later, generalized).
- ◆ B. Identify if proteinuria (3–3.5 g/day) is present.
- ◆ C. Identify if decreased serum albumin is present.
- D. Identify if elevated serum cholesterol, triglycerides, hyperlipidemia are present.
- E. Assess hypertension (related to function of renin-angiotensin system).
- F. Evaluate decreased cardiac output (secondary to fluid loss).
- G. Observe for pallor, malaise, anorexia, lethargy.

Implementation

- ◆ A. Provide nursing care directed toward control of edema.
 - 1. Sodium restriction in diet.
 - 2. Avoidance of sodium-containing drugs.
 - 3. Diuretics (Lasix and Edecrin [ethacrynic acid]) that block aldosterone formation.
 - 4. Salt-poor albumin.
- ◆ B. Provide dietary instruction.
 - 1. High protein (100 g or 0.8 g/kg/day) to restore body proteins.
 - 2. High calorie, low saturated fat.
 - 3. 500 mg sodium if edema present.
- ◆ C. Administer drug therapy.
 - 1. Adrenocortical therapy (Deltasone [prednisone]) to reduce proteinuria.

- 2. Immunosuppressives (Imuran [azathioprine]) or antineoplastic agents (Cytoxan [cyclophosphamide]).
- 3. Angiotensin-converting enzyme (ACE) inhibitors with diuretics to reduce proteinuria (4–6 weeks).
- ◆ D. Client education for home care is necessary.
- E. Instruct client in the maintenance of general health status, as the disorder may persist for months or years.
 - 1. Avoiding infections.
 - 2. Nutritious diet (low sodium, high protein).
 - 3. Activity as tolerated.
- F. Maintain fluid balance.
 - 1. Daily weights.
 - 2. Monitor intake and output.

Tuberculosis of the Kidney

◆ *Definition:* Tuberculosis of the kidney is an infection caused by *Mycobacterium tuberculosis*, which is usually blood-borne from other foci such as the lungs, lymph nodes, or bone.

Assessment

- A. Identify frequency and pain on urination.
- B. Evaluate burning, spasm, and hematuria.
- C. Assess for slight afternoon fever, weight loss, night sweats, loss of appetite, and general malaise.
- D. Evaluate findings of physical examination. Tuberculosis nodules may be present in the prostate.
- E. Evaluate outcome of diagnostic studies.
 - 1. Urine cultures to isolate the tubercle bacilli.
 - 2. X-ray to reveal lesions.
 - 3. Cystoscopic examination.
 - 4. Erythrocyte sedimentation rate (ESR) elevation.

Implementation

- ◆ A. Administer medications on time to maintain constant blood levels.
 - 1. Drug therapy aimed at treating the original focus of infection as well as the genitourinary involvement.
 - 2. Combinations of isoniazid, Myambutol (ethambutol), or Rifadin (rifampin) are used for 4 months.
 - 3. Usually given together in a single daily dose.
 - 4. Observe for side effects.
- B. Instruct client on methods to improve general health status.
 - 1. Good dietary habits.
 - 2. Adequate rest.

- C. Prepare the client for possible nephrectomy if kidney is extensively diseased.

SURGICAL INTERVENTIONS FOR THE RENAL SYSTEM

Cystostomy

Definition: An opening into the bladder for suprapubic drainage.

Characteristics

- A. Diverts urine flow from urethra.
- ◆ B. Empties bladder (similar to Foley catheter, but catheter is inserted in suprapubic area rather than through urinary meatus).
- C. Provides less risk of infection for client.
- D. Used
 - 1. For urethral stricture.
 - 2. Following vaginal surgery.
 - 3. For neurogenic bladder.
 - 4. Following surgery on prostate and bladder.

Implementation

- A. Provide care the same as for any client with indwelling catheter.
- ◆ B. Clamp catheter when ordered and then have client void on his or her own (through urinary meatus).
- C. Remove when able to void on own.

Urolithiasis (Renal Calculi)

◆ *Definition:* The presence of stones in any portion of the urinary system.

Characteristics

- A. Causes: dehydration; immobilization; hypercalcemia; excessive uric acid excretion; obstruction; deficiency of citrate, magnesium, nephrocalcin, and uropontin (prevent crystallization in urine); and urinary stasis.
- ◆ B. Diagnostic tests.
 - 1. Retrograde pyelography.
 - 2. Renal ultrasound.
 - 3. KUB x-ray.
 - 4. CT scan.
 - 5. Magnetic resonance imaging (MRI).
 - 6. Blood chemistries.
 - 7. Urinalysis.
- ◆ C. Surgical interventions.
 - 1. Ureterolithotomy: removal of stone from ureter.
 - 2. Pyelolithotomy: removal of stone from kidney pelvis.
 - 3. Lithotripsy.
 - a. Extracorporeal shock-wave lithotripsy (ESWL): Under general anesthesia, client is immersed in water and shock waves

- disintegrate stones that are then excreted in urine.
- b. Percutaneous ultrasonic tract is formed; nephroscope inserted through tract, stone extracted or pulverized.
 - c. Laser therapy.
- D. Chemolysis.
1. Dissolves stones using infusion of chemicals: alkylating agents, acidifying agents.
 2. Used for at-risk clients who could have complications with other procedures.
 3. Use percutaneous nephrostomy to inject warm solution continuously onto stone until stone breaks up.

Assessment

- A. Evaluate pain (starts low in back and radiates around front and down the ureter).
- B. Observe for nausea, vomiting, and diarrhea.
- C. Observe for hematuria.
- D. Assess for chills and fever.
- E. Observe for pyuria.

Implementation

- A. Manage pain with opioids or nonsteroidal anti-inflammatory drugs (NSAIDs).
- B. Apply moist heat or provide warm bath if not vomiting.
- ◆ C. Force fluids to at least 3000 mL/24 hr.
- D. Record intake and output.
- ◆ E. Strain all urine for stones.
- F. Send stones to laboratory for chemical analysis.
- G. Administer appropriate antibiotics (infections occur especially when stones block off a portion of kidney).
- H. Place heating pad on affected area.
- I. Watch vital signs for indication of infection.
- J. Instruct client in methods to prevent urolithiasis.
 1. Provide adequate fluid intake (8 glasses of 8 oz H₂O/day).
 2. Immediately treat urinary tract infection with appropriate antibiotics.
 3. Ambulate clients to prevent urinary stasis (or reposition in bed frequently).
 4. Dietary restrictions related to type of stone.

Urinary Diversion

◆ *Definition:* Procedure that diverts urine from bladder to a new exit site, through an opening in the skin termed a stoma. Most common type is the ileal loop.

Characteristics

- A. Cancer of neck of bladder or ureters.

◆ MEDICAL IMPLICATIONS

- A. Superficial low-grade tumors—transurethral resection (TUR).
- B. Monthly bladder instillations of thiotepa for 1 year for superficial tumors.
- C. Radon seeds for vesical tumors.
- D. Cystectomy for extensive tumors that are curable.
- E. High-voltage radiotherapy in conjunction with radical surgery.
- F. Radiotherapy and chemotherapy (Adrucil [fluorouracil]) for inoperable tumors.

- B. Cancer of pelvic area.
- C. Neurogenic bladder.

Assessment

- A. Assess type of urinary diversion.
 1. Incontinent ileal conduit; cutaneous—urine continuously drains through an opening created in abdominal wall and skin. Requires an external collection device.
 2. Continent—a portion of intestine is used to create a new reservoir for urine. Called Kock pouch or Indiana pouch—segment of small bowel or colon is used to create, holds urine without leakage, requires self-catheterization.
- B. Assess client's fluid balance.
 1. Ensure output is 30 mL/hr.
 2. Intake and output.
 3. Daily weights.
- C. Observe characteristics of urine. (Hematuria common in first 48 hours.)
- D. Observe for complications related to surgical intervention.
 1. Urinary fistula (urine around incision).
 2. Bowel fistula (feces from incision).
 3. Wound complications (dehiscence or evisceration).
- E. Assess skin.

Implementation

- A. If nasogastric tube is inserted, irrigate when necessary.
- B. Provide routine abdominal postoperative care.
- C. Provide stoma and skin care.
- D. Provide psychological support for altered body image, change in lifestyle, chronic disease.
- E. Refer to enterostomal therapist or cancer society for help with ostomy care.
- F. Provide range-of-motion exercise.
- G. Ensure tight-fitting ostomy bag around opening to prevent skin irritation.

- H. Provide home care teaching regarding appliance change, odor control, and skin care.

Nephrectomy

Definition: Surgical removal of a kidney.

Assessment

- A. Evaluate possible cause.
 - 1. Polycystic kidneys.
 - 2. Stones.
 - 3. Preparation for transplantation.
 - 4. Injury.
 - 5. Infection that has destroyed kidney function.
- B. Assess urine output for hematuria, cells, pus.
- C. Observe for signs of hemorrhage and shock.
- D. Evaluate intake and output (anuria can result if remaining kidney is damaged).
- ♦ E. Check for bowel sounds and abdominal distention (paralytic ileus may be a complication).
- F. Assess nasogastric tube drainage, both amount and consistency, if inserted.

Implementation

- ♦ A. Obtain urine specimens as ordered to detect renal function of remaining kidney.
- ♦ B. Force fluids after bowel sounds return.
- C. Monitor intake and output frequently.
- D. Monitor blood replacement therapy as needed.
- ♦ E. Turn, cough, and deep-breathe every 2 hours (turn to operative side and back).
- F. Encourage use of incentive spirometer.
- G. Begin range-of-motion exercises immediately.
- H. Encourage early ambulation.
- ♦ I. Observe that Foley or suprapubic catheter is draining adequately.
 - 1. Tape catheter to thigh or abdomen to prevent trauma to bladder.
 - 2. Position catheter bag below bed level to facilitate drainage.
- J. If nephrostomy tube is inserted, measure drainage and record characteristics of drainage (drains kidney after surgery).
 - 1. Do not clamp tubes unless ordered.
 - 2. Do not irrigate tubes unless ordered.
- K. Administer antibiotics as ordered.
- L. Administer low-dose heparin to reduce risk of thrombophlebitis.

RENAL FAILURE

Acute Renal Failure

- ♦ *Definition:* The sudden loss of kidney function caused by failure of renal circulation or damage to the tubules or

glomerulus. Condition reversible with spontaneous recovery in a few days to several weeks.

Categories of Acute Renal Failure

- A. Prerenal—condition decreasing blood flow.
 - 1. Decreased glomerular filtration rate (GFR).
 - 2. Severe dehydration; diuretic therapy.
 - 3. Circulatory collapse: hypovolemia, shock.
- B. Intrarenal—disease process, ischemic or toxic conditions.
 - 1. Acute glomerulonephritis.
 - 2. Vascular disorders.
 - 3. Toxic agents (e.g., carbon tetrachloride, sulfonamides, arsenic).
 - 4. Severe infection.
 - 5. Burns, crushing injuries.
- C. Postrenal obstruction to urine flow caused by calculi or tumors, accidental ligation of ureters during GU or gynecological (GYN) surgery.

Assessment

- ♦ A. Clinical phases—an initial period of oliguria (< 400 mL in 24 hours) followed by period of diuresis, and a period of recovery.
 - 1. Evaluate urine output often. If less than 20 mL/hr, measure at least every 2–4 hours.
 - 2. Observe lab reports for increased BUN and creatinine.
- ♦ B. Evaluate serum levels of potassium, sodium, pH, PCO₂, and HCO₃—indication of complications.
- C. Observe urinalysis for proteinuria, hematuria, casts.
- D. Note if specific gravity fixed at 1.010–1.016 (normal is 1.025).
- E. Evaluate for hyperkalemia.
- F. Assess for signs of infection—client may not demonstrate fever or increased white blood cells (WBC).

Implementation

- ♦ A. Monitor urinary output.
 - 1. Record intake and output (oliguria followed by diuresis).
 - 2. Weigh daily; lack of weight loss ($\frac{1}{2}$ –1 pound daily) indicates retention of too much fluid.
- ♦ B. Monitor fluid intake (observe for signs of CHF).
- ♦ C. Monitor for complications of electrolyte imbalances.
 - 1. Acidosis (treated with sodium bicarbonate).
 - 2. Serum potassium levels (above 6 mEq/L together with peaking T waves and shortening QT interval) for hyperkalemia.
- D. Allow client to verbalize concerns and effect of altered body image.
- ♦ E. Encourage the prescribed diet: moderate protein restriction (1 g/kg/day); high carbohydrate; restrict

- foods high in K⁺ and phosphorus (coffee, bananas, juices).
1. Elevated potassium reduced by exchange resins (Kayexalate).
 2. High level of serum potassium may require dialysis.
 3. Restrict sodium to 2 g daily.
- F. Be cautious when using antibiotics and other drugs.
- G. Continually assess status of client for potential complications: dyspnea, tachycardia, increased blood pressure.
- H. Evaluate slow return of decreased serum BUN, creatinine, phosphorus, and potassium to normal after diuresis phase begins.
- I. Maintain bed rest to decrease exertion and metabolic state.

Chronic Renal Failure

Definition: The progressive loss of kidney function that occurs in three stages and, without intervention, ends fatally in uremia.

♦ Characteristics

- A. First stage: diminished renal reserve.
 1. 40–75% loss of nephron function.
 2. Abnormal renal function tests.
 3. No accumulation of metabolic waste.
- B. Second stage: renal insufficiency.
 1. 75–90% loss of nephron function.
 2. Metabolic waste begins to accumulate.
 3. Increase in BUN and creatinine (10:1 ratio).
 4. Polyuria and nocturia occur.
 5. Stress poorly tolerated (e.g., infection).
 6. Chemical abnormalities resolve slowly.
 7. Anemia occurs.
- C. Third stage: end-stage renal failure or uremia.
 1. Less than 10% functioning nephrons.
 2. Normal regulatory, excretory, and hormonal functions of kidneys are impaired severely.
 3. Hypertension; edema.
 4. Poor urine output.
 5. Severe alterations of electrolytes.
 6. Moderately increased BUN and creatinine.
 7. Anemia common with this condition.
 8. Metabolic acidosis.

♦ Assessment

- A. Assess for weakness, fatigue, and headaches.
- B. Assess for anorexia, nausea, vomiting, and hiccups.
- C. Evaluate for hypertension, heart failure, and pulmonary edema.
- D. Evaluate for anemia, azotemia (nitrogen retention in the blood), and acidosis.
- E. Observe for personality changes (e.g., anxiety, irritability, hallucinations, convulsions, and coma).

- F. Evaluate for low and fixed specific gravity of urine of 1.010.
- G. Respirations may become Kussmaul, with deep coma following.
- H. Observe for severe skin itching.

Implementation

- ◆ A. Provide diet (low protein with supplemented vitamins and amino acids) and fluids (500–600 mL/day) for acute renal failure.
- ◆ B. Provide electrolyte replacement.
 1. Sodium supplements provided.
 2. Potassium and phosphorus restricted.
 3. Acidosis replacement of bicarbonate stores.
- C. Monitor and plan nursing care for hypertension and heart failure.
- D. Prepare client for dialysis or kidney transplant.
- E. Administer medications with caution—impaired renal function may require adjustment.
 1. Administer antihypertensives, EPO, iron supplements, phosphate-binding agents, and calcium supplements.
 2. Antacids are used to treat hyperphosphatemia and hypocalcemia.

Uremic Syndrome (Uremia)

♦ **Definition:** The accumulation of nitrogenous waste products in blood due to inability of kidneys to filter out waste products.

Characteristics

- A. May occur after acute or chronic renal failure.
- B. Increased urea, creatinine, uric acid.
- C. Extensive electrolyte imbalances (increased K⁺, increased Na⁺, decreased Cl⁻, decreased Ca⁺⁺, increased phosphorus).
- D. Acidosis—bicarbonate cannot be maintained at adequate level.
- E. Urine concentration ability lost.
- F. Anemia caused by decreased rate of production of RBCs.
- G. Metabolic acidosis accumulation affects all body systems.
- H. Disorders of calcium metabolism with secondary bone changes.

Assessment

- ◆ A. Observe for signs of oliguria for 1–2 weeks (produces less urine than 400 mL/day).
- ◆ B. Assess changes in urine characteristics.
 1. Urine contains protein, red blood cells, casts.
 2. Specific gravity of 1.010.
 3. Rise in urine solutes (e.g., urea, uric acid, potassium, magnesium).

- C. Assess for metabolic acidosis.
- D. Observe for hypotension or hypertension.
- E. Assess for gastrointestinal problems: stomatitis, nausea, vomiting, and diarrhea or constipation.
- F. Assess for respiratory complications.
- G. Evaluate coma—with alterations of blood chemistry and acid load.

Implementation

- A. Monitor restoration of blood volume.
- B. Monitor fluid and electrolyte balance.
- ◆ C. Provide dietary regulation.
 - 1. Limit protein (0.8 g/kg) unless on peritoneal dialysis.
 - 2. Reduce nitrogen, potassium, phosphate, and sulfate.
 - 3. Limit sodium intake.
 - 4. Provide glucose to prevent ketosis.
 - 5. Control potassium balance to prevent hyperkalemia.
 - 6. Carbohydrate intake 100 g daily.

DIALYSIS

Peritoneal Dialysis

Definition: A method of separating substances by interposing a semipermeable membrane. The peritoneum is used as the dialyzing membrane and substitutes for kidney function during failure.

◆ Principles of Peritoneal Dialysis

- A. Usually temporary; can be used for clients in acute, reversible renal failure.
 - 1. Treatment of choice for clients who are unable or unwilling to undergo hemodialysis or transplantation.
 - 2. Used for clients with diabetes and cardiovascular disease who are at risk for fluid shifts, cannot use heparin, or are not responsive to other treatments.
- B. Basic goals of dialysis therapy.
 - 1. Removal of end products of protein metabolism, such as creatinine and urea.
 - 2. Maintenance of safe concentration of serum electrolytes.
 - 3. Correction of acidosis and blood's bicarbonate buffer system.
 - 4. Removal of excess fluid.
- C. Renal perfusion is compromised when increased size of the intravascular compartment and redistribution of blood volume result from
 - 1. Gram-negative sepsis.
 - 2. Overdoses of some drugs.
 - 3. Anaphylactic shock.

- 4. Electrolyte disturbances, such as acidosis.
- D. Drugs may be used to check for renal failure before client is placed on dialysis.
 - ◆ 1. In most cases, Mannitol is tried before dialysis.
 - a. Not reabsorbed by kidney.
 - b. Has great osmotic effect and increases urinary flow.
 - c. Administration.
 - (1) Given quickly to get higher blood level, which initiates diuresis and may prevent or minimize renal failure.
 - (2) If infusion is too slow, changes in the urinary flow rate are delayed, as urine flow depends on the amount of Mannitol filtered.
 - (3) Give 12.5 g of a 25% solution in 3 minutes; if flow rate can be increased to 40 mL/hr, the client is in reversible renal failure.
 - (4) Keep urine at 100 mL/hr with Mannitol.
 - 2. Drugs such as Lasix and Edecrin may be used if Mannitol is not effective.
 - a. If the client does not respond to Lasix or Edecrin, diagnosis of acute tubular necrosis is made.
 - b. If the client has increased urine output with drugs, be sure to check electrolytes, as sodium and potassium depletion occurs along with water loss.
 - c. In renal disease, make sure that drugs that depend on kidneys for excretion are not given.

Peritoneal Dialysis Function

- ◆ A. Works on principles of diffusion and osmosis, similar to hemodialysis; however, in this instance, the peritoneum is the semipermeable membrane.
- ◆ B. Peritoneum is impermeable to large molecules (proteins).
- ◆ C. Peritoneum is permeable to low-molecular-weight molecules (urea, glucose, electrolytes).
- D. Cannot be used with clients who have the following conditions:
 - 1. Peritonitis.
 - 2. Recent abdominal surgery.
 - 3. Abdominal adhesions.
 - 4. Impending renal transplant.
- E. Dialysate.
 - 1. Contains electrolytes but no urea, creatinine.
 - a. Common electrolytes in dialysate in mEq/L.
 - Na⁺: 140–145
 - Cl⁻: 101–110
 - Ca⁺⁺: 3.5–4.0
 - Mg⁺⁺: 1.5
 - Lactate/acetate (base) : 43–45

- b. Osmolarity.
 - 1.51% = 365 mOsm
 - 4.25% = 504 mOsm
- c. Amount: 1500–2000 mL infused over 5–10 minutes.
- 2. Sterile.
- 3. Solutions vary in dextrose concentration.
 - a. Solution of 1.5%: Used for drug intoxication and acute renal failure if large amounts of fluid are not required to be removed.
 - b. Solutions of 2.5%: Used for clients requiring moderate amount of fluid removal.
 - c. Solution of 4.25%: Used for removal of excessive fluid.
- 4. If hyperkalemia is not a problem, 4 mEq of potassium chloride is added to each solution.
- 5. Heparin is added to bottles to prevent clotting of the catheter.
- 6. Antibiotics may be added to prevent peritonitis.
- F. Exchange process.
 - 1. A series of exchanges or cycles that includes an infusion, dwell, and drainage of dialysate.
 - 2. Cycles are repeated according to client need and MD orders.
 - 3. Dialysate is infused by gravity through catheter into peritoneal cavity over 5–10 minutes; catheter is clamped.
 - 4. Usual dialysate is 2 L per cycle and dwell time (time dialysate stays in peritoneal cavity) allows for process of diffusion and osmosis. Time varies from 30 minutes to 4 hours.
 - 5. Catheter is unclamped and dialysate is drained by gravity for 10–30 minutes.
- G. Observe dialysate solution during exchange.
 - 1. Bloody drainage may be seen in first few exchanges after insertion of catheter.
 - 2. Usual dialysate is straw-colored or colorless and clear.
 - 3. Cloudy effluent indicates infection, and client must be treated immediately.
- ◆ H. Monitor electrolyte balance throughout cycle.
 - 1. Check muscle weakness, nausea, diarrhea as signs of hyperkalemia.
 - 2. Monitor ECG for tall, peaked T waves and widening QRS as evidence of hyperkalemia.
 - 3. Observe for hypokalemia—frequently decreased with dialysis: muscle weakness, hypotension, arrhythmias, anorexia, nausea, and vomiting.
 - 4. Check for positive Chvostek's and Trousseau's signs as indications of low calcium levels.

Continuous Ambulatory Peritoneal Dialysis

- ◆ A. A variation of peritoneal dialysis developed to allow the client to be dialyzed while ambulatory.

- ◆ B. Procedure for continuous ambulatory peritoneal dialysis (CAPD).
 - 1. Peritoneal catheter is inserted.
 - 2. 500–2000 mL of dialysate infused through catheter by gravity (10–20 minutes).
 - 3. The catheter is clamped, bag folded and placed in waistband of client's clothes.
 - 4. Every 4–6 hours, client drains fluid from peritoneal cavity.
 - a. Unclamp catheter.
 - b. Place pouch to allow drainage by gravity—below level of abdomen.
 - c. Drain for approximately 20 minutes.
 - d. Reclamp catheter and remove bag with drainage.
 - e. Examine drainage—a change in color may indicate infection (glucose in dialysate predisposes client to infection).
 - 5. Aseptically attach a new bag of dialysate and repeat procedure.
 - 6. Repeat procedure 4–5 times daily.
 - 7. Instruct client to change tubing every 24 hours using strict aseptic technique.
- C. Be alert for possible complications: peritonitis, fluid and electrolyte imbalances, dehydration, catheter infection, abdominal pain and tenderness, and hemorrhage.
- D. Body image is altered when fluid fills abdomen.
- E. Altered sexuality and sexual dysfunction may occur.

Dialysis Procedure

- A. Preparation for hospitalized clients.
 - 1. Client voids before catheter insertion to prevent puncture of distended bladder.
 - 2. Abdominal skin is prepped.
 - 3. The area between the umbilicus and the pubic bone near the midline is most often used for catheter insertion.
 - 4. Client is weighed before procedure and after voiding.
 - 5. Baseline vital signs (including weight).
- B. Dialysis process.
 - 1. Dialysis fluid instilled in abdominal cavity.
 - 2. Occurrence of osmosis, diffusion, and filtration via peritoneal membrane (called equilibration).
 - 3. Fluid drained from abdominal cavity.
 - 4. Process repeated with a time sequence allowed for each step. Period of time and number of cycles will vary according to client problem, tolerance, response, and type of solution.
- C. Duration of dialysis depends on the following factors:
 - 1. Client's height and weight.
 - 2. Severity of uremia.
 - 3. Physical state of client.

- 4. Usual time period for dialysis is 24–72 exchanges or runs.
- D. Monitoring the procedure.
 - 1. Client's electrolyte status is monitored during the process.
 - 2. Periodic samples of the return dialysate are sent for culture.
 - 3. Compare client's weight before and after procedure to assess effectiveness of fluid removal.
 - 4. Vital signs must be monitored closely.
- E. Care of equipment during procedure.
 - 1. Tubing should be changed every 8 hours using sterile technique when the procedure continues for days.
 - 2. Warming the dialysate not only improves urea clearance but also maintains client's body temperature and comfort.
 - 3. Avoid getting air into tubing as this is uncomfortable for the client and impedes smooth and easy return of flow.
- F. Quality and quantity of return.
 - 1. Initial few outflows may be slightly bloody due to insertion process.
 - 2. Cloudy fluid is usually an indication of peritonitis.
 - 3. Bowel perforation should be suspected if flow is brown.
 - 4. Record amount and type of solution for each inflow. This includes the medications added (e.g., potassium chloride, heparin, antibiotics).
 - 5. Record outflow amount and characteristics.
 - 6. Duration of each phase of the process should be recorded.
 - 7. Keep a total net balance (difference between input and output for each exchange) and cumulative net balance.
 - 8. Inform physician if client loses or retains large volumes of fluid.
- G. Procedures to check when drainage slows.
 - 1. Check proper position of clamps.
 - 2. Look for kinking in tubes.
 - 3. Milk the drainage tube.
 - 4. Observe air vent in drainage bottle for patency.
 - 5. Flush catheter.
 - 6. Reposition direction of catheter within means.
 - 7. Have client change positions.
 - 8. Have physician change catheter.

Implementation

- A. Each morning, observe for signs of infection.
- B. Each day at the same time, weigh client with abdomen empty of solution.
- C. Monitor vital signs to observe for complications.
- D. Monitor dialysis exchange.
 - 1. Keep exchange on time.

- 2. Maintain aseptic technique when changing bottles and tubing.
- 3. Record accurate intake and output on flow sheet.
- E. Try the following interventions to assist in returning dialysate from peritoneal cavity.
 - 1. Turn client on side and prop with pillows.
 - 2. Place in Fowler's position after solution is infused into abdomen.
 - 3. Ambulate and/or have client sit in chair if client is able.
 - 4. Palpate abdomen.
 - 5. Place pillow or bath blanket under small of back (this also assists in relieving hiccoughs).
- F. Test urine for sugar.
- G. Monitor for complications of peritoneal dialysis.
 - 1. Peritonitis.
 - a. Diffuse abdominal pain.
 - b. Abdomen tender on palpation.
 - c. Abdominal wall rigidity.
 - d. Cloudy outflow.
 - 2. Hypertension.
 - 3. Pulmonary edema.
 - 4. Hyperglycemia (insulin may be needed).
 - 5. Hyperosmolar coma.
 - 6. Protein loss (0.5–1.0 g/L of drainage).
 - 7. Intestinal perforation.

Other Types of Peritoneal Dialysis

- ◆ A. Continuous cycling peritoneal dialysis (CCPD).
 - 1. Requires a peritoneal cycling machine.
 - 2. Consists of having three cycles done at night and one cycle with an 8-hour dwell time in morning.
 - 3. Peritoneal cavity opened only for the on and off procedures, thereby reducing risk of infection.
 - 4. Client does not need to do exchanges during the day.
- ◆ B. Intermittent peritoneal dialysis (IPD).
 - 1. Requires peritoneal cycling machine.
 - 2. Performed for 10–14 hours three to four times a week.
- C. Nightly peritoneal dialysis (NPD).
 - 1. Performed 8–12 hours each night.
 - 2. No daytime dwells.

Hemodialysis

- ◆ *Definition:* The diffusion of dissolved particles from one fluid compartment into another across a semipermeable membrane. In hemodialysis, the blood is one fluid compartment and the dialysate is the other.

◆ Principles of Hemodialysis

- A. The semipermeable membrane is a thin, porous, hollow, fiber (cellophane) system or flat-plate dialyzer.

- B. The pore size of the membrane permits the passage of low-molecular-weight substances such as urea, creatinine, and uric acid to diffuse through the pores of the membrane.
- C. Water molecules are also very small and move freely through the membrane.
- D. Most plasma proteins, bacteria, and blood cells are too large to pass through the pores of the membrane.
- E. The difference in the concentrations of the substances in the two compartments is called the concentration gradient.
- F. The blood, which contains the waste products, flows into the dialyzer, where it comes in contact with the dialysate.
- G. A maximum gradient is established so that movement of these substances occurs from the blood to the dialysate.
- H. Dialysate (bath).
 - 1. Composed of water and major electrolytes.
 - 2. Tap water can be used (need not be sterile because bacteria are too large to pass through membrane).

♦ **Hemodialysis Function**

- A. Removes by-products of protein metabolism: urea, creatinine, and uric acid.
- B. Removes excessive fluid by
 - 1. Changing osmotic pressure (by adding more dextrose to dialysate).
 - 2. Negative or positive hydrostatic pressure.
- C. Maintains or restores body buffer system.
- D. Maintains or restores level of electrolytes in the body.

Dialysis Management

Implementation

- A. Take vital signs to observe for shock and hypovolemia.
 - 1. Hypotension is caused by
 - a. Fluid loss initially.
 - b. Decreased blood volume, especially if hematocrit is low.
 - c. Use of antihypertensive drugs between dialysis procedures.
 - 2. Plasma or volume expanders can be used to increase blood pressure; sometimes blood is used while the client is on dialysis.
- B. Check serum electrolytes frequently (pre-, mid-, and postdialysis).
- C. Observe for painful cramping near end of dialysis as a result of rapid fluid and electrolyte loss.
- D. Weigh client before and after dialysis to determine fluid loss.

- E. Monitor for dysrhythmias resulting from electrolyte and pH changes.
- F. Watch for leakage around shunt site.
- G. Observe for dialysis disequilibrium syndrome.
 - 1. Cerebral dysfunction symptoms.
 - a. Nausea and vomiting.
 - b. Headache.
 - c. Hypertension leading to agitation.
 - d. Twitching, mental confusion, and convulsions.
 - 2. Syndrome is caused by rapid, efficient dialysis, resulting in shifts in water, pH, and osmolarity between fluid and blood.
 - 3. In acutely uremic clients, avoid this syndrome by dialyzing slowly, for short periods of time over 2–3 days.
 - 4. Use Dilantin (phenytoin) to prevent this syndrome in new clients.
- H. If client is heparinized while on dialysis machine, do the following:
 - 1. Take clotting time about 1 hour before client comes off the machine. If less than 30 minutes, do not give protamine sulfate (heparin antagonist)—not usually given, as there is usually no need to counteract effect of heparin.
 - 2. Keep clotting time at 30–90 minutes while on dialysis (normal 6–10 minutes).
- ♦ I. Shunt care.
 - 1. Temporary vascular access.
 - a. Percutaneous cannulation of subclavian, internal jugular, and femoral veins.
 - b. Catheters are double or multilumen.
 - c. Internal jugular and subclavian vein catheters in place 3–12 weeks, femoral catheter 2–3 days.
 - d. Assess for signs of infection, thrombosis with pulmonary emboli, and hematoma.
 - e. Maintain patency with intermittent heparin injection.
 - 2. Arterial–venous fistula.
 - a. Anastomosis of an artery and vein creates a fistula.
 - b. Arterial blood flow into the venous system results in marked dilation of veins, which are then easily punctured with a 14-gauge needle.
 - c. Two venipunctures are made at the time of dialysis.
 - (1) One for blood source.
 - (2) One for return.
 - (3) Arterial needle is inserted to within 2.5–3.8 cm (1–1½ inches) from fistula, and venous needle is directed away from fistula.
 - d. Observe for patency of graft site.
 - (1) Check for bruit with stethoscope.
 - (2) Observe for signs of infection.

- (3) Palpate pulses distal to shunt for circulation.
- e. No blood pressure monitoring (BPs), tourniquet, or blood drawing on shunt arm.
- 3. Arteriovenous graft.
 - a. Graft is implanted subcutaneously between an artery and a vein.
 - b. Performed when client's own vessels are not adequate for shunt.
 - c. Venipuncture same as for arteriovenous (AV) fistula.

♦ **Guidelines for Dialysis Management**

- A. Limit fluid intake (500 mL over previous day's output); provide accurate intake and output. (Goal is to keep client's weight gain under 1.5 kg between dialyses.)
- B. Provide diet low in sodium (2–3 g), 1 g/kg protein, high carbohydrate, high fat, and foods low in potassium.
 - 1. Dietary protein should be of animal source.
 - 2. Include meat, eggs, milk, poultry, fish in diet.
- C. Check vital signs for indication of hypovolemia; check temperature elevation for indication of possible infection.
- D. Auscultate lungs for signs of pulmonary edema.
- E. Provide shunt care for clients on hemodialysis.
- F. Observe level of consciousness—indicative of electrolyte imbalance or thrombus.
- G. Administer antihypertensive drugs between dialysis if ordered.
- H. Administer diuretics if ordered.
 - I. Administer blood if ordered (cellular portion only is needed because of low hematocrit).
- J. Weigh daily to assess fluid accumulation.
- K. Prevent use of soap (urea causes dryness and itching, and soap adds to this problem).
- L. Provide continued emotional support.
 - 1. Allow for expression of feelings about change in body image.
 - 2. Encourage expression of fears of death, especially during dialysis.
 - 3. Encourage family cooperation.
 - 4. Support required change in lifestyle.

Renal Transplant*

Definition: Implantation of a human kidney from a compatible donor to the recipient.

Characteristics

- A. Irreversible kidney failure.
- B. Recipient must take immunosuppressive medications for life.

*See Organ Donation in Chapter 2, Management Principles and Legal Issues.

Donors

- A. Living related.
 - 1. Most desirable source.
 - 2. Screened for ABO blood type, human leukocyte antigen (HLA) suitability, tissue-specific antigen, and histocompatibility.
 - 3. Must be in excellent health.
 - 4. Must have two fully functioning kidneys.
 - 5. Emotional well-being determined early in screening process.
 - 6. Must be able to comprehend the donation process and outcomes.
- B. Cadaver.
 - 1. Must be < 60 years of age.
 - 2. Must meet criteria for "brain death," cannot have cardiac death.
 - 3. Renal function must be normal.
 - 4. Cannot have metastatic disease, HIV-positive status, or hepatitis B-positive status.
 - ◆ 5. Donor cannot have the following:
 - a. Abdominal or renal trauma.
 - b. Hypotension.
 - c. Generalized infection.
 - 6. Must have cardiopulmonary support maintained until the kidneys are surgically removed.
 - 7. Once brain death has occurred, restore intravascular volume, wean from vasopressors, and maintain diuresis.
- C. Warm ischemic time—time elapsed between cessation of perfusion and cooling of the kidney and the time required to anastomose the kidney.
 - 1. Maximum time: 30–60 minutes.
 - 2. Kidney can be cooled; this increases transplant time to between 24 and 48 hours.

Implementation

- ◆ A. Preoperative.
 - 1. Verify histocompatibility tests (per hospital policy).
 - 2. Administer medications.
 - 3. Keep client free from infection (follow protective isolation as indicated).
 - 4. Follow hospital policy for dialysis prior to transplant.
 - 5. Provide emotional support to donor and recipient.
- ◆ B. Postoperative.
 - 1. Assess kidney function—may occur immediately or be delayed a few days; monitor every hour.
 - 2. Maintain hemodialysis until adequate kidney function is maintained.
 - 3. Monitor VS, I&O, daily blood work, urine tests.

4. Keep client in semi-Fowler's position.
5. Maintain patency of Foley—urine will be pink to bloody initially, returns to clear yellow within days to weeks. If clots occur, notify physician immediately.
6. Remove Foley as soon as indicated to prevent infection. CAUTI (catheter-associated urinary tract infection) common when Foley left in place for prolonged periods of time. CAUTI increases length of stay.
7. Maintain protective isolation with strict aseptic technique.
8. Monitor for possible complications.
 - a. Hemorrhage from anastomosis.
 - b. Failure of ureteral anastomosis—causing leakage of urine into peritoneal cavity.
 - c. Renal artery thrombosis.
 - d. Infection.
 - e. Resection.
9. Provide teaching to client and family.
 - a. Use and side effects of prescribed medications.
 - b. Vital signs and weight.
 - c. Signs and symptoms of organ rejection.
 - d. Dietary changes.
10. Provide psychological support to client and family.

MALE GENITOURINARY DISORDERS

Prostatitis

◆ *Definition:* Inflammation of the prostate gland caused by an infectious agent (bacteria, mycoplasma) or structure, hyperplasia.

Assessment

- A. Assess for peritoneal discomfort, burning, urgency, or frequency.
- B. Assess for generalized pain or pain associated with ejaculation or voiding.
- C. If acute, client may have sudden onset of fever, chills, and pain.
- D. Evaluate clients with chronic conditions, even with absence of pain.

Implementation

- ◆ A. Monitor broad-spectrum antimicrobials (sensitive to causative agent) may be tetracycline (Panmycin, Sumycin), doxycycline (Oracea, Vibramycin, or others). Treatment is 10–14 days.
- B. Maintain client on bed rest until symptoms are alleviated.

- C. Promote comfort with analgesics, antispasmodics, sedatives, sitz baths, stool softeners.

Benign Prostatic Hypertrophy

◆ *Definition:* Enlargement of prostate gland from normal tissue, usually in males over 50 years of age.

Assessment

- A. Causes narrowing of urethra, which may result in obstruction.
- ◆ B. Clinical manifestations.
 1. Recurring infection and urinary stasis.
 2. Nocturia, frequency, dysuria, urgency, dribbling, retention, and hematuria.
 3. Hesitancy in starting urination, abdominal straining with urination.

Implementation

- A. Treatment.
 1. Drug—Proscar (finasteride) reduces hypertrophy through inhibition of enzyme that blocks uptake of androgens; has severe side effects (impotence).
 2. Alpha-adrenergic receptor blockers (Hytrin [terazosin]) relax smooth muscles of bladder neck and prostate.
 3. Herbs (saw palmetto) and nutrients: magnesium, calcium, and zinc reduce hypertrophy.
 4. Monitor drug therapy if indicated.
- B. Encourage fluids: 2000–3000 mL/day as long as not contraindicated by cardiac or renal function.
- C. Suggest diet high in minerals: calcium, magnesium, zinc, manganese.
- D. Avoid drugs that could cause urinary retention (anticholinergics).
- E. Provide postoperative care for removal of the hypertrophied fibroadenomatous portion of the prostate. (See Prostatectomy.)

Cancer of the Prostate

Characteristics

- A. Type: androgen-dependent adenocarcinoma.
- B. Clinical manifestations.
 1. Early symptoms similar to BPH.
 2. Urinary obstruction late in disease.
 3. Pain radiating from lumbosacral area down legs strongly indicative of cancer.
- C. Many cancers so slow-growing the client will die of other diseases before the cancer spreads significantly.
- ◆ D. Prostate-specific antigen (PSA) test shows concentration is proportional to total prostatic mass.
 1. Does not necessarily indicate malignancy.

2. Used routinely to monitor client's response to cancer therapy.
3. Only biopsy determines malignancy.

Prostatectomy

Definition: Removal of the prostate gland.

♦ Assessment

- A. Observe for signs of hemorrhage and shock.
- B. Assess for fluid and electrolyte balance.
 1. Observe for water intoxication (after transurethral resection of the prostate [TURP]).
 2. Symptoms are confusion; warm, moist skin; nausea; vomiting.
- C. Observe for complications.
 1. Epididymitis (most frequent).
 2. Gram-negative sepsis.
 3. Overdistended bladder.

Implementation

- A. Maintain adequate bladder drainage via catheter.
 1. Suprapubic catheter used following suprapubic prostatectomy.
 2. Continuous bladder irrigation (or triple-lumen catheter) is used following transurethral resection.
 - a. One lumen is used for inflating balloon (usually 30 mL), one for outflow of urine, and one for instillation of irrigating solution.
 - b. Function.
 - (1) Continuous antibacterial irrigation of solution to prevent infection.
 - (2) Continuous saline irrigation to rid the bladder of tissue and clots following surgery.
 - c. Nursing management.
 - (1) Run solution in rapidly if bright red drainage or clots are present; when drainage clears, decrease to about 40 drops/min. Urine should be red to light pink in 24 hours, amber in 3 days.
 - (2) If clots cannot be rinsed out with irrigating solution, irrigate with syringe as ordered, usually 50 mL.
 - (3) Maintain accurate I&O. Observe color and consistency of fluid.
 3. After catheter removal, monitor for urinary retention and continence.
 4. Instruct client in perineal exercises to regain urinary control.
 - a. Tense perineal muscles by pressing buttocks together; hold for as long as possible.
 - b. Repeat this process 10 times every hour.

♦ MEDICAL IMPLICATIONS

- ♦ A. Medical regimen.
 1. Estrogen therapy or luteinizing-hormone antagonist (Lupron [leuprolide acetate] or another antiandrogen agent) may be given to slow rate of growth and extension of tumor.
 2. Orchectomy decreases androgen production.
 3. Radiation to local lesion to reduce tumor: external beam radiation or implant.
 4. Do no procedure—monitor annually.
- B. Surgical options.
 - ♦ 1. Transurethral resection (TUR) most common intervention—removal of prostatic tissue by instrumentation through urethra.
 - 2. Suprapubic prostatectomy—removal of prostate by abdominal incision with bladder incision.
 - 3. Retropubic prostatectomy—low abdominal incision without opening bladder.
 - 4. Perineal prostatectomy (may be radical resection)—perineal incision between scrotum and anus for gland removal.
 - 5. Transurethral incision of the prostate (TUIP)—instrument passed through urethra, one or two incisions made in prostate to reduce pressure and obstruction. Effective for treatment of BPH.
 - 6. Holmium laser may replace TUR for prostate surgery—advantages are less bleeding, fewer complications, and shorter hospital stay.

- B. Provide fluids to prevent dehydration (2–3 L).
- C. Provide high-protein, high-vitamin diet.
- D. Ambulate early (after urine has returned to nearly normal color)—avoid strenuous activity.
- E. Administer analgesics; urinary antiseptics or antibiotics to prevent infection; antispasmodics (spasms decrease within 24–48 hours).
- F. Provide wound care for suprapubic and retropubic prostatectomies (similar to that for abdominal surgery)—change dressing frequently.
- G. Provide sitz bath and heat lamp treatments to promote healing.

CONDITIONS OF THE FEMALE REPRODUCTIVE TRACT

Menstruation

Definition: The sloughing off of the endometrium, which occurs at regular monthly intervals if conception fails to take place. The discharge consists of blood, mucus, and cells, and it usually lasts for 4–5 days.

♦ Characteristics

- A. Menarche—onset of menstruation—usually occurs between the ages of 11 and 14.

- B. Abnormalities of menstruation.
 - 1. Dysmenorrhea (painful menstruation).
 - a. May be caused by psychological factors: tension, anxiety, preconditioning.
 - b. Physical examination is usually done to rule out organic causes.
 - c. May subside after childbearing.
 - d. Treatment.
 - (1) Oral contraceptives: produce anovulatory cycle.
 - (2) Mild analgesics such as aspirin.
 - (3) Client urged to carry on normal activities.
 - 2. Amenorrhea (absence of menstrual flow).
 - a. Primary: Occurs over the age of 17 and menstruation has not begun.
 - (1) Complete physical necessary to rule out abnormalities.
 - (2) Treatment aimed at correction of underlying condition.
 - b. Secondary: Occurs after menarche; does not include pregnancy and lactation.
 - (1) Causes include psychological upsets or endocrine conditions.
 - (2) Evaluation and treatment by physician is necessary.
 - 3. Menorrhagia (excessive menstrual bleeding). May be due to endocrine disturbance, tumors or inflammatory conditions of the uterus.
 - 4. Metrorrhagia (bleeding between periods). Symptom of disease process, benign tumors, or cancer.

Assessment

- A. Assess characteristics of the menstrual cycle.
- B. Evaluate cycle pattern.
- C. Evaluate discomforts associated with menstruation.
 - 1. Breast tenderness and feeling of fullness.
 - 2. Temperament and mood changes because of hormonal influence. Levels of estrogen and progesterone drop sharply.
 - 3. Discomfort in pelvic area, lower back, and legs.
 - 4. Retained fluids and weight gain.

Implementation

- A. Educate client about the physiology of normal menstruation. Answer questions about the myths and cultural beliefs associated with menstruation.
- B. Educate client about abnormal conditions associated with menstruation: absence of bleeding, bleeding between periods, etc.
- C. Educate client about normal hygiene during menstruation.
 - 1. Importance of cleanliness.

- 2. Use of perineal pads and tampons.
- 3. Continuing normal activities.

Menopause

Definition: The cessation of menstruation caused by physiologic factors; ovulation no longer occurs. Menopause usually occurs between the ages of 45 and 52.

Characteristics

- A. Ovaries lose the ability to respond to pituitary stimulation and normal ovarian function ceases.
 - ◆ 1. Gradual change due to alteration in hormone production.
 - a. Failure to ovulate.
 - b. Monthly flow becomes smaller, irregular, and gradually ceases.
 - 2. Menopause is accompanied by changes in reproductive organs: vagina gradually becomes smaller; uterus, bladder, rectum, and supporting structures lose tone, leading to uterine prolapse, rectocele, and cystocele.
- B. Atherosclerosis and osteoporosis are more likely to develop at this time.

Assessment

- A. Clinical manifestations vary from mild to severe.
- B. May be accompanied by psychological symptoms (e.g., feelings of loss, children grown, aging process occurring).
- C. May be accompanied by hot flashes and nervous symptoms, such as headache, depression, insomnia, weakness, and dizziness.

Implementation

- ◆ A. Instruct client in use of hormone replacement therapy (HRT) as alternative way to cope with menopause.
 - 1. Postmenopausal estrogen/progestin intervention (PEPI) appears to improve lipoproteins and lowers fibrinogen levels.
 - 2. Estrogen alone is not recommended for women who have not had a hysterectomy. It is associated with endometrial hyperplasia.
 - 3. HRT is contraindicated for women who have a history of breast cancer, vascular thrombosis, active liver disease.
 - 4. Methods of treatment vary from daily doses of both estrogen and progestin (now very controversial and not recommended) to 25 days of estrogen and natural progesterone taken 10–14 days during the cycle.
 - 5. Estrogen patches must have accompanying oral progestin or natural progesterone.
- B. Answer questions, clarify and/or counsel client on menopausal issues and alternatives to HRT.

- C. Alternatives to HRT.
 - 1. Selective estrogen receptor modulators (SERMs) such as Evista (raloxifene).
 - a. Acts like estrogen in some tissues but not in others.
 - b. Significantly reduces risk of breast cancer.
 - c. Used in treatment of osteoporosis.
 - 2. Studies indicate HRT (especially estrogen-progesterone combination) may present major cancer risk to women.
 - 3. Herbal combination used to decrease symptoms of menopause. (See Alternative Nursing: Herb-Drug Interactions table in Chapter 5, Pharmacology.)
 - 4. Other alternative is to use natural estrogen (estriol) and natural progesterone.

Vulvitis/Vaginal Infections

♦ *Definition:* An inflammation of the vulva or vagina, which usually occurs in conjunction with other conditions such as vaginal infections and venereal disease.

Characteristics

- A. Vagina normally protected from infection by acidic environment.
- B. Leukorrhea (whitish vaginal discharge) normal in small amounts at ovulation and prior to menstruation.

Assessment

- A. Evaluate burning pain during urination.
- B. Assess for itching.
- C. Observe for red and inflamed genitalia.
- D. Observe for discharge and odor.
- ♦ E. *Trichomonas vaginalis* (overgrowth of protozoan normally present in vaginal tract)—normal pH altered and overgrowth occurs.
- ♦ F. *Candida albicans*—fungal infection caused by yeast, also called monilia.
 - 1. More than 500,000 Americans get this infection annually—majority are women.
 - 2. Widespread use of antibiotics increasing epidemic—these destroy protective organisms normally present.
 - 3. Candida thrives in sugar-carbohydrate-rich environment.
 - 4. Symptoms: itching; swelling; white, cheesy discharge from vagina or thrush in mouth; may have systemic symptoms of fatigue, allergies, depression, flatus.
- G. Evaluate for related conditions, psychological factors, endocrine disorders, and reactions to chemical substances that the client may be using.

Implementation

- A. Give soothing compresses, colloidal baths.
- B. Apply medicated creams.
- C. Nystatin and Monistat (miconazole nitrate) are drugs of choice systemically; vaginal inserts and ointment.
- D. Gyne-Lotrimin (clotrimazole) and Terazol (terconazole) creams (vaginal) are inserted at night.
- E. Diflucan (fluconazole) (oral agent) is given one time. Results appear in 3 days.

Endometriosis

♦ *Definition:* The abnormal growth of endometrial tissue outside the uterine cavity. A common cause of infertility.

Characteristics

- A. Embryonic tissue that remains dormant until ovarian stimulation after menarche.
- B. Endometrial tissue transported from the uterine cavity through the fallopian tubes during menstruation.
- C. Endometrial tissue transported by lymphatic tissue during menstruation.
- D. Accidental transfer of endometrial tissue to pelvic cavity during surgery.

Assessment

- ♦ A. Evaluate lower abdominal and pelvic pain during menstruation due to distention of involved tissue and surrounding area by blood; symptoms are acute during menstruation.
- B. Assess for dysmenorrhea: usually steady and severe.
- C. Assess for abnormal uterine bleeding.
- D. Ask about pain during intercourse.
- E. Assess for back and rectal pain.

Implementation

- A. Explain to client that pregnancy may delay growth of lesions. Symptoms usually recur after pregnancy.
- B. Instruct that hormone therapy with oral contraceptives usually eliminates menstrual pain and controls endometrial growth.
- C. Discuss use of in vitro fertilization in cases where pregnancy is desired.
- D. Prepare client for surgical intervention; total hysterectomy may be indicated.

Pelvic Inflammatory Disease

♦ *Definition:* An inflammatory condition of the pelvic cavity that may involve ovaries, fallopian tubes, vascular system, or pelvic peritoneum.

Assessment

- ◆ A. Assess for cause of disease.
 1. Gonorrheal and chlamydial organisms most common causes.
 2. Caused by sexual transmission.
- B. Assess for elevated temperature, general malaise, headache.
- C. Evaluate for nausea and vomiting.
- D. Assess for lower pelvic pain and tenderness following menses.
- E. Pain increases during voiding and defecation.
- F. Observe for purulent, foul-smelling vaginal discharge.
- G. Evaluate for leukocytosis.

Implementation

- A. Instruct client on controlling spread of infection.
- B. Place in semi-Fowler's position: dependent drainage.
- C. Apply heat to abdomen for comfort.
- D. Take and record vital signs every 4 hours.
- E. Administer antibiotics as ordered.
- F. Note nature and amount of vaginal discharge.
- G. Instruct to avoid use of tampons and urinary catheterization to prevent spread of infection.
- H. Instruct on good nutrition and fluid intake.

Toxic Shock Syndrome

◆ *Definition:* An uncommon but serious illness reported by menstruating women, usually under age of 30, who use tampons. Toxic shock syndrome (TSS) may also occur in women using sanitary napkins.

Assessment

- ◆ A. Assess for two primary symptoms: sudden high fever (may be as high as 103–105°F or 39.4–40.5°C) and rash that looks like a sunburn.
- B. Other symptoms commonly observed: hypotension; vomiting and diarrhea; dizziness, fainting or near fainting when standing up, headache; copious vaginal discharge; and sore throat.
- C. Red macular rash occurs in many women first on torso.

Implementation

- ◆ A. When toxic shock is suspected, client is hospitalized—the development of severe circulatory compromise cannot be predicted.
- ◆ B. Blood, urine, and vaginal cultures determine sites of focal *Staphylococcus aureus* infection; a beta-lactamase-resistant antibiotic with bactericidal activity is administered when there is no focal infection site.
- C. Monitor blood pressure and administer IV colloids and vasopressor agents as ordered.

- D. Administer sodium bicarbonate for acidosis.
- E. Monitor for signs of respiratory distress.

Conditions of the Uterus

Definition: May include displacement of the uterus, prolapse of the uterus, or fibroid tumors of the uterus.

Assessment

- A. Assess for displacement.
 1. Retroversion and retroflexion: backward displacement of the uterus.
 2. May cause difficulty in becoming pregnant.
- ◆ B. Assess for prolapse.
 1. Weakening of uterine supports causes the uterus to slip down into the vaginal canal; the uterus may even appear outside the vaginal orifice.
 2. Prolapse may cause urinary incontinence or retention.

Implementation

- A. Instruct in good perineal hygiene if pessary is used.
- B. Follow nursing care for hysterectomy clients.

Fibroid Tumors

- ◆ A. Fibroid tumors are benign.
- B. Occur in 20–30% of all women between the ages of 25 and 40.
- ◆ C. Symptoms include menorrhagia, back pain, urinary difficulty, and constipation.
- D. Fibroid tumors may cause sterility.
- E. Treatment.
 1. Removal of tumors, if they are small.
 2. Hysterectomy, if tumors are large.

SURGICAL INTERVENTIONS**Tumors of the Breast**

Definition: Tumors or neoplasms are composed of new and actively growing tissue. They are classified in many ways, the most common according to origin and whether they are malignant or benign. The second highest cause of death in females is malignant tumors of the reproductive system.

◆ Assessment

- A. Assess for lump in upper outer quadrant of breast, usually nontender, but may be tender.
- B. Observe for dimpling of breast tissue surrounding nipple or bleeding from nipple.
- C. Check for presence of asymmetry with affected breast being higher.

- D. Check for prominent venous pattern—can signal increased blood supply to tumor.
- E. Erythema can indicate benign local infection or superficial lymphatic invasion by a neoplasm.
- F. Evaluate staging from Stage I to Stage IV.
- ◆ G. Evaluate types of surgery to be done.
 - 1. Breast-conserving therapy.
 - a. Surgical procedures: lumpectomy, wide excision, partial mastectomy, segmental mastectomy, quadrantectomy.
 - b. Removal of involved breast tissue and some surrounding tissue and axillary lymph nodes.
 - 2. Total mastectomy.
 - a. Removal of breast tissue only.
 - b. Performed for carcinoma in situ, typically ductal.
 - 3. Modified radical mastectomy.
 - a. Removal of breast tissue and axillary lymph nodes.
 - b. Pectoralis major and minor muscles remain intact.
 - 4. Radical mastectomy.
 - a. Removal of breast tissue and pectoralis major and minor.
 - b. Axillary lymph node dissection.

◆ Implementation: Mastectomy

- ◆ A. Begin emotional support preoperatively and continue in postoperative period.
 - 1. Client may have altered body image.
 - 2. Client may be extremely depressed.
- ◆ B. Place in semi-Fowler's position with affected arm elevated to prevent edema.
- ◆ C. Turn, cough, and deep-breathe to prevent respiratory complications.
- D. Turn only to back and unaffected side.
- E. Jackson-Pratt drain or Hemovac may be placed postoperatively.
- ◆ F. Prevent complications of contractures and lymphedema by encouraging range-of-motion exercises early in postoperative period.
- G. Provide IV fluids. Should not be administered in affected arm.
- H. Monitor vital signs for prevention of complications such as infection and hemorrhage. Take blood pressure on unaffected arm only.
- I. Reinforce pressure dressings. Observe for signs of restriction from dressing.
 - 1. Impaired sensation.
 - 2. Color changes of skin.
- J. If skin grafts were applied, provide nursing care as for any other graft.

- K. Encourage visit from Reach for Recovery Group.
- L. Instruct to perform self-breast exam monthly at a regular time, 7 days after start of menstruation.
- M. Teach importance of mammography.

Breast Reconstruction

- A. Emotional and psychological implications of loss of a breast are severe.
 - ◆ 1. Loss has impact on body image, self-esteem, sense of being sexually attractive, and intimate relationships.
 - 2. Reconstructive surgery following a mastectomy may positively affect the woman's adjustment to loss of a breast.
- ◆ B. Reconstruction may be immediate (following surgery) or delayed.
- C. Mastectomy without reconstruction—client uses a breast prosthesis.
- ◆ D. Types of procedures.
 - 1. Implants are soft sacs or a tissue-expander prosthesis filled with silicone gel.
 - a. Expander sac is gradually expanded via a needle until breast matches remaining breast; takes several months to complete process.
 - b. Following expansion, prosthesis may be removed and replaced by silicone implant.
 - 2. Silicone implants may result in complications.
 - a. Fibrous capsular contractions around implant.
 - b. Infection is usually a rare complication.
 - c. Debate about use of silicone led, in 1992, to the FDA's limiting use of silicone to breast reconstruction.
 - ◆ 3. Autogenous tissue flaps—second type of breast reconstruction.
 - a. Tissue flaps eliminate need for implant—unless there is insufficient skin available (TRAM [transverse rectus abdominis myocutaneous] flap, latissimus dorsi).
 - b. Involves use of tissue from upper portions of back or lower abdomen.
- E. Performing immediate breast reconstruction—eliminates need for second hospitalization and surgery.

Cancer in the Reproductive System

Characteristics

- A. Cancer of the cervix.
 - ◆ 1. Most common type of cancer in the reproductive system.
 - 2. Usually appears in females between the ages of 30 and 50.

- 3. Signs and symptoms include bleeding between periods—may be noted especially after intercourse or douching; leukorrhea.
- 4. May become invasive and include tissue outside the cervix, fundus of the uterus, and the lymph glands.
- ◆ 5. Treatment—depends on extent of the disease.
 - a. Hysterectomy.
 - b. Radiation.
 - c. Radical pelvic surgery in advanced cases.
- B. Cancer of the endometrium, fundus, or corpus of uterus.
 1. Usually not diagnosed until symptoms appear—Pap smear inadequate for diagnosis.
 2. Progresses slowly—metastasis occurs late.
 3. Treatment.
 - a. Early—hysterectomy.
 - b. Late—radium and x-ray therapy.
- C. Cancer of the vulva.
 1. Long-standing pruritus (itching) and local discomfort—itching occurs in half of women.
 2. Foul-smelling and slightly bloody discharge.
 3. Early lesions. May appear as chronic vulval dermatitis (cancerous lesions grow slowly).
 4. Surgical interventions.
 - a. Vulvectomy is the preferred treatment.
 - b. Radiation therapy is used in the inoperable lesions.
- ◆ D. Cancer of the ovary.
 1. Malignancy may occur at all ages—risk increases after age 40.
 - ◆ 2. The most deadly form of reproductive cancer; lack of warning symptoms; etiology not understood.
 - ◆ 3. Early diagnosis and surgical removal important (survival rate is 93%).
 - a. Usually detection is by chance, not screening.
 - b. Tumor marker, CA-125, may be useful, but many false negatives occur.
 - ◆ 4. Cancer is staged according to the involvement of tissue and may involve one or both ovaries.
 - a. Stage I—limited to the ovaries.
 - b. Stage II—pelvic extension.
 - c. Stage III—metastasis outside pelvis or positive retroperitoneal lymph nodes.
 - d. Stage IV—distant metastasis.
 5. Laparotomy is used for diagnosis and treatment—surgery is primary treatment.
 6. Chemotherapy may be used for Stage I; radioactive instillation for Stage II.

- a. Chemotherapeutic drugs include Cytoxan (cyclophosphamide), Platinol (cisplatin), Paraplatin (carboplatin), and Taxol (paclitaxel).
- b. Platinol and Taxol most commonly used because of clinical benefits and manageable toxicity.
- c. Leukopenia, neurotoxicity, and fever may occur with treatment.
- d. Taxol can cause cardiac effects.
- 7. Bone marrow transplantation or stem cell transplantation may be used.
- 8. Nursing care is the same as for any major abdominal surgery with the exception of psychosocial implications of cancer.

Implementation

- ◆ A. Provide immediate postoperative care.
 1. Observe dressings for signs of hemorrhage.
 2. Check vital signs until stable.
 3. Assist client to turn, cough, and deep-breathe every 2 hours.
 4. Give pain medications as ordered.
 5. Observe drainage and empty Hemovac as necessary.
 6. Record intake and output.
 7. Maintain IV.
 8. Maintain catheter care to reduce incidence of infection.
 9. Position for comfort.
- B. Provide convalescent care.
 1. Encourage verbalization regarding change in body image.
 2. Irrigate wound as ordered, using solution as prescribed (usual solution is either sterile saline or hydrogen peroxide), which cleans area and improves circulation.
 3. Prevent wound infection.
- C. Instruct client on discharge teaching.
 1. Signs of infection—foul-smelling discharge, elevated temperature, swelling.
 2. Nutritious diet and planned rest periods.
 3. Wound irrigation and dressing change.
 4. Importance of follow-up care by physician.

Hysterectomy

◆ Characteristics

- A. Total hysterectomy—removal of the uterus including the cervix; fallopian tubes and ovaries are not removed.
- B. Total abdominal hysterectomy and bilateral salpingo-oophorectomy—involves removal of the entire uterus, ovaries, and fallopian tubes.

- C. Radical hysterectomy—partial vaginectomy with dissection of lymph nodes in the pelvis.

Assessment

- ◆ A. Observe for hemorrhage—vaginal and at the incision site.
- ◆ B. Observe for signs of infection—elevated temperature, foul-smelling vaginal discharge, and pelvic congestion.
- C. Assess for changes in body image—feelings of loss.
- D. Evaluate for pneumonia.
- E. Auscultate for paralytic ileus.
- F. Observe for thrombophlebitis.

Implementation

- ◆ A. Immediate postoperative care.
 1. Observe incision site for bleeding and reinforce dressings as needed.
 2. Monitor vital signs frequently.
 3. Administer pain medications as ordered (assist with patient-controlled analgesia [PCA] use).
 4. Administer IV fluids as ordered.
 5. Observe for signs of thromboembolism—administer heparin if ordered.
 6. Provide for hygienic care.
 7. Give catheter care to prevent infection—observe amount and color of drainage.
 8. Assist client to cough, turn, and deep-breathe.
 9. Promote methods to decrease pelvic congestion.
 - a. Apply antiembolic stockings.
 - b. Avoid high-Fowler's position.
 - c. Promote range of motion.
- ◆ B. Provide convalescent care.
 1. Increase activity as tolerated.
 2. Ambulate with assistance.
 3. Auscultate chest for breath sounds.
 4. Auscultate abdomen for bowel sounds.
 5. Allow client to verbalize feelings of loss of femininity, childbearing ability, disfigurement, fear of cancer.
 6. Provide for emotional support.
 7. Increase diet as tolerated—fluids to 3000 mL/day provided no cardiac or renal problems.
 8. Administer laxatives and stool softeners as ordered, and rectal tubes or Harris flush for flatus—diet modification to prevent constipation.
- C. Prepare client for discharge.
 - ◆ 1. Encourage expression of feelings with significant other.

2. Explain that menstruation will no longer occur.
3. Explain that estrogen therapy may be ordered by the physician, if the ovaries were removed, to control menopausal symptoms.
- ◆ 4. Instruct the client to observe for signs of complications.
 - a. Elevation of temperature.
 - b. Foul-smelling vaginal discharge.
 - c. Redness, swelling, or drainage from the incision site.
 - d. Abdominal cramping.
5. Explain the importance of follow-up visits with the physician.
6. Explain the importance of taking medications as ordered.
7. Douching and coitus are usually avoided for 6 weeks.
8. Remind client to avoid both lifting heavy objects and prolonged sitting for several weeks as instructed by physician.

Anterior and Posterior Colporrhaphy

Characteristics

- ◆ A. Repair of cystocele—downward displacement of the bladder toward the vaginal entrance, caused by tissue weakness, injuries in childbirth, and atrophy associated with aging.
- ◆ B. Repair of rectocele—anterior sagging of rectum and posterior vaginal wall caused by injuries to the muscles and tissue of the pelvic floor during childbirth.

Assessment

- A. Observe for foul-smelling discharge from vaginal area or operative site.
- B. Observe for urinary retention and catheterize as necessary.

Implementation

- A. Provide postoperative care to decrease discomfort.
- ◆ B. Provide care of perineal sutures—two methods:
 1. Sutures left alone until healing begins; thereafter, daily vaginal irrigations with sterile saline.
 2. Sterile saline douches twice daily, beginning with the first postoperative day.
- C. Preparation of client for discharge. Client should be instructed in perineal hygiene (no douching or coitus until advised by physician), and to watch for signs of infection.

Pelvic Exenteration

Definition: A surgical procedure that is performed when cancer is widespread and cannot be controlled by other means—life-saving in certain malignancies.

Characteristics

- ◆ A. Total pelvic exenteration—removal of the reproductive organs, pelvic floor, pelvic lymph nodes, perineum, bladder, rectum, and distal portion of sigmoid colon.
- B. A substitute bladder is made from a segment of the ileum. Client will have a permanent colostomy.
- C. When cancer has spread beyond the pelvis, this procedure will not be done.

♦ Implementation

- A. Provide general postoperative procedures; in addition, give care for abdominal-perineal resection of the bowel and an ileal conduit.
- B. Observe surgical site for drainage and reinforce dressings as necessary; client may have drainage tubes connected to suction from incision area.
- C. Observe for complications (occur in 25–50%), usually involving urinary and GI systems.
- D. Encourage client to express feelings—especially important considering the diagnosis.
- E. Refer client to cancer support group, which studies have shown improve life expectancy.

GENITOURINARY SYSTEM REVIEW QUESTIONS

1. A client is scheduled for a voiding cystogram. Which nursing intervention would be essential to carry out several hours before the test?
 1. Maintaining NPO status.
 2. Medicating with urinary antiseptics.
 3. Administering bowel preparation.
 4. Forcing fluids.
2. A retention catheter for a male client is correctly taped if it is
 1. On the upper thigh.
 2. On the umbilicus.
 3. Under the thigh.
 4. On the inner thigh.
3. A client with a diagnosis of gout will be taking Colcrys (colchicine) and Zyloprim (allopurinol) BID to prevent recurrence. The most common early sign of colchicine toxicity that the nurse will assess for is
 1. Blurred vision.
 2. Anorexia.
 3. Diarrhea.
 4. Fever.
4. A client's laboratory results have been returned and the creatinine level is 7 mg/dL. This finding would lead the nurse to place the highest priority on assessing
 1. Temperature.
 2. Intake and output.
 3. Capillary refill.
 4. Pupillary reflex.
5. After the lungs, the kidneys work to maintain body pH. The best explanation of how the kidneys accomplish regulation of pH is that they
 1. Secrete hydrogen ions and sodium.
 2. Secrete ammonia.
 3. Exchange hydrogen and sodium in the kidney tubules.
 4. Decrease sodium ions, hold on to hydrogen ions, and then secrete sodium bicarbonate.
6. Conditions known to predispose to renal calculi formation include
 1. Polyuria.
 2. Dehydration, immobility.
3. Glycosuria.
4. Presence of an indwelling Foley catheter.
7. The most appropriate nursing intervention, based on physician's orders, for treating metabolic acidosis is to
 1. Replace potassium ions immediately to prevent hypokalemia.
 2. Administer oral sodium bicarbonate to act as a buffer.
 3. Administer IV catecholamines (Levophed) to prevent hypotension.
 4. Administer fluids to prevent dehydration.
8. The IV is attached to a controller to maintain the flow rate. If the alarm sounds on the controller, which of the following actions would the nurse not perform?
 1. Ensure that the drip chamber is full.
 2. Assess that height of IV container is at least 30 inches above venipuncture site.
 3. Ensure that the drop sensor is properly placed on the drip chamber.
 4. Evaluate the needle and IV tubing to determine if they are patent and positioned appropriately.
9. A 76-year-old woman who has been in good health develops urinary incontinence over a period of several days and is admitted to the hospital for a diagnostic work-up. The nurse would assess the client for other indicators of
 1. Renal failure.
 2. Urinary tract infection.
 3. Fluid volume excess.
 4. Dementia.
10. A 60-year-old male client's physician schedules a prostatectomy and orders a straight urinary drainage system to be inserted preoperatively. For the system to be effective, the nurse would
 1. Coil the tubing above the level of the bladder.
 2. Position the collection bag above the level of the bladder.
 3. Check that the collection bag is vented and distensible.
 4. Determine that the tubing is less than 3 feet in length.

- 11.** During a retention catheter insertion or bladder irrigation, the nurse must use
1. Sterile equipment and wear sterile gloves.
 2. Clean equipment and maintain surgical asepsis.
 3. Sterile equipment and maintain medical asepsis.
 4. Clean equipment and technique.
- 12.** The physician has ordered a 24-hour urine specimen. After explaining the procedure to the client, the nurse collects the first specimen. This specimen is then
1. Discarded, then the collection begins.
 2. Saved as part of the 24-hour collection.
 3. Tested, then discarded.
 4. Placed in a separate container and later added to the collection.
- 13.** You are assigned to a client with a retention catheter. You will assess for contamination, which could be caused by
1. Insertion technique.
 2. Catheter removal.
 3. Urethral/catheter interface.
 4. Migration to the bladder.
- 14.** A client in acute renal failure receives an IV infusion of 10% dextrose in water with 20 units of regular insulin. The goal of this therapy is to
1. Correct the hyperglycemia that occurs with acute renal failure.
 2. Facilitate the intracellular movement of potassium.
 3. Provide calories to prevent tissue catabolism and azotemia.
 4. Force potassium into the cells to prevent arrhythmias.
- 15.** A client with chronic renal failure is on continuous ambulatory peritoneal dialysis (CAPD). Which nursing diagnosis should have the highest priority?
1. Powerlessness.
 2. High risk for infection.
 3. Altered nutrition: less than body requirements.
 4. High risk for fluid volume deficit.
- 16.** The nurse is assigned a client undergoing chronic peritoneal dialysis. The priority assessment is
1. Pulmonary embolism.
 2. Hypotension.
 3. Dyspnea.
 4. Peritonitis.
- 17.** To formulate a care plan for a client receiving dialysis, the nurse understands that the physiological mechanism associated with peritoneal dialysis is that the
1. Peritoneum allows solutes in the dialysate to pass into the intravascular system.
 2. Peritoneum acts as a semipermeable membrane through which solutes move via diffusion and osmosis.
 3. Presence of excess metabolites causes increased permeability of the peritoneum and allows excess fluid to drain.
 4. Peritoneum permits diffusion of metabolites only from intravascular to interstitial spaces.
- 18.** A client is on dialysis treatments three times per week. The nurse explains that the main advantage of using an internal arteriovenous fistula rather than an external arteriovenous cannula for dialysis is
1. Accessing the internal fistula is less uncomfortable for the client.
 2. The internal fistula can be utilized immediately after insertion.
 3. There is less risk of hemorrhage from the internal fistula.
 4. It is easier to access the blood flow with the internal fistula than through the external cannula.
- 19.** The main complication following a nephrostomy that the nurse must assess for is
1. Bleeding from the nephrostomy site.
 2. Cardiopulmonary involvement following the procedure.
 3. Difficulty in restoring fluid and electrolyte balance.
 4. Contamination of the site.
- 20.** Client instructions following a vasectomy will include
1. No sexual activity for 2 weeks.
 2. Application of ice for pain or swelling.
 3. Bed rest for several days.
 4. Returning for suture removal in 1 week.
- 21.** The nurse explains to the client that decreasing dietary oxalate intake can reduce the formation of calcium-oxalate renal stones. The client is prepared to make correct diet choices when he tells the nurse he knows that foods to avoid on such a diet include
1. Red meats, butter, cheese.
 2. Carrots, spinach, tomatoes, green beans.
 3. Bananas, apples, apricots.
 4. Rice, potatoes, breads.

22. The nurse is doing discharge teaching to a client who will be discharged on diuretics. Measures to prevent hypokalemia will include
1. Eating one banana a day.
 2. Taking 1 teaspoon of salt substitute a day.
 3. Eating 10 prunes a day.
 4. Drinking an 8-ounce glass of orange juice every day.
23. A client is scheduled for a kidney transplant. A medication she will probably take on a long-term basis that will require specific client teaching to ensure compliance is
1. Corticosteroids.
 2. Antibiotics.
 3. Anticoagulants.
 4. Gamma globulin.
24. The client who is receiving Furadantin (nitrofurantoin) for a urinary tract infection may also receive ascorbic acid. The rationale for this additional agent is to
1. Promote tissue repair.
 2. Fortify mucosal resistance.
 3. Acidify the urine.
 4. Alkalize the urine.
25. A client is to start on Proscar (finasteride) for the treatment of benign prostatic hyper trophy (BPH). Which statement by the client indicates that he needs more teaching?
1. "This drug will eliminate the need for prostate surgery."
 2. "I will not be surprised if I experience a decreased interest in sex."
 3. "It may take 6 or more months before this drug works."
 4. "I should be able to empty my bladder better while I'm on this drug."

GENITOURINARY SYSTEM ANSWERS WITH RATIONALE

1. (4) Forcing fluids ensures a continuous flow of urine to provide adequate urine output for specimen collection. High fluid intake also reduces replication of bacteria that may have been introduced during the procedure.

NP:I; CN:PH; CL:A

2. (1) The catheter should be taped on the upper thigh or lower abdomen to prevent a penoscrotal angle that can cause fistula development.

NP:AN; CN:PH; CL:C

3. (3) Diarrhea is by far the most common early sign of colchicine toxicity. When given in the acute phase of gout, the dose of colchicine is usually 0.6 mg (PO) QH (not to exceed 10 tablets) until pain is relieved or gastrointestinal symptoms develop.

NP:A; CN:PH; CL:A

4. (2) The elevated creatinine level suggests impaired renal function. Assessing intake and output will provide data related to renal function. The other assessments are not indicative of renal function.

NP:A; CN:PH; CL:A

5. (4) By decreasing NA^- ions, holding on to hydrogen ions, and secreting sodium bicarbonate, the kidneys can regulate pH. Therefore, this is the most complete answer. While this buffer system is the slowest, it can completely compensate for acid–base imbalance.

NP:AN; CN:H; CL:C

6. (2) Urinary stasis, renal infection, and dehydration predispose the client to the formation of renal calculi, which may or may not require surgery.

NP:AN; CN:PH; CL:C

7. (4) Causes of metabolic acidosis include dehydration, diarrhea, and diabetes mellitus. Fluid administration is

a priority. Hyperkalemia results as cells are dehydrated; therefore, potassium will not be administered until hydration has occurred.

NP:P; CN:PH; CL:A

8. (1) The drip chamber should be only one-third full so that the sensor can “pick up” the drops. All of the other actions would be appropriate to carry out.

NP:I; CN:S; CL:C

9. (2) Urinary tract infections in the elderly often present as urinary incontinence that develops suddenly. Renal failure (1) and fluid volume excess (3) typically are characterized by oliguria. High uric acid level would result in symptoms of gout, not urinary incontinence.

NP:A; CN:PH; CL:A

10. (3) The collection bag must be able to fill easily; therefore, it needs to be distended. The bag must be vented with a filter so that urine can be drained from the chamber. The tube must not be allowed to coil or become kinked above the level of the bladder. The collection bag is positioned below the level of the bladder to allow for continuous urine drainage and prevent urine backflow into the bladder. To prevent reflux of urine, the tubing must be of sufficient length, usually 5 feet.

NP:E; CN:PH; CL:C

11. (1) To prevent introduction of pathogens into the urinary tract, sterile equipment is used and its sterility maintained.

NP:P; CN:S; CL:C

12. (1) The first specimen is discarded because it is considered “old urine” or urine that was in the bladder before the test began. After the first discarded specimen, urine is collected for 24 hours.

NP:I; CN:PH; CL:C

13. (4) Infection due to catheter presence is most commonly associated with migration to the bladder along the internal lumen of the catheter after contamination. Keeping the collection bag dependent of the tubing is important to prevent reflux and contamination. The other answers are potential, but not as common, causes of infection.

NP:P; CN:PH; CL:C

14. (2) Dextrose with insulin helps move potassium into cells and is immediate management therapy for hyperkalemia due to acute renal failure. An exchange resin may also be employed. This type of infusion is often administered before cardiac surgery to stabilize irritable cells and prevent arrhythmias; in this case KCl is also added to the infusion.

NP:P; CN:PH; CL:A

15. (2) There is a high risk of infection in clients receiving CAPD because microorganisms can enter the body by migrating around, or through, the peritoneal dialysis catheter. They may also enter through contaminated dialysate solutions. The other diagnoses are not as life threatening in a client on CAPD.

NP:AN; CN:PH; CL:A

16. (4) Peritonitis is a grave complication with peritoneal dialysis. Hemodialysis may be necessary until infection clears. Excess fluid and protein effluent into the peritoneum also complicate care. Use of aseptic technique is essential.

NP:E; CN:PH; CL:AN

17. (2) The peritoneum acts as a semipermeable membrane across which the substances move by osmosis from an area of high concentration (the blood) to an area of lower concentration (the dialysate). The dialysate contains small amounts or none of the substances that are to be removed from the body. This process takes 48 to 72 hours to be effective, and this time frame must be considered in planning for care.

NP:AN; CN:PH; CL:C

18. (3) There is an increased incidence of hemorrhaging with the external cannula. Hemorrhage results from the cannula becoming disconnected. One advantage of the external cannula is that it is painless to use. Surgery is required to establish the internal fistula, and it should be allowed to heal for several weeks before being utilized.

NP:I; CN:PH; CL:C

19. (1) While all the other conditions may be complications, bleeding from the site is the main concern. The procedure is done to achieve relief from infection caused by urinary stasis, which may have resulted in kidney congestion.

NP:A; CN:PH; CL:A

20. (2) If the client has pain or swelling, application of ice will help reduce symptoms. Sexual activity can be resumed, but the client will not be clear of sperm from the ductus for 4 to 6 weeks. Bed rest is not indicated, and sutures are absorbable.

NP:I; CN:S; CL:C

21. (2) Foods high in oxalate include spinach, green and wax beans, beets, and chocolate.

NP:E; CN:PH; CL:A

22. (2) To prevent hypokalemia, the client should take supplemental potassium. One teaspoon of salt substitute provides 50 mEq of potassium chloride. Potassium supplement tablets are also acceptable. While many texts advocate food for replacement, many foods have to be eaten in large quantities to provide sufficient potassium (50 mEq/day): four to six bananas, 1000 mL of orange juice, or 30 to 40 prunes. Often these foods are high in calories.

NP:I; CN:H; CL:A

23. (1) Deltasone (prednisone), a corticosteroid, is the usual drug of choice. The other medication classifications are not used in the routine care of transplant clients.

NP:P; CN:PH; CL:C

24. (3) Furadantin antimicrobial activity is more potent in acidic urine. Ascorbic acid or vitamin C tablets acidify the urine.

NP:AN; CN:PH; CL:C

25. (1) Because this statement is incorrect, the client will need more teaching. Proscar is an androgen inhibitor that may promote a reduction of prostatic hypertrophy, thereby improving bladder emptying. It may take 6 to 12 months to become effective and it does not work for all clients. Some clients, therefore, will need surgery to relieve the obstructive symptoms of BPH. One of the side effects of the drug is decreased libido.

NP:E; CN:PH; CL:A

MUSCULOSKELETAL SYSTEM

The musculoskeletal system provides the support and protective mechanism of the body. Bones, joints, and skeletal muscles comprise the system.

ANATOMY AND PHYSIOLOGY

Bone Structure

- A. Types of bones.
 - 1. Long: legs, arms.
 - 2. Short: wrists, ankles.
 - 3. Flat: skull, sternum, ribs.
 - 4. Irregular: vertebrae, face, scapulae, pelvic girdle.
- B. Bone surfaces.
 - 1. Grooves and holes provide passage for nerves and blood vessels.
 - 2. Protrusions at the ends of the bone form parts of the joints.
 - 3. Shallow depressions and ridges are attachment points for fibrous tissue.
- C. Bone function.
 - 1. Support and protect structures of the body skeleton.
 - 2. Provide attachments for muscles that move the skeleton.
 - 3. Central cavity of some bones contains hematopoietic tissue (connective tissue), which forms blood cells.
 - 4. Assist in regulation of calcium and phosphate concentrations.

Long Bones

- A. Diaphysis: long, central shaft.
- B. Epiphysis: the end of a long bone.
 - 1. Covered by hyaline cartilage.
 - 2. Auricular surface: the part of the epiphysis that contacts other bones.
- C. Periosteum: adhering sheath of connective tissue covering bone.
- D. Internal structures.
 - 1. Central medullary cavity: Contains yellow marrow composed of fat.
 - 2. Surface layer: an ivory-like, dense, compact bone.
 - 3. Cancellous bone: a spongy layer below the surface layer. It contains small cavities that merge with a large central cavity.
 - 4. Red marrow: Consists of hematopoietic tissue, macrophages, and fat cells. Fills the spaces between spongy bone.

Joints

Definition: Joints, also called articulations, are regions where two or more bones meet. Joints hold bones together while allowing movement.

- A. Classification.
 - 1. Synarthrosis: fibrous or fixed joints (immovable).
 - 2. Amphiarthrosis: cartilaginous or slightly movable joint.
 - 3. Diarthrosis: synovial or freely movable joint.
 - a. Ball and socket.
 - b. Condyloid.
- B. Function.
 - 1. Articulation is the meeting place of two or more joints.
 - 2. Assist in type and range of movement between bones.
- C. Synovial fluid.
 - 1. Function.
 - a. Lubricate the cartilage.
 - b. Cushion shocks.
 - c. Provide a nutrient source.
 - 2. Structure.
 - a. Fluid formed by the synovial membrane.
 - b. Synovial membrane lines the joint capsule, which contains the fluid.

System Assessment

- A. Observe for signs of a fracture.
 - 1. Assess for specific type of fracture.
 - ◆ 2. Observe all suspected fracture sites for edema, pain, and obvious deformities.
- B. Assess for possible complications associated with a cast.
- C. Evaluate client for complications associated with joint disorders.
- D. Observe for complications of amputation.
 - 1. Observe for presence of phantom limb pain.
 - 2. Assess stump dressings for bleeding and/or signs of infection.
- E. Observe for complications of hip surgery.
 - 1. Observe position in bed of clients with hip fractures to identify potential complications associated with hip flexion.
 - 2. Assess for signs of shock and hemorrhage following surgery.
 - 3. Evaluate need for client instruction on exercises, positioning, and crutch walking.
 - 4. Evaluate client's need for rehabilitation program.
- F. Observe circulation, motion, and sensation (CMS) for all orthopedic clients.
- G. Assess skin and neurovascular status before, during, and after any immobilizing modality—compare contralateral extremity and baseline data.

CMS

- Circulatory assessment: check digits for color, temperature, capillary refill, and edema.
 - a. Inadequate arterial flow: pallor, slow capillary filling (> 2 seconds), and coolness to touch.
 - b. Inadequate venous return: cyanosis, mottling, and increased temperature.
- Neurologic assessment: motion and sensation.

- H. Inspect and palpate the client's bones for any sign of obvious deformity or changes in size or shape. Palpation will elicit pain and tenderness; assess for warmth and crepitus.
- I. Measure extremities for length and circumference—compare bilaterally.
- J. Assess muscle mass and strength—compare bilaterally.

JOINT AND NERVE DISEASES

Rheumatoid Arthritis

Definition: Chronic, systemic, autoimmune inflammatory disease affecting the joints. Usual onset is from 30 to 50 years of age, but can occur at any age. Etiology unknown; may be autoimmunity, viral, or genetic. Follows course of recurrent exacerbations and remissions. (See **Table 8-5**, Comparison of Rheumatoid Arthritis and Osteoarthritis.)

Assessment

- ◆ A. Evaluate for bilateral joint involvement (erythema, warm, tender, painful).
- B. Assess for insidious onset of malaise, weight loss, paresthesia, stiffness.
- ◆ C. Assess pain and stiffness early in morning (subsides with moderate activity).
- D. Observe for subcutaneous nodules.
- E. Assess low-grade temperature.
- F. Observe for anemia with fatigue and weakness.
- G. Check for pattern of joint involvement—from small joints to knees, spine, etc.
- H. Assess for limitation of function and deformities of hands and feet.
- ◆ I. Laboratory and diagnostic tests.
 1. Rheumatoid factor (RF)—present in about 80% of people with rheumatoid arthritis (RA). High levels are associated with progressive disease and poorer prognosis.
 2. ANA (antinuclear antibody) titer, CRP (C-reactive protein), and ESR (erythrocyte sedimentation rate) are elevated due to active inflammation.
 3. Complete blood count (CBC)—hemoglobin and hematocrit; usually shows anemia.

- 4. Synovial fluid—shows inflammatory changes: increased turbidity, decreased viscosity, increased protein levels, 3000 to 50,000 white blood cells (WBCs)/ μ L with polymorphonuclear leukocytes (PMNs) (circulating neutrophils) predominating.
- 5. X-ray—few changes with early disease. As disease progresses there are joint changes.

Implementation

- A. Instruct client on medications and side effects. Chemotherapy reduces inflammation and relieves pain. Once the diagnosis of RA is made, clients should begin treatment with either a nonbiologic or biologic disease modifying antirheumatic drug (DMARD).
 1. Nonbiologic DMARDS—may slow or stop progression of joint damage.
 - a. The most commonly used:
 - (1) Plaquenil (hydroxychloroquine).
 - (2) Arava (leflunomide).
 - (3) Trexall (methotrexate).
 - (4) Azulfidine (sulfasalazine).
 - b. Usually taken as pill.
 - c. Trexall is sometimes given by injection.
 - d. Take from 4 to 6 weeks to begin working, longer to reach full effect.
 - e. Suppress the immune system, side effects vary with each medicine.
 - f. Serious risks include infection and kidney or liver damage.
 - g. Trexall and Arava can cause serious birth defects. Women taking any of these drugs should talk with their doctor before planning pregnancy.
 2. Biologic DMARDs
 - a. TNF-alpha antagonists:
 - (1) Humira (adalimumab).
 - (2) Cimzia (certolizumab pegol).
 - (3) Enbrel (etanercept).
 - (4) Simponi (golimumab).
 - (5) Remicade (infliximab).
 - b. Given under the skin or by intravenous (IV) injection.
 3. The most common side effects seen:
 - a. Injection site reactions.
 - b. The most significant side effect is increase in the risk of all types of infections, including tuberculosis (TB). Before starting a medication, a TB skin test is usually done.
 - c. Treatment with these agents should be stopped while you have an active infection and are taking an antibiotic or if you have a high fever.
 - d. Rare neurologic complications and people with multiple sclerosis should not use them.

Table 8-5 COMPARISON OF RHEUMATOID ARTHRITIS AND OSTEOARTHRITIS

Characteristics	Rheumatoid Arthritis	Osteoarthritis
Disease	Systemic with exacerbations and remissions	Localized; course varies and is progressive
Laboratory findings	RF + in 80% of clients Elevated ESR, CRP indicating active inflammation	RF negative Transient elevation of ESR related to synovitis
X-ray	Joint space narrowing and erosion with bony overgrowths, subluxation with advanced disease; osteoporosis related to corticosteroid use	Joint space narrowing, osteophytes, subchondral cysts, sclerosis
Age of onset	Young to middle age	Usually > 40
Gender	Female/male 2:1 or 3:1, less marked differences after age 60	< 50 more men than women, > 50 more women than men
Weight	Lost or maintained	Often overweight
Joints affected	Usually bilateral and symmetric small first joints, wrists, elbows, shoulders, and knees	Often asymmetric response seen in weight-bearing joints of knees and hips, small joints, cervical, lumbar spine
Pain	Stiffness lasts 1 hour to all day and may decrease with use; pain is variable and may disrupt sleep	Stiffness occurs on arising but usually subsides after 30 minutes; pain gradually worsens with joint use and time, lessens with rest
Effusions	Common	Uncommon
Nodules	Present, especially on extensor surfaces	Heberden's and Bouchard's nodes
Synovial fluid	WBC > 20,000 µL with mostly neutrophils	WBC < 2000 µL mild leukocytosis
Drug therapy	Disease-modifying antirheumatic drugs (DMARDs) NSAIDs Intra-articular or systemic corticosteroids Biologic/targeted therapy	Acetaminophen NSAIDs Antibiotics Intra-articular hyaluronic acid Intra-articular corticosteroids Opioid analgesics Reconstructive joint surgery
Surgery	Reconstructive joint surgery Implants Arthroplasty	

- ◆ 4. Salicylates.
 - a. Acetylsalicylic acid (ASA) most common.
 - b. Side effects include tinnitus, gastrointestinal (GI) upset/bleed, prolonged bleeding time.
 - ◆ 5. Nonsteroidal anti-inflammatory drugs (NSAIDs).
 - a. Butazolidine (phenylbutazone), Indocin (indomethacin), Motrin (ibuprofen), Naprosyn (naproxen), Nalfon (fenoprofen), Ansaid (flurbiprofen).
 - b. Side effects include GI disturbances, central nervous system (CNS) manifestations, skin rashes.
 - 6. Antimalarials.
 - a. Remission-inducing agents.
 - b. May cause ocular toxicity—ophthalmic exam twice yearly indicated.
 - 7. Gold salts (chrysotherapy).
 - a. Effective after 3–4 months.
 - b. Toxicity can be severe.
 - 8. Alternative to gold is an oral chelating agent, Cuprimine (pencillamine). Drug has an anti-inflammatory action.
 - 9. Corticosteroids: adjunct therapy only.
 - a. Used during exacerbations or severe involvement.
- b. Low dose to prevent toxicity.
 - c. Deltasone (prednisone), Cortef (hydrocortisone).
- ◆ B. Instruct client how to preserve joint function.
 - C. Provide rest periods throughout day.
 - D. Instruct client in diet control.
 - E. Provide psychological support for altered body image and living with chronic disease.
 - ◆ F. Prevent flexion contractures and promote exercise.
 - 1. Initiate range-of-motion exercises.
 - 2. Avoid weight bearing for inflamed joints.
 - 3. Instruct client to take warm baths.
 - G. Prepare for surgery if severe joint involvement.
 - 1. Synovectomy.
 - 2. Joint replacement.

Osteoarthritis

Definition: Hypertrophic degeneration of joints. Cartilage that covers the ends of bones disintegrates.

Characteristics

- A. Disorder strikes joints that receive the most stress (e.g., knees, toes, lower spine). Distal finger joint involvement is usually seen in women.
- B. Pain and stiffness in the joints.

Implementation

- A. Instruct client on well-balanced diet.
- ◆ B. Prevent permanent disability.
 - 1. Plan exercise to prevent joint fixation.
 - 2. Provide exercise periods to increase muscle tone.
 - 3. Control exercise periods to prevent fatigue.
- C. Maintain proper positioning.
 - 1. Align and frequently change position to prevent complications.
 - 2. Encourage and support client as frequent movements cause pain.
- ◆ D. Apply heat for relief of pain.
 - 1. Dry heat with a heat lamp to relieve stiffness.
 - 2. Moist heat with hot tubs, hot towels, or paraffin baths for the hands.
- E. Provide adequate rest—10–12 hours per day.
- F. Administer medications as ordered and teach client about side effects.
 - ◆ 1. Salicylates most common for relief of pain.
 - 2. Side effects of ASA include tinnitus, nausea, and prolonged bleeding time.
 - 3. Anti-inflammatory drugs (cortisone) reduce the effects of inflammation thus decreasing pain, swelling, and stiffness.
 - 4. NSAIDs.
 - a. COX-2 inhibitors: Celebrex (celecoxib).
 - b. Advil, Motrin, and others (ibuprofen).
- G. Physicians now prescribing natural Rx (glucosamine) for pain and stiffness.

Gout

- ◆ *Definition:* A disease caused by a defect in purine metabolism marked by urate deposits, which cause painful arthritic joints. Affects men over 50 years of age.

Assessment

- ◆ A. Assess joints (especially big toe) for pain, inflammation, tenderness, presence of urate deposits, and warm to touch.
- B. Assess for low-grade temperature.
- ◆ C. Evaluate serum uric acid and elevated urinary uric acid.

Implementation

- A. Maintain bed rest during acute attack.
- B. Immobilize inflamed, painful joints.
- ◆ C. Administer ordered medications.
 - 1. Analgesics for pain.
 - ◆ 2. Anti-inflammatory agents.
 - a. Colcrys (colchicine) PO or IV every hour × 8 hours until pain subsides or nausea, vomiting, cramping, or diarrhea occurs.
 - b. Butazolidine (phenylbutazone) or Indocin (indomethacin) may be used.
 - c. Corticosteroids.

- ◆ 3. Zyloprim (allopurinol) to decrease serum uric acid levels.
- 4. Uricosuric agents to promote uric acid excretion and inhibit uric acid accumulation (probencid, Anturane [sulfinpyrazone]).
- ◆ D. Instruct client on low-purine diet and avoidance of alcohol.
 - 1. See Chapter 4 for foods on a low-purine diet.
 - 2. If client is obese, place on weight-reduction diet.
- ◆ E. Force fluids to at least 2000 mL to prevent stone formation.

Carpal Tunnel Syndrome (Entrapment Neuropathy)

Definition: A syndrome caused by compression of the median nerve as a result of inflammation and swelling of the synovial lining of the tendon sheaths. Most commonly caused by repetitive motion of hand and wrist, also seen in rheumatoid arthritis, diabetes, acromegaly, hyperthyroid, and trauma.

Assessment

- A. Pain in the wrist.
- ◆ B. Numbness and tingling of the fingers, especially the thumb, index finger, and lateral ventral surface of the middle finger.
- C. Pain often worse at night, awakens client; may be relieved by shaking hand or massage.
- D. Diagnosis.
 - 1. History.
 - 2. Physical exam; positive Tinel's sign.
 - 3. Electrodiagnostic studies.

Implementation

- A. Surgery.
 - 1. Open nerve release—more painful, slow recovery.
 - 2. Endoscopic carpal tunnel release (ECTR)—immediate relief of pain.
- B. Activity modification, splinting, injection of steroids, NSAIDs.
- C. Alternative therapy: vitamin B₆ supplementation.

ORTHOPEDIC AND VASCULAR CONDITIONS**Osteoporosis**

Definition: Decrease in the amount of bone capable of maintaining structural integrity of the skeleton. Etiology is unknown. Loss of bone mass is associated with aging and increases fragility and risk of fractures.

Characteristics

- A. Factors that contribute to condition.
 - 1. Bone remodeling results in increased bone mass until age 35; thereafter, bone mass decreases.

- ◆ 2. Nutritional factors.
 - a. Lack of vitamin D.
 - b. Deficient calcium (minimum 800 mg; for women with decreased bone mass, 1200 mg).
 - c. Low estrogen levels after menopause.
 - ◆ 3. Excessive intake of drugs (corticosteroids).
 - 4. Coexisting medical conditions (malabsorption, lactose intolerance, alcohol abuse, renal failure).
 - 5. Immobility causes bone to be reabsorbed faster than it is formed.
- B. Diagnostic tests.
1. Routine x-ray when there is 25–45% demineralization.
 2. Single-photon absorptiometry identifies degree of bone mass in wrist.
 3. Dual-photon absorptiometry identifies bone loss at hip or spine.
 4. Laboratory studies exclude other diagnoses.
 - ◆ 5. Quantitative computed tomography (QCT) of the spine is the most sensitive test to detect osteoporosis.
 6. Dual-energy x-ray absorptiometry (DEXA) of the lumbar spine or hip is the most accurate method for measuring bone density—it is highly accurate and delivers negligible radiation.
 7. Serum bone Gla-protein (osteocalcin) is used as a marker for osteoclastic activity and indicates rate of bone turnover. It is most useful to evaluate treatment rather than as an indicator of the severity of the disease.

Assessment

- A. Assess for backache with pain radiating around trunk.
- B. Evaluate for skeletal deformities.
- C. Assess for pathologic fractures.
- ◆ D. Evaluate lab findings.
 1. Serum calcium, phosphorus, and alkaline phosphatase are usually normal.
 2. Parathyroid hormone may be elevated.

Implementation

- A. Provide pain control.
 1. Application of heat/cold.
 2. Medications to prevent pain—NSAIDs.
- ◆ B. Prevent fractures.
 1. Instruct in safety factors—watch steps, avoid use of scatter rugs.
 2. Keep side rails up to prevent falls.
 3. Move gently when turning and positioning.
 4. Assist with ambulation if unsteady on feet.
- ◆ C. Administer medications.
 1. Estrogen replacement therapy decreases osteoporosis (Estratab [esterified estrogens],

Estraderm [estradiol], Premarin [conjugated estrogens]); use is controversial as these medications may increase risk of cancer.

2. Calcium—prevents osteoporosis; found in milk, dairy products, yogurt, oysters, canned sardines, salmon, dark green leafy vegetables.
 3. Miacalcin (calcitonin)—prevents further bone loss and increases bone mass.
 4. Fluoride—decreases solubility of bone mineral and rate of bone reabsorption.
 5. Fosamax (alendronate)—a form of bisphosphonate. FDA warning—osteonecrosis of the jaw (jaw death) from taking this drug.
 6. Calcium and vitamin D—support bone metabolism.
- D. Instruct in regular exercise program.
- ◆ 1. Range-of-motion and weight-bearing exercises.
 - 2. Ambulation several times per day.
- E. Instruct in good use of body mechanics.
- F. Provide diet high in protein, calcium, vitamin D (adequate sunlight); avoid excesses of alcohol and coffee.

Compartment Syndrome

Definition: Following an injury that causes swelling, pressure increases in a muscle fascial compartment. Muscles, nerves, and blood vessels are compressed, causing ischemia, and can lead to amputation. This is a surgical emergency. There is no effective nonsurgical treatment.

Characteristics

- A. Pressure in the muscle compartment can be increased by edema or hematoma.
- B. Stricture around the limb or reperfusion following restoration of blood flow can result in this condition.

Assessment

- A. Monitor extremity for
 1. Pain—often out of proportion to the injury and unrelieved by narcotics. It increases on active and passive motion or elevation of extremity.
 2. Pallor.
 3. Paresthesia or numbness.
 4. Cold extremity compared to the other extremity.
 5. Pulselessness in affected extremity.

Implementation

- A. Position limb at level of client's heart (elevation higher may increase ischemia).
- B. Initiate IV line in alternate extremity and administer pain medication.

- C. Do not apply cold or heat without orders—may further compromise circulation.
- D. Prepare for surgery—fasciotomy to release pressure and skin grafting to decrease risk of sepsis.
- E. Avoid tight bandages, casts, and ace wraps.

Osteomyelitis

◆ **Definition:** An infection of the bone—it may occur as an acute, subacute, or chronic process. Cause is usually bacterial, with *Staphylococcus aureus* the most common organism. May be caused by fungi, parasites, and viruses.

◆ Assessment

- A. Signs of infection.
 - 1. Tachycardia.
 - 2. Nausea, vomiting, anorexia.
 - 3. Involved extremity is limp.
 - 4. Localized tenderness, especially in epiphyseal area.
 - 5. Drainage and ulceration at involved site.
 - 6. Swelling, erythema, and warmth at involved site.
 - 7. Lymph node involvement, especially in involved extremity.
 - 8. High temperature, abrupt onset of pain, malaise.
- B. Laboratory and diagnostic tests.
 - 1. X-rays.
 - 2. Magnetic resonance imaging (MRI)—shows epidural abscess.
 - 3. Computed tomography (CT)—detects sequestra, sinus tract, and soft-tissue abscess.
 - 4. Bone scan—determines if infection is active.
 - 5. Ultrasound—detects fluid collection, abscesses, and thickening.
 - 6. ESR—elevated in acute episode, normal in chronic osteomyelitis.
 - 7. WBC—elevated.
 - 8. Blood and tissue culture—determines infecting organism—directs antibiotic therapy.

Implementation

- ◆ A. Prevent transmission of infection.
 - 1. Strict hand hygiene.
 - 2. Administer antimicrobials.
 - 3. Maintain calorie and protein intake.
- ◆ B. Prevent hyperthermia.
 - 1. Monitor temperature every 4 hours.
 - 2. Maintain cool environment.
 - 3. Ensure daily fluid intake 2000–3000 mL daily.
- C. Improve physical mobility.
 - 1. Maintain limb in a functional position.
 - 2. Maintain rest, avoid subjecting affected extremity to weight-bearing activities.

- 3. Ensure active or passive range of motion (ROM) every 4 hours.
- D. Control of pain.
 - 1. Splint or immobilize to decrease pain caused by movement.
 - 2. Provide pain medications 20–30 minutes prior to planned activities.
 - 3. Warm moist packs.
 - 4. Assistive devices.
 - 5. Gentle handling and minimal manipulation.
- E. Provide emotional support.
- ◆ F. Medications.
 - 1. Parenteral antibiotics begun as soon as cultures are obtained.
 - 2. Penicillinase-resistant medication (methicillin, oxacillin) may be given until culture and sensitivity results are known.
 - 3. IV therapy usually given for 4–6 weeks.
 - 4. Cipro (ciprofloxacin) PO BID is effective and sometimes used.
- G. Surgical treatment.
 - 1. Needle biopsy or aspiration.
 - 2. Surgical debridement.

Fractures

Definition: A break in the continuity of bone caused by trauma, twisting, or as a result of bone decalcification.

Assessment

- A. Signs of a fracture.
 - ◆ 1. Cardinal signs of a fracture.
 - a. Pain or tenderness over involved area.
 - b. Loss of function of the extremity.
 - c. Deformity.
 - (1) Overriding.
 - (2) Angulation: Limb is in an unnatural position.
 - 2. Crepititation: sound of grating bone fragments.
 - 3. Ecchymosis or erythema.
 - 4. Edema.
 - 5. Muscle spasm.
- B. Evaluate cause of fracture.
 - 1. Fatigue—muscles are less supportive to bone and, therefore, cannot absorb the force being exerted.
 - 2. Bone neoplasms—cellular proliferations of malignant cells replace normal tissue causing a weakened bone.
 - 3. Metabolic disorders—poor mineral absorption and hormonal changes decrease bone calcification, which results in a weakened bone.
 - 4. Bed rest or disuse—atrophic muscles and osteoporosis cause decreased stress resistance.

◆ TYPES OF FRACTURE

- Greenstick or willow hickory stick.
 1. A crack; the bending of a bone with incomplete fracture. Affects only one side of the periosteum.
 2. Common in young children when bones are pliable; also seen in skull fractures.
- Comminuted.
 1. Bone completely broken in a transverse, spiral, or oblique direction (indicates the direction of the fracture in relation to the long axis of the fracture bone).
 2. Bone broken into several fragments.
- Open or compound.
 1. Bone is exposed to the air through a break in the skin.
 2. Can be associated with soft-tissue injury as well.
 3. Infection is common complication due to exposure to bacterial invasion.
- Closed or simple.
 1. Skin remains intact.
 2. Chances are greatly decreased for infection.
- Compression.
 1. Frequently seen with vertebral fractures.
 2. Fractured bone has been compressed by other bones.
- Complete: Bone is broken with a disruption of both sides of the periosteum.
- Impacted: One part of fractured bone is driven into another.
- Depressed fracture.
 1. Usually seen in skull or facial fractures.
 2. Bone or fragments of bone are driven inward.
- Pathological: Break caused by disease process.
- Impacted or telescoped: Bone fragments forcibly driven into other or adjacent bone structures.

- C. Identify whether break is intracapsular—bone broken inside the joint—or extracapsular—fracture outside the joint.
- D. Identify whether fracture is stable or unstable.
1. Stable (nondisplaced)—a fracture in which the bones maintain their anatomic alignment.
 2. Unstable (displaced)—a fracture in which the bones move out of correct anatomic alignment.

Implementation

- A. Evaluate type of treatment used for fracture.
1. Traction.
 - ◆ 2. Reduction (restoring bone to proper alignment).
 - a. Closed reduction.
 - (1) Manual manipulation.
 - (2) Usually done under anesthesia to reduce pain and relax muscles, thereby preventing complications.
 - (3) Cast is usually applied following closed reduction.
 - b. Open reduction.
 - (1) Surgical intervention.
 - (2) Usually treated with internal fixation devices (screws, plates, wires, etc.).

- (3) Following surgery, client can be placed in traction; however, client is usually placed in cast.

3. Cast.

◆ B. Fracture healing.

1. Occurs over several weeks.
2. New bone tissue occurs in region of break.
3. Repair is initiated by migration of blood vessels and connective tissue from periosteum in break area.
4. Dense fibrous tissue fills in the break and forms a callus (temporary union).
5. Types of cells.
 - a. Osteoblast: near the broken area.
 - b. Chondroblast: farther away from broken area.
6. Cells deposit cartilage between broken surfaces.
7. Cartilage is slowly replaced by mineralized bone tissue, which completes repair.
8. Fractures are a common injury in children even though bones can be bent 45 degrees before breaking.

◆ C. Emergency care of fractures.

1. Immobilize affected extremity to prevent further damage to soft tissue or nerve.
2. If compound fracture is evident, do not attempt to reduce it.
 - a. Apply splint.
 - b. Cover open wound with sterile dressing.
3. Splinting.
 - a. External support is applied around a fracture to immobilize the broken ends.
 - b. Materials used: wood, plastic (air splints), magazines.
4. Function of splinting.
 - a. Prevent additional trauma.
 - b. Reduce pain.
 - c. Decrease muscle spasm.
 - d. Limit movement.
 - e. Prevent complications, such as fat emboli if long bone fracture.

D. Provide specific care for fracture treatment.

1. Traction.
2. Cast.
3. Surgical intervention.
4. Positioning—use of trochanter rolls at the thigh prevents external rotation.

Traction

Definition: The application of a pulling force to an injured or diseased part of the body or extremity while countertraction pulls in the opposite direction.

Purposes of Traction

- A. Prevent or reduce muscle spasm.
- B. Immobilize a joint or part of the body.
- C. Reduce a fracture or a dislocation.
- D. Treatment of a joint condition.
- E. Prevent soft-tissue damage by immobilization.
- F. Reduce muscle spasm associated with low back pain or cervical whiplash.
- G. Expand joint space during arthroscopic procedures.
- H. Expand joint space during major joint reconstruction.

Assessment

- A. Assess for type of traction ordered. (See **Table 8-6** for types of traction devices.)
- ◆ B. Skeletal traction.
 - 1. Mechanical traction applied to bone, using pins (Steinmann), wires (Kirschner), or cervical tongs (Crutchfield, Gardner-Wells, halo external fixation).
 - 2. Most often used in fractures of femur, tibia, humerus, cervical spine.
 - 3. Balanced suspension traction.
 - a. Thomas's splint with Pearson attachment is used in conjunction with skin or skeletal

- traction (used particularly with skeletal traction for fractured femur).
- b. Balanced suspension traction is produced by a counterforce other than the client.
- ◆ C. Skin traction.
 - 1. Traction applied by use of elastic bandages, moleskin strips, or adhesive.
 - 2. Used most often in alignment or lengthening (for congenital hip displacement, etc.) or to relieve muscle spasms in preoperative hip clients.
 - 3. Most common types.
 - a. Russell traction.
 - b. Buck's extension.
 - c. Cervical traction (used for whiplashes and cervical spasm).
 - (1) Pull is exerted on one plane.
 - (2) Used for temporary immobilization.
 - d. Pelvic traction (used for low back pain).
- D. External fixation devices.
 - 1. Devices used for stabilizing bone or joint.
 - 2. Device has metal frame and percutaneous pins.
 - 3. Provides traction without ropes or weights so client has mobility.
- E. Assess for complications of immobility.

◆ **Table 8-6 TYPES OF TRACTION**

Type	Position	Purpose
◆ Skin Traction—usually short term; 48–72 hours, until skeletal traction is applied or surgery is done		
Cervical	Flat in bed or head of bed elevated 15–20 degrees	Relieve muscle spasms and compression in upper extremities and neck.
Buck's	Head of bed elevated 10–20 degrees for ADLs, knee flexed	Immobilize hip when fractured; relieve muscle spasms before hip surgery.
Bryant's	Flat with 45- to 90-degree hip flexion; buttocks raised 1 inch from mattress, legs extended	Stabilize fractured femur; correct congenital hip in children under 2 years old, weighing less than 30 lbs.
Russell's	Head of bed can be elevated 30–45 degrees; hip flexion at 20 degrees	Stabilize fractured femur prior to surgery; some knee injuries.
Pelvic girdle	Head of bed elevated, knee gatch elevated to same level (William's position)	Relieve low back, hip, or leg pain; reduce muscle spasm; herniated disc.
◆ Skeletal Traction—used for longer periods of treatment than skin traction		
Blackburn, Gardner-Wells, Crutchfield,Vinke Tongs	Spine immobilized; bed rest, supine position	Provide for hyperextension; traction allows vertebrae to slip back into position.
Halo traction	Flat, low-Fowler's in bed, ambulate, or sit up	Stabilize fractured or dislocated cervical vertebrae.
◆ Balanced Suspension		
Steinmann pin, Kirschner wires, used with Thomas splint and Pearson attachment	Low-Fowler's, either side or back; bed rest in supine position	To align bone and approximate fractures of femur, tibia, fibula.
External Fixation Devices		
Hoffman Synthes	Any position possible with device—allows client mobility and active exercise of unininvolved part	Manages complex fractures with soft-tissue damage; offers stability for comminuted fractures.

- F. Assess for signs and symptoms of infection with skeletal traction.
- G. Assess condition of skin for possible breakdown.

Implementation

- A. Check traction equipment.
 - 1. Check the ropes for fraying.
 - 2. Make sure ropes are in the center of the pulley.
 - 3. Check the weights for correct number of pounds and if weights are hanging free.
- ◆ B. Maintain body alignment through proper care of traction.
 - ◆ 1. Ensure that weights remain hanging freely and do not touch the floor.
 - 2. Ensure that pulleys are not obstructed.
 - ◆ 3. Check that ropes in the pulley move freely.
 - 4. Secure knot in rope to prevent slipping.
 - ◆ 5. Keep client up in bed, in direct line with traction and proper countertraction.
 - 6. Do not remove or lift weights without specific order. (Exceptions are pelvic and cervical traction that clients can remove at intervals.)
 - ◆ 7. Cover sharp edges on traction apparatus with hollowed-out rubber balls to prevent injury to personnel.
 - ◆ 8. Maintain counterbalance or correct pull.
 - a. Pull is exerted against traction in opposite direction (balanced suspension).
 - b. Pull is exerted against a fixed point.
 - c. Bed is elevated under area involved to provide the countertraction.
- C. Provide firm mattress or bed boards.
- D. Monitor for complications.
 - 1. Neurovascular compromise; check CMS.
 - 2. Inadequate bone alignment.
 - 3. Skin or soft-tissue injury.
 - 4. Pin-site infection.
 - 5. Osteomyelitis.
- E. Provide range-of-motion exercises for unaffected extremities.
- ◆ F. Prevent foot drop.
 - 1. Provide footplate.
 - 2. Encourage dorsiflexion exercises.
- G. Provide overhead trapeze to allow client to assist in activities (turning, moving up in bed, using bedpan, etc.).
- H. Prevent complications associated with immobility (p. 378).
- ◆ **Balanced Skeletal Traction**
 - A. Maintain proper alignment and check traction mechanism.
 - 1. Weights hanging freely, off floor and bed.
 - 2. Knots secure in all ropes.
 - 3. Rope should move freely through pulleys.
 - 4. Pulleys not constrained by knots.
 - B. Protect skin from excoriation.
 - 1. Check around top of Thomas splint.
 - 2. Pad with cotton wadding or ABDs.
 - C. Prevent pressure points around the top of Thomas splint keeping client pulled up in bed.
 - ◆ D. Provide pin-site care.
 - 1. Observe pin or tong insertion site for migration or drainage, odors, erythema, edema (usually indication of inflammatory process of infection).
 - 2. Watch for skin breakdown if bandage is used to apply traction.
 - 3. Cover ends of pins or wires with rubber stoppers or cork to prevent injury to nursing personnel or client.
 - 4. Cleanse area surrounding insertion site of pin or tongs with antimicrobial solution. Some physicians order antibiotic ointments to be applied to area or order “no pin-site care.”
 - E. Maintain at least 20-degree angle from thigh to the bed.
 - F. Provide footplate to prevent foot drop.
 - G. Keep heels clear of Pearson attachment to prevent skin breakdown and pressure sores.
 - H. Position client frequently from side to side (as ordered). Place table on unaffected side.
 - I. Unless contraindicated, elevate head of bed for comfort and to facilitate adequate respiratory functions.
 - J. Do not remove traction without a physician’s order.

Halo Traction

- A. Complete a neurologic assessment.
 - 1. Cranial, peripheral nerves at base of skull—this area is prone to injury.
 - 2. Check motion and sensation.
- B. Check alignment—neck should not be flexed or extended.
- C. Safety issues.
 - ◆ 1. Keep Allen wrench taped to front of vest in case of emergency (need for cardiopulmonary resuscitation [CPR]).
 - 2. Client is top heavy with limited view—remove obstacles when walking.
 - 3. Have emergency tracheostomy tray and bag-valve mask available on unit.
 - 4. Never use bars of halo brace to move client.
- D. Inspect pin site for drainage, crusting or inflammation.
- E. Provide skin care under vest.

Skin Traction

- ◆ A. Buck’s extension.
 - 1. Apply foam boot appliance with Velcro fastener.

2. Attach a foot block with a spreader and rope that goes into a pulley.
 3. Attach weight to pulley and hang freely over edge of bed (not more than 8–10 pounds of weight can be applied).
 4. Observe and readjust bandages for tightness and smoothness (can cause constriction that leads to edema or even nerve damage).
 5. Do not apply Buck's traction over or under a calf compression device. Foot pumps are allowed to prevent deep vein thrombosis (DVT).
- ◆ B. Cervical traction.
1. Use head harness (or halter).
 - a. Pad chin.
 - b. Protect ears from friction rub.
 2. Elevate head of bed and attach weights to pulley system over head of bed.
 3. Observe for skin breakdown.
 - a. Be sure to keep skin dry in areas encased in the halter.
 - b. Place back of head on padding.
- C. Pelvic traction.
1. Apply girdle snugly over client's pelvis and iliac crest; attach to weights.
 2. Observe for pressure points over iliac crest.
 3. Keep client in good alignment.
 4. May raise foot of bed slightly (30 cm) to prevent client from slipping down in bed.

External Fixation Devices

- A. Check pin site for signs of infection.
- B. Provide pin-site care (see p. 376).
- C. Check neurovascular status (circulation, motion, and sensation) every 4 hours; client may have extensive soft-tissue and vessel damage.
- D. Instruct client to keep extremity elevated if edema is present.

Cast Care

- A. After application of cast, allow 24–48 hours for drying. For synthetic cast, allow 30 minutes; 60 minutes for weight bearing.

◆ 1. Cast will change from dull to shiny substance when dry.

2. Heat can be applied to assist in drying process.
- ◆ B. Do not handle cast during drying process, because indentation from fingermarks can cause skin breakdown under cast.
- ◆ C. Keep extremity elevated to prevent edema and promote venous return.
- ◆ D. Provide for smooth edges surrounding cast.
 1. Smooth edges prevent crumbling and breaking down of edges.
 2. Stockinet can be pulled over edge and fastened down with adhesive tape to outside of cast.

CMS INTERVENTION

- Circulation—report if
 - a. Digits are swollen despite elevation and active exercise.
 - b. Digits are pale, blue, or cool to touch.
 - c. There is delayed capillary refill (> 2 seconds).
- Motion—report if
 - a. There is pain on passive movement.
 - b. Strength of action is unequal in both extremities.
 - c. Unable to wiggle toes.
- Sensation—report if
 - a. Pain increases; there is pain with passive motion of digits or when extremity is elevated.
 - b. Client complains of numbness or paresthesia (pins and needles sensation).

E. Observe casted extremity for signs of circulatory impairment. Cast may have to be cut if edematous condition continues.

- ◆ F. Always observe for signs and symptoms of complications: pain, swelling, discoloration, tingling or numbness, diminished or absent pulse, paralysis, pain, cool to touch.
- G. If there is an open, draining area on the affected extremity, a window (cut-out portion of cast) can be utilized for observation and/or irrigation of wound.
- H. Keep cast dry.
 1. Breaks down when water comes in contact with plaster.
 2. Use plastic bags or plastic-coated bed Chux during the bath or when using bedpan, to protect cast material.
 3. Synthetic cast can be cleaned—does not easily break down.
- I. Utilize isometric exercises to prevent muscle atrophy and to strengthen the muscle. Isometrics prevent joint from being immobilized.
- J. Position client with pillows to prevent strain on unaffected areas.
- K. Turn every 2 hours to prevent complications. Encourage client to lie on abdomen 4 hours a day.

Complications of Immobilization

- ◆ A. Prevent respiratory complications.
1. Have client cough and deep-breathe every 2 hours.
 2. Turn every 2 hours if not contraindicated.
 3. Provide suction if needed.
- ◆ B. Prevent thrombus and emboli formation.
1. Apply antiembolic stockings.
 2. Initiate isometric and isotonic exercises.
 3. Start anticoagulation therapy, if indicated.
 4. Turn every 2 hours.
 5. Observe for signs and symptoms of pulmonary and/or fat emboli.

- ◆ C. Prevent contractures.
 1. Start range-of-motion exercises to affected joints QID, all joints BID.
 2. Provide foot board and/or foot cradle.
 3. Position and turn every 2 hours.
- ◆ D. Prevent skin breakdown.
 1. Massage with lotion once a day to prevent drying.
 2. Use alcohol for back care to toughen skin.
 3. Massage elbows, coccyx, heels BID.
 4. Turn every 2 hours.
 5. Alternate pressure mattress, sheepskin.
 6. Use Stryker boots or heel protectors.
 7. Use elbow guards.
- E. Prevent urinary retention and calculi.
 1. Encourage fluids.
 2. Monitor intake and output.
 3. Administer urinary antiseptic (Mandelamine [methenamine], etc.).
 4. Offer bedpan every 4 hours.
- F. Prevent constipation.
 1. Encourage fluids.
 2. Provide high-fiber diet.
 3. Administer laxative or enema as ordered.
 4. Offer bedpan at same time each day—encourage to establish good bowel habits.
- G. Provide psychological support.
 1. Allow client to vent about feelings of dependence.
 2. Encourage independence when possible (bathing, self-feeding, etc.).
 3. Encourage visitors for short time periods.
 4. Provide diversionary activities (television, newspapers, etc.).

COMPLICATIONS OF IMMOBILIZATION

Many nursing interventions will prevent complications of immobilization.

Interventions	Purpose
Turn and position client every 2 hours if not contraindicated.	Prevent respiratory complications. Prevent thrombus and emboli formation. Prevent contractures. Prevent skin breakdown.
Encourage fluids.	Prevent skin breakdown. Prevent urinary retention and calculi.
Monitor intake and output.	Prevent constipation. Prevent skin breakdown. Prevent urinary retention and calculi.

Fractured Ribs

- ◆ **Assessment**
 - A. Assess lung sounds for pneumothorax or hemothorax.
 - B. Examine chest excursion for asymmetry.
- ◆ C. Assess for shock.
 1. Monitor vital signs every hour until stable.
 2. Check color and warmth every 2 hours.
 3. Check level of consciousness (LOC).
 4. Observe for restlessness.
- D. Evaluate pain and need for analgesic.
- E. Evaluate need for chest tubes.

Implementation

- A. Provide nursing intervention for shock.
 1. Administer oxygen as indicated.
 2. Administer IV if signs of shock present.
 3. Keep lightly covered.
 4. Have chest tube insertion tray available.
- B. Relieve pain from muscle spasms and fractures.
 - ◆ 1. Give pain medication 30 minutes before any movement.
 - 2. Change position every 2 hours.
 - 3. Use pillows for support.
 - 4. Place client in semi-Fowler's position.
- ◆ C. Prevent complications of immobility.
 1. Cough and deep-breathe every 2 hours to prevent hypostatic pneumonia.
 2. Turn to unaffected side and back every 2 hours.
 3. Maintain skin care to prevent pressure sores and circulatory impairment.
 - a. Back care.
 - b. Heel, elbow, coccyx massage.
 4. Institute leg exercises to prevent circulatory impairment.
 5. Prevent constipation and flatus.
 - a. Insert rectal tube (no more than 20 minutes at a time).
 - b. Provide stool softener.
 - c. Maintain diet high in bulk and fiber.
 - d. Force fluids.
 6. Chest strapping is avoided as much as possible because it limits expansion and may lead to pneumonia and atelectasis.

Hip Conditions

- ◆ **Characteristics**
 - A. High incidence in elderly group—hip fractures most common cause of traumatic death after age 75.
 - B. Fractures in the elderly caused by brittle bones (osteoporosis) and frequent falls.
 - C. Elderly clients with hip fractures frequently have associated medical conditions (cardiovascular, renal disorders).

Assessment

- ◆ A. Evaluate types of fracture.
 - ◆ 1. **Intracapsular** (within the joint capsule); head or neck of the femur.
 - a. Treated by internal fixation—replacement of femoral head with a prosthesis.
 - b. Occasionally, primary total hip replacement.
 - c. Usually placed in skin traction first for immobilization and relief of muscle spasm.
 - d. Client can be out of bed without weight bearing in 1–2 days postoperatively (depending on other physical problems).
 - ◆ 2. **Extracapsular:** trochanteric fracture outside the joint.
 - ◆ a. Fracture of greater trochanter.
 - (1) Can be treated by balanced suspension traction if little displacement of bone. Full weight bearing usually in 6–8 weeks, when healing takes place.
 - (2) Surgical intervention is necessary if large displacement or extensive soft-tissue damage; usually internal fixation with wire.
 - ◆ b. Intertrochanteric fracture.
 - (1) Extends from medial region of the junction of the neck and lesser trochanter toward the summit of the greater trochanter.
 - (2) Treated initially by balanced suspension traction.
 - (3) Surgically treated early due to debilitated physical condition of most of these clients (usually 70 years and older with other system diseases like diabetes, hypertension, etc.).
 - (4) Internal fixation used with nail plate, screws, and wire.
 - ◆ c. Not allowed to flex hip to the side, on the side of the bed, or in a low chair. When hip is flexed, displacement can occur.
- B. Assess for complications of immobility.

Implementation

- ◆ FOR CLIENTS OTHER THAN THOSE WITH HIP PROSTHESIS
 - A. Hemovac will usually be in place to drain off excessive blood and fluid accumulation.
 - 1. Compute intake and output.
 - 2. Keep Hemovac compressed to facilitate drainage.
 - B. Have client perform bed exercises at least four times per day.
 - 1. Flex and extend foot, tense muscles, and straighten knee.

- 2. Tighten buttocks, straighten knee, and push leg down in bed.
- 3. Tighten stomach muscles by raising neck and shoulders.
- 4. Stretch arms to head of bed and deep-breathe.
- C. Change positions by raising head of bed.
 - 1. Gatch knees slightly to relieve strain on hips and back.
 - 2. Turn to unaffected side.
 - 3. Pivot into chair within 1–2 days postoperatively.
- ◆ **HIP PROSTHESIS**
 - A. Replacement of head of femur with prosthesis.
 - ◆ B. Keep affected leg abducted to prevent dislocation of the prosthesis—use Charnley wedge.
 - ◆ C. Make sure hip flexion angle does not exceed 60–80 degrees.
 - ◆ D. Forbid client to flex hip while getting out of bed; forbid client to sit in low chair.
 - 1. Use high stools.
 - 2. Use wheelchairs with adjustable backs.
 - 3. Use commode extenders.
 - E. Elevate head of bed 30–40 degrees for meals only.
 - F. Turn client to unaffected side with pillow support between legs.
 - G. Ambulate in 2–4 days with partial weight bearing.
- ◆ **TOTAL HIP REPLACEMENT**
 - A. Replacement of both the acetabulum and the head of the femur with metal or plastic prosthesis.
 - B. Used in degenerative diseases or when fracture of head of femur has occurred with nonunion.
 - ◆ C. To prevent flexion, keep operative leg in abduction by use of pillows or abductor splints.
 - 1. Positioning is important (every 2 hours).
 - 2. Turn client about 45 degrees with aid of trapeze and pillows. Do not elevate bed more than 30–45 degrees.
 - 3. Do not turn to affected side unless specific orders.
 - 4. Maintain antirotation boot (if indicated) while client is supine, but remove when client is turned.
 - 5. When using fracture bedpan, instruct client to flex unoperated hip and use trapeze.
 - ◆ D. Keep Hemovac in place until drainage has substantially decreased (24–96 hours).
 - 1. By 48 hours, drainage should be 30 mL in 8 hours.
 - 2. Check dressing to ensure patency of Hemovac.
 - 3. Observe drainage for signs of hemorrhage or infection.
 - E. Prevent edema and thrombus formation from venous stasis.

INSTRUCT CLIENT NOT TO

- Cross legs at ankle or knee.
- Stand with toes turned in.
- Flex hips greater than 90 degrees or sit with knees lower than hips.
- Sit in bathtub—use showers.
- Bend over.
- Use low chairs or sit on edge of bed.

1. Incidence of deep vein thrombosis is 45–70%; of these, 20% develop pulmonary emboli.
 2. Readjust antiembolic stockings at least every 4–8 hours.
 3. Change position frequently by raising and lowering head of bed. When ordered, tilt bed to change positions.
 4. Promote leg exercises—flexing feet and ankles.
 5. Administer anticoagulants as ordered.
- F. Prevent infections—can be fatal in elderly.
1. Monitor prophylactic antibiotics.
 2. Remove suction device as soon as possible to prevent infection.
 3. Keep dressing clean and dry.
- G. Continuous passive motion (CPM) first day postop with increasing degrees of flexion to 90 degrees.
- ♦ H. Ambulate client carefully at bedside—first or second postoperative day.
1. Do not allow client to bear weight on affected hip.
 2. Up with walker second postoperative day.
 - ♦ 3. Avoid positions with greater than 90 degrees flexion such as sitting straight up in a chair.
 4. Use commode extenders.
 5. Use wheelchair with adjustable back.
 6. Use high stools.
- I. Start physical therapy as ordered.
- J. Observe for neurovascular problems in affected leg.
1. Capillary refill response in toes; pedal pulses in feet.
 2. Color and temperature in leg and toes.
 3. Edema in leg.
 4. Pain on passive flexion of foot.
 5. Numbness—inability to move leg.
 6. Report any signs of dislocation. Note knee flexion, leg appearing longer or shorter than the unaffected limb, turning inward or outward, feeling head of femur in hip area.

KNEE SURGERY**Arthroscopy**

Definition: Small incision in knee joint through which cartilage fragments are removed.

Assessment

- A. Assess for pain, tenderness, decreased range of motion, clicking noise—torn cartilage (meniscus).
- B. Assess for joint instability and pain—torn ligaments.

Implementation

- A. Instruct client in surgical procedure for postoperative care.
 1. Arthroscopic meniscectomy—removal of torn cartilage fragments through small incision in knee joint using arthroscope.
 2. Open meniscectomy—direct surgical technique to knee joint for repair.
- ♦ B. Elevate leg to minimize swelling.
- ♦ C. Start client on quad-setting, straight-leg raise exercises. Should be done for 5 minutes every 30 minutes.
 1. Quad-setting: tightening or contracting the muscles of anterior thigh (kneecap is drawn up toward thigh).
 2. Straight-leg raising: lifting leg straight off the bed, keeping knee extended and foot in neutral position.
- D. Apply ice bags to knee to reduce edema.
- E. Ambulate first postoperative day without weight bearing (use three-point, crutch-walking gait).
- F. In addition, give routine postoperative care.
- G. Monitor for pulmonary embolism—complication of surgery.

Total Knee Arthroplasty

Definition: Implantation of a metallic upper portion that substitutes for the femoral condyles and a high-polymer plastic lower portion that substitutes for the tibial joint surfaces.

Assessment

- A. Assess incisional area for drainage.
- B. Observe for infection.
- C. Observe for circulation, sensation, movement.

♦ Implementation

- A. Control pain; client may have epidural or patient-controlled analgesia (PCA) for first 24 hours, then oral analgesic.
- B. Monitor dressing and drainage if closed-wound drainage system is used.
- C. Promote mobility.
 1. Continuous passive motion (CPM) may be ordered postop—moderate flexion and extension—increases circulation, movement, and prevents adhesion formation.
 - ♦ 2. Have client perform quad-setting and straight-leg raise exercises every hour.
 3. Have client perform passive range-of-motion exercises.

- D. Soft foam knee immobilizer, brace, or splint is usually applied. (Nursing care is same as for any client in a splint.)
 - 1. If hinged splint (Bledsoe) is ordered, do not open or adjust without physician's order.
 - 2. Assess skin and CMS every 4 hours.
- ◆ E. *Do not dangle* to prevent dislocation.
- F. Monitor for signs of infection—a serious complication.
 - 1. Clients should remind physicians and dentists about prosthesis for prescribed antibiotics.
 - 2. Infection could occur 3 months or even a year after surgery.
- G. Instruct client in crutch walking.
- H. Client will be out of bed in 2–3 days.
- I. Provide general postoperative care—monitor for pulmonary embolism. Anticoagulant therapy may be ordered prophylactically.

Crutch Walking

- ◆ A. Measure client for crutches.
 - 1. Distance between axilla and arm pieces on crutches should be two finger widths in axilla space—incorrect measurement could damage brachial plexus.
 - 2. Elbows should be slightly flexed when walking.
- ◆ B. Teach gait sequence.
 - ◆ 1. Four-point; crutch-foot sequence.
 - a. Move right crutch; move left foot; move left crutch; move right foot.
 - b. Gait is slow, but stable; client can bear weight on each leg.
 - 2. Three-point gait.
 - a. Client can bear little or no weight on one leg—two crutches support affected leg.
 - b. Move both crutches and affected leg forward; then move unaffected leg forward.

Diagnostic Test for Problems of the Spine

Myelogram

Definition: Contrast medium injected into the subarachnoid space of the spinal column to visualize the spinal cord. If water-soluble contrast is used, the head of the bed must be kept elevated to avoid the possibility of seizure; if oil contrast, client is kept flat.

SPINAL SURGERY

Laminectomy, Discectomy, Etc.

Definition: Disorders of the vertebrae that require excision of vertebral posterior arch, removal of the nucleus of the disc, or enlargement of the opening between discs.

◆ Characteristics

- A. Laminectomy—removal of part of vertebral lamina.
- B. Discectomy—removal of the nucleus pulposus of the intervertebral disc (may be performed alone or with laminectomy).
- C. Foraminitomy—enlargement of the opening between the disc and the facet joint to remove overgrowth compressing the nerve.
- D. Microdiscectomy—microsurgical techniques to remove nucleus pulposus of disc.

Assessment

- ◆ A. Evaluate for circulatory impairment of extremities.
 - 1. Check blanching.
 - 2. Observe color.
 - 3. Check warmth of lower or upper extremities (depends on surgical site).
- ◆ B. Observe for sensation and motion in lower extremities (nerve root damage).
 - 1. Assess sensation.
 - 2. Check client's ability to wiggle toes and move feet; record ability to do plantar flexion, dorsiflexion of feet, toes, and ankles.
- ◆ C. Observe dressings for spinal fluid leak, hemorrhage, and infection. If present, notify physician.
 - 1. Use Dextrostix to test leakage. If positive for glucose, it is a very strong indicator that this is cerebrospinal fluid (CSF).
 - 2. Leaking CSF increases risk of infection to wound and meninges.
- D. Note bowel sounds and bladder function.
- E. Observe for respiratory problems—especially with cervical laminectomy.
- ◆ F. Assess for hematoma formation as manifested by severe incisional pain not relieved by medication. If left untreated, it may cause irreversible neurologic deficits.
- ◆ G. Assess for laryngeal nerve damage—may cause permanent hoarseness. Impaired ability to swallow puts the client at risk for aspiration.

Implementation

- ◆ A. Change client's position every 2 hours (by log-rolling) for at least 48 hours.
 - 1. Turn client as one unit by using draw sheet (or pull sheet), placing pillows between legs.
 - 2. Turn client to either side and back (unless contraindicated). Use support mechanisms when on side.
- ◆ B. Keep NPO until flatus and bowel sounds present.
- C. Promote general range-of-motion exercises.
- D. Ambulate client or have client lie in bed; sitting puts strain on surgical site.
- E. Ambulate in 1–2 days postoperatively, unless contraindicated.

- F. Provide general postoperative care.
- G. Administer stronger pain medication postop, if on medication for a long time preoperatively.
- H. Encourage fluid intake and diet rich in nutrients.
 - 1. Suggest increased intake of fruits and vegetables.
 - 2. Increased fiber to prevent constipation.
- I. Encourage use of incentive spirometer.

Spinal Fusion

♦ *Definition:* The fusion of spinous processes—stabilizing the spine by removing bony chips from iliac crest and grafting them to fusion site.

For spinal cord injury, see page 190; for scoliosis, see page 710.

Assessment

- A. Assess for spinal fluid leak or hemorrhage.
- B. Measure vital signs; identify symptoms of infection.
- C. Evaluate for circulatory, motion, sensation impairment.
- D. Evaluate bladder and bowel function.

Implementation

- ♦ A. Maintain postoperative positioning.
 - 1. Some physicians keep client supine for first 8 hours to reduce possibility of compression.
 - 2. Most physicians keep client off back for first 48 hours.
- ♦ B. Provide ambulation. Starting ambulation varies with physicians, from 3–4 days to 8 weeks, depending on extent of fusion.
 - 1. Brace is applied when client is ambulated.
 - 2. Spine should be immobilized for early healing of bone graft and for new callus to form.
- ♦ C. Instruct client to not lift, bend, stoop, or sit for prolonged periods for at least 3 months.
- D. Inform client grafts are stable by the end of the first year.
- E. Explain there are some limitations to flexion of spine, depending on extent of fusion.
- F. Provide additional interventions same as for laminectomy.

Harrington Rod Instrumentation

Used to treat scoliosis—see Chapter 13, page 710.

AMPUTATION

Definition: The surgical removal of a limb, a part of a limb, or a portion of a bone elsewhere than at the joint site. Removal of a bone at the joint site is termed disarticulation.

♦ Characteristics

- A. Open type (guillotine)—performed when infections are present, wound left open to drain; once infection is cleared, wound is closed.
- B. Closed type (flap)—wound is closed with a flap of skin.

Assessment

- A. Evaluate dressings for signs of infection or hemorrhage.
- B. Observe for signs of a developing necrosis or neuroma in incision.
- C. Evaluate for phantom limb pain.
- D. Observe for signs of contractures.

Implementation

- ♦ A. Provide preoperative nursing management.
 - 1. Have client practice lifting buttocks off bed while in sitting position.
 - 2. Provide range of motion to unaffected leg.
 - 3. Inform client about phantom limb sensation.
 - a. Pain and feeling that amputated leg is still there; caused by nerves in the stump.
 - b. Exercises lessen sensation.
- ♦ B. Provide postoperative nursing management.
 - 1. Observe stump dressing for signs of hemorrhage, infection, or wound that will not heal.
 - a. Keep tourniquet at bedside to control hemorrhage if necessary.
 - b. Mark bleeding by circling drainage with pencil and marking date and time.
 - c. Elevate foot of bed to prevent hemorrhage and to reduce edema first 24 hours ONLY. (Elevating the stump itself can cause a flexion contracture of hip joint.)
 - d. Avoid dependent positioning of stump—to prevent edema and discomfort.
 - 2. Observe for symptoms of a developing necrosis or neuroma in area of incision.
 - ♦ 3. Provide stump care.
 - a. Rewrap Ace bandage 3–4 times daily.
 - b. Wash stump with mild soap and water.
 - c. While washing stump, tap and massage skin toward incision line to prevent development of adhesions.
 - ♦ 4. Teaching related to stump care.
 - a. Below-the-knee amputation—prevent edema formation.
 - (1) Do not hang stump over edge of bed.
 - (2) Do not sit for long periods of time.
 - b. Above-the-knee amputation—prevent external or internal rotation of limb.
 - (1) Place rolled towel along outside of thigh to prevent rotation.

- (2) Use low-Fowler's position to provide change in position.
- ◆ c. Position client with either type of amputation in prone position to stretch flexor muscles and to prevent flexion contractures of hip. Done usually after first 24–48 hours postoperative.
 - (1) Place pillow under abdomen and stump.
 - (2) Keep legs close together to prevent abduction.
- d. Teach use of ambulatory aids—crutch walking (started when client achieves stable balance) and wheelchair transfer.
- ◆ e. Prepare stump for prosthesis.
 - (1) Stump must be conditioned for proper fit.
 - (2) Shrinking and shaping stump to conical form by applying bandages or an elastic stump shrinker.
 - (3) A cast readies stump for the prosthesis.
- f. Provide care for temporary prosthesis, which is applied until stump has shrunk to permanent state.
- 5. Recognize and respond to client's psychological reactions to amputation.
 - a. Feelings of loss, grieving.
 - b. Loss of independence.
 - c. Lowered self-image.
 - d. Depression.
- ◆ 6. Continue discussing phantom limb pain with client.
 - a. Feelings of pain in the part that has been amputated will eventually disappear.
 - b. Occurs more frequently in above-the-knee amputation.
 - c. TENS (transcutaneous electrical nerve stimulation) may provide relief.

Fibromyalgia

Definition: A syndrome that affects about 2% of the population. The triad of symptoms that are the hallmark of the syndrome include long-lasting, widespread pain (with tender points), sleep disturbances, and fatigue.

Characteristics

- A. Cause unknown—may be caused by genetic predisposition, a stressor such as an acute injury, an illness with fever, surgery, immune system depression, or long-term psychosocial stress (sometimes childhood trauma).

- B. Disease is difficult to diagnose because symptoms are common and laboratory results generally are normal.
- C. Affects women between the ages of 30 and 50 years, and about 0.5% of men.
- D. Central nervous system in people with fibromyalgia is not functioning properly and components of the body's stress response are responsible for symptoms.
 - 1. Sensory processing: experience great sensitivity not just to pain, but also to loud noises, bright lights, odors, drugs, temperature changes, and chemicals.
 - 2. Substance P: threefold higher concentration in spinal fluid of this chemical that amplifies pain signals.
 - 3. Serotonin: low or processed poorly.
 - 4. HPA (hypothalamic–pituitary–adrenal) axis: several abnormalities in the axis.

Assessment

- A. General symptoms: pain and tenderness, non-cardiac chest pain, fatigue, sleep disturbance, frequent headaches—may be migraines, cognitive difficulties, irritable bowel syndrome, urinary urgency and frequency, dry eyes and mouth, temporomandibular joint syndrome (TMJ), sensitivity to loud noises, unusual and uncontrollable eye movements.
- B. Constitutional symptoms: weight fluctuations, heat and cold intolerance, night sweats, weakness.
- C. “Allergic” symptoms: multiple chemical sensitivity, nasal congestion, rhinitis.
- D. Depression and anxiety.
- E. Painful menstrual periods; itching, burning sensations around the vaginal opening.

Implementation

- A. There is no “one” treatment—treatment is geared toward relieving symptoms.
- B. Monitor medications.
 - 1. Analgesics: Lyrica (pregabalin) has been shown to reduce pain and improve sleep for up to 6 months; Tylenol (acetaminophen); Ultram (tramadol)—stronger analgesic than acetaminophen, rarely as addictive as narcotics; NSAIDs—often used for pain relief rather than for their anti-inflammatory effects (ASA, Advil, Aleve).
 - 2. Tricyclic antidepressants.
 - a. Work by raising the levels of norepinephrine in the brain.
 - b. Given in doses lower than required for antidepressant effects—drugs can improve the quality of sleep.

- 3. Selective serotonin reuptake inhibitors (SSRIs).
 - a. Increase amount of serotonin in brain, reducing fatigue and possibly pain.
 - b. Often prescribed in combination with a tricyclic antidepressant.
- C. Nutrition, vitamin and mineral supplements: limit caffeine, sugar, and alcohol—muscle irritants.
- D. Exercise—eases the symptoms of fibromyalgia. Ongoing rehabilitation program maximizes outcomes.
- E. Coping skills—techniques to help ease tension, anxiety, and pain.
- F. Complementary therapies—massage, movement therapies (such as Pilates), chiropractic manipulations and acupuncture, among others.

MUSCULOSKELETAL SYSTEM REVIEW QUESTIONS

1. A client has sustained an intertrochanteric fracture of the hip and has just had a nail plate inserted for internal fixation. The client has been instructed that she should not flex her hip. The best explanation of why this movement would be harmful is
 1. It will be very painful for the client.
 2. The soft tissue around the site will be damaged.
 3. Displacement can occur with flexion.
 4. It will pull the hip out of alignment.
2. When the client is lying supine, the nurse will prevent external rotation of the lower extremity by using a
 1. Trochanter roll by the knee.
 2. Sandbag to the lateral calf.
 3. Trochanter roll to the thigh.
 4. Footboard.
3. A client has just returned from surgery after having his left leg amputated below the knee. Physician's orders include elevation of the foot of the bed for 24 hours. The nurse observes that the nursing assistant (NA) has placed a pillow under the client's amputated limb. The nursing action is to
 1. Leave the pillow, as his stump is elevated.
 2. Remove the pillow and elevate the foot of the bed.
 3. Leave the pillow and elevate the foot of the bed.
 4. Check with the physician and clarify the orders.
4. A client has sustained a fracture of the femur, and balanced skeletal traction with a Thomas splint has been applied. To prevent pressure points from occurring around the top of the splint, the most important intervention is to
 1. Protect the skin with lotion.
 2. Keep the client pulled up in bed.
 3. Pad the top of the splint with washcloths.
 4. Provide a footplate in the bed.
5. The major rationale for the use of acetylsalicylic acid (aspirin) in the treatment of rheumatoid arthritis is to
 1. Reduce fever.
 2. Reduce inflammation of the joints.
 3. Assist the client in range-of-motion activities without pain.
 4. Prevent extension of the disease process.
6. Following an amputation, the advantage to the client for an immediate prosthesis fitting is
 1. Ability to ambulate sooner.
 2. Less chance of phantom limb sensation.
 3. Dressing changes are not necessary.
 4. Better fit of the prosthesis.
7. One method of assessing for signs of circulatory impairment in a client with a fractured femur is to ask the client to
 1. Cough and deep-breathe.
 2. Turn himself in bed.
 3. Perform biceps exercises.
 4. Wiggle his toes.
8. The morning of the second postoperative day following hip surgery for a fractured right hip, the nurse will ambulate the client. The first intervention is to
 1. Get the client up in a chair after dangling at the bedside.
 2. Use a walker for balance when getting the client up.
 3. Have the client put minimal weight on the affected side when getting up.
 4. Practice getting the client out of bed by having her slightly flex her hips.
9. A client is in the hospital with his left leg in Buck's traction. The team leader asks the nurse to place a footplate on the affected side. The purpose of this action is to
 1. Anchor the traction.
 2. Prevent foot drop.
 3. Keep the client from sliding down in bed.
 4. Prevent pressure areas on the foot.
10. When evaluating all forms of traction, the nurse knows that the direction of pull is controlled by the
 1. Client's position.
 2. Rope/pulley system.
 3. Amount of weight.
 4. Point of friction.
11. Russell's traction incorporates a
 1. Sling under the knee.
 2. Cervical halter.
 3. Pelvic girdle.
 4. Pearson attachment.

- 12.** Which of the following statements is true of skeletal traction?
1. Neurovascular complications are less apt to occur than they are with skin traction.
 2. The client has less mobility than he or she does with skin traction.
 3. Skeletal traction maintains the affected part in optimal alignment to maximize healing.
 4. It is preferred for children because fracture fragment alignment is so important.
- 13.** Following a fracture of the right hip, a client has an open reduction with internal fixation using a prosthesis. Postoperatively, the affected leg should be maintained in a position of
1. Adduction.
 2. External rotation.
 3. Internal rotation.
 4. Abduction.
- 14.** A cast placed on a client's leg has dried. If the drying process were completed, the nurse would observe the cast to be
1. Dull and gray in appearance.
 2. Shiny and white in appearance.
 3. Cool to the touch and gray in appearance.
 4. Warm to the touch and white in appearance.
- 15.** When a client is being instructed in crutch walking using the swing-through gait, the most appropriate directions are
1. "Look down at your feet before moving the crutches to ensure you won't fall as you move them."
 2. "Place one crutch forward with the opposite foot and then place the second crutch forward followed by the second foot."
 3. "Move both crutches forward, then lift and swing your body past the crutches."
 4. "Use the crutch bar to balance yourself to prevent falls."
- 16.** A client's physician orders a Charnley pillow (wedge). The nurse understands that the purpose of using this type of pillow is to
1. Support the ball-and-socket joint.
 2. Maintain abduction.
 3. Maintain adduction.
 4. Encourage internal rotation of the hips.
- 17.** Before the nurse assists the client to crutch walk, a critical assessment is to
1. Evaluate the desire to be independent.
 2. Assess the lower extremity muscle tone.
- 18.** Determine the ability to ambulate alone.
1. Evaluate the need for other assistive devices.
- 19.** The nurse is preparing a client for a myelogram using a water-soluble contrast material. The nurse will know the client understands the postmyelogram care regimen when she says
1. "I will need to keep my head elevated for at least 8 hours."
 2. "I will need to lie flat for 12 to 24 hours."
 3. "I will not be allowed to drink much liquid for 12 hours."
 4. "I expect to have some itching and a stiff neck for a few days."
- 20.** To achieve the desired outcome of functional healing of a fracture, which nursing goal should receive the highest priority?
1. Maintain immobilization and alignment.
 2. Provide optimal nutrition and hydration.
 3. Promote independence in activities of daily living.
 4. Provide relief from pain and discomfort.
- 21.** A young male client has had a cast placed on his right leg. While caring for the client, the nurse identifies a "hot spot" or area on the cast that feels warm. The nurse reports the findings to the physician because the data indicates possible
1. Poor circulation.
 2. Pressure from the cast.
 3. Uneven cast drying.
 4. Infection.
- 22.** When a client has cervical halter traction to immobilize the cervical spine, countertraction is provided by
1. Elevating the foot of the bed.
 2. Elevating the head of the bed.
 3. Application of the pelvic girdle.
 4. Lowering the head of the bed.
- 23.** After falling down the basement steps in his house, a client is brought to the emergency room. His physician confirms that his leg is fractured. Following application of a leg cast, the nurse will first check the client's toes for
1. Increase in temperature.
 2. Change in color.
 3. Edema.
 4. Movement.

- 23.** A 23-year-old female client was in an automobile accident and is now a paraplegic. She is on an intermittent urinary catheterization program and diet as tolerated. The nurse's priority assessment should be to observe for
1. Urinary retention.
 2. Bladder distention.
 3. Weight gain.
 4. Bowel evacuation.
- 24.** A female client with rheumatoid arthritis has been on aspirin 650 mgm and Deltasone (prednisone) 10 mg BID for the last 2 years. The most important assessment question for the nurse to ask related to the client's drug therapy is whether she has
1. Headaches.
 2. Tarry stools.
 3. Blurred vision.
 4. Decreased appetite.
- 25.** A 7-year-old boy with a fractured leg tells the nurse that he is bored. An appropriate intervention would be to
1. Read a story and act out the part.
 2. Watch a puppet show.
- 26.** Which nursing interventions should the nurse teach the client with fibromyalgia? Choose all that apply.
1. Stress the importance of participating in an ongoing rehabilitation program.
 2. Teach that sugar and coffee provide energy and should be included in the diet.
 3. Encourage checking with the primary care provider about vitamin and mineral supplements.
 4. Increase the amount of sleep the client receives each day.
- 27.** Which of the following is not a symptom associated with fibromyalgia?
1. Joint damage caused by inflammation.
 2. Noncardiac chest pain.
 3. Migraine.
 4. Irritable bowel syndrome.

MUSCULOSKELETAL SYSTEM ANSWERS WITH RATIONALE

1. (3) If the hip is flexed to the side, on the side of the bed or in a low chair, hip displacement can occur. Displacement could result in pain, but this is not the primary reason for the instructions. The remaining two answers are not specific or adequate explanations.

NP:AN; CN:PH; CL:C

2. (3) External rotation of the lower leg is a result of external rotation at the hip. Neutral rotation of the trochanter is promoted by placing a thigh trochanter roll that extends from the upper hip to the knee.

NP:P; CN:PH; CL:A

3. (2) The orders state bed elevation (this is done to reduce edema and prevent hemorrhage). A pillow under the stump may lead to a flexion contracture of the hip joint, so it is contraindicated. Also, further teaching by the RN is indicated so that the NA understands why the pillow is contraindicated.

NP:I; CN:PH; CL:A

4. (2) The most important intervention for preventing pressure points is to keep the client pulled up in bed. The nurse may also pad the top of the splint with soft material such as cotton wadding or ABDs to prevent excoriation. The footplate would prevent foot drop.

NP:I; CN:PH; CL:A

5. (2) Aspirin acts as an anti-inflammatory drug and, thus, reduces the inflammation of the joint. In doing so, it also relieves pain. Aspirin does not prevent extension of the disease. While aspirin reduces fever, this is not the major reason for its use in the treatment of rheumatoid arthritis.

NP:AN; CN:PH; CL:K

6. (1) When the prosthesis is in place immediately following surgery, the client can stand up several hours

postoperatively and walk the next day. The operative site is closed to outside contamination and benefits from improved circulation due to ambulation.

NP:P; CN:PH; CL:C

7. (4) The only activity that will indicate a complication directly related to circulatory impairment due to a fractured femur is the inability to wiggle his toes.

NP:A; CN:PH; CL:A

8. (2) Postoperative hip replacement clients may get up the first day, but need to use a walker for balance. They should not bear any weight on the affected side, dangle, or sit in a chair, flexing their hips. Positions with 60- to 90-degree flexion should be avoided.

NP:I; CN:PH; CL:A

9. (2) The purpose of the footplate is to prevent foot drop while the client is immobilized in traction. This will not anchor the traction, keep the client from sliding down in bed, or prevent pressure areas.

NP:P; CN:PH; CL:C

10. (2) The rope/pulley and weight system is arranged so that fracture fragments are in the desired approximate position for healing. The client's position should always rest in line with the traction pull. The line of pull must never be interfered with by changing the position of a pulley and extension bar.

NP:E; CN:PH; CL:C

11. (1) Russell's traction is a type of skin traction that incorporates a sling under the knee that is connected by a rope to an overhead bar pulley. It is frequently used to treat femoral shaft fractures in the adolescent.

NP:AN; CN:PH; CL:K

Coding for Questions/Answers Abbreviations: Nursing Process: NP, Assessment: A, Analysis: AN, Planning: P, Implementation: I, Evaluation: E; Client Needs: CN, Safe, Effective Care Environment: S, Health Promotion and Maintenance: H, Psychosocial Integrity: PS, Physiological Integrity: PH; Clinical Area: CA, Medical Nursing: M, Surgical Nursing: S, Maternal/Newborn Nursing: MA, Pediatric Nursing: P, Psychiatric Nursing: PS; Cognitive Level: CL, Knowledge: K, Comprehension: C, Application: A, Analysis: AN.

12. (3) It is not used commonly in the elderly because of prolonged immobilization. It is not preferred for children because some displacement of fracture fragments is desirable to prevent growth disturbance. Frequently, clients have more mobility than they do with skin traction because more weight can be applied and it reduces fractures and maintains alignment.

NP:AN; CN:PH; CL:K

13. (4) To prevent dislocation of the prosthesis, the legs are kept abducted with neutral rotation. Adduction (1), flexion, and internal rotation (3) are to be avoided.

NP:P; CN:PH; CL:C

14. (2) The cast will be shiny and cool to the touch when dry. It will have a dull appearance when wet.

NP:A; CN:PH; CL:K

15. (3) This is the procedure for using the swing-through gait. Clients are instructed to look straight ahead when walking with crutches. Looking down can lead to falls and uneven gait. Putting pressure from the arm on the crutch bar can cause nerve damage.

NP:I; CN:S; CL:C

16. (2) A Charnley pillow (wedge) is applied to maintain abduction (not adduction) and external (not internal) rotation of the hips. This is most commonly used when the head of the femur is replaced by a prosthesis. Hip flexion angle should not exceed 60 to 90 degrees.

NP:AN; CN:PH; CL:C

17. (3) The ability to ambulate alone or the requirement of personnel to assist with ambulation is the most critical step in assisting a client in crutch walking. Lower muscle strength needs to be evaluated to determine readiness to ambulate and need for assistance.

NP:A; CN:PH; CL:A

18. (1) The head must be kept elevated because this drug could provoke a seizure if it reaches the brain in a bolus form. After myelography using an oil-based contrast medium, clients are kept flat. Forcing fluids helps prevent postmyelogram headache by replacing lost spinal fluid. Itching suggests an allergic reaction, while a stiff neck suggests meningeal irritation; neither is an expected response to a myelogram.

NP:E; CN:PH; CL:C

19. (1) Maintaining the prescribed immobilization and body alignment will keep the fracture fragments in close anatomical proximity, thereby promoting functional fracture healing. This goal should receive the highest priority. The other goals, although applicable in the care of a client with a fracture, do not have as high a priority in meeting this particular desired outcome.

NP:P; CN:PH; CL:C

20. (4) Infection can be identified by “hot spots,” or areas on the cast that feel warm to the touch. A hot spot is not evidence of poor circulation (1) or too tight a cast (2).

NP:I; CN:PH; CL:A

21. (2) To keep the client from migrating toward the head of the bed while the cervical halter traction is used, the head of the bed is slightly elevated. Lowering the head of the bed (4) would aggravate such migration, as would elevating the foot of the bed (1).

NP:P; CN:PH; CL:C

22. (2) A cast is rigid and used to maintain alignment. If it is too tight, it will press on blood vessels. The color of the toes will change first, then temperature, when blood supply is decreased. As the blood flow slows through the walls of the vessels, edema will occur.

NP:A; CN:PH; CL:A

23. (2) Bladder distention indicates the need for catheterization. Catheterizations are usually performed every 4 to 6 hours. The danger of not intervening when the bladder is distended is that it could lead to overdistension or stretching.

NP:A; CN:PH; CL:A

24. (2) Aspirin impedes clotting by blocking prostaglandin synthesis, which can lead to bleeding. A side effect of Deltasone is gastric irritation, also leading to bleeding. Tarry stools indicate bleeding in the upper GI system.

NP:A; CN:PH; CL:A

25. (1) This activity involves the child so that he is actively, if not physically, participating in play. It also allows the child to use his creativity, unlike watching a puppet (2) or television show (3) or listening to the radio (4).

NP:I; CN:H; CL:A

26. (1, 3, 4) Once a client has fibromyalgia, it is a lifelong, noncurable disease that requires continued rehabilitation. Caffeine, sugar, and alcohol (which are muscle irritants) should be avoided. Vitamins, minerals, and supplements should not be taken without physician guidance as they may interact with other prescription drugs. In many clients, the pain of fibromyalgia occurs as a direct response to lack of sleep. Assisting the client to get a better night's sleep can reduce the amount of pain experienced.

NP:AN; CN:S; CL:C

27. (1) There is no inflammation associated with fibromyalgia. Choices (2), (3), and (4) are all common symptoms of fibromyalgia.

NP:A; CN:S; CL:C

INTEGUMENTARY SYSTEM

The integumentary system comprises the enveloping membrane, or skin, of the body and includes the epidermis, the dermis, and all the derivatives of the epidermis, such as hair, nails, and various glands. It is indispensable for the body, as it forms a barrier against the external environment and performs many vital body functions.

ANATOMY AND PHYSIOLOGY

Skin

Definition: The organ that envelops the body. It accounts for approximately 15% of the body weight and forms a barrier between the internal organs and the external environment.

Characteristics

- A. Consists of three layers: epidermis, dermis, and subcutaneous.
- B. It is the largest sensory organ, equipped with nerves and specialized sensory organs sensitive to pain, touch, pressure, heat, and cold.
- C. Chief pigment is melanin, produced by basal cells.
- D. Functions of skin.
 - 1. Protection.
 - 2. Temperature regulation.
 - 3. Sensation.
 - 4. Storage.

♦ Bacterial Flora on the Skin

- A. Normally present in varying amounts are coagulase-positive *Staphylococcus*, coagulase-negative *Staphylococcus*, *Mycobacterium*, *Pseudomonas*, diphtheroids, nonhemolytic *Streptococcus*, and hemolytic *Streptococcus* (group A).
- B. The organisms are shed with normal exfoliation of skin; bathing and rubbing may also remove bacteria.
- C. Damaged areas of skin are potential points of entry for infection.

Hair

Definition: A threadlike structure developed from a papilla in the corium layer.

- A. Hair goes through cyclic changes: growth, atrophy, and rest.
- B. Melanocytes in the bulb of each hair account for color.
- C. All parts of the body except the palms, soles of the feet, distal phalanges of fingers and toes, and penis are covered with some form of hair.

Sweat Glands

Definition: Aggregations of cells that produce a liquid (perspiration) having a salty taste and a pH that varies from 4.5 to 7.5.

- A. Eccrine sweat glands.
 - 1. Located in all areas of the skin except the lips and part of the genitalia.
 - 2. Open onto the surface of the skin.
 - 3. Activity controlled by the sympathetic nervous system.
 - 4. Secrete sweat (perspiration).
 - a. The chief components of sweat are water, sodium, potassium, chloride, glucose, urea, and lactate.
 - b. Concentrations vary from individual to individual.
- B. Apocrine sweat glands.
 - 1. Located in the axilla, genital, anal, and nipple areas.
 - 2. Located in ear and produce ear wax.
 - 3. Develop during puberty.
 - 4. Respond to adrenergic stimuli.
 - 5. Produce an alkaline sweat.

Sebaceous Glands

- A. Develop at base of hair follicle.
- B. Secrete sebum.
- C. Hormone controlled. Increased activity with androgens; decreased activity with estrogen.

System Assessment

- ♦ A. Assess color.
 - 1. Assess color of skin, including deviations from the normal range within the individual's race.
 - a. Use a nonglare daylight or 60-watt bulb.
 - b. Note especially the bony prominences.
 - c. Observe for pallor (white), flushing (red), jaundice (yellow), ashen (gray), or cyanotic (blue) coloration.
 - d. Check mucous membranes to be accurate.
 - 2. Observe for increased or decreased areas of pigmentation.
 - 3. Observe for various skin discolorations: ecchymosis, petechiae, purpura, or erythema.
- ♦ B. Evaluate skin temperature.
 - 1. Palpate skin (especially areas of concern) for temperature.
 - 2. Note changes in different extremities.
- ♦ C. Assess turgor.
 - 1. Observe skin for its ease of movement and speed of return to original position.
 - 2. Observe for excessive dryness, moisture, wrinkling, flaking, and general texture.
 - 3. Observe for a lasting impression or dent after pressing against and removing finger from skin—indicates edema or fluid in the tissue.

- ◆ D. Assess skin sensation.
 1. Observe the client's ability to detect heat, cold, gentle touch, and pressure.
 2. Note complaints of itching, tingling, cramps, or numbness.
- E. Assess signs of poor nutrition.
 1. Rough, dry, scaly skin.
 2. Pigmented or irritated.
 3. Bruises or petechiae.
- ◆ F. Observe cleanliness.
 1. Observe general state of hygiene. Note amount of oil, moisture, and dirt on the skin surface.
 2. Note presence of strong body odors.
 3. Investigate hair and scalp for presence of body lice.
- ◆ G. Assess integrity (intactness of skin).
 1. Note intactness of skin. Observe for areas of broken skin (lesions) or ulcers.
 2. Assess any lesion for its location, size, shape, color(s), consistency, discomfort, odor, and sensation associated with it.
- ◆ H. Assess for presence of skin lesions.

◆ Skin Lesions

- A. **Macule:** a flat, circumscribed, discolored lesion less than 1 cm in diameter.
- B. **Papule:** a raised, solid lesion less than 1 cm in diameter.
- C. **Nodule:** similar to a papule except greater depth.
- D. **Vesicle:** an elevated lesion of skin or mucous membrane filled with fluid.
- E. **Pustule:** a pus-filled vesicle.
- F. **Wheal:** an irregularly shaped and elevated lesion of skin or mucous membrane due to edema; diameter variable.
- G. **Plaque:** a collection of papules.
- H. **Erosion:** a moist depressed area due to partial or full loss of epidermis.
- I. **Ulcer:** the complete loss of dermis leaving irregular depression; scars on healing.

System Implementation

- ◆ A. Monitor client's most vulnerable body areas for ischemia, hyperemia, or broken areas.
- B. Encourage a well-balanced diet, especially protein-rich foods.
- C. Promote high fluid intake to maintain hydration status and prevent skin breakdown.
- ◆ D. Change the client's body position at least every 2 hours to rotate weight-bearing areas and prevent pressure ulcers.
 1. Observe all vulnerable areas at this time.
 2. Include right and left lateral, prone, supine, and swimming-type positioning if possible.

- E. Massage skin to increase circulation.
- F. Keep skin clean.
- G. Protect healthy skin from drainage and environmental pollutants.
- H. Encourage active exercise or range of motion to promote circulation.
- I. Monitor medications for various skin conditions or lesions.
- J. Instruct clients about appropriate skin care.

COMMON SKIN LESIONS

Pressure Ulcers

See Gerontological Nursing, Chapter 15.

Cellulitis

Definition: Infection of the dermis or subcutaneous tissue caused by either streptococcal or staphylococcal organisms—may follow surgical wound, impetigo, trauma, or otitis media.

Assessment

- ◆ A. Swelling, erythema.
- B. Leukocytosis.
- C. Pain and itching.

Implementation

- ◆ A. Monitor systemic antibiotics—effective for the condition.
- B. Elevate the extremity to reduce dependent edema.
- C. Apply heat to extremity to promote blood circulation.
- D. Encourage rest to decrease muscular contractions to limit extension of organism into circulatory system.

Impetigo

- ◆ **Definition:** A bacterial disease caused by *Streptococcus*, *Staphylococcus*, or both.

Characteristics

- A. Lesions are intraepidermal vesicles.
- B. Lesions progress to pustules, which become crusted.

Implementation

- ◆ A. Instruct client that the most important intervention is the prevention of the spread of the disease.
 1. Complete cleansing with hexachlorophene soap and other hygienic care materials.
 2. Separate towels.
- B. Instruct that lesions dry by exposure to air; use compresses of Burow's solution to remove the crusts to allow faster healing.

- C. Apply antibiotic ointments.
 - 1. Bacitracin or Bactroban (mupirocin).
 - 2. If no response to topical antibiotic cream, systemic drug (erythromycin) is used.

Herpes Simplex

Definition: A viral disease (cold sore) caused by herpes virus, hominis types 1 and 2.

Characteristics

- ◆ A. Herpes 1.
 - 1. Most common type.
 - 2. Causes burning, tingling, and itching; soon followed by tiny vesicles.
 - 3. Most frequently occurs on lips, but can occur on the face and around the mouth.
- ◆ B. Herpes 2. (See Chapter 12, page 562.)
 - 1. Most often the cause of genital infection.
 - 2. Transmitted primarily through sexual contact.
 - 3. Difficult to treat and to prevent recurrence.

Implementation

- A. Herpes simplex virus, type 1.
 - 1. Keep area dry; apply drying agent (ether).
 - ◆ 2. L-Lysine amino acid: 1 g/day for 6 months.
- ◆ B. Herpes genitalis, type 2.
 - 1. Avoid sexual contact with active lesion.
 - 2. Use Zovirax (acyclovir) cream; recurrence—give Zovirax 200 mg PO × 5 for 5 days.

Herpes Zoster (Shingles)

Definition: Acute invasion of the peripheral nervous system due to reactivation of *Varicella zoster* virus.

Assessment

- A. Evaluate eruption with fever, malaise, and pain.
- B. Assess vesicles (exudate contains virus) that appear in 3–4 days.
- C. Assess client's status—if immunosuppressed, condition can be life-threatening.

Implementation

- A. Isolate client.
- B. Apply lotions—calamine, cayenne pepper cream.
- C. Administer drugs: analgesics for pain; antiviral agents (Zovirax) and anti-inflammatory drugs such as NSAIDs.
- D. Instruct client on preventive measures to enhance immune system.

Syphilis

◆ *Definition:* A communicable sexually-transmitted disease that leads to many structural and cutaneous lesions.

Caused by the spirochete *Treponema pallidum*. The disease is transmitted by direct, intimate contact, or in utero.

Characteristics

- ◆ A. Transmitted commonly by sexual intercourse, but infants may become infected during birth process. Early-stage syphilis up 29% from 2000, largely among gay men.
- B. No age or race is immune to the disease.
- C. Diagnosed by serum studies and/or darkfield examination of secretions of the chancre.
- ◆ 1. Wassermann test.
- 2. Kahn test.
- D. No immunity develops, and reinfection is common.
- E. Types of syphilis.
 - 1. Early syphilis—two stages.
 - a. Primary stage.
 - (1) Incubation period is 10 days to 3 weeks.
 - ◆ (2) Characteristic lesion is red, eroded, indurated papule; the sore or ulcer at the site of the invasion by the spirochete is called a chancre.
 - (3) Accompanied by enlarged lymph node in drainage area of chancre.
 - (4) May be painless or painful.
 - (5) This stage is highly infectious.
 - b. Secondary stage.
 - (1) Develops if the individual is not treated in the primary stage. Occurs in 2–6 months and may last 2 years.
 - (2) May be mild enough to pass unnoticed or may be severe, with a generalized rash on skin and mucous membrane.
 - (3) Headache, fever, sore throat, and general malaise are common.
 - (4) Disappears by itself if untreated in 3–12 weeks.
 - 2. Late syphilis—tertiary stage.
 - a. Symptoms may develop soon after secondary stage or lie hidden for years.
 - b. Blood test may be negative.
 - c. Less contagious but very dangerous to individual.
 - d. If untreated, cardiovascular problems may ensue.
 - e. Blindness or deep ulcers may occur.
 - f. May be treated with antibiotics but cure is more difficult.

Implementation

- A. Advise client that strict personal hygiene is an absolute requirement.
- B. Educate client in prevention: symptoms, mode of transmission, and treatment.

- C. Assist in case finding; encourage use of clinics for diagnosis and treatment.
- D. Administer long-acting penicillin G benzathine (still primary treatment in the early stages).
- E. Instruct client to avoid sexual contact until clearance is given by physician.

ALLERGIC RESPONSES

Eczema (Atopic Dermatitis)

Definition: A superficial inflammatory process involving primarily the epidermis.

Characteristics

- A. Eczema is a chronic condition with remissions and exacerbations.
- B. Eczema occurs at all ages and is common in infancy, especially in those with hereditary allergic tendencies.
- C. Treatment is dependent on cause (foods, emotional problems, familial tendencies).
- D. Child is isolated from recently vaccinated children; child is not vaccinated.

Assessment

- A. Assess for eruptions that are erythematous, papular, or papulovesicular.
 - 1. May be edematous, weeping, eroded, crusted, and/or dry.
 - 2. Chronic form may cause skin to be thickened, scaling, and fissured.
- B. Assess if regional lymph nodes are swollen.
- C. Assess if irritability is present.

Implementation

- A. There is no cure—goals are to reduce pruritus and inflammation and to hydrate and lubricate the skin.
 - 1. Have clients keep fingernails short; provide gloves to prevent scratching.
 - 2. Apply wet dressings soaked in aluminum acetate or tepid therapeutic baths (no soap during acute stages; if client shivers stop bath as body is trying to produce heat to keep warm).
 - 3. Apply mild lotion (calamine) when no oozing or vesication is present.
 - 4. Use cornstarch paste to remove crusts.
- B. Apply corticosteroids 1% to 2½% (Flonase [fluticasone propionate]) as anti-inflammatory agent.
- C. Oral corticosteroids may be given for acute reaction.
- D. Topical treatment of zinc spray shows excellent results.

Contact Dermatitis

Definition: A skin reaction caused by contact with an agent to which the skin is sensitive.

Characteristics

- A. Causes.
 - 1. Clothing (especially woolens).
 - 2. Cosmetics.
 - 3. Household products (especially detergents).
 - 4. Industrial substances (e.g., paints, dyes, cements).
- B. Treatment.
 - 1. Avoidance of irritant or removal of irritating clothing.
 - 2. Avoidance of contact with detergent (use of rubber gloves for household chores).
 - 3. Avoidance of contact with industrial agent (use of protective clothing or, for highly sensitive individuals, change of job locations).

SKIN CONDITIONS

Malignant Skin Tumors

Assessment

- A. Evaluate lesion that starts as a papule and spreads; central area may become depressed and ulcerated.
- B. Assess extent of local invasion or extensive local destruction.
- C. Evaluate lesions that enlarge rapidly (may indicate basal cell epithelioma, and can metastasize).
- D. Assess for any nodular tumor that appears, usually on the lower lip, tongue, head, or neck.
- ◆ E. Assess for specific type of skin tumor.
 - 1. Basal cell epithelioma is a tumor arising from the basal layer of the epidermis formed because of basal cell keratinization. The typical lesion is a small, smooth papule with telangiectasis and atrophic center.
 - 2. Melanoma is the most malignant of all cutaneous lesions. It arises from melanocytes and is often fatal. It occurs most frequently in light-skinned people when they are exposed to sunlight.
 - 3. Squamous cell carcinoma is a tumor of the epidermis that frequently comes from keratosis and is considered an invasive cancer. The lesion begins as erythematous macules or plaques with indistinct margins, and the surface often becomes crusted.

Implementation

- A. Assist with surgical excision, the most effective treatment.

- B. Administer cancer drugs if ordered.
- C. Assist with irradiation if ordered.
 - 1. Counsel client on side effects of treatment.
 - 2. Offer emotional support throughout treatment.
- D. Advise client to prevent occurrence of skin cancer by using sun screening devices.
- E. Advise client to avoid prolonged exposure to sun.
- ♦ F. Educate client to observe any changes in color or form of moles.
- G. Watch for potential malignancy in other locations.

Lupus Erythematosus

Definition: A chronic, multisystem autoimmune disease of the connective tissue that may involve any organ of the body. Etiology unknown.

Characteristics

- A. Affects women nine times more than men.
- B. May affect every cell in the body.
- C. Prognosis poor when cardiac, pulmonary, or renal involvement early in disease.

Assessment

- A. Onset may be insidious or acute.
- ♦ B. Assess for discoid eruption—a chronic, localized, scaling erythematous skin eruption over the nose, cheeks, and forehead, giving a characteristic “butterfly” appearance.
- C. Evaluate for fever, malaise, and weight loss.
- D. Observe for exacerbation and remission of symptoms.
- E. Assess for sensitivity to sunlight.
- ♦ F. Systemic (disseminated) lupus erythematosus may have multiple organ involvement that can lead to death.
 - 1. Pericarditis is common manifestation (30%); myocarditis also present (25% of clients).
 - 2. Lung and pleural involvement common (40% to 50%).
 - 3. Vascular system often involved with inflammation, producing lesions on fingertips, elbows, toes, etc.
 - 4. Lymphadenopathy occurs in half of all clients.
 - 5. Neuropsychiatric symptoms are often present and require intervention.

Implementation

- A. Goal of treatment is to prevent loss of organ function—involves careful monitoring.
- ♦ B. Administer corticosteroid treatment to prevent progression of the disease—most important class of drugs used for treatment.
- ♦ C. Instruct client to avoid sunlight and local antibiotic ointments that spread the lesions.

- D. Apply topical sunscreen preparations.
- E. Advise client of possible side effects of prescribed medications; advise client to notify physician promptly if side effects occur so drugs may be discontinued before serious complications.
- F. Counsel client to avoid fatigue.
- G. Cover up disfigurement from scarring with opaque or tinted cosmetics as recommended by physician.

BURNS

Definition: Destruction of layers of the skin by thermal, chemical, or electrical agents; fire, steam, or radiation.

Degree of Burn According to Depth

- A. Classified by depth of tissue destruction. Categories are similar to, but not the same as, prior categories of first-, second-, third-, and fourth-degree burns.
- ♦ B. Superficial, partial-thickness (first-degree).
 - 1. Involves epidermis.
 - 2. Area is red or pink.
 - 3. Moderate pain.
 - 4. Spontaneous healing.
- ♦ C. Deep, partial-thickness (second-degree).
 - 1. Involves epidermis and dermis to the basal cells.
 - 2. Blistering.
 - 3. Severe pain.
 - 4. Regeneration in 1 month.
 - 5. Scarring may occur.
- ♦ D. Full-thickness (third-degree).
 - 1. Involves epidermis, dermis, and subcutaneous tissue and may extend to the muscle in severe burns.
 - 2. White, gray, or black in appearance.
 - 3. Absence of pain.
 - 4. Edema of surrounding tissues.
 - 5. Eschar formation.
 - 6. Grafting needed due to total destruction of dermal elements.
- E. Full-thickness (fourth-degree) from prolonged exposure to high voltage electrical current.
 - 1. Involves fat, fascia, muscle, and/or bone.
 - 2. Tissue is charred.
 - 3. Depending on body surface area (BSA) of injured and response, client may be in shock.
 - 4. Myoglobinuria (red pigments in the urine) and possible hemolysis.
 - 5. Amputations are likely.
 - 6. Grafting of no benefit given depth and severity of injury.

Extent of Burn

- ◆ A. Rule of nines—good for rapid estimation of extent of BSA involved.

1. Head and neck	9%
2. Anterior trunk	18%
3. Posterior trunk	18%
4. Arms (9% each)	18%
5. Legs (18% each)	36%
6. Perineum	1%
- B. Lund/Browder method.
 1. More accurate and appropriate to use when calculating fluid replacement.
 2. A chart is necessary to compute percentages assigned to body areas.
 3. Percentages vary for different age groups.
- C. Palm method.
 1. Client with scattered burns may have percentage calculated with this method.
 2. Size of client's palm is 1% of BSA—this percentage is used to assess injury.
- ◆ D. Fluid replacement formulas.
 1. Brooke Army formula—colloids, electrolytes, and glucose first 24 hours.
 2. Parkland/Baxter—lactated Ringer's only first 24 hours; day 2, colloid is added.
 3. Consensus formula—lactated Ringer's solution first 24 hours.
 4. Evans formula—colloids, electrolytes, and glucose first 24 hours.
- E. Associated factors that determine seriousness of burn.
 1. Age.
 - a. Younger than 18 months.
 - b. Older than 65 years.
 2. General health.
 3. Site of burn.
 4. Associated injuries (fractures).
 5. Causative agents.
 6. Other medical problems.

Category of Burn Classification

- ◆ A. Classification according to the percentage of body area destroyed.
 1. **Major burns:** 25% or more of the body has sustained second-degree burn, and 10% has sustained third-degree burn; further complicated by fractures, respiratory involvement, and smoke inhalation. Burns of feet, hands, face, and genitalia.
 2. **Moderate burns:** Less than 10% of the body has sustained third-degree burn, and 15% to 25% has sustained second-degree burn.

- 3. **Minor burns:** Less than 15% of the body has sustained second-degree burn, and less than 2% has sustained third-degree burn.
- B. Classification according to cause.
 1. **Thermal burns:** flame burns, scalding with hot liquids, or radiation.
 2. **Chemical burns:** strong acids or strong alkali solutions.
 3. **Electrical burns.**
 - a. Most serious type of burn.
 - b. Body fluids may conduct an electrical charge through body (look for entrance and exit area).
 - c. Cardiac arrhythmias may occur; often the cause of immediate death.
 - d. Toxins that injure kidneys are created postburn.
 - e. Voltage and ampere information important in history taking.

Assessment

- A. Assess extent of injury.
 1. Assess for superficial burn: involves only reddening of the skin.
 2. Assess for partial-thickness burn: skin blisters, regeneration of epithelium without grafting.
 3. Assess for full-thickness burn: destruction of most of the epidermal tissue; unable to regenerate without graft.
 4. Assess for full thickness that involves fat, fascia, muscle, and/or bone.
- B. Assess type of treatment appropriate to extent of burn and how burn occurred.
 - ◆ 1. First aid.
 - a. Provide comfort and prevent chilling.
 - b. Wash area with cool, sterile solution or water if no sterile solution is available.
 - c. Cover with a sterile cloth to prevent contamination.
 - d. Do not apply any substances until burn is evaluated.
 - e. Wash surrounding area thoroughly with mild detergent.
 - 2. Exposed method: No dressing is used so that hard eschar forms, protecting wound from infection. This method is excellent for areas difficult to bandage effectively. Requires isolation and is difficult for a child.
 - 3. Closed method: Sterile occlusive dressing is applied frequently, usually with topical

- medications. Debridement occurs every time the dressing is changed, preventing a large loss of blood at one time, as when eschar is removed.
- C. Continued assessment during acute burn phase.
 - 1. Respiratory status.
 - 2. Fluid status.
 - 3. Vital signs.
 - 4. pH from nasogastric (NG) tube and residual gastric volume; gives data on need for antacid therapy.
 - 5. Pain level and need for pain relief.
 - 6. Wound assessment—color, odor, exudate, eschar, etc.
 - 7. Body weight; need for adjusted caloric intake.
 - 8. Psychosocial response to injury.

Implementation

- ◆ A. Maintain patent airway. Monitor for tracheal-laryngeal edema.
- B. Provide fluid replacement therapy.
 - ◆ 1. Resuscitative phase.
 - a. First 24 to 48 hours postburn, fluid shifts from plasma to interstitial space.
 - b. Potassium levels rise in plasma.
 - c. Blood hemoconcentration and metabolic acidosis occur.
 - d. Fluid loss is mostly plasma.
 - e. Nursing responsibilities.
 - (1) Monitor vital signs frequently.
 - (2) Monitor urinary output (50 to 100 mL/hr—minimum output 30 mL/hr).
 - (3) Give one-half of total fluids in first 8 hours or as ordered. (The first 8 hours starts at the time the burn occurs, not the time the client arrives at the healthcare facility.)
 - (4) Notify physician if urine output less than 30 mL/hr, weight gain, jugular vein distention, crackles, or increased arterial pressure.
 - ◆ 2. Acute or intermediate phase.
 - a. Capillary permeability stabilizes and fluid begins to shift from interstitial spaces to plasma.
 - b. Hypokalemia, hypernatremia, hemodilution, and pulmonary edema are potential dangers.
 - c. Nursing responsibilities.
 - (1) Monitor central venous pressure (CVP).
 - (2) Observe lab values.
 - (3) Maintain adequate urine output.

- C. Assess pain level frequently and relieve pain with morphine sulfate IV as ordered. Give small doses frequently.
- ◆ D. Prevent infection.
 - 1. Provide aseptic technique and environment.
 - a. Use meticulous hand hygiene technique or antiseptic gel before and after client care.
 - b. Use clean or sterile gloves.
 - c. Use isolation protocol. (See **Table 8-7**.)
 - 2. Observe for signs of infection, increased temperature and pulse, wound drainage.
 - 3. Provide prophylactic measures: tetanus and antibiotics.
- ◆ E. Prevent pulmonary complications.
 - 1. Establish and observe for adequate airway.
 - 2. Suction PRN.
 - 3. Provide humidified oxygen PRN.
 - 4. Teach coughing and deep-breathing.
 - 5. Provide frequent position changes.
- ◆ F. Establish adequate circulatory volume to prevent shock.
 - 1. Observe for signs of hypovolemia (e.g., thirst, vomiting, increased pulse, decreased blood pressure, and decreased urinary output).
 - 2. Observe for signs of circulatory overload, particularly around the second to fifth days, when fluid in extracellular tissues returns to circulation. There is danger of congestive heart failure.
 - 3. Monitor intravenous fluid therapy.
 - 4. Monitor intake and output.
- G. Monitor for complications.
 - 1. Congestive heart failure and/or pulmonary edema.
 - 2. Sepsis.
 - 3. Acute respiratory failure.
- ◆ H. Promote good body alignment—prevent contractures.
 - 1. Keep body parts in alignment.

◆ **Table 8-7 ISOLATION PROTOCOL**

Protocol for Entering Isolation Room	Protocol for Leaving Isolation Room
<ol style="list-style-type: none"> 1. Complete hand hygiene. 2. Put on gown and tie. 3. Put on and tie mask. 4. Don goggles or face shield. 5. Don gloves. 	<ol style="list-style-type: none"> 1. Untie gown at waist. 2. Take off gloves. 3. Untie gown at neck. 4. Pull gown off and place in laundry hamper. 5. Take off goggles or face shield. 6. Take off mask. 7. Leave room and complete hand hygiene.

- 2. Elevate burned extremities.
- 3. Provide active and/or passive range of motion to all joints.
- ◆ I. Provide adequate nutrition (total parenteral nutrition [TPN] or enteral feedings).
 - 1. Give high-protein, high-caloric diet—goal is to provide positive nitrogen balance.
 - 2. Give nutritional supplements and vitamin/mineral supplements.
 - 3. Provide small, frequent, and attractive meals.
 - 4. Encourage child, who is frequently anorexic, to eat.
- J. Provide adequate heat to maintain temperature.
- ◆ K. Administer antacids, H₂-receptor antagonists, and Carafate (sucralfate) to prevent stress ulcer, as ordered.
- ◆ L. Maintain wound dressings.
 - 1. Initial excision: mainly for electrical burns.
 - 2. Occlusive dressings.
 - a. Painful and costly.
 - b. Decrease water loss.
 - c. Limit range-of-motion exercises.
 - d. Help to maintain functional position.
 - e. Advent of topical antibiotics has led to decreased use.
 - 3. Exposure method.
 - a. Allows for drainage of burn exudate.
 - b. Eschar forms protective covering.
 - c. Use of topical therapy.
 - d. Skin easily inspected.
 - e. Range-of-motion exercises easier to perform.
- ◆ M. Apply topical preparations to wound area.
 - 1. Sulfamylon (mafénide) 5% to 10%.
 - a. Exerts bacteriostatic action against many organisms.
 - b. Penetrates tissue wall.
 - c. Dressings not needed when used.
 - d. Agent of choice for electrical burns.
 - e. Breakdown of drug provides heavy acid load. Inhibition of carbonic anhydrase compounds situation.
 - f. Monitor arterial blood gases (ABGs) for acidosis. Individual compensates by hyperventilating.
 - g. Alternate use with Silvadene (silver sulfadiazine).
 - h. Topical of choice for electrical burns.
 - 2. Silvadene 1%.
 - a. Broad antimicrobial activity.
 - b. Effective against yeast.
- c. Inhibits bacteria resistant to other antimicrobials.
 - (1) Not usually used prophylactically.
 - (2) Given for specific organism.
 - (3) Not helpful first 48 hours due to vessel thrombosis.
- d. Can be washed off with water.
- e. Assess for leukopenia after 2–3 days—may resolve automatically.
- 3. Silver nitrate 0.5%.
 - a. Used for many years but decreasing in popularity.
 - b. Controls bacteria in wound and reduces water evaporation.
 - c. Disadvantages are that it acts only on surface organisms, dressings are messy and must be kept wet, and bulk of dressing decreases ROM, electrolyte imbalance (low sodium, chloride, calcium, and potassium).
- N. Administer systemic antibiotics when there is wound sepsis or positive cultures.
- O. Debridement and eschar removal daily.
- P. Provide long-term care.
 - 1. Maintain good positioning to prevent contractures.
 - 2. Prevent infection.
 - 3. Maintain adequate protein and caloric intake to promote healing.
 - 4. Monitor hydration status.
 - 5. Protect skin grafts.
 - 6. Provide psychological support (as important as physical care).
 - a. Deal with the client's fear of disfigurement and immobility from scarring.
 - b. Provide constant support, as plastic repair is lengthy and painful.
 - c. Involve the family in long-term planning and day-to-day care.
- ◆ Q. Design activities for the burned child while child is hospitalized.
 - 1. Actively involve the child (e.g., acting out part of a story verbally).
 - 2. Provide television, books, and games.
 - 3. Allow the child to associate with friends.
- R. Counsel parents.
 - 1. Parents and child have difficulty dealing with disfigurement and need assistance.
 - 2. Parents frequently feel guilty, although they are usually not at fault and need assistance working out these feelings.

◆ TREATMENT

- A. Immediate care.
 - 1. Put out the flames—have client drop to floor or ground and roll.
 - 2. Apply cold water for brief duration in second-degree burn if seen within 10 minutes of injury.
 - 3. Do not apply any ointment.
 - 4. Cover burns with sterile or clean cloth.
 - 5. Irrigate chemical burns thoroughly.
- B. Emergency care.
 - ◆ 1. Patent airway and IV line are established.
 - 2. 100% oxygen if burn occurred in enclosed area.
 - 3. Degree and extent of burn are determined—adequate pain relief given.
 - ◆ 4. Fluid balance is maintained.
 - a. First day, give formula of choice according to percentage of body burn and weight plus 2000 mL D₅W.
 - b. Second day, give colloids with solutions.
 - c. Urine output is maintained at least 50 mL/hr.
 - d. Vital signs—CVP line usually inserted or pulmonary artery pressure (PAP) catheter as PAP the most effective method of monitoring the cardiovascular system.
 - 5. Nasogastric tube (inserted to prevent vomiting from paralytic ileus).
 - 6. Tetanus toxoid.
 - 7. Escharotomy or fasciotomy if needed.
- C. Long-term care.
 - 1. Wound debridement.
 - 2. Wound care: ointment and/or dressing.
 - 3. Skin grafting.
- ◆ D. Types of skin grafting.
 - 1. Homograft or allograft: from cadaver or other person.
 - 2. Xenograft: from an animal (usually pigs).
 - 3. Autograft: from self.
 - 4. Biosynthetic covering (Biobrane): Mimics skin's most important function—protecting against trauma and infection.
 - 5. Cultured epithelial autograft (CEA): Provides permanent covering (client's cells are harvested and grown in laboratory, then grafted).
 - 6. Integra: Artificial skin approved by FDA in 1996—permanent, immediate covering that reproduces skin's normal function and stimulates regeneration of dermal tissue.
 - a. Consists of two layers that completely adhere to wound bed and mimic dermis and epidermis.
 - b. As dermis is regenerated, the matrix is absorbed and a “neodermis” forms in 14–21 days—once dermis has healed, silicone layer is removed and replaced by thin, meshed epidermal graft.

LYME DISEASE

◆ *Definition:* A multisystem inflammatory disorder caused by an infection acquired through ticks that live in wooded areas and survive by attaching themselves to animal and human hosts.

Assessment

- A. Disease is caused by a spirochete.
- B. This disease has many and varied symptoms and is difficult to diagnose because it masquerades as other illnesses.
- ◆ C. Following a tick bite, the first symptoms occur several days to a month following the bite.
 - 1. Assess for a small red pimple, macule, or papule that spreads into a ringed-shaped rash in 4–20 days. Rash may be large or small, or not occur at all (making diagnosis difficult).

- 2. Assess for flulike symptoms: headache, stiff neck, muscle aches, and fatigue.
- D. Assess for the second stage occurring several weeks following the bite: central nervous system abnormalities; heart disease symptoms—heart block or joint pain (arthritis).
- E. Assess for third-stage symptoms: arthritis progresses and large joints are usually involved (50%).
 - 1. Lingering Lyme arthritis may be caused by lingering infection or immune response.
 - 2. A test called the polymerase chain reaction (PCR) identifies persistent Lyme arthritis that may persist even after aggressive antibiotic therapy.

Implementation

- ◆ A. Blood test may detect the disease but is usually negative during the early phases.

1. Once diagnosis is confirmed, administer antibiotics—dosage depends on severity of symptoms.
 2. Penicillin-type drugs given as soon as possible—shorten course of disease.
 3. IV Rocephin (ceftriaxone) is prescribed for severe cardiac and neurologic problems.
- B. Prevention is the best treatment.
1. Avoid areas that contain ticks—those that are wooded, grassy, especially in the summer months. There is no vaccine.
 2. Wear tight-fitting clothing and spray body with tick repellent.
 3. Examine entire body for ticks upon return home; if tick is located, remove with tweezers and wash skin with antiseptic, and preserve tick for examination.

INTEGUMENTARY SYSTEM REVIEW QUESTIONS

1. When the nurse is administering a tepid bath, a client begins to shiver. The intervention would be to
 1. Continue with the bath, as this helps dissipate the heat.
 2. Stop the bath for a few minutes and place a warm blanket on the client to stop shivering.
 3. Stop the bath, as the body is attempting to produce heat.
 4. Warm the solution, continue the bath, and change the location of cloth placement.
2. A client has interrupted skin integrity. All of the nursing actions below would be appropriate. Which intervention would have the highest priority as a skin protection measure?
 1. Use of appropriate skin care products.
 2. Use of a therapeutic bed (continuous air-flow mattress).
 3. Aseptic technique during skin care.
 4. Pressure ulcer care for the specific stage of the ulcer.
3. The nurse will know a client with lupus erythematosus understands principles of self-care when she can discuss
 1. Drying agents.
 2. Moisturizing agents.
 3. Antifungal creams.
 4. Solar protection.
4. The treatment prescribed for the burned area of skin before skin grafting can take place will include
 1. Silver nitrate soaks for 24 hours.
 2. Burn irrigations with Sulfamylon (mafenide).
 3. Warm soaks with sterile water.
 4. Germicidal soap scrubs to the affected area.
5. While assessing a client with systemic lupus erythematosus, the nurse should keep in mind that the disease affects multiple systems. The nurse should assess for the most common symptoms of
 1. Psychiatric disorders.
 2. Photosensitivity.
 3. Glomerulonephritis.
 4. Joint symptoms.
6. When a client has suffered severe burns all over his body, the most effective method of monitoring the cardiovascular system is
 1. Cuff blood pressure.
 2. Arterial pressure.
 3. Central venous pressure.
 4. Pulmonary artery pressure.
7. The client's skin becomes irritated from the bed linen. A possible nursing intervention that could alleviate the problem is to
 1. Change the linen.
 2. Switch to a pressure-relieving mattress.
 3. Use lotion on the skin.
 4. Keep the client out of bed as much as possible.
8. All of the following are objectives for bathing clients. Which one is the most important?
 1. Maintain muscle tone.
 2. Provide comfort.
 3. Assess the client's overall status.
 4. Improve the client's sense of self-worth.
9. Monitoring the client's skin condition involves several specific nursing actions. Which action would be the *least* important?
 1. Check the skin color.
 2. Assess the skin temperature.
 3. Observe skin turgor.
 4. Examine skin for dryness.
10. When the nurse is completing an assessment of a burned client, second-degree burns would appear as
 1. Full-thickness with extension to underlying muscle and bone.
 2. Partial-thickness with erythema and often edema, but no vesicles.
 3. Partial-thickness with involvement of epidermis and dermis, showing edema and vesicles.
 4. Full-thickness with dry, waxy, or leathery appearance without vesicles.

- 11.** A client has chronic dermatitis involving the neck, face, and antecubital creases. She has a strong family history of varied allergy disorders. This type of dermatitis is probably best described as
1. Contact dermatitis.
 2. Atopic dermatitis.
 3. Eczema.
 4. Dermatitis medicamentosa.
- 12.** Burn clients require continuous emotional support. Evaluating the nursing care for this male client, the nurse will know that he will receive therapeutic support by which of the following nursing actions?
1. The staff's keeping his room neat and clean.
 2. Rotating the staff so he could have varied interactions.
 3. Reacting to him as an individual by spending time with him.
 4. Keeping family members aware of his condition.
- 13.** A client sustains a 30% burn over her lower extremities. When she arrives in the emergency room, the most important intervention is to
1. Clean and dress the wound.
 2. Immediately perform endotracheal intubation.
 3. Administer a tetanus booster.
 4. Start an IV.
- 14.** The following types of clients all require similar diets: a young client with second- and third-degree burns, a middle-aged client following abdominal surgery, and an elderly client prior to elective surgery. The most appropriate diet is one high in
1. Fat and vitamin C.
 2. Protein and calories.
 3. Carbohydrates and low in fat.
 4. Protein and low in carbohydrates.

INTEGUMENTARY SYSTEM ANSWERS WITH RATIONALE

- 1.** (3) Stop or modify the bath to prevent shivering. Shivering is a method of producing body heat.

NP:I; CN:S; CL:A

- 2.** (4) The most important intervention is to implement pressure ulcer care. The specific ulcer stage treatment is necessary to stop the ulcer from increasing and institute healing therapy. The other interventions are more important for prevention of skin breakdown, even though they should be carried out after skin integrity has been interrupted.

NP:I; CN:PH; CL:A

- 3.** (4) It is most important that the client with lupus protects herself from sun exposure with large-brimmed hats, long sleeves, and sunscreen cream. Keeping the skin moist and clean are also important, but lesions are best prevented by sun protection.

NP:E; CN:H; CL:C

- 4.** (4) In addition to the germicidal soap scrubs, systemic antibiotics are administered to prevent infection of the wound. Silver nitrate is not a common treatment today.

NP:P; CN:PH; CL:C

- 5.** (4) Joint involvement (with or without synovitis) is seen in almost all clients with lupus. Glomerulonephritis (3) develops in about 50% of clients and may lead to renal failure. Photosensitivity (2) is less common, and psychiatric disorders (1) due to neurologic involvement are seen in clients with severely active disease.

NP:A; CN:PH; CL:C

- 6.** (4) Pulmonary artery pressure is the most effective method. Clients with a large percentage of burned body surface often do not have an area where a cuff can be applied. Cuff blood pressures (1) are also affected more by peripheral vascular changes. Pulse monitoring is not accurate enough to detect subtle changes in the system.

Central venous pressures (3) are less than optimal because changes in left heart pressure (sign of pulmonary edema) are often not reflected in the right heart pressures.

NP:A; CN:PH; CL:C

- 7.** (2) A pressure-relieving mattress could help to lessen the irritated skin. Changing the linen (1) would help only if the linen were hypoallergenic. The other two answers are not therapeutic and would not solve the problem. It is important to keep the linen free from wrinkles, which contribute to irritation.

NP:I; CN:S; CL:A

- 8.** (3) Assessing the client's overall status, including physical and mental, is the broadest and most important because it gives cues to the total condition of the client. The other objectives will be fulfilled as this activity is completed.

NP:P; CN:S; CL:A

- 9.** (4) Dryness of the skin is the least important because the other parameters give more information about the client's overall condition. Color (1) helps to identify poor circulation or oxygen exchange, skin temperature (2) may indicate increased temperature, and turgor (3) may indicate dehydration.

NP:A; CN:PH; CL:C

- 10.** (3) A second-degree burn involves the epidermis and dermis. Answer (1) is the definition of a fourth-degree burn, (2) is characteristic of a first-degree burn, and (4) is the definition of a third-degree burn.

NP:A; CN:PH; CL:C

- 11.** (2) Atopic dermatitis is chronic, pruritic, and allergic in nature. Typically, it has a longer course than contact dermatitis (1) and is aggravated by commercial face or body lotions, emotional stress, and, in some instances, particular foods.

NP:AN; CN:PH; CL:K

12. (3) Reacting to each client as an individual and spending time with him shows that the nurse is aware of the client's personal situation and will make an effort to support the client.

NP:E; CN:PS; CL:C

13. (4) Fluid resuscitation is critical to maintain circulation and prevent hypovolemic shock. Fluid is lost as it shifts from the vessels as a result of increased vascular permeability. If the burn were around the face and neck,

intubation (2) may be done to preserve a patent airway. A tetanus booster (3) would be given, but it is not the first intervention.

NP:I; CN:PH; CL:A

14. (2) Kilocalories and protein are essential for tissue repair and healing. These clients are in a hypermetabolic state and will require increased protein and kilocalories to prevent negative nitrogen balance.

NP:P; CN:PH; CL:AN

BLOOD AND LYMPHATIC SYSTEM

The circulatory system, a continuous circuit, is the mechanical conveyor of the body constituent called blood. Blood, composed of cells and plasma, circulates through the body and is the means by which oxygen and nutritive materials are transported to the tissues and carbon dioxide and metabolic end products are removed for excretion. The lymphatic system collects toxins from the tissues and carries it to the blood.

BLOOD AND BLOOD FACTORS

Blood Components

See Table 8-8.

Plasma

- ◆ A. Plasma accounts for 55% of the total volume of blood.
- B. It is composed of 92% water and 7% proteins.

Solid Particles

- A. Solid particles account for 45% of the total blood volume.
- ◆ B. Blood cells.
 - 1. Erythrocytes (red blood cells).
 - ◆ a. Normal count in an adult is 4–6 million cells/mm³.
 - b. They contain hemoglobin, which carries oxygen to cells, and carbon dioxide from cells to lungs.
 - c. Red blood cells (RBCs) originate in bone marrow and are stored in the spleen.
 - d. Average life span is 10–120 days.
 - 2. Leukocytes (white blood cells).
 - ◆ a. Normal count in an adult is 4500 to 11,000/mm³.
 - ◆ b. Primary defense against infections.
 - c. Neutrophils play an active role in the acute inflammatory process and have phagocytic action.
 - d. Macrophages—both fixed and wandering cells—act as scavengers and phagocytize foreign bodies, cellular debris, and more

Table 8-8 BLOOD COMPONENT THERAPY

Type	Use	Alerts	Administration Equipment
Fresh plasma	To replace deficient coagulation factors To increase intravascular compartment	Hepatitis is a risk Administer as rapidly as possible Use within 6 hours	Any straight-line administration set
Platelets	To prevent or treat bleeding problems, especially in surgical clients To replace platelets in clients with acquired or inherited deficiencies (thrombocytopenia, aplastic anemia) To replace when platelets drop below 20,000 mm ³ (normal 150,000 to 350,000 mm ³)	Administer at rate of 10 minutes per unit (usually comes in multiple platelet packs)	Platelet transfusion set with special filter to allow platelets to infuse through filter
Granulocytes	To treat oncology clients with severe bone marrow depression and progressive infections To treat granulocytopenic clients with infections that are unresponsive to antibiotics To treat clients with gram-negative bacteremia or infections where marrow recovery does not develop	Administer slowly, over 2–4 hours Give one transfusion daily until granulocytes increase or infection resolves Use within 48 hours after drawn Give when granulocytes are below 500 Observe for shaking, chills, and fever (treat with Tylenol [acetaminophen] before transfusions) Observe for hives and laryngeal edema (treat with antihistamines)	Use Y-type blood filters and prime with physiological saline A microaggregate filter is not used, as it filters out platelets
Serum albumin	To treat shock To treat hypoproteinemia	Available as 5% or 25% solution Infuse 25% solution slowly at 1 mL/min to prevent circulatory overload	Special tubing accompanies albumin solution in individual boxes

- resistant organisms (e.g., fungi and *Mycobacterium tuberculosis*).
- e. Lymphocytes play an important role in immunologic responses.
- f. Monocytes are the largest of the leukocytes and are less phagocytic than macrophages.
- 3. Platelets (thrombocytes).
 - ◆ a. About 100,000–400,000/mm³ are needed for clot retraction.
 - b. Fewer than 60,000/mm³ may lead to a tendency to bleed.

System Assessment

- A. Assess onset of symptoms, whether insidious or abrupt.
- B. Assess for petechiae, ecchymosis.
- C. Evaluate bleeding time.
- D. Assess for fatigue and general weakness.
- E. Assess for chills or fever.
- F. Assess for dyspnea.
- G. Observe for ulceration of oral mucosa and pharynx.
- H. Assess for pruritus.
 - I. Check skin color—pallor, yellow cast, or reddish-purple hue.
 - J. Assess for visual disturbances.
 - K. Palpate for hepatomegaly or splenomegaly.
 - L. Assess for dietary deficiencies—ask questions about daily intake of foods.
- M. Assess for neurological symptoms.
 - 1. Numbness and tingling in the extremities.
 - 2. Personality changes.
- N. Evaluate cardiovascular signs and symptoms.
 - 1. Hypotension or hypertension.
 - 2. Character of pulse.
 - 3. Capillary engorgement.
 - 4. Venous thrombosis.
- O. Assess for gastric distress and weight loss.

System Implementation

- ◆ A. Prevent infections.
 - 1. Maintain isolation, if indicated, and meticulous medical asepsis.
 - 2. Suggest bed rest.
 - 3. Provide high-protein, high-vitamin, and high-calorie diet.
 - 4. Administer antibiotics as ordered.
- ◆ B. Promote rest for fatigue and weakness.
 - 1. Conserve client's strength.
 - 2. Suggest frequent rest periods.
 - 3. Ambulate as tolerated.
 - 4. Decrease disturbing activities and noise.
 - 5. Provide optimal nutrition.
- ◆ C. Provide care for hemorrhagic tendencies.
 - 1. Provide rest during bleeding episodes.
 - 2. Apply gentle pressure to bleeding sites.
 - 3. Apply cold compresses to bleeding sites when indicated.
 - 4. Do not disturb clots.
 - 5. Use small-gauge needles to administer medications by injection.
 - 6. Support the client during transfusion therapy.
 - 7. Observe for symptoms of internal bleeding.
 - 8. Have tracheostomy set available for client who is bleeding from mouth or throat.
- D. Give care for ulcerative lesions of the tongue, gums, and/or mucous membranes.
 - 1. Provide nonirritating foods and beverages.
 - 2. Give frequent oral hygiene with mild, cool mouthwash and solutions.
 - 3. Use applicators or soft-bristled toothbrush.
 - 4. Lubricate lips.
 - 5. Give mouth care both before and after meals.
- ◆ E. Monitor and treat oxygen deficit.
 - 1. Elevate head of the bed.
 - 2. Support client in the orthopneic position.
 - 3. Administer oxygen when indicated.
 - 4. Prevent unnecessary exertion.
- F. Provide measures to alleviate bone and joint pain.
 - 1. Use cradle to relieve pressure of bedding.
 - 2. Apply hot or cold compresses as ordered.
 - 3. Immobilize joints when ordered.
- G. Apply cool sponges if fever present.
- H. Administer antipyretic drugs as ordered.
- I. Encourage fluid intake unless contraindicated.
- J. Provide care for pruritus and/or skin eruptions.
 - 1. Keep client's fingernails short.
 - 2. Use soap sparingly, if at all.
 - 3. Apply emollient lotions for skin care.
- K. Attempt to decrease client's anxiety.
 - 1. Explain nature, discomforts, and limitations of activity associated with diagnostic procedures and treatments.
 - 2. Listen to client.
 - 3. Treat client as an individual.
 - 4. Allow family to participate in client's care.
 - 5. Encourage family to visit with client; provide privacy for family and client.

TRANSFUSION ADMINISTRATION

Implementation

- ◆ A. Follow agency policy and guidelines for preventing transfusion reaction.
 - ◆ 1. Check physician's orders—type and number of units.
 - ◆ 2. Identify client and blood bag. Check:

◆ Table 8-9 SUMMARY OF ABO BLOOD GROUPING

Client Blood Type (Rh Factor)	Transfuse with Type A	Transfuse with Type B	Transfuse with Type AB	Transfuse with Type O	Transfusion Options
A (+)	Yes	No	No	Yes	A+, A- O+, O-
A (-)	Yes	No	No	Yes	A-, O-
B (+)	No	Yes	No	Yes	B+, B- O+, O-
B (-)	No	Yes	No	Yes	B-, O-
AB (+)	Yes	Yes	Yes	Yes	A+, A- B+, B- O+, O-
AB (-)	Yes	Yes	Yes	Yes	A- B- O-
O (+)	No	No	No	Yes	O+, O-
O (-)	No	No	No	Yes	O-
					Universal recipient Universal donor

- a. Client's room number; check that ID band number matches transfusion record number. Use agency method of client identification (usually name and date of birth).
- b. Name spelled correctly on transfusion record and consent form is signed.
- c. Patency of IV.
- d. Blood type matches on transfusion record and blood bag (A, B, O, and Rh). (See Table 8-9.) Note expiration date.
- ◆ B. Observe blood bag for bubbles, cloudiness, dark color, or black sediment—indicative of bacterial invasion.
- ◆ C. Check blood with another RN before infusing. Sign transfusion form with another RN according to hospital policy.
- ◆ D. Ask client about allergy history and report any previous blood reactions.
- ◆ E. Start infusion with normal saline and appropriate blood tubing. Start blood within 30 minutes from time it is removed from refrigeration. (Blood should not remain at room temperature for long period of time.)
- ◆ F. Do not allow duration of blood infusion to exceed 4 hours.
- ◆ G. Use blood filter to prevent fibrin and other materials from entering the bloodstream.
- ◆ H. Maintain aseptic technique during procedure.
- ◆ I. Start transfusion slowly at 20–25 drops per minute and observe for transfusion reaction—usually occurs during the first 5–15 minutes.
- ◆ J. Take baseline vital signs at start of transfusion and again 5 minutes later.

- ◆ K. Complete the transfusion in no less than 2 hours unless hypovolemic.
 1. After initial slow rate, infuse at a rate of 60–80 drops/min. (Administration set—10 gtt/mL.)
 2. Hypovolemic client.
 - a. Administer blood at the rate of 500 mL in 10 minutes by use of a blood pump or as ordered.
 - b. Observe for pulmonary edema and hypervolemia.

TRANSFUSION REACTIONS

Hemolytic or Incompatibility Reaction

Characteristics

- A. Most severe complication.
- B. Caused by mismatched blood.
- ◆ C. The reaction is caused by agglutination of the donor's red cells.
 1. The antibodies in the recipient's plasma react with the antigens in the donor's red cells.
 2. The clumping blocks off capillaries and, therefore, obstructs the flow of blood and oxygen to cells. (See Table 8-10.)

Assessment

- ◆ A. Assess for increased temperature.
- ◆ B. Evaluate for decreased blood pressure.
- ◆ C. Observe for pain across chest and at site of needle insertion.
- ◆ D. Assess for chills.
- E. Observe for hematuria.

◆ Table 8-10 TRANSFUSION REACTIONS

Type	Clinical Manifestations	Nursing Interventions
Bacterial	Sudden increase in temperature Hypotension Dry, flushed skin Abdominal pain Headache Lumbar pain Sudden chill	Stop transfusion immediately. Maintain IV site; change tubing as soon as possible. Observe for shock. Monitor vital signs every 15 minutes until stable. Obtain urine specimen. Insert Foley if necessary Notify physician and obtain order for broad-spectrum antibiotic. Draw blood cultures before antibiotic administration. Send blood tubing and bag to lab for culture and sensitivity Control hypothermia.
Allergic	Mild: urticaria and hives, pruritus Severe: respiratory wheezing, laryngeal edema	Stop transfusion immediately. Monitor vital signs for possible anaphylactic shock. Obtain order for antihistamine.
Hemolytic	Anaphylactic reaction Severe pain in kidney region and chest Pain at needle insertion site Fever (may reach 105°F), chills Dyspnea and cyanosis Headache Hypotension Hematuria Nausea	Monitor for signs of progressive allergic reaction as transfusion continues. Stop transfusion immediately and remove blood tubing. Maintain patent IV, start normal saline infusion at “keep open” rate Obtain vital signs. Notify blood bank STAT. Reconnect tubing to needle and obtain new tubing as soon as possible. Administer oxygen. Send two blood samples from different sites, urine sample (catheterize if necessary), blood, and transfusion record to lab. Obtain orders for IV volume expansion and diuretic (mannitol) to ensure flushing of kidneys to prevent acute renal tubular necrosis. Monitor vital signs every 15 minutes for shock. Monitor urine output hourly for possible renal failure. Foley catheter may need to be inserted.
Transfusion-related acute lung injury (TRALI)	Characterized by noncardiogenic pulmonary edema with sudden onset of hypoxic respiratory insufficiency during or shortly after the transfusion of a blood product. Symptoms may be delayed as long as 6 hours, but usually begin within 1–2 hours of initiating the blood component infusion.	If TRALI is suspected, stop transfusion immediately. Notify physicians and blood bank and initiate an evaluation for a transfusion reaction. Management of the client with TRALI is supportive, with oxygen supplementation for the correction of hypoxemia being the basis of treatment. Noninvasive respiratory support with continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BiPAP) may be sufficient in less severe cases. Endotracheal intubation mechanical ventilation may be necessary.

- F. Evaluate if backache in the kidney region is present.
- G. Assess dyspnea and cyanosis.
- H. Observe for jaundice in severe cases.

Implementation

- ◆ A. Stop transfusion immediately upon appearance of symptoms.
- ◆ B. Return remaining blood and client's blood sample to the laboratory for type and cross-match.
- ◆ C. Keep IV patent after changing blood tubing with either normal saline or D₅W, as ordered.
- ◆ D. Take vital signs every 15 minutes.
- E. Get a urine sample for red blood cells and an accurate output record.
- F. Check for oliguria.

- G. Administer medications such as vasopressors if indicated.
- H. Administer oxygen as necessary.

Allergic Reactions

Characteristics

- A. Allergic response to any type of allergen in the donor's blood.
- ◆ B. Common reaction, usually mild in nature.

Assessment

- A. Assess for hives.
- B. Assess for urticaria.
- C. Observe for wheezing.
- D. Check for laryngeal edema.

♦ Implementation

- A. Administer an antihistamine like Benadryl (diphenhydramine) to control itching and to relieve edema.
- B. Slow infusion rate, evaluate, and, if reaction is severe, discontinue the transfusion immediately and keep vein open with normal saline.

Bacterial Contamination

Assessment

- ♦ A. Check blood to see if it is cloudy or discolored or appears to have bubbles present.
- B. Assess for sudden increase in temperature.
- C. Check for dry, flushed skin.
- D. Assess for abdominal or lumbar pain.
- E. Assess for hypotension.
- F. Assess for headache and sudden chills.

Implementation

- ♦ A. If transfusion has been started, discontinue immediately.
- B. Send remaining blood to laboratory for culture and sensitivity. It is usually advisable to send client's blood sample as well, if transfusion has been started.
- C. Change IV tubing and keep line patent.
- D. Check vital signs, including temperature, every 15 minutes.
- E. Insert Foley catheter for accurate output and urine specimen as ordered.
- F. Control hyperthermia, if present, with antipyretics, cooling blankets, or sponge baths.
- G. Draw blood cultures before antibiotics started.

Transmission of AIDS

- A. Blood donations are now screened for the acquired immune deficiency syndrome (AIDS) virus.
- ♦ B. AIDS antibody test keeps potentially infectious blood and blood products out of the U.S. blood supply.
 - 1. AIDS antibody is a protein naturally produced in body in response to presence of the AIDS virus.
 - 2. Positive test indicates the AIDS antibody is in blood.
 - 3. Blood that tests positive will not be accepted (even if result may be a false positive).
- C. Based on the AIDS antibody test for all blood and blood products, transfusion-related AIDS is now extremely rare.

(See also Chapter 6, Infection Control.)

Transmission of Viral Hepatitis

Characteristics

- ♦ A. Donors are screened to prevent transmission.
 - 1. If blood shows positive for hepatitis B surface antigen (formerly Australian antigen), donor is rejected.
 - 2. If donor has had jaundice or hepatitis, donor is rejected permanently.
- B. Hepatitis transmitted through blood is usually not fatal.
- C. Nursing management is related to the care of clients with hepatitis, based on the seriousness of the condition. (Refer to Gastrointestinal System, pages 315–316, for specific nursing actions.)

Circulatory Overload

Characteristics

- ♦ A. Transfusion is administered too rapidly.
- ♦ B. Quantity is in excess of the amount the circulatory system can accommodate.
- C. Usually occurs when transfusion is administered to debilitated clients, elderly or young clients, or clients with cardiac or pulmonary disease.

Assessment

- ♦ A. Observe CVP for increased reading.
- ♦ B. Assess for tachycardia, sudden increase in blood pressure.
- ♦ C. Evaluate for respiratory difficulty (e.g., dyspnea, shortness of breath, cough, rales, rhonchi).
- D. Assess for hemoptysis and/or pink frothy sputum.
- E. Evaluate edema, especially pulmonary edema.

Implementation

- ♦ A. Discontinue transfusion.
- ♦ B. Provide for patent airway and adequate ventilation.
 - 1. Administer oxygen at 2 L/min/nasal cannula.
 - 2. Intubate as needed.
- ♦ C. Place client in semi- to high-Fowler's position to facilitate respiration.
- ♦ D. Give diuretics (Lasix [furosemide]) as ordered.
 - 1. Drugs will help to decrease blood volume.
 - 2. Reduces effects of hypervolemia on the heart.
- E. If client is in congestive heart failure, may need to digitalize.
- F. Be prepared for electrocardiogram (ECG) and chest x-ray.

Massive Blood Transfusion Reaction

Definition: Massive transfusion is a transfusion of a volume of blood greater than or equal to one's blood volume in 24 hours (e.g., 10 units in a 70-kg (154 lbs) adult). If a client receives stored blood in such large volumes, his or her own blood may be, in effect, "washed out."

Assessment

- A. Hypothermia due to rapid transfusion of large amounts of cold blood.
- B. Arrhythmias or cardiac arrest.
- C. Liver failure clients may have difficulty metabolizing citrate.
- D. Hypocalcemia.

Implementation

- A. Hypothermia can be avoided by using a heat-exchange device that gently warms blood. All other means of warming blood are contraindicated due to hemolysis.
- B. Treatment for hypocalcemia (rarely required) is 10 mL of a 10% solution of calcium gluconate IV diluted in 100 mL D₅W given over 10 minutes.
- C. Do not transfuse blood stored for longer than 1 week if client has renal failure because client may have elevated K⁺.

Transfusion-Related Acute Lung Injury

Definition: Transfusion-related acute lung injury (TRALI) is a syndrome that includes dyspnea, hypotension, bilateral pulmonary edema, and fever.

Characteristics

- A. TRALI has surpassed hemolytic reactions as the leading cause of transfusion-related death. Mortality rate is reported to be 5% to 10%.
- B. Sudden development of noncardiogenic pulmonary edema (acute lung injury).
- C. Usually occurs within 2–6 hours after transfusion of blood product; can occur up to 48 hours later.
- D. As many as one-third of all clients who develop acute lung injury have been exposed to blood products.
- E. TRALI may be an important and potentially preventable cause of acute lung injury.

Assessment

- A. Clients present with findings similar to those of adult respiratory distress syndrome.
- B. Symptoms.
 1. Hypotension.
 2. Fever.
 3. Dyspnea and tachycardia.
 4. Noncardiogenic pulmonary edema with diffuse bilateral pulmonary infiltrates on chest radiography is characteristic.
- C. Assess for presence of TRALI with transfusions of all types of blood products.

Implementation

- A. Generally supportive and similar to that for adult respiratory distress syndrome.

- B. Ventilatory and hemodynamic assistance are utilized as required. Most symptoms resolve within 96 hours after ventilatory support.
- C. There are no clear indications for the use of corticosteroids, and their use remains controversial in this setting.
- D. Additional blood component therapy should not be withheld if clear indications for transfusion exist.

DISORDERS OF THE BLOOD**Purpuras**

Definition: The extravasation of blood into the tissues and mucous membranes.

Characteristics

- A. Idiopathic thrombocytopenic purpura is characterized by platelet deficiency due to either hypoproliferation, excessive destruction, or excessive pooling of platelets in the spleen.
- B. Vascular purpura is characterized by weak, damaged vessels, which rupture easily.

Assessment

- ◆ A. Observe for petechiae; bruising.
- B. Assess postsurgical bleeding.
- C. Evaluate increased bleeding time.
- D. Evaluate abnormal platelet count (less than 20,000).
- E. Assess for ecchymosis.

Implementation

- A. Identify underlying cause (medication) if possible.
- B. Complete steps to control bleeding.
- C. Monitor transfusion of platelets.
- D. Monitor administration of corticosteroids.
- E. Monitor client with postsurgical splenectomy for idiopathic thrombocytopenia.

Agranulocytosis

- ◆ *Definition:* An acute, potentially fatal blood disorder characterized by profound neutropenia; most commonly caused by drug toxicity or hypersensitivity.

Assessment

- A. Assess for chills and fever.
- B. Assess for sore throat.
- C. Assess for exhaustion and depletion of energy.
- D. Observe for ulceration of oral mucosa and throat.

Implementation

- ◆ A. Discontinue suspected chemical agents or drugs.
- B. Isolate client to reduce exposure to infections.
- C. Administer antiviral, antibiotic, and antifungal medications as ordered.

Polycythemia Vera

◆ *Definition:* A chronic disease of unknown etiology characterized by overactivity of bone marrow with overproduction of red cells and hemoglobin. Hematocrit is elevated (55% of males and 50% of females).

Assessment

- ◆ A. Assess skin.
 1. Reddish-purple hue.
 2. Pruritus.
- B. Diagnosis made by elevated RBC mass, normal O₂ saturation level, and enlarged spleen.
- ◆ C. Assess for complications.
 1. Increased blood volume.
 2. Capillary engorgement.
 3. Hemorrhage, nose bleeds.
 4. Risk for venous thrombosis.
 5. Hypertension.
- D. Assess for signs of hypervolemia: visual disturbances, congestion of conjunctiva, headache, tinnitus, and vertigo.
- E. Assess for gastric distress and weight loss.

Implementation

- ◆ A. Monitor alkylating agent—Busulfex (busulfan).
- ◆ B. Assist with phlebotomy to remove 500 to 2000 mL of blood per week until hematocrit reaches 50%; procedure is repeated when hematocrit rises.
 1. Monitor blood pressure, pulse, and respirations for tachycardia during procedure and postprocedure.
 2. Promote client comfort by positioning in prone position to prevent vertigo and syncope.
 3. Instruct clients to avoid iron supplements (especially in multivitamins).
 4. Instruct clients to avoid aspirin and aspirin-containing drugs; alters platelet functioning.
- C. Monitor for complications (impending cerebrovascular accident [CVA], thrombocytosis).
- D. Instruct client to monitor symptoms of iron deficiency.
- E. Instruct client to watch common bleeding sites (nose, skin) and report immediately.

Anemia

◆ *Definition:* A condition that occurs when there is a decrease in either quantity or quality of blood. The deficiency may be a decrease in erythrocytes or a lower than normal level of hemoglobin.

Characteristics

- ◆ A. Common causes of anemia.
 1. Acute or chronic blood loss (hemorrhage, bleeding ulcers, malignancy).
 2. Destruction of red blood cells (hemolysis).

3. Abnormal bone marrow function—drugs, chemicals, chemotherapy.
4. Decreased erythropoietin due to renal damage.
5. Inadequate maturation of red blood cells.

◆ B. Classifications.

- ◆ 1. Hemolytic anemias—premature destruction of RBCs.
 - a. Thalassemia.
 - b. Sickle cell disease.
 - c. Acquired hemolytic anemia.
- ◆ 2. Hypoproliferative (inadequate production) anemias.
 - a. Vitamin B₁₂ deficiency or folic acid deficiency.
 - b. Result of marrow damage caused by medications or chemicals.
- ◆ 3. Secondary to blood loss.
 - a. Chronic blood loss.
 - b. Acute blood loss.

Assessment

- ◆ A. Assess for signs related to tissue hypoxia.
 1. Weakness and fatigue.
 2. Need for sleep and rest.
 3. Lethargy.
 4. Dyspnea.
 5. Tachycardia and tachypnea.
 6. Pallor.
 7. Cold extremities.
- ◆ B. Assess for signs related to the central nervous system.
 1. Vertigo.
 2. Irritability.
 3. Depression.
- C. Evaluate poor wound healing.
- D. Assess for dietary deficiencies.

Implementation

- ◆ A. Provide diet high in protein, iron, and vitamins to increase production of erythrocytes; remember that client is sensitive to hot, cold, and spicy foods.
- ◆ B. Maintain adequate fluid intake.
- ◆ C. Protect from infection.
- D. Manage fatigue (most common symptom). Provide complete bed rest if necessary.
- E. Promote good skin care to prevent pressure ulcers.
- F. Protect from falls and injury (due to vertigo).
- G. Avoid extremes of heat and cold (due to disturbance in sensory perception).
- H. Provide good mouth care with diluted mouthwash and soft toothbrush.
- I. Provide emotional support for long-term therapy.

Iron-Deficiency Anemia

◆ *Definition:* The most common type of anemia in the world, slowly progressive, related to a deficiency in iron.

Characteristics

- A. Occurs most often in infants, adolescents, pregnant females, alcoholics, and the elderly.
- B. Results from chronic blood loss, inadequate nutritional intake, defective absorption, improper utilization of iron, prolonged drug therapy, or improper cooking of foods.

Assessment

- ◆ A. Assess for cheilosis—corners of the mouth are cracked, red, and painful.
- ◆ B. Assess for exertional dyspnea.
- ◆ C. Check glossitis.
- D. Assess for papillae atrophy of tongue (shiny).
- E. Check for pica syndrome (abnormal craving for sand, clay, ice).
- F. Observe for concave, brittle nails.
- G. Assess for fatigue and lack of energy.
- H. Observe for signs of anaphylactic shock, particularly with IV iron medications.

Implementation

- ◆ A. Provide diet high in iron: liver, lean meats, egg yolk, dried fruit, whole-wheat bread, wheat germ, red beans, asparagus, and molasses.
- ◆ B. Administer iron preparations for 6 to 12 months.
 1. Oral.
 - a. Administer ferrous sulfate, 300 mg TID.
 - ◆ b. Give liquid iron with straw to avoid staining of teeth.
 - ◆ c. Administer oral iron on empty stomach to increase absorption, or, because it is irritating to the GI tract, suggest client take iron after meals.
 - ◆ d. Give iron with orange juice or vitamin C, because iron absorption is aided by vitamin C.
 - e. Watch for side effects: epigastric distress, abdominal cramps, nausea, and diarrhea or constipation.
 - f. Warn client that stools will be black.
 2. Parenteral.
 - a. Administer Imferon (iron dextran) IV or intramuscular (IM).
 - ◆ b. Use Z-track (deep IM) to prevent pain and discoloration.
- C. Monitor fluid and electrolyte balance.
- D. Provide frequent rest periods for intense fatigue.

Megaloblastic Anemia

◆ *Definition:* A group of anemias that have morphologic changes caused by defective DNA synthesis and abnormal RBC maturation.

Characteristics

- ◆ A. The primary cause is a deficiency of vitamin B₁₂ or folic acid.
- ◆ B. Sources.
 - ◆ 1. Absence of intrinsic factor (pernicious anemia).
 - 2. Surgical resection of the stomach.
 - 3. Atrophy of gastric mucosa.
 - 4. Dietary deficiency—malabsorption disease.
 - 5. Bacterial or parasitic infections.
 - 6. Drugs: Trexall (methotrexate), oral contraceptives, and anticonvulsants.
 - 7. Alcohol abuse and anorexia.
- C. Genetic predisposition (especially in northern Europe).

Assessment

- ◆ A. Assess for neurological disturbance—tingling of extremities, peripheral neuropathy.
 1. These symptoms do not occur with folic acid deficiency.
 2. Distinction between deficiency in vitamin B₁₂ must be made with deficiency in folic acid.
- ◆ B. Assess for symptoms of spinal cord degeneration—alterations in gait (loss of balance).
- C. Check any loss of finger movement.
- D. Evaluate personality and behavioral changes.
- E. Assess for glossitis—beefy, red tongue.
- F. Assess for anorexia.
- G. Assess for fatigue, weakness, pallor.
- H. Observe yellow cast to skin.

Implementation

- A. Obtain blood work for RBC count and megaloblastic maturation.
- ◆ B. Prepare client for the following tests.
 1. Bone marrow aspiration (assist physician during test).
 2. Upper GI series (administer bowel prep).
 3. Schilling test (maintain NPO for 12 hours; collect 24-hour urine) for pernicious anemia.
 4. Gastric analysis—insertion of nasogastric tube, collection of aspirant, injection of histamine.
- ◆ C. Administer vitamin B₁₂ deep IM—usually once a month; usual dose of folic acid is 1 mg/day PO or 5 mg/day for malabsorption.
- ◆ D. Change in diet and oral folic acid if anemia is caused by folic acid deficiency (chronic alcoholism, malabsorption syndrome, or medications).
- E. Provide emotional support during bone marrow aspiration.

- F. Provide safety measures if a neurological deficiency is present—assist with ambulation.
- G. Provide support and explain behavior changes to client and family.

Aplastic Anemia

◆ *Definition:* Deficiency of marrow stem cells resulting from bone marrow suppression. Pancytopenia frequently accompanies RBC deficiency.

Characteristics

- ◆ A. Etiology.
 - 1. Toxic action of drugs: Chloromycetin (chloramphenicol), sulfonamides, Dilantin (phenytoin), alkylating agents, antimetabolites, and anticonvulsants (Mesantoin [mephenytoin]).
 - 2. Chemicals: DDT, benzene.
 - 3. Exposure to radiation.
 - 4. Diseases that suppress bone marrow activity (leukemia and metastatic cancer).
- B. Treatment.
 - 1. Removal of causative agent.
 - 2. Hematopoietic stem cell transplant (HSCT).
 - 3. Bone marrow or stem cell transplant is treatment of choice for clients younger than age 40.
 - 4. Immunosuppressive therapy.
 - a. Antithymocyte globulin (ATG).
 - b. Restasis (cyclosporine).
 - c. High-dose Cytoxan (cyclophosphamide).
 - d. Steroids.

Assessment

- A. Exposure to chemicals and/or drugs.
- B. Assess for increased fatigue.
- C. Assess for ability to complete activities of daily living.
- D. Assess for dyspnea, fatigue.
- E. Evaluate blood for low platelet and leukocyte count.
- F. Assess for infection.

Implementation

- ◆ A. Avoid use of toxic chemical agents—DDT, carbon tetrachloride, etc.
- B. Administer androgens and/or corticosteroids—now not commonly used due to toxic side effects.
- ◆ C. Monitor transfusion of fresh platelets (RBC transfusion may be introduced also).
- ◆ D. Protect from infections—avoid contact with others who have infection; provide meticulous hygiene, clean environment.
 - 1. Administer antibiotics when infection occurs.
 - 2. Place client in private room.
- E. Prevent fatigue—provide for adequate rest periods. Avoid activities that are stressful.

- F. Observe for complications.
- G. Provide physical comfort measures.
- H. Provide emotional support for client and family.
- I. Educate client how to protect from infection and excessive bleeding.
- J. Educate public in use of toxic pesticides and chemicals.

Thrombocytopenia

Definition: Condition that is a lower than normal number of circulating platelets.

Characteristics

- ◆ A. Normal platelet count is 150,000 to 400,000/mm³. A count lower than 100,000 leads to this condition; lower than 60,000 may result in tendency to bleed.
- B. Condition results from decreased platelet production, destruction of platelets (most common), decreased platelet survival, or sequestration of blood in the spleen.
- ◆ C. Common causes of platelet destruction.
 - 1. Idiopathic thrombocytopenic purpura—production of an antibody that works against platelet antigen.
 - 2. Heparin induced—may develop with client's receiving heparin for more than 5 days. (Use of low-molecular-weight heparin may prevent this complication.)
 - 3. Certain drugs (alcohol, aspirin, chemotherapeutic agents, gold salts, sulfonamides, thiazides, penicillin, etc.) induce this condition, which usually resolves in 1–2 weeks after drug is withdrawn.

Assessment

- ◆ A. Assess skin signs: petechiae (occurring only in platelet disorders), ecchymoses, and purpura.
- B. Assess for history of menorrhagia, epistaxis.
- C. Check low platelet count, bleeding time, and bone marrow examination.

Implementation

- A. Monitor corticosteroid therapy—decreases antibody production. Inform client not to stop medication suddenly.
- B. Administer care following a splenectomy—removal of the organ responsible for destruction of antibody-coated platelets.
- C. Monitor use of immunosuppressive drugs.
- ◆ D. Monitor platelet transfusion—may be done for certain clients, especially for thrombocytopenic bleeding.
- ◆ E. Constantly monitor for bleeding tendency—when platelet count is less than 60,000, avoid

1. Injections.
2. Rectal temperature.
- ◆ F. Apply pressure to venipuncture sites for 5 minutes.
- ◆ G. Educate client on how to recognize signs and measures to prevent injury.
 1. Avoid trauma and contact sports.
 2. Use soft toothbrush—avoid trauma to gums.
 3. Use electric shaver.
 4. Avoid drugs that thin blood (aspirin).

Note: For sickle cell anemia and thalassemia, see Pediatric Nursing, Chapter 13.

SPLEEN

◆ *Definition:* A gland-like organ located in the upper left part of the abdominal cavity; it is a storage organ for red corpuscles and, because of a large number of macrophages, acts as a blood filter.

Characteristics

- A. Functions as a blood reservoir.
- B. Purifies blood by removing waste and infectious organisms.
- C. Destroys old red blood cells.
- D. Is the primary source of antibodies in infants and children.
- E. Produces lymphocytes, plasma cells, and antibodies in adults.
- F. Produces erythrocytes in fetus.
- G. Destroys erythrocytes when they reach the end of their life span.

Hypersplenism

Definition: The premature destruction of erythrocytes, leukocytes, and platelets.

Characteristics

- ◆ A. The most common form of hypersplenism is congestive splenomegaly, usually due to portal hypertension secondary to cirrhosis.
- ◆ B. Other causes are idiopathic thrombocytopenia, thrombosis, stenosis, or atresia.
- C. Secondary hypersplenism occurs in association with leukemias, lymphomas, Hodgkin's disease, and tuberculosis.
- D. Treatment: correct underlying condition and/or splenectomy.

Rupture of the Spleen

Definition: Traumatic rupture following violent blow or trauma to the spleen.

Assessment

- ◆ A. Assess weakness due to blood loss.
- ◆ B. Evaluate abdominal pain and muscle spasm particularly in the left upper quadrant.
- C. Assess for rebound tenderness.
- D. Assess for referred pain to left shoulder.
- E. Palpate for tenderness.
- F. Check leukocytes (well over 12,000).
- G. Assess for progressive shock with rapid, thready pulse; drop in blood pressure; and pallor.

Implementation

- ◆ A. Prepare for surgical intervention—splenectomy.
- B. Prevent infection.
- C. Monitor vital signs closely.

Splenectomy

Definition: Excision of the spleen.

Assessment

- ◆ A. Evaluate indications for surgical intervention.
 1. Trauma.
 2. Hypersplenism.
 3. Idiopathic thrombocytopenia.
 4. Hodgkin's disease.
 5. Lymphoma.
- B. Observe for signs of infection.
- C. Assess vital signs for baseline data.

Implementation

- ◆ A. Prevent thrombus formation.
 1. Initiate bed exercises.
 2. Ambulate early.
 3. Provide adequate hydration.
- ◆ B. Prevent respiratory complications due to reduced expansion of left lung and location of spleen near diaphragm.
 1. Turn, cough, and deep-breathe every 2 hours.
 2. Maintain intermittent positive-pressure breathing (IPPB) if prone to upper respiratory infection (URI).
- C. Prevent infection if rupture occurs.
 1. Observe for signs of infection.
 2. Administer antibiotics.

NEOPLASTIC BLOOD DISORDERS

Leukemia

- ◆ *Definition:* A malignant disorder of blood-forming tissue characterized by neoplastic proliferation of hematopoietic cells or their precursors.

CHEMOTHERAPY PRINCIPLES

- ◆ • Combination of drugs used.
 1. Limits toxicity of individual drugs.
 2. Increases destruction of cells sensitive to various agents.
- Induction therapy used after initial diagnosis.
- Maintenance therapy used during remission.

◆ Characteristics

- A. The increased proliferation process alters the cell's ability to mature and/or function correctly.
- B. In acute processes the predominant cell is poorly differentiated, but in chronic processes the leukemic cell is well defined.
- C. Anemia results from an increased number of white blood cells that are immature and do not function normally, and a decreased number of red blood cells, hemoglobin, and platelets.
- D. Diagnostic tests.
 1. Bone marrow aspiration/biopsy.
 2. Differential count.
- E. Etiology—predisposing factors.
 1. Excess radiation exposure.
 2. Viral factors.
 3. Immune alteration.
 4. Noxious chemicals and drugs.
 5. Bone marrow alterations.

Assessment

- ◆ A. Assess for sudden high fever with abnormal bleeding.
- ◆ B. Assess for nosebleeds, purpura, ecchymosis, petechiae, or prolonged menses.
- C. Evaluate general nonspecific symptoms such as weakness, lethargy, low-grade fever.
- D. Evaluate recurrent infections if any of the above symptoms are present.

Implementation

- ◆ A. Administer chemotherapeutic agents.
 1. Specific drugs and combinations are ordered according to the specific type of leukemia and whether it is acute or chronic.
 2. See chemotherapy drugs and protocol in Chapter 9, Oncology Nursing.
- ◆ B. Prevent complications related to the side effects of drugs.
 1. Proper mouth care (ulcerations and bleeding).
 2. Anorexia.
- C. Maintain fluid and electrolyte balance.
- D. Administer Zyloprim (allopurinol) to combat problems associated with increased serum uric acid (from rapid destruction of body tissue).

- E. Provide high-calorie, high-vitamin diet to prevent weight loss, weakness, debilitation.
- ◆ F. Provide emotional support for
 1. Alopecia.
 2. Altered body image.
 3. Fear of dying.
 4. Depression.
 5. Financial burden.
- G. Provide client education.
 1. Drugs—dosage and side effects.
 2. Associated treatments.
 3. Disease process.
- H. Prevent infections, ulcerations, hemorrhage.

Acute Myeloid Leukemia

Characteristics

- A. Incidence: occurs more commonly at adolescence and after age 55. Slightly higher incidence in males. Onset can be insidious or rapid.
- B. Pathophysiology: uncontrolled proliferation of myeloblasts (precursors of granulocytes), which replace normal cells in the marrow.

Assessment

- ◆ A. Assess for anemia and symptoms of dyspnea, fatigue, pallor, palpitations.
- ◆ B. Assess for symptoms of platelet deficiency: epistaxis, gingival bleeds, purpura, petechiae, or bleeding in major systems.
- C. Assess for symptoms of local abscesses, elevated temperature, chills.
- D. Palpate for splenomegaly.
- ◆ E. Assess for lymph node enlargement and difficulty with respiration and swallowing.
- F. Assess for bone pain.
- G. Evaluate CNS involvement with signs of increased intracranial pressure (ICP).
- H. Check for hyperuricemia (excessive uric acid).

Implementation

- ◆ A. Administer chemotherapy, called induction therapy.
 - ◆ 1. Ara-C (cytarabine), Cerubidine (daunomycin), Novantrone (mitoxantrone), or Idamycin (idarubicin).
 - 2. Seventy percent of clients suffer a relapse and long-term survival is only 5%.
- B. Bone marrow transplant is another option for treatment.
- C. Administer antibiotics for increased temperature.
- D. Monitor platelet administration when bleeding occurs.
- E. Administer allopurinol when hyperuricemia occurs.

Chronic Myeloid Leukemia

Characteristics

- ◆ A. Incidence: primarily a disease of young adults (age 30 to 50). Thought to have a genetic origin. Philadelphia chromosome is involved.
- ◆ B. Pathophysiology: abnormal stem cell leading to a marked increase of granulocytes and megakaryocytes (platelet cells). The mature neutrophil is the cell that is predominant.
- C. Clients may be without symptoms.

Assessment

- A. Assess for fatigue and malaise.
- B. Palpate for large, tender spleen.
- C. Observe skin for pallor, purpura, nodules.
- D. Assess for abdominal discomfort.
- E. Evaluate fever, heat intolerance, or increased perspiration.
- F. Assess for retinal hemorrhage.
- G. Assess for bone pain.
- H. Assess anemia.
- I. Evaluate increased uric acid level.

Implementation

- A. Administer oral alkylating agent Myleran (busulfan) and Hydrea (hydroxyurea).
- B. Prepare for splenectomy or irradiation.
- C. Instruct client and family in preventive principles.
 1. Good nutrition.
 2. Prevention of infection.
 3. Complicating signs.
 4. Skin care.
 5. Adequate rest to minimize weakness.

Chronic Lymphocytic Leukemia

Characteristics

- ◆ A. Incidence—insidious onset, most common in ages 50 to 70.
- ◆ B. Pathophysiology—the small lymphocyte (B cell) is the predominant cell type and eventually leads to decreased production of other hematopoietic cells.

Assessment

- A. Many clients are asymptomatic but diagnosed by increased lymphocyte count.
- ◆ B. Assess classic signs.
 1. Weakness, fatigue, and lymphadenopathy.
 2. Anemia.
 3. Weight loss.
 4. Abdominal discomfort with hepatomegaly/splenomegaly.
 5. Vesicular skin lesions.
- C. Assess less common signs.
 1. Excessive diaphoresis.
 2. Infection.

Implementation

- A. Administer drugs: Leukeran (chlorambucil), Cytoxan (cyclophosphamide), and glucocorticoids.
 1. Clients who don't respond may go into remission with Fludara (fludarabine).
 2. Fludara may cause bone marrow depression; clients at risk for infections.
- B. Prepare for splenectomy in some cases.
- C. Prevent infection, be especially oriented toward maintaining clean skin.
- D. Observe for complications: thrombocytopenia.
- E. Provide emotional support.

Acute Lymphocytic Leukemia

Characteristics

- ◆ A. Incidence—usually appears before age 15 but is highest in 3- to 4-year-olds. Males slightly more at risk. More than 80% of all children survive 5 years or more.
- B. Pathophysiology—uncontrolled proliferation of lymphoblasts with eventual reduction of other blood cells.

Assessment

- A. Assess for malaise, fatigue, and fever.
- B. Assess bone involvement, and lymph and spleen alterations.
- C. Check for bleeding gums, skin, and nose.
- D. Evaluate CNS symptoms, especially stiff neck and headache.

Implementation

- A. Prepare for induction therapy.
- B. Maintain therapy when in remission.
- ◆ C. Administer drugs.
 1. Purinethol (mercaptopurine; 6-MP) and Trexall.
 2. Oncovin (vincristine) and Deltasone (prednisone) intermittently.
- D. Complete remission occurs in more than 90% of clients treated with drug protocols.

MALIGNANCY OF THE LYMPHATIC SYSTEM

Hodgkin's Disease

- ◆ *Definition:* A chronic, progressive, neoplastic, invariably fatal reticuloendothelial disease involving the lymphoid tissues of the body. It is most common between the ages of 20 and 40. While the exact etiology is unknown, the suspected sources are viral (20% of clients are infected with Epstein-Barr virus), environmental, genetic, and immunologic. Onset is often insidious.

◆ MEDICAL IMPLICATIONS

- A. Radiation is used for stages I, II, and III in an effort to eradicate the disease (80–90% cure rate).
- B. Wide-field megavoltage radiation with doses of 3500 to 4000 roentgens over a 4- to 6-week period.
- C. Recent results show improvement with a 2- to 4-month course of chemotherapy followed by radiation.
- D. Combination chemotherapy for stages III and IV and all B symptoms: Adriamycin (doxorubicin), Blenoxane (bleomycin), Velban (vinblastine), and dacarbazine (ABVD).

◆ Assessment

- A. Assess for painless enlargement of cervical lymph nodes.
- B. Assess for severe pruritus.
- C. Evaluate irregular fever, night sweats.
- D. Palpate for splenomegaly and hepatomegaly.
- E. Observe for jaundice, weight loss.
- F. Assess edema and cyanosis of the face and neck.
- G. Evaluate pulmonary symptoms including dyspnea, cough, chest pain, cyanosis, and pleural effusion.
- H. Assess for fatigue, malaise, and anorexia, which indicate progressive anemia.
- I. Evaluate bone pain and vertebral compression.
- J. Assess nerve pain and paraplegia.
- K. Assess laryngeal paralysis.
- L. Evaluate increased susceptibility to infection.
- ◆ M. Assess degree of staging—crucial to treatment regimen.
 - 1. **Stage I:** Disease is restricted to single anatomic site, or is localized in a group of lymph nodes; asymptomatic.
Treatment: If nodes are above diaphragm, radiation alone. Depending on size of nodes, chemotherapy may be added.
 - 2. **Stage II:** Two or three adjacent lymph nodes in the area on the same side of the diaphragm are affected.
Treatment: Same as above. If lymph nodes are large, combination radiation and chemotherapy.
 - 3. **Stage II(E):** Localized extralymphatic site on same side of diaphragm.
 - 4. **Stage III:** Disease is widely disseminated on both sides of diaphragm into the lymph areas and organs.
Treatment: Full-dose chemotherapy and radiation to areas of enlarged nodes.
 - 5. **Stage IV:** Involvement of bone, bone marrow, pleura, liver, skin, gastrointestinal tract, central nervous system, and gradually the entire body.
Treatment: Six rounds of chemotherapy with CT and PET scans for monitoring; may also get radiation.
- N. B symptoms: fever over 38°C (100.4°F), night sweats, more than 10% weight loss.

Implementation

- ◆ A. Provide supportive relief from effects of radiation and chemotherapy.
 1. Side effects include nausea and vomiting.
 2. Controlled by premedication of sedatives and antiemetic agents.
- ◆ B. Assist client to maintain as normal a life as possible during course and treatment of disease.
 1. Counsel client and family to accept process of treatment.
 2. Provide supportive assistance in dealing with feelings of anger, depression, fear, and loneliness.
- C. Prevent infection as body's resistance is lowered.
- D. Continually observe for complications: pressure from enlargement of lymph glands on vital organs.

Non-Hodgkin's Lymphoma

◆ *Definition:* A malignant disorder (involving malignant B cells) that originates from lymphoid tissues but is not characterized as Hodgkin's disease.

Assessment

- ◆ A. Assess for enlarged lymph nodes; painless.
- B. Unexplained fever, night sweats, weight loss, fatigue.
- ◆ C. Assess for gastrointestinal involvement—jaundice, abdominal cramping, bloody diarrhea, bowel obstruction.
- D. Ureteral obstruction may cause hydronephrosis.
- E. Compression of the spinal cord may impair neurologic function.
- F. Hemolytic anemia may occur late in the disease.
- ◆ G. Diagnosis.
 1. Biopsy of suspicious node.
 2. Staged like Hodgkin's disease.
 3. Once diagnosis is made, chest x-ray, CT scan, bone marrow, and blood work are done to determine stage.
 4. Treatment is based on these features.
- H. Prognosis—varies among types.
 1. Good survival rate with low-grade localized lymphomas.
 2. Aggressive type—one-third survival rate.

Implementation

- ◆ A. Based on actual classification of disease—same as for Hodgkin's disease.
 1. Radiation treatment of choice for nonaggressive form.
 2. Chemotherapy combination is used for aggressive form.
 3. Interferon recently approved for follicular low-grade lymphomas.
- B. Remission may occur but typically the disease recurs more aggressively.
- C. Bone marrow and blood stem transplants may prolong survival—considered for clients younger than age 60.

BLOOD AND LYMPHATIC SYSTEM REVIEW QUESTIONS

1. The client has orders to draw blood for serum electrolytes. She is on bed rest and has an IV in the basilic vein of the right forearm. The most appropriate site for blood withdrawal is the
 1. Left upper arm (brachial vein).
 2. Right forearm (radial vein).
 3. Foot (greater saphenous vein).
 4. Left forearm (median cubital vein).
2. For client safety, it is essential to check data on the requisition form against the blood unit. The essential data would not include
 1. Client's name.
 2. Blood group and type.
 3. Blood unit number.
 4. Blood bank that issued the blood.
3. LVNs/LPNs are allowed to withdraw blood specimens according to nurse practice guidelines if they
 1. Have received in-service education in this area.
 2. Practiced the skill in their nursing program.
 3. Are IV certified.
 4. Are the team leader in a facility.
4. A client is about to be discharged on the drug dicumarol (bishydroxycoumarin). Of the principles below, which is the most important to teach the client before discharge?
 1. He should be sure to take the medication before meals.
 2. He should shave with an electric razor.
 3. If he misses a dose, he should double the dose at the next scheduled time.
 4. It is the responsibility of the physician to do the teaching for this medication.
5. A client's laboratory results are returned, and the hemoglobin is 10 g/dL and the hematocrit is 30%. The highest priority nursing goal should be to
 1. Promote skin integrity.
 2. Conserve the client's energy.
 3. Prevent constipation.
 4. Encourage mobility.
6. When a client with a high fever and a diagnosis of viral infection is admitted to the hospital, the nurse would expect the lymphocyte (T cell) count to be
 1. Higher than normal.
 2. Lower than normal.
 3. Within normal limits.
 4. Absent.
7. A client receiving a blood transfusion begins to wheeze, and her skin becomes flushed with hives. The nurse knows that these symptoms are characteristic of a(n)
 1. Allergic reaction.
 2. Hemolytic reaction.
 3. Thrombotic crisis.
 4. Transfusion reaction.
8. A client with acute lymphocytic leukemia is scheduled to receive Trexall (methotrexate). The most important nursing goal when caring for this client is to
 1. Prevent infection.
 2. Maintain fluid balance prior to and following drug administration.
 3. Observe for signs of gastrointestinal disturbance.
 4. Observe for changes in mental alertness.
9. A client has just had a blood infusion started. The nurse suspects a possible hemolytic reaction to the blood. After stopping the blood transfusion, which nursing intervention would not be carried out?
 1. Return the blood bag to the laboratory.
 2. Obtain frequent urine specimens.
 3. Send a blood specimen to the laboratory for detection of intravascular hemolysis.
 4. Start another unit of blood to prevent further hemolysis.
10. A general guideline for starting a blood transfusion is to start it at how many macrodrops per minute, for how long a time?
 1. 10 drops for 10 minutes.
 2. 20 drops for 10 minutes.
 3. 25 to 50 drops for 15 minutes.
 4. 120 drops for 15 minutes.

- 11.** You are caring for a client who has been on Prevacid (lansoprazole), Desyrel (trazodone), and Zoloft (sertraline) for the past 8 weeks. This client has an absolute neutrophil count of $300/\text{mm}^3$ and a white blood cell count of $1500/\text{mm}^3$. The nurse should consider which of the following implementations as the priority?
1. Rapid administration of packed cells to raise blood count.
 2. Frequent vital signs.
 3. Maintaining neutropenic precautions.
 4. Regularly scheduled administration of Prevacid, Desyrel, and Zoloft to maintain blood levels.
- 12.** A client has lost about 30% of his total blood volume. Blood has been replaced, but his blood pressure remains low. Which of the following drugs would the nurse anticipate the physician's ordering?
1. A vasopressor.
 2. A vasodilator.
 3. An adrenergic-blocking drug.
 4. A parasympatholytic drug.
- 13.** The nurse has orders to administer blood to a client. The primary IV solution to which the nurse will add the blood is normal saline (NS). The rationale for using this solution rather than D₅W is
1. NS prevents cell hemolysis.
 2. NS is more compatible with blood.
 3. The dextrose in D₅W inactivates the blood.
 4. NS is more common as a primary IV solution.
- 14.** When assessing a client for Coumadin (warfarin sodium) therapy, the condition that will exclude this client from Coumadin therapy is
1. Diabetes.
 2. Arthritis.
 3. Pregnancy.
 4. Peptic ulcer disease.
- 15.** While monitoring a client's blood transfusion, the nurse determines that a hemolysis reaction is occurring. The first nursing intervention is to
1. Slow down the transfusion.
 2. Administer IV Benadryl.
 3. Stop the transfusion.
 4. Notify the physician.
- 16.** A client has aplastic anemia secondary to radiation exposure. What is the pathologic process involved in aplastic anemia?
1. Decreased intake of iron.
 2. Increased rate of red blood cell destruction.
 3. Decreased liver function.
 4. Decreased bone marrow production of red blood cells.
- 17.** The nursing diagnosis with the highest priority for the client with aplastic anemia who is being treated with both prednisone and Cytoxan (cyclophosphamide) is a risk for
1. Activity intolerance.
 2. Infection.
 3. Injury.
 4. Impaired skin integrity.

BLOOD AND LYMPHATIC SYSTEM ANSWERS WITH RATIONALE

- 1.** (4) The most appropriate site is the other (left) arm given that the IV is running in the right arm. The median cubital vein is the easiest vein from which to draw blood, and because the nurse will need to use a tourniquet, the left arm is appropriate—otherwise, this procedure would interfere with the IV.

NP:P; CN:PH; CL:A

- 2.** (4) The blood bank source is not part of the essential data that must be checked. Additional items that should be checked are ID number and expiration date of the blood.

NP:P; CN:S; CL:C

- 3.** (3) If LVNs or LPNs are IV certified, they will be able to withdraw blood according to most nurse practice act guidelines. In-service education (1) or practice (2) is not enough training for this skill.

NP:P; CN:S; CL:K

- 4.** (2) Dicumarol is an anticoagulant drug, and one of the dangers involved is bleeding. Using a safety razor can lead to bleeding through cuts. The drug should be given at the same time daily but not related to meals (1). Due to danger of bleeding, missed doses (3) should not be made up.

NP:P; CN:H; CL:A

- 5.** (2) These test results indicate anemia. Impaired oxygen-carrying capacity of red blood cells causes cellular hypoxia and results in fatigue. Conserving energy limits oxygen expenditure and minimizes fatigue. Increased mobility (4) increases the demand for oxygen and contributes to fatigue. Although hypoxic tissues are more vulnerable to breakdown, protecting the integumentary system (1) is not as high a priority as is the promotion of the body's overall oxygenation. Constipation (3) is not a problem in anemia.

NP:P; CN:PH; CL:AN

- 6.** (1) A high T-cell count (above 3400/mm³, lymphocytosis) would occur with a viral infection or influenza. These are the cells (along with B cells) that fight chronic bacterial and acute viral infections.

NP:A; CN:PH; CL:C

- 7.** (1) These signs, in addition to laryngeal edema, are characteristic of an allergic reaction that is, less specifically, a transfusion reaction. Chills, increased temperature, and pain in the kidney region are indications of a hemolytic reaction.

NP:AN; CN:PH; CL:C

- 8.** (1) A serious side effect of Trexall (methotrexate) is leukopenia—fewer white blood cells than normal, which results in neutropenia. This condition could lead to infection, in which case the client would have to be admitted to the hospital and the drug stopped. Antibiotics would be started.

NP:I; CN:PH; CL:AN

- 9.** (4) The nurse would not start another unit of blood; a normal saline infusion would be started at a “keep open” rate with new IV tubing. The blood, IV tubing, urine specimen, and transfusion record would be sent to the lab. Urine specimens (2) would be checked to monitor for acute renal tubular necrosis caused by the incompatibility of the blood.

NP:I; CN:PH; CL:A

- 10.** (3) A blood transfusion should be started slowly (from 25 to 50 drops per minute) for the first 15 minutes because slow administration allows time to observe for an adverse reaction. Most reactions occur in the first 15 minutes. The continuing rate is 100 mL/hr.

NP:P; CN:PH; CL:C

Coding for Questions/Answers Abbreviations: Nursing Process: NP, Assessment: A, Analysis: AN, Planning: P, Implementation: I, Evaluation: E; Client Needs: CN, Safe, Effective Care Environment: S, Health Promotion and Maintenance: H, Psychosocial Integrity: PS, Physiological Integrity: PH; Clinical Area: CA, Medical Nursing: M, Surgical Nursing: S, Maternal/Newborn Nursing: MA, Pediatric Nursing: P, Psychiatric Nursing: PS; Cognitive Level: CL, Knowledge: K, Comprehension: C, Application: A, Analysis: AN.

11. (3) Maintaining neutropenic precautions is the most important implementation for this client. The client is at risk for infection. Low neutrophil and white blood cell counts are often found in clients with aplastic anemia or malignancies or in clients who have received cytotoxic therapy. These low blood counts are most likely due to the Prevacid, Desyrel, and Zoloft. Administration of blood (1) is not indicated; frequent vital signs (2) are important, but not the highest priority; continuing the medications that are the most likely cause of the low blood count (4) will merely make the situation worse.

NP:I; CN:PH; CL:AN

12. (2) Vasodilator drugs are given when volume replacement has been completed. They decrease vascular resistance, decrease the work of the heart, and improve cardiac output and tissue perfusion. Vasopressor drugs (1) intensify shock by increasing vasoconstriction in the microcirculatory beds.

NP:P; CN:PH; CL:A

13. (1) Normal saline does prevent cell hemolysis, so it is the solution of choice. Answer (2) is also correct, but it is not as specific.

NP:AN; CN:PH; CL:A

14. (3) Coumadin therapy is contraindicated in the pregnant woman because it crosses the placenta. The

pregnant client should be taught heparin administration with a heparin lock if anticoagulation therapy must be continued. The arthritic client (2) may take aspirin or NSAIDs, which potentiate the effects of Coumadin, and should be watched for gastrointestinal bleed, as should the client with ulcer disease (4).

NP:A; CN:PH; CL:A

15. (3) The first action would be to stop the transfusion to avoid administering any additional incompatible cells. The incompatible cells can lead to agglutination, oliguric renal failure, pulmonary emboli, and death if administered in large quantities. Some resources state that as little as 50 mL of incompatible blood can lead to severe complications and death.

NP:I; CN:S; CL:A

16. (4) The term *aplastic* indicates arrested development. Aplastic anemia is a rare and serious condition in which the bone marrow stops producing enough red and white blood cells to keep the body healthy, resulting in an increased risk of infection and uncontrollable bleeding.

NP:AN; CN:PS; CL:K

17. (2) Both Deltasone (prednisone) and Cytoxan (cyclophosphamide) increase the risk for infection and decrease the body's immune function.

NP:AN; CN:S; CL:C

ENDOCRINE SYSTEM

The endocrine system consists of a series of glands that function individually or conjointly to integrate and control innumerable metabolic activities of the body. These glands automatically regulate various body processes by releasing chemical signals called hormones.

ANATOMY AND PHYSIOLOGY

Function

- A. Maintenance and regulation of vital functions.
 - 1. Response to stress or injury.
 - 2. Growth and development.
 - 3. Reproduction.
 - 4. Fluid, electrolyte, and acid-base balance.
 - 5. Energy metabolism.
- B. Endocrine glands.
 - 1. Have specific functions.
 - 2. Influence one another.
 - 3. Secrete hormones directly into the bloodstream.
 - 4. Controlled by autonomic nervous system.
 - 5. Located in various parts of body.
- C. Hormones. (See Table 8-11.)
 - 1. Chemical messengers that stimulate or inhibit life processes.
 - 2. Transmitted via the bloodstream to target tissues.
 - ◆ 3. Regulated through negative feedback control system (hypothalamic–pituitary axis). For example, the thyrotropin-releasing hormone (TRH) is secreted by the hypothalamus, which causes the pituitary to secrete thyroid-stimulating hormone (TSH). TSH stimulates the thyroid to secrete thyroxine (T_4). Thyroxine feeds back on the pituitary and inhibits production of TSH.
 - 4. Also regulated by renin–angiotensin–aldosterone, insulin–glucose, and calcium–parathormone.
 - 5. Endocrine disorders are caused by a deficit or excess in hormone production.

Structure

- ◆ A. Hypothalamus connects pituitary gland to central nervous system.
- ◆ B. Pituitary gland divided into three lobes.
 - 1. Anterior pituitary control (master gland).
 - a. Tropic hormones exert effect through regulation of other endocrine

- glands—adrenocorticotrophic hormone (ACTH), TSH, follicle-stimulating hormone (FSH), luteinizing hormone (LH).
- b. Target tissues: Hormones have direct effect on tissues—growth hormone, prolactin, melanophore-stimulating hormone (MSH).
 - 2. Posterior lobe (neurohypophysis)—antidiuretic hormone (ADH; also called vasopressin), oxytocin, melanophore-stimulating hormone.
 - 3. Intermediate lobe.
 - C. Adrenal gland—located on the top of each kidney.
 - 1. Cortex produces glucocorticoids, mineralocorticoids, sex hormones.
 - 2. Medulla produces epinephrine and norepinephrine.
 - D. Thyroid gland—located anterior to the trachea. Produces thyroxine, triiodothyronine (T_3), and thyrocalcitonin.
 - E. Parathyroid gland—located near thyroid. Produces parathormone (PTH).
 - F. Pancreas—located between stomach and small intestine. Produces insulin and glucagon.
 - G. Ovaries—located in female pelvic cavity. Produce estrogen and progesterone.
 - H. Testes—located in male scrotum. Produce testosterone.

System Assessment

- A. Assess for growth imbalance.
 - 1. Excessive growth.
 - a. Pituitary or hypothalamic disorders.
 - b. Excess adrenal, ovarian, or testicular hormone.
 - 2. Retarded growth.
 - a. Endocrine and metabolic disorders; difficult to distinguish from dwarfism.
 - b. Hypothyroidism.
- B. Evaluate for obesity.
 - 1. Sudden onset suggests hypothalamic lesion (rare).
 - 2. Cushing's syndrome (with characteristic buffalo hump).
- C. Assess abnormal skin pigmentation.
 - 1. Hyperpigmentation may coexist with depigmentation in Addison's disease.
 - 2. Thyrotoxicosis may be associated with spotty brown pigmentation.
 - 3. Pruritus is a common symptom in diabetes.
- D. Check for hirsutism.
 - 1. Normal variations in body occur on nonendocrine basis.
 - 2. First sign of neoplastic disease.
 - 3. Indicates changes in adrenal status.
- E. Evaluate appetite changes.

◆ Table 8-11 ENDOCRINE SYSTEM

Endocrine Gland	Hormones Produced	Function	Endocrine Disorder
Pituitary Location: base of the brain	Anterior Lobe Adrenocorticotrophic hormone glands (ACTH) Thyrotropic hormone (TSH) Gonadotropic hormones (FSH, LH, LTH) Somatotrophic growth-stimulating hormone (STH)	Termed “master gland” as it directly affects the function of other endocrine Acromegaly Regulates thyroid gland and metabolism Promotes growth of body tissues Controls sexual development and function Influences water absorption by kidney Influenced by hypothalamus hormone (MSH)	Anterior pituitary Gigantism Dwarfism
	Posterior Lobe (neurohypophysis) Vasopressin (ADH) Oxytocin Melanophore-stimulating		Posterior pituitary Diabetes insipidus
Adrenal Location: on top of each kidney	Intermediate Lobe Cortex Glucocorticoids Cortisol Cortisone Corticosterone Mineralocorticoids Aldosterone Deoxycorticosterone Corticosterone Sex hormones Androgens Estrogens Medulla Epinephrine (adrenaline)	Regulates sodium and electrolyte balance Affects carbohydrate, fat, and protein metabolism Influences the development of sexual characteristics Stimulates “fight or flight” response to danger Increases blood glucose levels Stimulates release of ACTH from pituitary, which then stimulates adrenal cortex to release glucocorticoids Increases rate and force of cardiac contractions Constricts blood vessels in skin, mucous membranes, and kidneys Dilates blood vessels in the skeletal muscles, coronary arteries, and pulmonary arteries Increases heart rate and force of contraction Vasoconstricts blood vessels throughout the body	Addison’s disease Cushing’s syndrome Pheochromocytoma Primary aldosteronism
Thyroid Location: anterior part of the trachea just inferior to the larynx	Thyroxine Triiodothyronine Thyrocalcitonin	Controls rate of body metabolism, growth, and nutrition Secretes calcitonin, a hormone that decreases excessive levels of calcium in the body by slowing the calcium-releasing activity of bone cells	Goiter Cretinism Myxedema Hyperthyroidism (Graves’ disease)
Parathyroid Location: near thyroid	Parathormone (PTH)	Controls calcium and phosphorus metabolism	Hypoparathyroidism Hyperparathyroidism
Pancreas Islets of Langerhans	Insulin Glucagon	Influences carbohydrate metabolism Indirectly influences fat and protein metabolism	Diabetes mellitus Hyperinsulinism
Ovaries Location: pelvic cavity	Estrogen, progesterone, and testosterone	Controls development of secondary sex characteristics	Lack of acceleration or regression of sexual development
Testes Location: scrotum	Estrogen, progesterone, and testosterone		

1. Polyphagia is a common sign of uncontrolled diabetes.
 2. Indicates thyrotoxicosis.
 3. Nausea and weight loss may indicate Addisonian crisis or diabetic acidosis.
- F. Check for polyuria and polydipsia.
1. Symptoms usually of nonendocrine etiology.
 2. If sudden onset, suggest diabetes mellitus or insipidus.
 3. May be present with hyperparathyroidism or hyperaldosteronism.
- G. Assess mental changes.
1. Though often subtle, may be indicative of underlying endocrine disorder.
 - a. Nervousness and excitability may indicate hyperthyroidism.
 - b. Mental confusion may indicate hypopituitarism, Addison's disease, or myxedema.
 2. Mental deterioration is observed in untreated hypoparathyroidism and hypothyroidism.
- H. Assess metabolic status.
1. Changes in energy level.
 2. Fatigue.
 3. Changes in heat or cold tolerance.
 4. Recent weight changes.
 5. Changes in sleep pattern.
- I. Assess for coma state.
1. Drowsiness.
 2. Hyperpnea.
 3. Tachycardia.
 4. Subnormal temperature.
 5. Fruity odor to breath.
 6. Acetone in urine.
 7. Stupor leading to coma.
- J. Assess diagnostic tests (radioactive iodine uptake, T_3 and T_4 , thyroid stimulation, and glucose tolerance test). See Chapter 11, Laboratory Tests.

System Implementation

- A. Administer hormone replacement on time to keep blood level stable.
- ◆ B. Monitor for side effects of hormone replacement therapy.
- C. Identify clinical manifestations indicating hyperfunction or hypofunction of endocrine glands.
- ◆ D. Monitor for fluid and electrolyte imbalances due to hormone imbalance.
- E. Provide appropriate diet specific for endocrine disorder.
- F. Promote rest and reduce stress.
- G. Prepare client physically and psychologically for surgical removal of endocrine gland.
- H. Instruct client on methods to prevent infection.

CONDITIONS ASSOCIATED WITH HORMONAL IMBALANCES

- A. Tumors of the glands.
 1. Benign (common).
 2. Malignant (rare).
- B. Absence of gland.
- C. Autoimmune factors.
- D. Infections.
- E. Side effects of replacement hormones.
- F. Dysfunction of the pituitary gland, which affects functioning of the target glands.

- ◆ I. Differentiate diabetic coma from other causes.
 1. Urinalysis for sugar and acetone.
 2. Blood sugar level.

PITUITARY GLAND DISORDERS

Acromegaly (Anterior Pituitary Hyperfunction)

◆ *Definition:* The hypersecretion of growth hormone by the anterior pituitary. Occurs in **adulthood after closure of the epiphyses of the long bones**.

Assessment

- A. Assess for excessive growth of short, flat bones.
 1. Large hands and feet.
 2. Thickening and protrusion of the jaw and orbital ridges that cause teeth to spread.
 3. Increased growth of soft tissue.
 4. Coarse features.
 5. Pain in joints.
 6. Forehead enlarges.
 7. Tongue enlarges.
 8. Hypertension.
 9. Peripheral nerve damage.
 10. Congestive heart failure.
 11. Seizures.
- B. Evaluate voice, which becomes deeper.
- C. Assess increased diaphoresis.
- D. Assess for oily, rough skin.
- E. Assess increased hair growth over the body.
- F. Evaluate menstrual disturbances; impotence.
- G. Assess for symptoms associated with local compression of brain by tumor.
 1. Headache.
 2. Visual disturbances; blindness.
- H. Check any related hormonal imbalances.
 1. Diabetes mellitus (growth hormone is insulin antagonist).
 2. Cushing's syndrome.
- I. Evaluate laboratory values—increased growth hormone level.

Implementation

- A. Provide emotional support.
 - 1. Encourage client's expression of feelings.
 - a. Loss of self-image and self-esteem.
 - b. Fears about brain surgery.
 - c. Consequences of surgery (sterility and life-time hormone replacement).
 - 2. Have client avoid situations that may be embarrassing.
 - 3. Encourage support of and communication with family.
- B. Provide frequent skin care.
- C. Position and support painful joints.
- D. Test urine for glucose and acetone.
- E. Administer supportive care for irradiation of pituitary.
- F. Provide preoperative and postoperative care for hypophysectomy.

Gigantism (Anterior Pituitary Hyperfunction)

◆ *Definition:* The hypersecretion of growth hormone by the anterior pituitary. Occurs **in childhood prior to closure of the epiphyses of the long bones.**

Assessment

- A. Assess for symmetrical overgrowth of the long bones.
- ◆ B. Evaluate increased height in early adulthood (may be 7–9 feet).
- C. Check for deterioration of mental and physical processes, which may occur in early adulthood.
- D. Assess for other tissue responses similar to acromegaly.

Implementation

- A. Supportive care for irradiation of pituitary.
- B. Provide preoperative and postoperative care for hypophysectomy.

Hypophysectomy

◆ *Definition:* The removal of the pituitary gland because of tumor formation. If tumors are small, an adenectomy (surgical excision of the gland) may be performed.

Treatment

- A. Surgical procedures.
 - 1. Craniotomy—for large, invasive tumors.
 - 2. Microsurgery—Endoscopic transnasal preferred approach, associated with fewer complications.
 - 3. Cryohypophysectomy.
- B. Medical treatment.
 - 1. Radiation therapy.
 - 2. Stereotactic radiosurgery.

Drugs

- a. Somatostatin analogs (Sandostatin [octreotide]).
- b. GH receptor antagonists (Somavert [pegvisomant]).
- c. Dopamine antagonists (Dostinex [cabergoline]).

Implementation

- A. Preoperative care.
 - 1. Provide general preoperative care.
 - 2. Provide emotional support.
- ◆ B. Postoperative care.
 - 1. Administer corticosteroids on time.
 - 2. Elevate the head of the bed.
 - ◆ 3. Monitor fluid and electrolyte balance.
 - a. Hyponatremic due to ADH disturbance leading to fluid imbalance and diabetes insipidus.
 - b. Avoid water intoxication.
 - c. Encourage fluid intake of 2500–3000 mL/day unless otherwise ordered.
 - 4. Carefully monitor vital signs.
 - 5. Monitor blood gas determinations.
 - 6. Provide routine care for craniotomy. Observe for
 - a. Vital signs.
 - b. Increased intracranial pressure.
 - c. Shock.
 - d. Level of consciousness (LOC).
 - 7. Initiate client education.
 - a. Compensate for altered stress response.
 - b. Avoid contact with infectious individuals.
 - c. Carry emergency adrenal hormone drugs.
 - d. Use Medic-Alert band.
- ◆ C. Monitor for complications.
 - 1. Craniotomy—bleeding in acromegaly (due to excessive growth of frontal bones). ↑ ICP, meningitis, hypopituitarism.
 - 2. Microsurgery—rhinorrhea and meningitis (due to interruption of CSF during surgery). Cerebrospinal fluid (CSF) leak, hypopituitarism.
 - 3. Cryohypophysectomy—probe hits other vital structures.

Dwarfism (Anterior Pituitary Hypofunction)

◆ *Definition:* Dwarfism is the hyposecretion of growth hormone by the anterior pituitary. Growth is symmetrical but decreased.

Assessment

- A. Assess for retarded physical growth.
- B. Evaluate premature body-aging processes.

- C. Assess for pale, dry, smooth skin.
- D. Check poor development of secondary sex characteristics and external genitalia.
- E. Evaluate slow intellectual development.

Implementation

- ◆ A. Administer human growth hormone (HGH) injections if the imbalance is diagnosed and treated in early stage.
- B. Monitor for complications.

Diabetes Insipidus (Posterior Pituitary Hypofunction)

◆ *Definition:* An antidiuretic hormone (ADH) deficiency, usually seen in young adults, resulting from damage or tumors in the posterior lobe of the pituitary gland. May develop following brain surgery, head injury, infection of the central nervous system (CNS).

Characteristics

- A. Neurogenic diabetes—can result from a disruption of the hypothalamus and pituitary gland (e.g., head trauma or cranial surgery) or can be idiopathic.
- B. Nephrogenic—disorder that occurs when renal tubules are not sensitive to ADH. May be familial or the result of renal failure.

Assessment

- ◆ A. Assess for severe polyuria (as much as 24 L/day) and polydipsia.
- B. Evaluate fatigue and muscle pain.
- C. Assess for dehydration. ↓ Skin turgor and dry mucous membranes, tachycardia.
- D. Assess weight loss, muscle weakness, headache.
- E. Evaluate for inability to concentrate urine.
- F. Monitor laboratory values.
 - 1. Urine specific gravity. Low urinary specific gravity (< 1.006 or less).
 - 2. Serum sodium.
 - 3. Serum vasopressin.
- G. Assess for postural hypotension that may result in collapse if not rehydrated.

Implementation

- A. Maintain adequate fluids.
- B. Measure intake and output and weight.
- ◆ C. Stress importance of Medic-Alert band.
- D. Avoid liquids or foods with diuretic-type action.
- E. Provide comfort measures if client is on radiation therapy.
- F. Provide preoperative and postoperative care for hypophysectomy.
- ◆ G. Administer Pitressin tannate (vasopressin tannate) intramuscular (IM) or nasal spray if ordered (often given for temporary DI after head trauma or surgery).

- ◆ H. Monitor diet: low sodium, low protein with diuretics.
- I. Administer benzthiazide diuretics for mild cases.
- J. Administer Diabinese (chlorpropamide) to potentiate vasopressin or act as antidiuretic.
- K. Administer Atromid-S (clofibrate) for antidiuretic effect.
- L. Monitor administration of nonsteroidal anti-inflammatory agents (NSAIDs) to increase urinary concentration.
- M. Give supportive care for irradiation of tumor.

ADRENAL CORTEX DISORDERS**Addison's Disease (Adrenocortical Insufficiency)**

◆ *Definition:* The hypofunction of the adrenal cortex of the adrenal gland, resulting in a deficiency of the steroid hormones. It often has a slow and insidious onset, and is eventually fatal if left untreated.

Assessment

- A. Assess for normal dietary intake.
- ◆ B. Assess for lassitude, lethargy, fatigue, and muscular weakness.
- C. Check out any gastrointestinal (GI) disturbances, nausea, diarrhea, and anorexia.
- D. Assess for hypotension.
- E. Evaluate increased pigmentation of the skin of nipples, buccal mucosa, and scars. This condition occurs in 15% of clients.
- F. Evaluate emotional disturbances, depression.
- G. Assess for weight loss, emaciation.
- ◆ H. Assess laboratory values and diagnostic tests.
 - 1. Elevated potassium; decreased sodium; elevated blood urea nitrogen (BUN) levels due to decreased glomerular filtration rate.
 - 2. Low blood glucose.
 - 3. Lack of normal rise in urinary output of 17-ketosteroids and 17-hydroxycorticosteroids following intravenous (IV) administration of ACTH over 8 hours.
 - 4. Lack of normal rise in blood level of plasma cortisol following IM injection of ACTH.
 - 5. Serum cortisol levels—decreased.
 - 6. ACTH stimulation test—cortisol levels rise with pituitary deficiency but do not rise in primary adrenal insufficiency.
 - 7. Computed tomography (CT) of head—identify intracranial problems impinging on the pituitary gland.
 - 8. Electrocardiogram (ECG)—look for characteristic changes associated with hyperkalemia (peaked T waves, widening QRS complex, and an increased PR interval).

Implementation

- ◆ A. Monitor daily weight and record accurate intake and output—restoration of fluid and electrolyte balance priority.
- B. Take vital signs QID (more often if client unstable).
- ◆ C. Check for inadequate or overdosage of hormones.
 - 1. Cortisone and Cortef (hydrocortisone).
 - a. Sodium and water retention.
 - b. Potassium depletion or hyperkalemia (may disappear with cortisol therapy).
 - c. Drug-induced Cushing's syndrome.
 - d. Gastric irritation (give medication with meal or antacid).
 - e. Mood swings.
 - f. Local abscess at injection site when given intramuscularly (IM) (inject deeply into gluteal muscle).
 - g. Addisonian crisis, which might be produced by sudden withdrawal of medication.
 - 2. Florigen (fludrocortisone acetate)—the same side effects as cortisone and hydrocortisone, particularly sodium retention and potassium depletion.
- D. Protect from exposure to infection.
- E. High-protein, high-carbohydrate diet in small, frequent feedings.
- F. Provide emotional support; assist client to avoid stress.
- G. Provide client education.
 - ◆ 1. Safe self-administration of replacement hormones. Lifelong replacement therapy with synthetic corticosteroid drugs is necessary.
 - 2. Avoidance of over-the-counter drugs.
 - 3. Care to avoid infections; report promptly to physician if infections appear.
 - 4. Medic-Alert band.
 - 5. Regular exercise; avoid strenuous activity, particularly in hot weather.
 - 6. Importance of continuous medical supervision.
 - 7. Avoidance of stress.
 - 8. Avoidance of exposure to cold.

Addisonian Crisis

◆ *Definition:* A life-threatening condition caused by acute adrenal insufficiency that may be precipitated by infection, trauma, stress, surgery, or diaphoresis with excessive salt loss. Death may occur from shock, vascular collapse, or hyperkalemia.

Assessment

- ◆ A. Assess for severe headache and abdominal, leg, and lower back pain.
- ◆ B. Assess for extreme, generalized muscular weakness.

- C. Assess for manifestations of shock.
 - 1. Hypotension.
 - 2. Rapid, weak pulse.
 - 3. Pallor.
 - 4. Rapid respiratory rate.
 - 5. Extreme weakness.
- D. Assess for irritability and confusion.

Implementation

- ◆ A. Administer parenteral fluids for restoration of electrolyte balance.
- ◆ B. Administer adrenocorticosteroids; do not vary dosage or time from that ordered.
- C. Continually monitor vital signs and intake and output until crisis passes.
- D. Protect client from infection.
- E. Keep client immobile and as quiet as possible; avoid unnecessary nursing procedures.
- F. Monitor neurological status, noting confusion and irritability.

Cushing's Syndrome (Adrenocortical Hyperfunction)

◆ *Definition:* Clinical condition resulting from the combined metabolic effects of persistently elevated blood levels of glucocorticoids.

Characteristics

- ◆ A. Etiology.
 - 1. Overactivity of adrenal cortex.
 - 2. Benign or malignant tumor of adrenal gland.
- B. Cause may be iatrogenic—drug therapy for other conditions.

Assessment

- ◆ A. Assess for abnormal adipose tissue distribution.
 - 1. Moon face.
 - 2. Buffalo hump.
 - 3. Obese trunk with thin extremities.
- B. Assess skin—color and texture.
 - 1. Florid facies.
 - 2. Red striae of skin stretched with fat tissue.
 - 3. Fragile skin, easily bruised.
- ◆ C. Assess for osteoporosis—susceptible to fractures, renal stones.
- ◆ D. Assess for hyperglycemia—may eventually develop diabetes mellitus.
 - E. Evaluate mood swings—euphoria to depression.
 - F. Assess for high susceptibility to infections; diminished immune response to infections once they occur.
 - G. Evaluate lassitude and muscular weakness.
 - H. Assess for masculine characteristics in females.
 - I. Assess for thin extremities.
 - J. Assess for hypertension.

- ◆ K. Evaluate electrolyte imbalance.
 1. Potassium depletion.
 2. Sodium and water retention.
 3. Metabolic alkalosis.
- ◆ L. Assess laboratory values.
 1. Elevated blood glucose and glycosuria.
 2. Elevated white blood count (WBC) with depressed eosinophils and lymphocytes.
 3. Elevated plasma cortisone levels.
 4. Elevated 17-hydroxycorticosteroids in urine.

Implementation

- ◆ A. Protect from infections.
- B. Protect from accidents or falls.
- C. Provide meticulous skin care, avoiding harsh soaps.
- D. Provide low-calorie, high-protein, high-potassium diet.
- ◆ E. Provide emotional support.
 1. Allow for venting of client's feelings.
 2. Avoid reactions to client's appearance.
 3. Anticipate the needs of the client.
 4. Explain that changes in body appearance and emotional lability should improve with treatment.
- ◆ F. Measure intake and output and daily weights; test blood glucose.
- G. Follow specific nursing measures postadrenalectomy or hypophsectomy.
- H. Provide comfort measures during radiation therapy, cobalt irradiation of the pituitary or implants.
- ◆ I. Provide postsurgery care for adrenalectomy, unilateral or bilateral.
 1. Bilateral—lifetime replacement of steroids.
 2. Unilateral—temporary steroid replacement (6–12 months).
- ◆ J. Monitor drug therapy.
 1. Cytadren (aminoglutethimide)—inhibits cholesterol synthesis.
 2. Metopirone (metyrapone)—inhibits adrenal cortex steroid synthesis.
 3. Lysodren (mitotane)—usually for inoperable, cancerous tumors.
 4. Cyproheptadine—serotonin antagonist that inhibits ACTH.
- K. Provide client teaching.
 1. Importance of continuous medical supervision.
 2. Safe self-administration of replacement hormones.
 3. Side effects of medications.
 4. Avoidance of infections and stress.
 5. Need for adequate nutrition and rest.

Primary Aldosteronism

Definition: A disorder due to the hypersecretion of aldosterone from the adrenal cortex of the adrenal gland. It is usually caused by tumors. Females are at greater risk.

Assessment

- ◆ A. Assess for hypokalemia.
 1. Weakness of muscles.
 2. Excessive urine output (polyuria); excessive thirst (polydipsia).
 3. Metabolic alkalosis.
- ◆ B. Assess for hypertension, postural hypotension, headache.
- ◆ C. Assess for positive Chvostek's sign (muscle twitching when area over facial nerves is tapped).
- D. Assess laboratory values.
 1. Lowered potassium level.
 2. Elevated serum sodium level.
 3. Increased urinary output of aldosterone.
 4. Metabolic alkalosis.

Implementation

- A. Provide quiet environment.
- B. Measure intake and output and daily weights.
- C. Check muscular strength and presence of Chvostek's sign.
- D. Measure blood pressure in supine and standing positions.
- E. Monitor administration of potassium salts and spironolactone.

ADRENAL MEDULLA DISORDERS

Pheochromocytoma (Hyperfunction)

Definition: A small tumor in the adrenal medulla of the adrenal gland that secretes large amounts of epinephrine and norepinephrine. Familial autosomal dominant.

Assessment

- A. Observe that condition occurs primarily in children and middle-aged women.
- ◆ B. Assess for hypertension—primary manifestation.
- ◆ C. Observe for sudden attacks that resemble overstimulation of the sympathetic nervous system.
 1. Hypertension (intermittent or persistent).
 2. Severe headache.
 3. Excessive diaphoresis.
 4. Palpitation, tachycardia.
 5. Nervousness and hyperactivity.
 6. Nausea, vomiting, and anorexia.
 7. Dilated pupils.
 8. Cold extremities.
 9. Tremors.
 10. Flushing.
 11. Anxiety.
 12. Vertigo.
 13. Blurred vision.
 14. Dyspnea.
 15. Cardiac failure or cerebral hemorrhage leading to death if not treated.

- D. Assess for increased rate of metabolism and loss of weight.
- E. Assess for hyperglycemia.
- F. Assess laboratory values.
 - 1. Findings common to hypertension, cardiac disease, and loss of kidney function.
 - 2. Elevated vanillylmandelic acid (VMA) and catecholamine levels in urine.
 - 3. Elevated blood levels of catecholamines.
 - 4. Elevated blood glucose and glycosuria.
- G. Presence of tumor may be found on x-rays or identified during surgical exploration.

Implementation

- ◆ A. Monitor for evidence of hypertensive attacks; keep Regitine (phentolamine) at bedside for hypertensive crisis.
- ◆ B. Monitor for normal vital signs and absence of glycosuria after alpha-adrenergic-blocking agents (Dibenzyline [phenoxybenzamine]) are given: 1–2 weeks before surgery.
- ◆ C. Assess daily for glucose and acetone in urine.
- D. Provide high-calorie, nutritious diet omitting stimulants.
- E. Promote rest and reduce stress.
- F. Provide preoperative care for surgical excision of tumor.
 - 1. Give Regitine 1–2 days before surgery to counteract hypertensive effects of epinephrine and norepinephrine.
 - 2. Closely monitor blood pressure (every 15 minutes) during interval of Regitine administration.
- G. Provide postoperative care—observe for precipitous shock, hemorrhage, persistent hypertension.
- H. Administer drugs if ordered: alpha blocker; Regitine, Dibenzyline, Nitropress (sodium nitroprusside).
- I. Surgical removal of the tumor is the treatment of choice.

Adrenalectomy

- ◆ *Definition:* Surgical removal of an adrenal gland when overproduction of adrenal hormone is evident (Cushing's syndrome, pheochromocytoma) or in metastatic breast or prostatic cancer.

Assessment

- A. Assess test results that indicate whether radiation, drug therapy, or surgery is appropriate to reverse Cushing's syndrome or restore hormone balance.
- ◆ B. Surgical intervention requires special management—central venous pressure (CVP), blood pressure (BP), pulse (P).
 - 1. Assess hypertension.
 - 2. Assess degree of edema.

- 3. Evaluate for signs of diabetes—blood glucose levels.
- 4. Assess for cardiovascular manifestations.
- C. Assess client's knowledge of disorder and understanding of management.
- D. Assess all laboratory reports before surgery.
 - 1. Check for signs of hypernatremia and hypokalemia.
 - 2. Assess for hyperglycemia or glycosuria.
- E. Assess dietary intake and fluid intake and output.
- F. Assess for complications.
 - 1. Wound infections.
 - 2. Hemorrhage.
 - 3. Peptic ulcers.
 - 4. Pulmonary disorders.

Implementation

- A. Preoperative care.
 - 1. Provide general preoperative care.
 - 2. Administer exogenous glucocorticoids.
- ◆ B. Postoperative care.
 - 1. Monitor vital signs and intake and output.
 - 2. Minimize effects of postural hypotension.
 - 3. Strictly adhere to sterile techniques when changing dressings; assess for infections.
 - 4. Observe for shock, hypoglycemia, hypotension.
 - 5. Maintain IV cortisol replacement (24–48 hours); mineralocorticoids.
 - 6. Monitor for paralytic ileus as this may develop from internal bleeding.
 - 7. Administer IV fluids to maintain blood volume.
 - 8. Monitor ECG changes.
 - 9. Monitor electrolytes.
 - 10. Monitor blood glucose levels.

THYROID GLAND DISORDERS

Cretinism (Thyroid Hypofunction)

Definition: A condition caused by inadequate secretions from the thyroid gland in the fetus, in utero, or soon after birth caused by congenital hypothyroidism.

◆ **Assessment**

- A. Assess for severe retardation of physical development, resulting in grotesque appearance, sexual retardation.
- B. Assess for severe cognitive impairment and apathy.
- C. Check for dry skin; coarse, dry, brittle hair.
- D. Assess for constipation.
- E. Evaluate slow teething.
- F. Evaluate poor appetite.
- G. Observe for large tongue.

- H. Observe for pot belly with umbilical hernia.
- I. Evaluate sensitivity to cold.
- J. Assess for yellow skin.
- K. Assess laboratory values.
 - 1. T₄ less than 3 µg/100 mL.
 - 2. Elevated serum cholesterol.
 - 3. Low radioactive iodine uptake.

Implementation

- ◆ A. Administer desiccated thyroid or Synthroid (levothyroxine).
- B. Administer Cytomel (liothyronine); effects more difficult to monitor.

Hypothyroidism (Myxedema)

Definition: The decreased synthesis of thyroid hormone in adulthood, resulting in a hypothyroid state—acquired hypothyroidism. Occurs primarily in older age group, five times more frequent in women than in men.

Assessment

- ◆ A. Assess for slowed rate of body metabolism.
 - 1. Lethargy, apathy, and fatigue.
 - 2. Intolerance to cold, hypothermia.
 - 3. Hypersensitivity to sedatives and barbiturates.
 - 4. Weight gain.
 - 5. Cool, dry, rough skin.
 - 6. Coarse, dry hair; hair loss; brittle nails.
 - 7. Numbness and tingling of fingers.
 - 8. Hoarseness.
- B. Assess for personality changes.
 - 1. Forgetfulness and loss of memory.
 - 2. Complacency.
 - 3. Slowed speech.
- C. Assess for anorexia, constipation, and fecal impactions.
- D. Observe for interstitial edema.
 - 1. Nonpitting edema in the lower extremity.
 - 2. Generalized puffiness.
- E. Observe for decreased diaphoresis.
- ◆ F. Check for reproductive disturbances.
 - 1. Menorrhagia (females).
 - 2. Infertility (females).
 - 3. Decreased libido (males).
- G. Assess for cardiac complications.
 - 1. Coronary heart disease.
 - 2. Angina pectoris.
 - 3. Myocardial infarction (MI) and congestive heart failure.
 - 4. Bradycardia
 - 5. Dysrhythmias.
- H. Evaluate anemia.

- I. Assess laboratory findings.
 - 1. Low serum thyrotoxin concentration.
 - 2. Hyponatremia.
 - 3. Elevated serum cholesterol.

Implementation

- A. Allow time for client to complete activities.
- B. Provide warm environment: extra blankets, etc.
- C. Provide meticulous skin care.
- D. Orient client as to date, time, and place.
- E. Prevent constipation.
- ◆ F. If sedatives or narcotics are necessary, give one-half to one-third normal dosage, as ordered by physician.
- G. Monitor thyroid replacement (initial small dosage, increased gradually).
- H. Maintain individualized maintenance dosage.
 - 1. Desiccated thyroid.
 - 2. Thyroxine (Synthroid).
 - 3. Triiodothyronine (Cytomel).
 - 4. Natural combinations from animal thyroid.
- I. Monitor for overdosage symptoms of thyroid preparations.
 - 1. Myocardial infarction and angina and cardiac failure, particularly in clients with cardiac problems.
 - 2. Restlessness and insomnia.
 - 3. Headache and confusion.
- J. Monitor arterial blood gases.
- K. Monitor pulse oximetry.
- L. Monitor oxygen administration.

Myxedema Coma

- ◆ *Definition:* A serious condition resulting from persistent low thyroid production.

Assessment

- A. Assess for hypoventilation, compromised respiratory function.
- B. Observe for hypotension leading to cardiac abnormalities; bradycardia.
- C. Evaluate cold sensitivity leading to severe hypothermia.
- D. Evaluate mood swings.

Implementation

- A. Monitor administration of thyroid hormone IV.
- B. Provide total supportive care.
- C. Provide psychological support.
 - 1. Body image change.
 - 2. Complete dependency.
 - 3. Mental depression.
- D. Closely observe for problems of immobility.

- E. Provide low-calorie diet.
- F. Provide ventilatory support if needed.
- G. Measure vital signs frequently, especially temperature.
- H. Monitor fluid intake to prevent dilutional hyponatremia.
- I. Avoid use of sedatives and hypnotics.

Hashimoto's Thyroiditis

◆ **Definition:** An autoimmune disorder in which antibodies that destroy thyroid tissue develop.

◆ **Characteristics**

- A. Functional tissue is replaced with fibrous tissue, and thyroid hormone (TH) level decreases.
- B. Decrease in TH levels prompt the gland to enlarge in an effort to compensate, causing goiter.

Assessment and Implementation

See Thyrotoxicosis/Hyperthyroidism/Graves' Disease below.

Thyrotoxicosis/Hyperthyroidism/Graves' Disease

◆ **Definition:** A condition that results from the increased synthesis of thyroid hormone. When associated with ocular signs and a diffuse goiter, it is called Graves' disease. Occurs four times more frequently in women than in men; usually occurs between 20 and 40 years of age.

◆ **MEDICAL IMPLICATIONS**

- A. Antithyroid drugs.
 - 1. PTU, Propyl-Thiouracil (propylthiouracil).
 - 2. Tapazole (methimazole).
 - 3. Side effect: agranulocytosis.
- ◆ B. Iodine preparations.
 - 1. Saturated solution of potassium iodide (SSKI).
 - 2. Lugol's solution—give in milk or juice.
 - 3. Pima (potassium iodide).
- C. Alternative to iodines: lithium—blocks hormone release.
- D. Propranolol and calcium antagonists.
 - 1. Rapidly reverse toxic manifestations.
 - 2. Used preoperatively.
- ◆ E. Radioiodine therapy.
 - 1. Safer therapy and useful in clients who are poor surgical risks.
 - 2. Uptake of ^{131}I by thyroid gland results in destruction of thyroid cells. This is contraindicated in pregnant women because radioactive iodine crosses the placental barrier and can have negative effects on the thyroid of the developing fetus.
 - 3. Myxedema may occur as a complication.
 - 4. Because the amount of gland destroyed is not readily controllable, the client may become hypothyroid and require lifelong TH replacement.
- F. Thyroidectomy.

◆ **Assessment**

- ◆ A. Evaluate laboratory tests.
 - 1. Thyroid antibodies (TAs)—used to determine if thyroid autoimmune disease is causing symptoms. TA is elevated in Graves' disease.
 - 2. Thyroid suppression test. Radioactive iodine (RAI) and T_4 levels are measured. The client then takes TH for 7 to 10 days, after which the tests are repeated. Failure of hormone therapy to suppress RAI and T_4 indicates hyperthyroidism.
 - 3. Above-normal test results: protein-bound iodine test (PBI), ^{131}I , and T_3 , T_4 .
 - 4. Relatively low serum cholesterol.
- ◆ B. Assess increased rate of body metabolism.
 - 1. Weight loss despite ravenous appetite and ingestion of large quantities of food.
 - 2. Intolerance to heat.
 - 3. Nervousness, jitters, and fine tremor of hands.
 - 4. Smooth, soft skin and hair.
 - 5. Tachycardia, palpitations, atrial fibrillation, angina, and congestive heart failure.
 - 6. Diarrhea.
 - 7. Diaphoresis.
 - 8. Flushed, moist skin.
 - 9. Muscular weakness.
- ◆ C. Assess personality changes.
 - 1. Irritability and agitation.
 - 2. Exaggerated emotional reactions.
 - 3. Mood swings—euphoria to depression.
 - 4. Quick motions, including speech.
- ◆ D. Assess any enlargement of the thyroid gland (goiter).
 - 1. Toxic multinodular goiter is characterized by small, discrete, independently functioning nodules in thyroid gland that secrete TH.
 - 2. May be benign or malignant. Slow to develop. Usually found in women in 60s or 70s.
- E. Observe for exophthalmos.
 - ◆ 1. Fluid collects around eye sockets, causing eyeballs to protrude (may be unilateral or bilateral).
 - 2. Not always present.
 - 3. Usually does not improve with treatment.
- F. Assess for cardiac arrhythmias.
- G. Evaluate difficulty focusing eyes.

◆ **Implementation**

- A. Provide adequate rest.
 - 1. Bed rest.
 - 2. Diversionary activities.
 - 3. Sedatives.
- B. Provide cool, quiet, stable environment.
- C. Maintain high-calorie, high-protein, high-carbohydrate, high-vitamin diet without stimulants—six small meals/day and snacks.

- D. Monitor daily weights.
- E. Provide emotional support.
 - 1. Be aware that exaggerated emotional responses are a manifestation of hormone imbalance.
 - 2. Be sensitive to needs.
 - 3. Avoid stress-producing situations.
- F. Adhere to regular schedule of activities.
- G. Provide client education.
 - 1. Protection from infection.
 - 2. Safe self-administration of medications.
 - 3. Importance of adequate rest and diet.
 - 4. Avoidance of stress.
- ◆ H. When giving iodine solutions in milk or juice, have client drink through a straw to prevent discoloration of the teeth.

Thyroidectomy

Definition: Removal of thyroid gland for persistent hyperthyroidism.

Assessment

- A. Assess type of surgery to be done: total resection or subtotal resection of the gland.
- B. Assess vital signs and weight for baseline data.
- C. Assess serum electrolytes for hyperglycemia and glycosuria.
- D. Assess level of consciousness.
- E. Evaluate for signs of thyroid storm.

Implementation

- ◆ A. Preoperative care—prevent thyrotoxicosis.
 - 1. Administer antithyroid drugs to deplete iodine and hormones (5–7 days).
 - 2. Administer iodine to decrease vascular-ity and increase size of follicular cells (5–7 days).
 - 3. Provide routine preoperative teaching.
 - 4. Reassure client.
 - 5. Maintain nutritional status.
 - 6. Monitor for evidence of iodine toxicity.
- ◆ B. Postoperative care.
 - 1. Check frequently for respiratory distress—keep tracheostomy tray at bedside.
 - 2. Maintain semi-Fowler's position to avoid strain on suture line.
 - 3. Observe for bleeding.
 - a. Vital signs—tachycardia, hypotension.
 - b. Pressure on larynx.
 - c. Hematoma around wound.
 - 4. Observe for damage to laryngeal nerve.
 - a. Respiratory obstruction.
 - b. Dysphonia.
 - c. High-pitched voice.

- d. Stridor.
- e. Dysphagia.
- f. Restlessness.
- 5. Observe for signs of hypoparathyroidism (causes an acute attack of tetany).
 - a. Positive Chvostek's sign and Troussseau's sign.
 - b. Convulsions.
 - c. Irritability and anxiety.
 - d. Stridor, wheezing, and dyspnea.
 - e. Photophobia, diplopia.
 - f. Muscle and abdominal cramps.

Thyroid Storm (Thyrotoxic Crisis)

- ◆ **Definition:** An acute, potentially fatal hyperthyroid condition that may occur as a result of surgery, inadequate preparation for surgery, severe infection, or stress.

Characteristics

- A. Cause not known; symptoms reflect exaggerated thyrotoxicosis.
- B. Infrequent due to premedication of iodine and antithyroid drugs.
- C. Can be precipitated by stressors.
 - 1. Infection.
 - 2. Abrupt withdrawal of medication.
 - 3. Metabolic causes.
 - 4. Emotional stress.
 - 5. Pulmonary embolism.
 - 6. Trauma.
 - 7. Surgery.
 - 8. Pregnancy.
 - 9. Vigorous palpation of thyroid.

Assessment

- ◆ A. Assess for increased temperature ($> 101^{\circ}\text{F}$, 38.3°C).
- B. Assess diaphoresis.
- C. Assess for dehydration.
- ◆ D. Evaluate cardiopulmonary symptoms.
 - 1. Tachycardia (> 120).
 - 2. Arrhythmias.
 - 3. Congestive heart failure.
 - 4. Pulmonary edema.
- ◆ E. Assess gastrointestinal symptoms.
 - 1. Abdominal pain.
 - 2. Nausea, vomiting, and diarrhea.
 - 3. Jaundice.
 - 4. Weight loss.
- F. Assess central nervous system symptoms.
 - 1. Tremors.
 - 2. Severe agitation, restlessness, and irritability.
 - 3. Apathy leading to delirium and coma.
 - 4. Altered mental state.

◆ MEDICAL IMPLICATIONS

- A. Large doses of IV Inderal (propranolol) to control thyroid storm.
- B. Adrenergic- and catecholamine-blocking agents to decrease heart activity.
- C. Glucocorticoids to allay stress effects.
- D. Sodium iodide to slow IV infusion.
- E. SSKI PO.
- F. Antithyroid drugs.

◆ MEDICAL IMPLICATIONS

- A. Acute condition.
 - 1. Slow drip of IV calcium gluconate or calcium chloride.
 - 2. Anticonvulsants and sedatives (Dilantin [phenytoin] and Luminal [phenobarbital]).
 - 3. Parathyroid hormone IM or SUB Q.
 - 4. Aluminum hydroxide (decreases phosphate level).
 - 5. Rebreathing bag to produce mild respiratory acidosis.
 - 6. Tracheostomy if laryngospasm causes obstruction.
- B. Chronic condition.
 - 1. Oral calcium carbonate (Os-Cal)—1–3 g/day.
 - 2. Active form of vitamin D preparations (Calciferol).
 - 3. High-calcium, low-phosphorus diet.
 - 4. Warning—many high-calcium foods are also high in phosphorus.

Implementation

- ◆ A. Do not palpate thyroid gland (stimulus increases symptoms).
- ◆ B. Decrease temperature: acetaminophen, external cold (ice packs, cooling blanket). Salicylates contraindicated—increase free thyroid hormone levels.
- C. Protect from infection, especially pneumonia.
- D. Monitor vital signs.
- ◆ E. Maintain fluid and electrolyte balance.
 - 1. Electrolyte shifts cause brittle situation of over- and underhydration.
 - 2. Maintain adequate output.
 - 3. Observe for sodium and potassium imbalance due to vomiting and diarrhea.
 - 4. Observe for signs of overhydration if cardio-pulmonary complications are evident.
- ◆ F. Monitor ECG for arrhythmias if
 - 1. Adrenergic blockers are used.
 - 2. Diuretics are given.
 - 3. Electrolyte imbalance is present.
 - 4. Cardiovascular medication is given.
- G. Humidify oxygen.
- H. Administer IV glucose diet with glucose and large doses of vitamin B complex.
- I. Protect for safety if agitated or comatose.
- J. Provide calm, quiet environment.
- K. Reassure client and family.

PARATHYROID GLAND DISORDERS

Hypoparathyroidism

- ◆ *Definition:* A condition caused by acute or chronic deficient hormone production by the parathyroid gland. Usually occurs following thyroidectomy.

Assessment

- ◆ A. Assess for acute hypocalcemia.
 - 1. Numbness, tingling, and cramping of extremities.
 - ◆ 2. Acute, potentially fatal tetany.
 - a. Painful muscular spasms.

- b. Seizures.
- c. Irritability.
- d. Positive Chvostek's sign.
- e. Positive Troussseau's sign.
- f. Laryngospasm.
- g. Cardiac arrhythmias.
- ◆ B. Assess for chronic hypocalcemia.
 - 1. Poor development of tooth enamel.
 - 2. Mental retardation.
 - 3. Muscular weakness with numbness and tingling of extremities.
 - 4. Tetany.
 - 5. Loss of hair and coarse, dry skin.
 - 6. Personality changes.
 - 7. Cataracts.
 - 8. Cardiac arrhythmias.
 - 9. Renal stones.
- C. Assess laboratory values.
 - 1. Low serum calcium levels.
 - 2. Increased serum phosphorus level.
 - 3. Low urinary calcium and phosphorus output.
 - 4. Increased bone density on x-ray examination.

Implementation

- ◆ A. Same as for seizures and epilepsy.
- B. Administer parenteral parathormone.
- ◆ C. Frequently check for increasing hoarseness.
- D. Observe for irregularities in urine.
- E. Force fluids as ordered.
- F. Observe for dystonic reactions if on phenothiazines.
- G. Maintain environment free of bright lights and noise.
- H. Provide psychological support.
 - 1. Altered body image.
 - 2. Emotional instability.
 - 3. Extreme weakness.
- I. Provide high-calcium diet.

Hyperparathyroidism

♦ *Definition:* A condition caused by overproduction of the parathyroid hormone by parathyroid gland.

Characteristics

- ♦ A. Primary hyperparathyroidism—occurs when there is hyperplasia or adenoma in one of the parathyroid glands.
- ♦ B. Secondary hyperparathyroidism (caused primarily from malabsorption and renal failure) results in chronic hypocalcemia (which stimulates excessive production of PTH).
- C. Tertiary hyperparathyroidism (usually the result of long-term secondary hyperparathyroidism) results in hypercalcemia.
- ♦ D. Treatment focus—decrease elevated serum calcium levels.
 1. When cause is malabsorption, there is decreased absorption of calcium from the intestine and a deficiency in vitamin D. Treatment is calcium supplements and vitamin D.
 2. When cause is renal failure, phosphate is retained, causing serum calcium levels to decrease and PTH levels to rise. Treatment is aimed at lowering phosphorus level, increasing calcium with oral supplements and vitamin D.
 3. If lowering phosphate level (thus, elevating calcium level, which stops chronic stimulation of parathyroid gland) does not work, surgery is performed.

Assessment

- A. Assess for bone demineralization with deformities, pain, high susceptibility to fractures.
- ♦ B. Assess for hypercalcemia.
 1. Mild hypercalcemia may not evidence symptoms.
 2. Calcium deposits in various body organs: eyes, heart, lungs, and kidneys (stones).
 3. Gastric ulcers.
 4. Personality changes, depression, apathy, and paranoia.
 5. Nausea, vomiting, anorexia, and constipation.
 6. Polydipsia and polyuria.
 7. Hypertension.
 8. Cardiac dysrhythmias.
 9. Skeletal pain.
 10. Pathologic fractures.
- ♦ C. Assess laboratory values.
 1. Elevated serum calcium level; lowered serum calcium.
 2. Normal to elevated serum phosphorus levels.

3. Elevated urinary calcium and phosphorus levels.
4. Evidence of bone changes on x-ray examinations.
5. Normal to increased alkaline phosphatase.

Implementation

- ♦ A. Force fluids for hypercalcemia. Include juices to make urine more acidic.
- B. Provide normal saline (NS) IV infusion.
- ♦ C. Observe for electrolyte imbalance with Lasix (furosemide) administration.
- D. Measure intake and output.
- E. Closely observe urine for stones and gravel.
- ♦ F. Observe for digitalis toxicity if client is taking digitalis.
- G. Prevent accidents and injury through safety measures.
- H. Provide surgical care if subtotal surgical resection of parathyroid glands is done.
- I. Oral supplements of calcium and vitamin D will be administered with malabsorption, renal failure, or for bone rebuilding processes (several months).
- J. Administer calcitonin and corticosteroids if ordered.

Parathyroidectomy

Definition: Removal of one or more of the parathyroid glands, usually as a result of thyroidectomy.

Assessment

- ♦ A. Assess for positive Chvostek's and Trousseau's signs.
- ♦ B. Assess for CNS signs of psychomotor or personality disturbances.
- ♦ C. Evaluate laboratory results for baseline data.
 1. Serum potassium, calcium, phosphate, and magnesium.
 2. Renal magnesium function tests (renal damage from hyperplasia).
- D. Evaluate urine for presence of stones.
- E. Assess lung sounds for prevention of pulmonary edema.
- F. Assess muscle weakness, ability to walk, and range of movement for minimizing bone stress.

Implementation

- ♦ A. Observe for tetany and treat accordingly.
- ♦ B. Maintain patent airway.
 1. Observe for respiratory distress.
 2. Keep a tracheostomy tray at the bedside.
- ♦ C. Provide diet high in calcium, vitamin D, and magnesium salts.
- D. Increase fluids to prevent formation of urinary stones—monitor intake and output for low levels of calcium, magnesium, and phosphate.

- ◆ E. Monitor IV administration of calcium gluconate if given for postoperative emergency.
- F. Monitor for postoperative complications.
 1. Renal colic.
 2. Laryngeal nerve damage.
 3. Acute psychosis (look for listlessness).
- ◆ G. Position client in semi-Fowler's position and support head and neck to decrease edema.
- H. Ambulate client as soon as possible to speed up recalcification of bones.

PANCREAS DISORDERS

Diabetes Mellitus (Types I and 2)

Definition: A group of disorders that have a variety of genetic causes, but have glucose intolerance as a common thread.

Characteristics

- A. Classifications (see **Table 8-12**).
- 1. Type 1—insulin-dependent diabetes mellitus with beta cell destruction or defect in function affects about 5% of all diabetics.
 - a. **Immune mediated**—presence of islet cell or insulin antibodies that identify the autoimmune process leading to beta cell destruction.
 - b. **Idiopathic**—no evidence of autoimmunity.
- 2. Type 2—non-insulin-dependent diabetes mellitus is the most common. Results when body produces insufficient insulin or there is insulin resistance with relative insulin deficiency. Affects 90%

- of all diabetics. Twenty-one million Americans have type 2 and 41 million are prediabetic.
- a. Type 2 accounts for half of all cases in young people.
 - b. Incidence in young has risen dramatically last 10 years.
 - 3. Type 3—Gestational (GDM)—increased blood glucose levels during pregnancy.
 - 4. Type 4—Other specific types—genetic defects of beta-cell function or insulin action, pancreatic diseases, endocrinopathies, or drug- or chemical-induced diabetes.
 - ◆ B. Pathophysiology.
 - ◆ 1. Type 1 (insulin-dependent).
 - a. Rapid onset—requires insulin due to absence of circulating insulin.
 - b. Autoimmune response or idiopathic.
 - c. Presence of anti-islet cell antibodies.
 - d. Pancreatic beta cells die.
 - e. Ketosis unless treated.
 - ◆ 2. Type 2 (non-insulin-dependent), formerly adult-onset type.
 - a. Gradual onset—may be controlled by diet.
 - b. Ninety percent of diabetes cases are this type.
 - c. Impaired beta-cell response to glucose (client usually nonobese).
 - d. Tissues insensitive to insulin (client usually obese).
 - (1) Extrapancreatic defect.
 - (2) Normal or high levels of circulating insulin.

Table 8-12 COMPARISON OF TYPE I AND TYPE 2 DIABETES

	Type I	Type 2
Etiology	Unknown; autoimmune process involved	Heredity more relevant (100% of children contract type 2 when both parents have it)
Cause	Absence of circulating insulin (in some cases, disease is mild and benign)	Insulin insufficient, not totally deficient; defective glucose-mediated insulin secretion
Onset	Usually abrupt—under age 35	Insidious, often over age 35
Weight	History of failure to gain despite voracious appetite	Linked to obesity and inactivity
Sex	Found in girls and boys equally	Most common in females
Cardinal signs	Polydipsia, polyphagia, polyuria	Polydipsia, polyphagia, polyuria
Other signs	Weakness, tiredness, urinary tract infections, skin infections, blurred vision	Overweight, fatigue, frequent infections, blurred vision, impotence, absence of menstruation
Stability	Unstable; brittle—difficult to control	Stable with compliance; less difficult to control
Distinguishing feature	Honeymoon phase—symptoms decrease with a short remission	No honeymoon phase
Complications	Hyperglycemia, diabetic ketosis, and ketoacidosis	Neuropathy, retinopathy, uropathy
Treatment	Insulin and ADA diet, exercise	ADA diet alone; ADA and insulin, or ADA and oral hypoglycemic agents

- C. **Somogyi phenomenon.** Hypoglycemia usually at night followed by compensatory rebound hyperglycemia in the morning (lasts 12–72 hours).
1. Usually caused by too much insulin or an increase in insulin sensitivity.
 2. Client may be stabilized by gradual lowering of insulin dose and increase in diet at the time of the hypoglycemia reaction.

- ◆ D. **Dawn phenomenon.**
1. Blood glucose normal until 3 AM—begins to rise in early morning hours.
 2. Common problem—glucose released from liver in early AM—needs to be controlled.
 3. Algorithm for hyperglycemia—altering time and dose of insulin (NPH or Ultralente) by one or two units stabilizes client.

◆ MEDICAL IMPLICATIONS

- A. Diet.
1. The cornerstone of management, interdependent with medication and exercise.
 2. Attainment of normal weight may clear symptoms in type 2 diabetes.
 3. Total calories are individualized.
- ◆ 4. American Diabetes Association (ADA) general dietary guidelines.
- a. High complex carbohydrates, high-soluble-fiber foods (oat bran cereals, beans, peas, fruits with pectin) assist in controlling blood glucose; fiber: up to 40 g/day. Focus is now on total carbohydrate—not source of carbohydrate (such as sugar).
 - b. Protein—10–20% of total calories from both animal and vegetable sources.
 - c. Fat—less than 30% of daily calories.
 - d. Limit saturated fat to 10% or less of daily calories. Emphasize low-saturated fats and mono- and polyunsaturated fats.
5. The goal of the diet is to improve overall health through optimal nutrition using “exchange lists,” *Dietary Guidelines for Americans*, or the food pyramid called *MyPyramid*.
 6. ADA exchange diet; six exchange lists.
 - a. Starch/bread, meat and meat substitutes, vegetables, fruit, milk, and fat.
 - b. Foods can be substituted or exchanged for each other.
 - c. Diet prescribed as to total calories and number of exchanges from each group.
 7. The revised Food Pyramid.
 - a. Grains: half should be whole grain.
 - b. Vegetables: fresh or frozen.
 - c. Fruits: fresh or frozen, dried or juices.
 - d. Oils: liquid, not solid.
 - e. Milk: low fat or nonfat.
 - f. Meat and beans: poultry, fish, eggs, nuts, and seeds.
 8. Carbohydrate counting—grams consumed are monitored and adjusted daily according to blood glucose levels.
 9. Calorie counting—more appropriate for obese client. Emphasizes food choices based on number of calories.
 10. Glycemic index—diet based on how much a certain food raises the blood glucose level as compared to an equivalent amount of glucose. (See Chapter 4.)
- ◆ B. Medications.
1. Insulin type: See **Table 8-13**.
 2. Oral hypoglycemic drugs—improve sensitivity to insulin.
 - a. Effective for those with some functioning beta cells in islets of Langerhans.
 - b. Used for older clients, noninsulin dependent with normal weight, and diet will not control hyperglycemia.
 - c. First-generation sulfonylureas.
 - (1) Thought to stimulate beta cells to increase insulin release.
 - (2) Orinase (tolbutamide), short acting (6–12 hours).
 - (3) Diabinese (chlorpropamide), long acting (36–60 hours).
 - (4) Dymelor (acetohexamide), intermediate acting (10–20 hours).
 - (5) Tolinase (tolazamide), intermediate acting (12–24 hours).
 - d. Second-generation (longer-acting drugs) sulfonylureas.
 - (1) DiaBeta, Micronase, Glynnase (glyburide), intermediate acting (12–24 hours).
 - (2) Glucotrol (glipizide), short acting (12–24 hours).
 - (3) Amaryl (glimepiride).
 - e. Nonsulfonylureas insulin secretagogues—stimulate pancreas to secrete insulin: Prandin (repaglinide).
 - f. Biguanides—inhibit production of glucose by the liver: Glucophage, GlucophageXL, Fortamet (metformin), Glucovance (metformin with glyburide).

- g. Alpha-glucosidase inhibitors—delay absorption of complex carbohydrates in the intestine: Precose (acarbose) and Glyset (miglitol).
 - h. Thiazolidinediones—sensitize body tissue to insulin: Avandia (rosiglitazone) and Actos (pioglitazone).
 - i. A new class of oral medications, dipeptidyl peptidase (DDP-4) inhibitors—lower blood glucose levels by increasing and prolonging action of GLP-1: Januvia (sitagliptin) and Galvus (vildagliptin).
- ◆ C. Insulin pump—newer method of insulin administration.
1. Continuous delivery of fixed small amounts of diluted insulin—mimics release of insulin by pancreas.
 2. Uses regular insulin: 50% continuous delivery and 50% divided into three premeal bolus doses.
 3. Amount calculated by blood glucose monitoring; done two to four times per day.
 4. Usually pump and syringe with needle placed in abdomen and taped in place; changed every 3 days.
 5. Method useful for conscientious, active person who does not want to adjust life to coincide with insulin peaks.
 6. Client disadvantages.
 - a. Requires conscientious client commitment to understand and learn pump use.
 - b. Requires extensive client teaching.
 - c. Regimen is complicated and may require more time than client can spend.
- D. Insulin pens.
1. Prefilled insulin cartridges loaded into pen-like holder.
 2. Dial dose.
 3. No need to carry insulin or draw up before administration.
- E. Jet injectors.
1. Deliver insulin through skin; it is absorbed faster.
 2. No needles.
- F. Exercise.
1. Decreases body's need for insulin.
 2. Moderate activity recommended.
 3. Administer 10 g carbohydrate (CHO) before exercise.

◆ Table 8-13 INSULIN TYPES AND ACTION

Types	Source	Onset	Peak	Duration
Rapid Acting (Clear)				
Humalog (lispro)	Human	10–15 min	30–90 min	2–4 hr
NovoLog (aspart)		5–15 min	40–50 min	2–4 hr
Apidra (glulisine)		5–15 min	30–60 min	2 hr
Short Acting (Clear)				
Novolin R	Human	0.5–1 hr	2–4 hr	5–7 hr
Humulin R	Human			
Intermediate Acting (Cloudy)				
Humulin N (NPH)	Human	1–2 hr	4–12 hr	16–24 hr
Novolin N (NPH)	Human	3–4 hr	4–12 hr	16–22 hr
Mixture (Cloudy)				
Humulin 70/30	Human (70% NPH, 30% regular)	30 min	2–12 hr	24 hr
Novolin 70/30	Human (70% NPH, 30% regular)			
Humulin 50/50	Human (50% NPH, 50% regular)			
Humalog 75/25	(75% lispro protamine suspension, 25% lispro)	15 min	1 hr	24 hr
Novolin L	Human	3–4 hr	4–12 hr	16–20 hr
Long Acting (Clear)				
Humulin Ultralente	Human	6–8 hr	12–16 hr	20–30 hr
Lantus (glargine)		4–6 hr	No peak	24 hr

NPH = neutral protamine Hagedorn. Note: The time of insulin onset, peak, and duration may vary in different clients. Human insulin is biologically engineered through the process of recombinant DNA technology; it is modified human insulin.

Data from: Smith, S., Duell, D., & Martin, B. (2008). *Clinical nursing skills*, 7th ed. Upper Saddle River, NJ: Prentice Hall Health.

Assessment

- ◆ A. Assess for early symptoms.
 - ◆ 1. Common to both type 1 and type 2.
 - a. Polyuria.
 - b. Polydipsia.
 - c. Polyphagia.
 - d. Blurred vision.
 - e. Fatigue.
 - f. Abnormal sensations (prickling, burning).
 - g. Infections (vaginitis).
 - h. Weakness.
 - i. Tingling or numbness in hands or feet.
 - j. Dry skin.
 - 2. Type 1.
 - a. Postural hypotension.
 - b. Decreased muscle mass.
 - c. Weight loss in spite of increased appetite.
 - 3. Type 2.
 - a. Often asymptomatic.
 - b. Often obese.
 - c. Slow wound healing.
 - d. Blurred vision.
 - e. Fatigue.
 - f. Paresthesias.
 - 4. Type 2 in young people.
 - a. Hyperglycemia.
 - b. Hypertension.
 - c. Dyslipidemia.
- B. Assess for distinguishing features of type 1 and type 2 diabetes.
- C. Assess for risk factors.
 - 1. Client history—hereditary predisposition.
 - 2. Weight—presence of obesity.
 - 3. High stress levels.
- ◆ D. Diagnosis of diabetes: assess results of laboratory values.
 - ◆ 1. Fasting blood sugar > 126 mg/dL on two separate occasions, postprandial blood sugar > 200 mg/dL and at least once between meals at 2 hours PC; abnormal glucose tolerance test or Orinase tests.
 - 2. Impaired glucose tolerance (IGT) is a fasting blood sugar of 100–125 mg/dL. Current ideal normal fasting level of 80–100 mg/dL.
 - 3. Elevated cholesterol and triglyceride levels.
 - 4. Capillary blood glucose (finger-stick) is most common method.
 - 5. *Glycosylated hemoglobin test (HgbA₁)*.
 - a. Monitors blood sugar and hemoglobin; determines how well diabetes is controlled.
 - b. Reflects glycemic state over preceding 8 to 12 weeks.
- c. Abnormally high in diabetics with chronic hyperglycemia.
- d. Values: normal 4% to 6%; good control less than 7%; fair control 7% to 8%; poor control more than 9%.

♦ Implementation

- A. When diabetic client is hospitalized:
 - 1. Administer IV fluids and medications as ordered.
 - 2. Adhere to procedures for other laboratory tests.
 - 3. Provide meticulous skin care, particularly for lower extremities.
 - 4. Observe for signs of insulin reactions and ketoacidosis.
 - 5. Measure intake and output.
- B. Provide emotional support.
 - 1. Allow for verbalization of client's feelings.
 - a. Necessary changes in lifestyle, diet, and activities.
 - b. Changes in self-image and self-esteem.
 - c. Fear of future and complications.
 - 2. Provide special counseling for adolescents because of their heightened sensitivity to being different and their frequently unusual dietary habits.
 - a. Diet should be adequate for normal growth and development, and regulated according to diabetic needs.
 - b. The type of diet prescribed is influenced by the philosophy of the physician.
 - c. Diets vary from free diets to strict dietary control.
 - 3. Encourage involvement of family.
- ◆ C. Provide client education (key to effective self-management).
 - 1. Assessment.
 - a. Level of knowledge.
 - b. Cultural, socioeconomic, and family influences.
 - c. Daily dietary and activity patterns.
 - d. Emotional and physical status and effect on client's current ability to learn.
 - 2. Insulin and insulin injections.
 - a. Keep insulin at room temperature; refrigerate extra supply of insulin.
 - b. Turn insulin bottle top to bottom several times prior to drawing up insulin.
 - c. Use sterile injection techniques.
 - d. Choose injection sites to prevent injection in dystrophic areas.
 - e. Watch for signs of hypo- and hyperglycemia.

- ◆ 3. Self-monitoring of blood glucose level (SMBG).
 - a. Balancing blood glucose levels results in fewer complications.
 - b. Protocol is taking blood glucose levels two to four times/day.
 - (1) Glucose monitors are small and easy to use. Lancets and lasers are used to obtain blood samples.
 - (2) A monitor that measures glycated protein is now available—indicator of overall glucose control during previous 2 weeks.
 - c. Pattern control is goal.
 - d. Use algorithms as guidelines for amount of insulin.
 - e. Clients should use a diary or log to record results.
- 4. Continuous glucose monitoring systems (CGMS) are now available.
 - a. Sensor implanted under skin in abdomen sends continuous readings to a pager device clipped on belt.
 - b. Glucose readings occur every few seconds for close monitoring.
 - c. Appropriate for those with “brittle diabetes,” in a health crisis, or who display a wide range of levels.
- 5. Oral medications.
 - a. Take medications regularly.
 - b. Watch for hypoglycemic reactions occurring with sulfonylureas.
 - c. Remember that alcohol ingestion in conjunction with sulfonylureas causes an Antabuse (disulfiram)-like reaction.
- 6. Avoidance of infection and injury.
 - a. Report infection or injury promptly to physician.
 - b. Maintain meticulous skin care.
 - ◆ c. Maintain proper foot care.
 - (1) Wash with mild soap—dry well.
 - (2) Use lanolin to prevent cracking.
 - (3) Cut toenails straight across, or have nails trimmed by podiatrist.
 - (4) Use clean cotton socks.
 - (5) Inspect feet daily—report skin breaks.
 - (6) Avoid “bathroom surgery” for corns and calluses.
 - d. Be aware that insulin requirements may increase with infections.
 - e. Be prepared for healing process impairment.
 - f. Avoid tight-fitting garments and shoes.

CURRENT TRENDS IN INSULIN ADMINISTRATION

- Abdominal injection sites preferred for consistent and rapid rate of absorption.
- Rotating injection areas is recommended for clients using pork or beef insulin. Rotation within sites is recommended for those using human or purified pork insulin.
- Injection site should be 1 inch–2.54 cm—from the previous injection site.
- Wait 30 seconds after slowly injecting insulin before removing needle to prevent insulin leakage.
- Aspirating before and massaging after injection are no longer recommended.

- ◆ 7. Diet.
 - a. Do not vary meal times.
 - b. Incorporate diet with individual needs, lifestyle, cultural, and socioeconomic patterns.
 - c. Most adults require 30 calories/kg of ideal body weight.
- ◆ 8. Exercise.
 - a. Regulate time and amount.
 - b. Avoid sporadic, vigorous activities; use aerobic exercise.
 - c. Give 10 g CHO before exercise and every hour during exercise.
 - d. Do not exercise during peak action time of insulin.
 - e. Rigorous exercise while blood sugar is 240–300% may precipitate ketoacidosis.
- 9. Medic-Alert band.
- 10. Provide constant availability of concentrated sugar.

Syndrome X—Metabolic Syndrome

Definition: A group of risk factors that, in combination, put someone at higher risk of coronary artery disease. These risk factors include central obesity (excessive fat tissue in the abdominal region), glucose intolerance, high triglycerides and low high-density lipoprotein (HDL) cholesterol, and hypertension.

Characteristics

- A. Underlying cause is resistance to insulin.
 1. Normally, blood carries the glucose to the body's tissues, where the cells use it as fuel. Glucose enters the cells with the help of insulin.
 2. In insulin resistance, cells don't respond to insulin and glucose can't enter the cells. The body reacts by putting out more and more insulin to help glucose get into the cells.
 3. This results in higher than normal levels of insulin and glucose in the blood.

- 4. Increased insulin raises triglycerides level and interferes with how the kidneys work, leading to increased blood pressure.
- B. Combined effects of insulin resistance put a client at risk of heart disease, stroke, diabetes, and other conditions.
- C. Risk factors.
 - 1. Age—increases with age.
 - 2. Race—greater in Hispanics and Asians.
 - 3. Obesity—body mass index (BMI) > 25, abdominal obesity, having an apple shape rather than a pear shape.
 - 4. History of diabetes—family history of type 2 diabetes or a history of gestational diabetes.
 - 5. Other diseases—high blood pressure, cardiovascular disease, polycystic ovary syndrome.

Treatment

- A. Screening and diagnosis.
 - 1. Elevated waist circumference—greater than 35 inches for women and 40 inches for men.
 - 2. Elevated level of triglycerides of 150 mg/dL or higher, or client receiving treatment for high triglycerides.
 - 3. Reduced HDL < 40 mg/dL in men or < 50 mg/dL in women.
 - 4. Elevated blood pressure \geq 130 mm Hg systolic, \geq 85 mm Hg diastolic.
 - 5. Elevated fasting blood glucose of 100 mg/dL or higher.
- B. Intervention.
 - 1. Exercise.
 - 2. Weight loss.
 - 3. Stop smoking.

COMPLICATIONS

♦ Ketoacidosis

Definition: One of the most serious results of poorly managed diabetes. The two major metabolic problems that are the source of this condition are hyperglycemia and ketoacidemia, both due to lack of insulin associated with hyperglucagonemia.

Characteristics

- A. Without insulin, carbohydrate metabolism is affected.
- B. Hyperglycemia results from increased liver production of glucose and decreased glucose uptake by peripheral tissues.
- C. The liver oxidizes fatty acids into
 - 1. Acetoacetic acid (increased ketone bodies lead to ketoacidosis).
 - 2. Beta-hydroxybutyric acid (acetone is volatile and is blown off by lungs).

- 3. As glucose levels increase, there is osmotic overload in kidneys, resulting in dehydration and electrolyte losses.
- 4. As ketone bodies increase, acidosis and comatose states occur.

Assessment

- A. Assess for ketoacidotic coma—usually preceded by a few days of polyuria and polydipsia with associated symptoms (classic symptoms of hyperglycemia).
- B. Assess for ill appearance.
- C. Assess for anorexia, nausea, and vomiting.
- D. Assess for drowsiness, confusion, and mental stupor.
- E. Assess for dehydration; deep, rapid breathing; and fruity odor of acetone to breath.
- F. Observe for complications of circulatory collapse or respiratory distress.

Implementation

- ♦ A. Maintain fluid and electrolyte balance.
 - 1. Normal saline IV until blood sugar reaches 250–300 mg/dL; then a dextrose solution (5% glucose) is started.
 - 2. Potassium added to IV after renal function is evaluated and hydration is adequate.
- ♦ B. Provide insulin management.
 - 1. Give one-half dose IV during acute phase and one-half dose sub Q or low-dose protocol; IV bolus of 5–10 U of regular insulin followed by infusion of 5–10 U/hr until plasma glucose level is 250 mg/100 mL.
 - 2. Regulating level takes 4–6 hours; regulation of pH takes 8–12 hours.
 - 3. Monitor for onset of insulin reaction.
- ♦ C. Maintain patent airway and adequate circulation to brain (cardiac monitoring if status indicates).
- D. Monitor vital signs every 1–2 hours; arterial blood gases (ABGs) hourly until pH is 7.2+.
- E. Monitor urine frequently for glucose and acetone.
- F. Test blood glucose level every 1–2 hours.
- G. Perform hourly urine measurements.
- H. Maintain personal hygiene.
- I. Keep client warm.
- J. Protect from injury.

Insulin Reaction/Hypoglycemia

- ♦ **Definition:** An abnormally low blood glucose, usually below 50 mg, resulting from too much insulin, not enough food, or excessive activity.

Assessment

- A. Assess for symptoms, especially before meals.
- ♦ B. Assess for sweating, tremors, pallor, tachycardia, palpitations, or nervousness.

INSULIN RESISTANCE

- Definitions
 1. People (25% of the U.S. population) who produce insulin, but the quality of its action is inadequate.
 2. The body does not respond to insulin the way a normal body would (high insulin level or decreased insulin action).
- The underlying disorder is a prediabetic state, called metabolic syndrome—a precursor to coronary artery disease and diabetes.
- The major symptoms of metabolic syndrome are obesity, high blood pressure, low HDL and high triglycerides, mildly elevated blood sugar (not high enough to be called diabetes), and family history of diabetes.
- Treatment
 1. Reversing primary symptoms (weight loss, exercises, stress reduction, etc.).
 2. Medications: Glucophage, Fortamet (metformin) improves insulin resistance by decreasing glucose production in the liver; Avandia (rosiglitazone) and Actos (pioglitazone) improve insulin resistance by improving glucose uptake by muscles and fat cells.

- ♦ C. Evaluate for headache, confusion, emotional changes, memory lapses, slurred speech, numbness of lips and tongue, alterations in gait, loss of consciousness.
- D. Evaluate lab tests.
 - ◆ 1. Blood glucose, usually below 50–60 mg/dL.
 - 2. Urine for acetone (usually negative).

Implementation

- ♦ A. Administer oral carbohydrate in form of dextrosol tablet, unsweetened orange juice, or 8 oz. of skim milk if client is alert; administer glucagon (sub q or IV) if client is not alert.
- B. Administer carbohydrates by mouth when client awakens.
- ♦ C. Provide client teaching.
 1. Maintain regimen of diet, medications, and exercise.
 2. Treat the symptoms early to prevent complications.
 3. Instruct client to always carry simple carbohydrates for treatment of early symptoms.
 4. Take 200-calorie snack 30 minutes before peak time of insulin to prevent hypoglycemia.
 5. Extra food should be taken before engaging in heavy physical exercise.
- D. Prevent compensatory rebound hyperglycemia (Somogyi phenomenon).
 1. Caused by the body's attempt to oppose the excessive action of insulin through liver glycogenolysis.

2. Insulin dose is reduced and client returned to stabilized rate.
- E. Provide instruction in use of portable insulin pump if ordered.
- F. Provide instruction in use of blood sugar monitors.
 1. Prick finger and smear drop of blood on reagent strip.
 2. Compare results with monitor or chart and record.

Chronic Complications

Definition: Chronic complications of diabetes are becoming more common as diabetics live longer. Included in this category are blindness, renal disease, and vascular conditions. (See **Table 8-14**.)

- ♦ A. **Diabetic retinopathy:** progressive impairment of retinal circulation that eventually causes vitreous hemorrhage with vision loss.
 1. Assessment.
 - a. Duration and degree of disease (incidence increases with length of time disease is present).
 - b. Impaired vision.
 - c. Ability to carry out daily tasks: blood glucose testing and insulin injections.
 - d. Need for assistance from others.
 2. Implementation.
 - a. Assist in ways to maintain independence and self-esteem.
 - b. Support client when treatment is implemented: photocoagulation or vitrectomy.
 - c. Instruct in actions that prevent or reduce complications: stable blood glucose levels.
 - d. Instruct client to have frequent eye examinations.
- ♦ B. **Diabetic nephropathy:** the specific renal disease, intercapillary glomerulosclerosis, called Kimmelstiel-Wilson syndrome. It is the result of chronic diabetes.
 1. Assessment.
 - a. Urine alterations; proteinuria, azotemia, frequent urinary tract infections, neurogenic bladder.
 - b. Serum lab values; BUN, creatinine.
 - c. Thirst and fatigue.
 - d. Hypertension.
 2. Implementation.
 - a. Administer medications to prevent urinary tract infections.
 - b. Instruct client to keep blood glucose levels within normal limits.
 - c. Maintain adequate fluid intake.
 - d. Instruct in 20- to 40-g protein diet.
 - e. Restrict sodium and potassium in diet.

◆ Table 8-14 COMPLICATIONS ASSOCIATED WITH DIABETES

Clinical Manifestations	Hypoglycemia	Diabetic Ketoacidosis (DKA)	Hyperosmolar Hyperglycemic Nonketotic Syndrome (HHNS)
	Type I	Type I	Type 2
Cause	Too much insulin or too little food	Absence or inadequate insulin	Uncontrolled diabetes or oral hypoglycemic drugs
Onset	Rapid (within minutes)	Slow (about 8 hours)	Slow (hours to days)
Appearance	Exhibits symptoms of fainting	Appears ill	Appears ill
Respirations	Normal	Hyperpnea (Kussmaul's breathing) from metabolic acidosis	No hyperpnea unless lactic acidosis is present
Breath odor	Normal	Sweetish due to acetone	Normal
Pulse	Tachycardia	Tachycardia	Tachycardia
Blood pressure		Hypotension	Hypotension
Hunger	Hunger pangs in epigastrium	Loss of appetite	Hunger
Thirst	None	Increased	Increased, dehydration
Vomiting	Nausea; vomiting rare	Common	Common
Eyes	Staring, double vision	Appear sunken	Visual loss
Headache	Common	Occasionally	Occasionally
Skin	Pallor, perspiration, chilling sensation	Hot, dry skin	Hot, dry skin
Muscle action	Twitching common, unsteady gait	Twitching absent	Twitching absent
Pain in abdomen	None	Common	Common
Mental status	Confusion, erratic, change in mood, unable to concentrate	Malaise, drowsy, confusion, coma	Confused, dull, coma
Lab findings			
Sugar in urine	None after residual is discarded	Present	Present
Blood sugar	Below 50–70 mg/dL	High, 350–900 mg/dL	Very high, 800 mg/dL up to 2400 mg/dL
Ketones	Absent	High	Absent
Ketones in blood plasma	Absent	4+ present	Absent

- f. Prepare client for dialysis therapy if appropriate.

- g. Administer medications to control hypertension.

◆ C. **Neuropathy:** general deterioration that affects the peripheral and autonomic nervous systems.

1. Assessment.

a. Peripheral neuropathy.

- (1) Pain in the legs.
- (2) Aching and burning sensations in lower extremities.

b. Alterations in bowel and bladder function.

- (1) Bowel dysfunction: constipation, diarrhea, nocturnal fecal incontinence.
- (2) Urinary dysfunction: infrequent voiding, weak stream, dribbling, signs of urinary infection.

c. Autonomic nervous system impairment.

- (1) Sexual dysfunction.
- (2) Orthostatic hypotension.
- (3) Pupillary changes.

- d. Circulatory abnormalities.

- (1) Skin breakdown and signs of infection.
- (2) Thick toenails: suggestive of circulatory impairment.
- (3) Low temperature and poor color in feet; athlete's foot.
- (4) Thin, shiny, atrophic skin.
- (5) Weak peripheral pulses.

2. Implementation.

a. Assist client to deal with pain.

- (1) Encourage walking for exercise.
- (2) Provide foot cradle when in bed.

b. Assist client to deal with bladder-bowel problems.

- (1) Provide privacy for toileting.
- (2) Provide psychological support.
- (3) Administer Lomotil (diphenoxylate/atropine) as ordered for diarrhea.
- (4) Administer neomycin as ordered to prevent bacterial growth in an atonic bowel.

- (5) Administer Urecholine (bethanechol) as ordered.
- (6) Establish 2-hour voiding schedule to prevent urinary stasis.
- (7) Encourage fluids.
- c. Counsel client who has sexual dysfunction.
 - (1) Allow client to vent feelings about sexual impotence.
 - (2) Observe for depression (sexual impotence is usually permanent).
- d. Provide excellent foot care.
 - (1) Wash with soap and warm water or antibacterial gel, dry thoroughly.
 - (2) Massage feet with lanolin or mineral oil to prevent scaling or cracking.
 - (3) File or cut toenails across nail. Do not injure soft tissue around nail (check hospital policy for nail care).
 - (4) Prevent moisture from accumulating between toes; use lamb's wool.
 - (5) Instruct in well-fitting shoes. Do not go barefoot.
 - (6) Wear loose-fitting socks.
 - (7) Exercise feet daily.
 - (8) See podiatrist regularly.
 - (9) Notify physician if cuts, pain, or blisters appear on feet.

Functional Hyperinsulinism/Hypoglycemia

◆ *Definition:* A condition that occurs as the result of excess secretion of insulin by the beta cells of the pancreas gland.

Characteristics

- ◆ A. May be associated with "dumping syndrome" following gastrectomy.
- B. May occur prior to development of diabetes mellitus.

Assessment

- A. Assess for personality changes.
 - 1. Tension.
 - 2. Nervousness.
 - 3. Irritability.
 - 4. Anxiousness.
 - 5. Depression.
- B. Assess for excessive diaphoresis.
- C. Assess for excessive hunger.
- D. Evaluate muscle weakness and tachycardia.
- E. Assess laboratory values—low blood sugar during hypoglycemic episodes.

Implementation

- ◆ A. High-protein, low-carbohydrate diet.
- B. Counseling may reduce anxiety and tension.

ENDOCRINE SYSTEM REVIEW QUESTIONS

1. Following brain surgery, the client suddenly exhibits polyuria and begins voiding 15 to 20 L/day. Specific gravity for the urine is 1.006. The nurse will recognize these symptoms as the possible development of
 1. Diabetes insipidus.
 2. Diabetes, type 1.
 3. Diabetes, type 2.
 4. Addison's disease.
2. A person with a diagnosis of type 2 diabetes should understand the symptoms of a hyperglycemic reaction. The nurse will know this client understands if she says these symptoms are
 1. Thirst, polyuria, and decreased appetite.
 2. Flushed cheeks, acetone breath, and increased thirst.
 3. Nausea, vomiting, and diarrhea.
 4. Weight gain, normal breath, and thirst.
3. The type 2 diabetic who is obese is best controlled by weight loss because obesity
 1. Reduces the number of insulin receptors.
 2. Causes pancreatic islet cell exhaustion.
 3. Reduces insulin binding at receptor sites.
 4. Reduces pancreatic insulin production.
4. A nursing assessment for initial signs of hypoglycemia will include
 1. Pallor, blurred vision, weakness, behavioral changes.
 2. Frequent urination, flushed face, pleural friction rub.
 3. Abdominal pain, diminished deep tendon reflexes, double vision.
 4. Weakness, lassitude, irregular pulse, dilated pupils.
5. Which of the following nursing diagnoses would be most appropriate for the client with decreased thyroid function?
 1. Alteration in growth and development related to increased growth hormone production.
 2. Alteration in thought processes related to decreased neurologic function.
 3. Fluid volume deficit related to polyuria.
 4. Hypothermia related to decreased metabolic rate.
6. The RN should assess for which of the following clinical manifestations in the client with Cushing's syndrome?
 1. Hypertension, diaphoresis, nausea, and vomiting.
 2. Tetany, irritability, dry skin, and seizures.
 3. Unexplained weight gain, energy loss, and cold intolerance.
 4. Water retention, moon face, hirsutism, and purple striae.
7. The client with hyperparathyroidism should have extremities handled gently because
 1. Decreased calcium bone deposits can lead to pathologic fractures.
 2. Edema causes stretched tissue to tear easily.
 3. Hypertension can lead to a stroke with residual paralysis.
 4. Polyuria leads to dry skin and mucous membranes that can break down.
8. Which of the following is the priority nursing implementation for a client with a tumor of the posterior lobe of the pituitary gland who has had a urine output of 3 L in the last hour with a specific gravity of 1.002?
 1. Measure and record vital signs each shift.
 2. Turn client every 2 hours to prevent skin breakdown.
 3. Administer Pitressin tannate (vasopressin tannate) as ordered.
 4. Maintain a dark and quiet room.
9. A client has the diagnosis of diabetes. His physician has ordered short- and long-acting insulin. When administering two types of insulin, the nurse would
 1. Withdraw the long-acting insulin into the syringe before the short-acting insulin.
 2. Withdraw the short-acting insulin into the syringe before the long-acting insulin.
 3. Draw up in two separate syringes, then combine into one syringe.
 4. Withdraw long-acting insulin, inject air into regular insulin, and withdraw insulin.

- 10.** Certain physiological changes will result from the treatment for myxedema. The symptoms that may indicate adverse changes in the body for which the nurse should observe are
1. Increased respiratory excursion.
 2. Increased pulse and cardiac output.
 3. Hyperglycemia.
 4. Weight loss, nervousness, and insomnia.
- 11.** A client with myxedema has been in the hospital for 3 days. The nursing assessment reveals the following clinical manifestations: respiratory rate of 8/min, diminished breath sounds in the right lower lobe, crackles in the left lower lobe. The most appropriate nursing intervention is to
1. Increase the use of range-of-motion (ROM), turning, and deep-breathing exercises.
 2. Increase the frequency of rest periods.
 3. Initiate postural drainage.
 4. Continue with routine nursing care.
- 12.** In an individual with the diagnosis of hypoparathyroidism, the nurse will assess for which primary symptom?
1. Fatigue, muscular weakness.
 2. Cardiac arrhythmias.
 3. Tetany.
 4. Constipation.
- 13.** The nurse explains to a client who has just received the diagnosis of type 2 diabetes mellitus that sulfonylureas, one group of oral hypoglycemic agents, act by
1. Stimulating the pancreas to produce or release insulin.
 2. Making the insulin that is produced more available for use.
 3. Lowering the blood sugar by facilitating the uptake and utilization of glucose.
 4. Altering both fat and protein metabolism.
- 14.** A client has been admitted to the hospital with a tentative diagnosis of adrenocortical hyperfunction. In assessing the client, an observable sign the nurse would chart is
1. Butterfly rash on the face.
 2. Moon face.
 3. Positive Chvostek's sign.
 4. Bloated extremities.
- 15.** The nurse is teaching a diabetic client to monitor her blood glucose using a glucometer. The nurse will know the client is competent in performing her finger-stick to obtain blood when she
1. Uses the ball of a finger as the puncture site.
 2. Uses the side of a fingertip as the puncture site.
 3. Avoids using the fingers of her dominant hand as puncture sites.
 4. Avoids using the thumbs as puncture sites.

ENDOCRINE SYSTEM ANSWERS WITH RATIONALE

- 1.** (1) Diabetes insipidus is an antidiuretic deficiency and may occur following brain surgery or head injury. It also occurs in young adults resulting from damage to the posterior lobe of the pituitary gland. Severe polyuria occurs when there is an inability to concentrate urine. These are not symptoms of types 1 and 2 diabetes (2, 3) or Addison's disease (4) (which is adrenocortical hypofunction).

NP:AN; CN:PH; CN:C

- 2.** (2) All the other choices have one wrong answer or symptom: (1) hunger, not decreased appetite; (3) pain in abdomen, not diarrhea; (4) breath odor of acetone, not normal. Answers such as this are tricky, because you have to pick out the wrong answers from among several right answers.

NP:E; CN:PH; CL:A

- 3.** (3) Obesity causes reduced insulin binding at receptor sites, which leads to pancreatic hypersecretion of insulin and eventual pancreatic cell exhaustion.

NP:AN; CN:H; CL:C

- 4.** (1) Weakness, fainting, blurred vision, pallor, and perspiration are all common symptoms when there is too much insulin or too little food—hypoglycemia. The signs and symptoms in answers (2) and (3) are indicative of hyperglycemia.

NP:A; CN:PH; CL:C

- 5.** (4) Because the thyroid gland regulates the metabolic rate, a decrease in thyroid function would result in a decreased metabolic rate.

NP:AN; CN:PH; CL:C

- 6.** (4) Clinical manifestations of Cushing's syndrome include water retention, moon face, hirsutism, and purple striae.

NP:A; CN:PH; CL:C

- 7.** (1) The parathyroid glands regulate calcium in the body. Excessive activity results in calcium leaving the bones and teeth to enter the bloodstream. This makes the bones more brittle and susceptible to fracture.

NP:P; CN:PH; CL:A

- 8.** (3) The client is experiencing antidiuretic hormone deficiency. Pitressin produces concentrated urine by increasing tubular reabsorption of water, thus preserving up to 90% of water.

NP:I; CN:PH; CL:AN

- 9.** (2) Short-acting insulin is withdrawn first to prevent possible contamination of the short-acting insulin bottle by the longer-acting insulin.

NP:P; CN:PH; CL:A

- 10.** (2) The increased pulse rate and increased cardiac output caused by thyroid compounds can cause angina, arrhythmias, or, in extreme cases, heart failure. The older the client, the more compromised the cardiovascular system may become.

NP:E; CN:PH; CL:A

- 11.** (1) Clients with myxedema often experience a decreased respiratory rate and chest excursion, so they require extra care to prevent atelectasis. Encouraging moving, turning, and coughing exercises will open the alveoli, thus decreasing the risk of atelectasis. Postural drainage (3) will not prevent atelectasis because the treatment does not expand the alveoli.

NP:I; CN:PH; CL:A

- 12.** (3) Tetany occurs mainly in the distal extremities, manifested by flexion of the fingers, hands, and toes (carpopedal spasms). Increased mechanical irritability exists especially with attempts at voluntary movements.

Laryngeal spasms, convulsions, and death will result if the tetany is not treated promptly.

NP:A; CN:PH; CL:C

- 13.** (1) Sulfonylurea drugs (e.g., Orinase) lower the blood sugar by stimulating the beta cells of the pancreas to synthesize and release insulin.

NP:I; CN:H; CL:C

- 14.** (2) Moon face, thin extremities, and buffalo hump are characteristics of Cushing's syndrome (adrenocortical

hyperfunction). A positive Chvostek's sign (3) is seen with primary aldosteronism; butterfly rash (1) is seen with lupus.

NP:A; CN:PH; CL:C

- 15.** (2) The sides of fingertips have fewer nerve endings than do the balls of the finger, so less discomfort will result from selecting the sides as puncture sites. Both hands, including the thumbs, can be used as puncture sites.

NP:E; CN:PH; CL:A

PERIOPERATIVE CARE CONCEPTS

The term *perioperative* refers to all phases of surgical care: preoperative, intraoperative, and postoperative. This section outlines the nursing care measures for surgical clients and covers the principles of care, anesthesia, postoperative complications, and fluid replacement therapy.

PREOPERATIVE AND POSTOPERATIVE CARE

Routine Preoperative Care

Psychological Care

- ◆ A. Reinforce the physician's teaching regarding the surgical procedure.
- B. Identify client's anxieties; notify physician of extreme anxiety.
- C. Listen to client's verbalization of fears.
- D. Provide support to the client's family (where family can wait during surgery, approximately how long the surgery takes, etc.).

Preoperative Teaching

- A. Postoperative exercises: leg, coughing, deep-breathing, etc.
- B. Equipment utilized during postoperative period: incentive spirometer, nasogastric (NG) tube for suctioning, etc.
- ◆ C. Pain medication and when to request it.
 1. Patient-controlled epidural analgesia (PCEA) or patient-controlled analgesia (PCA).
 2. Client needs to be taught use of PCEA or PCA before surgery with instructions reinforced after surgery.
- D. Explanation of NPO (nil per os, nothing by mouth).

Physical Care

- ◆ A. Completed before surgery.
 1. Observe and record client's overall condition.
 - a. Nutritional status.
 - b. Physical defects, such as loss of limb function, skin breakdown.
 - c. Hearing or sight difficulties.
 2. Obtain chest x-ray, ECG, and blood and urine samples, as ordered.
 3. Take preoperative history and assess present physical condition.
 4. Determine if any drug allergies.
- ◆ B. Completed early morning of surgery after client is admitted.

1. Perform skin prep and clip excess hair (shaving the operative site is no longer recommended); clean operative site with topical antiseptics (povidone-iodine, chlorhexidine) to reduce bacterial count.
2. Give enema, if ordered.
3. Insert indwelling catheter, nasogastric tube, IV.
4. Administer preoperative medications.
5. Provide quiet rest with side rails up and curtains drawn.
6. Monitor blood glucose levels, if ordered (nosocomial infections increased when blood glucose level is more than 220 mg/dL).

♦ Nurse's Responsibility

- A. Perform or supervise skin prep and cleansing.
- B. Carry out preoperative nursing interventions.
- C. Notify physician of drug allergies, overwhelming anxiety, unusual ECG findings, abnormal lab findings (blood glucose level).
- D. Ensure that consent form is signed.
- E. Administer preoperative medications on time.
- F. Complete preoperative checklist.
- G. Check if history and physical examination findings are on chart.
- H. Chart preoperative medications.
- I. Check Identaband, provide quiet environment.
- J. Remove dentures, nail polish, hairpins, all body piercings, etc.

Postanesthesia Unit

♦ Assessment

- ◆ A. Assess patent airway.
- B. Assess need for oxygen.
 1. Administer humidified oxygen by mask or nasal cannula as ordered.
 2. Monitor oxygen saturation using finger probe monitor.
- C. Check gag reflex.
- D. Observe for adverse signs of general anesthesia or spinal anesthesia.
- ◆ E. Assess vital signs—initially every 5–15 minutes according to condition.
 1. Pulse rate, quality, and rhythm.
 2. Blood pressure.
 3. Respirations, rate, rhythm, and depth.
 - F. Evaluate temperature for heat control.
- ◆ G. Observe dressings and surgical drains.
 1. Mark any drainage on dressings by drawing a line around the drainage; note date and time.
 2. Note color and amount of drainage on dressings and in drainage tubes.
 3. Ensure that dressing is secure.
 4. Reinforce dressings as needed.

- H. Assess IV fluids—type and amount of solution, flow rate, IV site.
- I. Measure urine output hourly.
- J. Observe client's overall condition.
 - 1. Check skin for warmth, color, and moisture.
 - 2. Check nail beds and mucous membranes for color and blanching; report if cyanotic.
 - 3. Observe for return of reflexes.
- K. Assess client for return to room.
 - 1. Be sure that vital signs are stable and within normal limits for at least 1 hour.
 - 2. See if client is awake and reflexes are present (gag and cough reflex). Check for movement and sensation in limbs of clients with spinal anesthesia.
 - 3. Take oral airway out (if not out already). Observe for cyanosis.
 - 4. Be sure dressings are intact and there is no excessive drainage.

Implementation

- A. Maintain patent airway—leave airway in place until gag reflex returns.
- B. Administer humidified SpO₂ by mask or nasal cannula at 6 L/min.
- C. Monitor O₂ saturation finger probe.
- D. Position client for adequate ventilation—side-lying is best, if not contraindicated.
- E. Observe for adverse signs of general anesthesia or spinal anesthesia.
 - 1. Level of consciousness.
 - 2. Movement of limbs.
- ♦ F. Monitor vital signs every 10–15 minutes.
 - 1. Pulse—check rate, quality, and rhythm.
 - 2. Blood pressure—check pulse pressure and quality as well as systolic and diastolic pressure.
 - 3. Respiration—check rate, rhythm, depth, and type of respiration (abdominal breathing, nasal flaring).
 - 4. Vital signs are sometimes difficult to obtain due to hypothermia.
 - 5. Movement from operating room table to gurney can alter vital signs significantly, especially with cardiovascular clients.
- G. Maintain temperature (operating room is usually cold)—apply warm blankets.
- H. Maintain patent IV.
 - 1. Check type and amount of solution being administered.
 - 2. Adjust correct flow rate.
 - 3. Check IV site for signs of infiltration.
 - 4. Check blood transfusion.
 - a. Blood type and blood bank number.
 - b. Time transfusion started.

- c. Client's name, identification number, expiration date.
- d. Amount in bag upon arrival in recovery room. Color and consistency of blood.
- I. Monitor urine output if indwelling catheter in place.
- J. Monitor dressings and surgical drains for drainage.
 - 1. Empty drainage collection device as needed.
 - 2. Report unusual amount of drainage.
- K. Administer medications.
 - 1. Begin routine drugs and administer all STAT drugs.
 - 2. Pain medications are usually administered sparingly and in smaller amounts.
- L. Discharge client from postanesthesia unit.
 - 1. Call anesthesiologist to discharge client from recovery room (if appropriate).
 - 2. Give report, using SBAR (situation, background, assessment, recommendation) on client's condition to floor nurse receiving client.
 - 3. Ensure IV is patent.
 - 4. Reinforce or change dressings as needed.
 - 5. Ensure all drains are functioning.
 - 6. Record amount of IV fluid remaining and amount absorbed.
 - 7. Record amount of urine in drainage bag.
 - 8. Record all medications administered in recovery room.
 - 9. Clean client as needed (change gown, wash off excess surgical scrub solution).
- M. Use Postanesthesia Recovery Scoring System in addition to vital signs.
 - 1. Ability to move extremities.
 - 2. Ability to cough and deep-breathe.
 - 3. Normal blood pressure maintained within 20 mm Hg preanesthesia.
 - 4. Fully awake.
 - 5. Normal skin color.

Phase II Surgical Unit

♦ **Assessment**

- A. Assess for patent airway; administer oxygen as necessary.
- B. Assess vital signs—usual orders are every 15 minutes until stable; then every 30 minutes × 2, every hour × 4; then every 4 hours for 24–48 hours.
- C. Check IV site and patency frequently.
- D. Observe and record urine output.
- E. Assess intake and output.
- F. Observe skin color and moisture.

♦ **Implementation**

- ♦ A. Maintain patent airway. Position client for comfort and maximum airway ventilation.

- ◆ B. Turn every 2 hours and prn—avoid sharply bent knees and hips. (See **Table 8-15**.)
- C. Apply elastic stockings and compression device if ordered.
- D. Encourage coughing and deep-breathing every 2 hours (may use incentive spirometer).
- E. Keep client comfortable with medications (monitor PCA if ordered).
- F. Check dressings and drainage tubes every 2–4 hours; if abnormal amount of drainage, check more frequently.
- G. Give oral hygiene at least every 4 hours; if NG tube, nasal oxygen, or endotracheal tube is inserted, give oral hygiene every 2 hours.
- H. Bathe client when temperature can be maintained—bathing removes the antiseptic solution and stimulates circulation.
- I. Keep client warm and avoid chilling, but do not increase temperature above normal.
 - 1. Increased temperature increases metabolic rate and need for oxygen.
 - 2. Excessive perspiration causes fluid and electrolyte loss.
- J. Irrigate NG tube as ordered and PRN with normal saline to keep patent and to prevent electrolyte imbalance.
- K. Maintain dietary intake—type of diet depends on type and extent of surgical procedure.

♦ **Table 8-15 SURGICAL PROCEDURES: POSTOPERATIVE POSITIONS AND AMBULATION**

System	Postop Position* or as Ordered	Ambulation*
Neurosurgical		
Craniotomy		
Surgery involving: posterior fossa	Supine or low-Fowler's (10 degrees) side to side only	Evening of surgery or first day
Anterior or middle fossa	Low- or semi-Fowler's side to back to side unless bone flap removed, then nonoperative side and back only	Evening of surgery or first day
Ventriculoperitoneal shunt	Supine, back to unoperative side	First to second day
Respiratory		
Laryngectomy	Semi-Fowler's; side-back-side	First or second day
Tracheostomy	Semi-Fowler's; side-back-side	Evening of surgery
Nasal surgery	Semi-Fowler's; back	First day
Tonsillectomy	Semi-Fowler's if local anesthesia used; modified Trendelenburg, side-lying or prone with head turned to side if general anesthesia used	Evening of surgery
Lung surgery (lobectomy)	Semi- to high-Fowler's; unaffected side-back-side	Evening of surgery or first day
Pneumonectomy	Semi- to high-Fowler's; affected side-back-side	First day
Circulatory		
Open-heart surgery for atrial and ventricular septal defects	Low-Fowler's or supine; turn side-back-side	First to third day
Valve replacement surgery	Supine or low-Fowler's until vital signs stable; turn side-back-side	First to second day
Coronary artery bypass	Supine or low-Fowler's until vital signs stable; turn side-back-side	First to second day
Ear		
Stapedectomy	Low-Fowler's; unoperative side only	Evening of surgery or first day
Eye		
Cataract removal	Low-Fowler's; unoperative side only	Day of surgery; usually within 2–4 hours postop
Repair of detached retina	Varies with site of detachment; unoperative side only or as ordered	Evening of surgery or first day
Enucleation	High-Fowler's; unoperative side only or as ordered	First day
Gastrointestinal		
Gastric resection	Minimum low-Fowler's; turn side-back-side	Evening of surgery or first day
Ileostomy; colostomy	Sims', lateral recovery, semi-Fowler's	First day
Appendectomy	Semi-Fowler's	Evening of surgery or first day
Cholecystectomy—open	Semi- to low-Fowler's	First day
Cholecystectomy—laparoscopic	Sims' to relieve gas pockets near diaphragm	Evening of surgery
Small bowel resection	Low-Fowler's; turn side-back-side	First day
Portacaval shunt	Semi-Fowler's	Evening of surgery or first day
Partial pancreatectomy	Semi-Fowler's	First day
Hemorrhoidectomy	Supine; turn side to side	First day
Radical neck	Fowler's, side-lying either side	First to second day
Genitourinary		
Nephrostomy	Semi- to high-Fowler's; unoperative side only	Evening of surgery
Nephrectomy	Semi- to high-Fowler's; side-back-side	Evening of surgery

◆ Table 8-15 SURGICAL PROCEDURES: POSTOPERATIVE POSITIONS AND AMBULATION

System	Postop Position* or as Ordered	Ambulation*
Kidney transplant	As ordered	First day
Ureterolithotomy	Low-Fowler's; side-back-side	Evening of surgery
TURP	Low- to semi-Fowler's	Evening of surgery
Orchiectomy	As ordered	First day
Cystectomy and ileal conduit	Low-Fowler's; side-back-side	First day
Gynecologic		
Hysterectomy	Low-Fowler's; side-back-side	Evening of surgery
Radical hysterectomy	Supine or low-Fowler's; side-back-side	First day
Pelvic exenteration	As ordered	First day
Vulvectomy	As ordered	First day
Mastectomy	Fowler's; unoperative side or back	Evening of surgery
Musculoskeletal amputation	Low-Fowler's; unoperative side and back; prone once per shift	Evening of surgery use adaptive devices (i.e., crutches)
Open reduction and internal fixation	Fowler's; side-back-side	Evening of surgery or first day
Hip prosthesis	Low-Fowler's; back or unoperative side only. DO NOT FLEX hips, keep in abduction and external rotation	First or second day, non-weight-bearing
Hip nailing	Low-Fowler's; unoperative side and back only	First day, non-weight-bearing
Total knee replacement	As ordered	First day with client
Total hip replacement	Supine or side to side with orders; DO NOT FLEX hips, keep in abduction and external rotation	First to third day, non-weight-bearing
Laminectomy	Low-Fowler's; turn side to side, may position on back, logroll	Evening of surgery or first day
Spinal fusion	Flat, side to side only, logroll	Second or third day with brace

* Postop positioning and ambulation are dependent on client condition and type of anesthesia used.

1. Minor surgical conditions—client may drink or eat as soon as he or she is awake and desires food or drink.
2. Major surgical conditions.
 - ◆ a. Maintain NPO until bowel sounds return or start enteral feedings for non-GI surgery.
 - b. Clear liquid advanced to full liquid as tolerated.
 - c. Soft diet advanced to full diet within 3 to 5 days (depending on type of surgery and physician's preference).
- L. Place on bedpan 2–4 hours postoperatively if catheter not inserted.
- M. Start activity as tolerated and dictated by surgical procedure. Most clients are ambulatory within first 24 hours. (See Table 8-15.)

ANESTHESIA

Preoperative Medications

General Action

- A. Decreases secretions of mouth and respiratory tract.
- B. Depresses vagal reflexes—slows heart and prevents complications with excitation during intubation.
- C. Produces drowsiness and relieves anxiety.

- D. Allows anesthesia to be induced more smoothly and in smaller amounts.

◆ Types of Drugs

- A. Barbiturates.
 1. Short-acting barbiturate at bedtime (Seconal [secobarbital] or Nembutal [pentobarbital]).
 2. Short-acting tranquilizer 1 hour preoperatively (decreases blood pressure and pulse and relieves anxiety).

◆ PREOPERATIVE MEDICATION TYPE AND ACTION

- Hypnotic or opiate—given night before surgery.
 1. Decreases anxiety.
 2. Promotes good night's sleep.
- Tranquilizers and sedative-hypnotics—preoperative medication.
 1. Decreases anxiety.
 2. Allows smooth anesthetic induction.
 3. Provides amnesia for immediate perioperative period.
- Anticholinergic—preoperative medication.
 1. Decreases secretions.
 2. Counteracts vagal effects during anesthesia.

- B. Belladonna alkaloids.
 - 1. General action.
 - a. Decrease salivary and bronchial secretions.
 - b. Allow inhalation anesthetics to be administered more easily.
 - c. Prevent postoperative complications such as aspiration pneumonia.
 - 2. Scopolamine is used in conjunction with morphine or Demerol (meperidine) to produce amnesia block.
 - 3. Atropine blocks the vagus nerve response of decreased heart rate, which can occur as a reaction to some inhalation anesthetics.
- C. Nonnarcotic analgesic.
 - 1. Actions.
 - a. Stadol (butorphanol) used as component of balanced anesthesia.
 - b. Given IM.
 - c. Does not cause dependence or respiratory depression with increased dose.
 - d. Contraindicated in narcotic addiction.
 - 2. Side effects.
 - a. Sedation, lethargy.
 - b. Headache, vertigo.
 - c. Nervousness, palpitations, diplopia.
 - d. Nausea, dry mouth.

Anesthetic Agents

- A. Anesthesia produces insensitivity to pain or sensation.
- B. Dangers associated with anesthesia depend on overall condition of client.
 - 1. High risk if associated cardiovascular, renal, or respiratory conditions.
 - 2. High risk for unborn fetus and mother.
 - 3. High risk if stomach is full (chance of vomiting and aspiration).
- C. Types of anesthesia.
 - 1. General—administered IV or by inhalation. Produces loss of consciousness and decreases reflex movement.
 - 2. Local—applied topically or injected regionally. Client is alert, but pain and sensation are decreased in surgical area.

◆ General Anesthesia

- ◆ A. Balanced anesthesia (combination of two or more drugs) is used to decrease side effects and complications of anesthetic agents.
- B. Goals of general anesthesia.
 - 1. Analgesia.
 - 2. Unconsciousness.
 - 3. Skeletal muscle relaxation.

- C. Stages of general anesthesia.
 - 1. Stage one: early induction—from beginning of inhalation to loss of consciousness.
 - 2. Stage two: delirium or excitement.
 - a. No surgery is performed at this point—dangerous stage.
 - b. Breathing is irregular.
 - 3. Stage three: surgical anesthesia.
 - a. Begins when client stops fighting and is breathing regularly.
 - b. Four planes, based on respiration, pupillary and eyeball movement, and reflex muscular responses.
 - 4. Stage four: medullary paralysis—respiratory arrest.
- ◆ D. Anesthetic agents.
 - 1. Tranquilizers and sedative-hypnotics: benzodiazepines.
 - a. Given IV: Versed (midazolam), Valium (diazepam), Ativan (lorazepam).
 - b. Generally short acting—used preoperatively.
 - 2. Opioids (narcotics): morphine, Actiq (Fentanyl).
 - a. Given IV: Demerol IM—fast onset.
 - b. Do not provide amnesia.
 - 3. Neuroleptanalgesics: Sufenta (sufentanil).
 - a. Combination of short-acting opioid Actiq (Fentanyl) and Inapsine (droperidol)—called a narcotic agonist analgesic.
 - b. Analgesia is profound with this combination.
 - 4. Dissociative agents: ketamine.
 - a. Given IV or IM—rapid induction.
 - b. Client is not asleep, but dissociated.
 - 5. Barbiturates: Penthal (thiopental), Brevital (methohexitol).
 - a. Given IV—rapid induction.
 - b. High doses required for prolonged induction; may lead to respiratory depression.
 - 6. Nonbarbiturate hypnotics Amide (etomidate), Diprivan (propofol).
 - a. Given IV—rapid induction.
 - b. Few respiratory or cardiovascular side effects—used for fragile clients.
 - 7. Inhalation agents.
 - a. Volatile liquids: Fluothane (halothane), Penthrane (methoxyflurane), Ethrane (enflurane). Rapid induction—used for every type of surgery. Possible respiratory depression.
 - b. Gases: nitrous oxide—used for short-term procedures.

- ◆ E. Adjuncts for general anesthesia.
 1. Preoperative medications.
 2. Neuromuscular blocking agents: Tubarine (tubocurarine), Pavulon (pancuronium), Flaxedil (gallamine triethiodide)—used to facilitate intubation.
 3. Depolarizing neuromuscular blocking agents: Anectine (succinylcholine), Syncurine (deca-methonium)—mimic action of acetylcholine at neuromuscular junction.

◆ Local Anesthesia

- A. Topical anesthetics: Xylocaine (lidocaine).
 1. Poorly absorbed through skin but usually rapid through mucous membranes (mouth, gastrointestinal tract, etc.).
 2. Systemic toxicity is rare but local reactions common, especially if used for long periods of time on clients allergic to chemicals.
 3. Used for hemorrhoids, episiotomy, nipple erosion, and minor cuts and burns.
 4. Used on eye procedures extensively—removing foreign bodies and tonometry.
- B. Infiltrated local anesthesia or field block: Marcaine (bupivacaine), Xylocaine, Duranest (etidocaine).
 1. Anesthesia directly applied to surgical area.
 2. Drug is injected into tissue.
 3. Can have systemic effects if injected into highly vascular area.
- C. Regional anesthetics, central nerve blocks: Pontocaine (tetracaine), Novocain (procaine).
 1. Types: spinal, caudal, saddle, epidural.
 2. Precautions.
 - a. Spinal and epidural anesthesia: Position client with head and shoulders elevated (prevents diffusion of anesthesia to the intercostal muscles, which could produce respiratory distress).
 - b. Epidural (continuous anesthesia used in obstetrics): Make sure catheter is securely fastened to prevent it from slipping out.

Conscious Sedation

- ◆ A. Form of IV anesthesia—depressed level of consciousness with the ability to respond to stimuli and verbal commands.
 1. Combined sedation and analgesic effect so client is pain free during procedure.
 2. Client can maintain patent airway.
- B. Specific drugs used vary with credentials of person administering agents.
 1. Versed or Valium IV frequently used.
 2. Other drugs used are analgesics ([morphine, Actiq [Fentanyl]) and reverse agonists (Narcan [naloxone]).

3. Client must never be left alone and must be closely monitored for respiratory, cardiovascular, or CNS depression.
 4. Client is monitored by ability to maintain airway and respond to verbal demands.
- C. Agents may be used alone or in combination with local, regional, or spinal anesthesia.
 - D. Levels of sedation.
 1. Minimal: Client is relaxed and may be awake—understands direction.
 2. Moderate: Client is drowsy—may sleep, but easily awakened.
 3. Deep: Client sleeps through procedure; has little or no memory; oxygen given because breathing is slowed.

POSTANESTHESIA

Implementation

- ◆ A. General anesthesia.
 1. Maintain patent airway.
 2. Promote adequate respiratory function (position client for lung expansion).
 3. Have client deep-breathe and cough frequently, especially if inhalation anesthesia used, to promote faster elimination of gases.
 4. Turn frequently to promote lung expansion and to prevent hypostatic pneumonia and venous stasis.
- ◆ B. Spinal and epidural anesthesia.
 1. Take precautions to prevent injury to lower extremities (watch heating pad, position limb correctly, etc.).
 2. Provide gentle passive range of motion to prevent venous stasis.
 3. Keep head flat or slightly elevated to prevent spinal headache (client may turn head from side to side).
 4. Increase fluid intake, if tolerated, to increase cerebral spinal fluid.

Postoperative Medications

- A. Evaluate need for pain relief.
- B. Provide nonmedication measures for relief of pain such as relaxation techniques, back care, positioning.
- C. Identify the pharmacological action of the medication.
- D. Review the general side effects of the medication.
 1. Drowsiness.
 2. Euphoria.
 3. Sleep.
 4. Respiratory depression.
 5. Nausea and vomiting.

- E. Administer medications as ordered, usually at 3- to 4-hour intervals for first 24–48 hours for better action and pain relief. Assess for pain relief.
- F. Know the action of the following drugs.
 - 1. Opioids.
 - 2. Synthetic opiate-like drugs.
 - 3. Nonnarcotic pain relievers.
 - 4. Narcotic antagonists.
 - 5. Antiemetics.

Narcotic Analgesics

- A. Pharmacological action—reduces pain and restlessness.
- B. General side effects.
 - 1. Drowsiness.
 - 2. Euphoria.
 - 3. Sleep.
 - 4. Respiratory depression.
 - 5. Nausea and vomiting.
- C. Given at 3- to 4-hour intervals for first 24–48 hours for better action and pain relief.
- D. Types of analgesics.
 - ◆ 1. Opioids (narcotics).
 - ◆ a. Morphine sulfate—potent analgesic.
 - (1) Specific side effects: miosis (pinpoint pupils) and bradycardia.
 - (2) Usual dosage: $\frac{1}{4}$ – $\frac{1}{8}$ gr IM every 3–4 hours PRN.
 - ◆ b. Dilaudid (hydromorphone)—potent analgesic.
 - (1) Specific side effects: hypotension, constipation, euphoria.
 - (2) Usual dosage: 2–4 mg PO, IM, or IV every 4–6 hours.
 - c. Numorphan (oxymorphone)—potent analgesic.
 - (1) Specific side effects: urinary retention, ileus, euphoria.
 - (2) Usual dosage: 1–1.5 mg SUB Q or IM every 4–6 hours; 0.5 mg IV every 4–6 hours.
 - d. Vicodin (hydrocodone)—potent analgesic.
 - (1) Specific side effects: dizziness, drowsiness, sedation, nausea, and vomiting.
 - (2) Usual dosage: 10 mg orally every 3–4 hours.
 - e. Codeine sulfate—mild analgesic.
 - (1) Specific side effect: constipation.
 - (2) Usual dosage: 30–60 mg every 3–4 hours IM.
 - f. OxyContin (oxycodone HCl); also Percocet (with acetaminophen) and Percodan (with aspirin).

- (1) Potent opioid analgesic that is very addictive, especially with high dosage and long-term use.
- (2) Usual dosage is 20–80 mg PO daily.
- (3) This drug is very popular “on the street” and is dangerous because of its addictive quality.
- ◆ 2. Synthetic opiate-like drugs.
 - a. Demerol (meperidine)—potent analgesic (rarely used as of 2000).
 - (1) Specific side effects: miosis or mydriasis (dilatation of pupils), hypotension, and tachycardia.
 - (2) Usual dosage: 25–100 mg every 3–4 hours IM.
 - (3) Used less frequently today.
 - b. Talwin (pentazocine)—potent analgesic.
 - (1) Specific side effects: gastrointestinal disturbances, vertigo, headache, and euphoria.
 - (2) Usual dosage: 50 mg oral tablets every 3–4 hours; 30 mg IM every 3–4 hours PRN.
- ◆ 3. Nonnarcotic pain relievers.
 - a. Salicylates (aspirin).
 - (1) Decrease pain perception without causing drowsiness and euphoria. Act at point of origin or pain impulses.
 - (2) Side effects.
 - (a) Gastrointestinal irritation (give client milk and crackers).
 - (b) Gastrointestinal bleeding.
 - (c) Increased bleeding time. Use special precaution if client is on anticoagulants.
 - (d) Hypersensitivity reactions to aspirin.
 - (e) Tinnitus indicates toxic level reached.
 - (f) Thrombocytopenia can occur with overdose (especially in children).
 - (3) Usual dosage: 300–600 mg every 3–4 hours, orally or rectally.
 - b. Nonsalicylate analgesics (acetaminophen).
 - (1) Action similar to aspirin.
 - (2) Side effects: hemolytic anemia and kidney damage.
 - (3) Usual dosage: 325–650 mg every 3–4 hours orally.
 - c. Nonsteroidal anti-inflammatory drugs (NSAIDs).
 - (1) Action: analgesic and antipyretic for moderate to severe pain.

- (2) Side effects: nausea, gastrointestinal disturbances, vertigo, drowsiness, rash.

Antiemetics

- A. Pharmacological action.
 - 1. Reduce the hyperactive reflex of the stomach.
 - 2. Make the chemoreceptor trigger zone of medulla less sensitive to nerve impulses passing through this center to the vomiting center.
- B. General side effects.
 - 1. Drowsiness.
 - 2. Dry mouth.
 - 3. Nervous system effects.
- ♦ C. Common drugs.
 - 1. Phenothiazines.
 - a. Compazine (prochlorperazine).
 - (1) Specific side effects: amenorrhea, hypotension, and vertigo.
 - (2) Normal dosage: 5–10 mg every 3–4 hours IM.

- b. Phenergan (promethazine).
 - (1) Specific side effects: dryness of mouth and blurred vision.
 - (2) Normal dosage: 12.5–50 mg every 4 hours PRN.
- 2. Nonphenothiazines.
 - a. Dramamine (dimenhydrinate).
 - (1) Specific side effect: drowsiness.
 - (2) Normal dosage: 50 mg IM every 3–4 hours.
 - b. Tigan (trimethobenzamide).
 - (1) Specific side effects (rare); hypotension and skin rashes.
 - (2) Normal dosage: 200 mg (2 mL) TID or QID IM.

COMMON POSTOPERATIVE COMPLICATIONS

See **Table 8-16**.

◆ **Table 8-16 POSTOPERATIVE COMPLICATIONS**

Potential Complication	Clients at Risk	Indicative Findings	Prevention	Intervention	Drug Therapy
Atelectasis: collapse of alveoli; may be diffuse and involve a segment, lobe, or entire lung <i>Potential onset:</i> First 48 hours	All with general anesthesia <i>Special-risk clients:</i> Smokers Chronic bronchitis Emphysema Obesity Elderly	Fever to 102°F Tachycardia Restlessness Tachypnea 24–30 minutes Altered breath sounds Dullness to percussion Diminished or breath sounds Crackles ABGs: decreased PaO ₂	<i>Preoperative:</i> Have client practice turning, coughing, and deep-breathing <i>Postoperative clients at risk:</i> Turn every 30 minutes <i>Other clients:</i> Initiate turning and deep-breathing exercises every 1–2 hours Ambulate as soon as possible Medicate to reduce pain, splinting and resistance to treatment	Deep-breathing and incentive spirometry Administer supplemental oxygen as ordered Monitor response to treatment Monitor for onset of pneumonia If entire lobe of lung is involved, prepare for bronchoscopy to remove plug Change position q2h	Analgesics: pain control Bronchodilators (nebulized through IPPB); liquefy secretions Water or saline (nebulized through IPPB); liquefy secretions
Pneumonia: inflammatory process in which alveoli are filled with exudate <i>Potential onset:</i> First 36–48 hours	Clients with unresolved atelectasis Following aspiration Smokers Elderly Chronic bronchitis Emphysema Heart failure Debilitated Alcoholic Immobile	Client complains of dyspnea; tachycardia; increasing temperature; productive cough, and increasing amount of sputum becoming tenacious, rusty, or purulent Tactile fremitus Dullness to percussion Bronchial breath sounds Increased crackles or rhonchi Voice sounds present Bronchophony	Provide vigorous treatment for atelectasis Prevent aspiration Ambulate as soon as possible	Turn, cough, and deep-breathe every 1 hour May need to stimulate cough with nasotracheal suctioning Send sputum for culture and sensitivity Frequent mouth care for comfort	Antibiotics: Cephalosporin or ampicillin prophylactically for 48 hours for high-risk clients Cephalosporin IV or parenteral for infections

(Continues)

◆ Table 8-16 POSTOPERATIVE COMPLICATIONS (Continued)

Potential Complication	Clients at Risk	Indicative Findings	Prevention	Intervention	Drug Therapy
	Cough suppressant medications Respiratory depressant medications	Egophony Whispered pectoriloquy ABGs: decreased PaO ₂		Administer oxygen as ordered Increase fluid intake Monitor for response to treatment	Antipyretics: decrease temperature
Pulmonary embolism: foreign object has migrated to branch of pulmonary artery <i>Potential onset:</i> Seventh to tenth day Massive embolism: Pulmonary hypertension, dyspnea, right heart failure, shock, ABGs: decreased PaO ₂ , increased PaCO ₂	Superficial vein thrombosis: rare Deep vein thrombosis: 40–60% Air emboli: intraperitoneal surgery Fat emboli: long bone fracture, split sternum	Only 10% recognized clinically Pain sharp and stabbing, occurs with breathing, localized (right lower lobe most frequent) Marked shortness of breath Increased heart rate—tachycardia Restlessness and other symptoms of hypoxia (severe anxiety)	Provide range of motion Encourage early ambulation Prevent thrombophlebitis Do not massage an area with potential for or suspected thrombus Elastic stockings or leg compression devices	Administer oxygen to relieve hypoxia Reduce anxiety Position client on left side with head dependent to prevent air embolus Prevent recurrent embolization; prepare for fibrinolysis; prepare for anticoagulation Prepare for x-ray, angiography, and/or ventilation/perfusion scan Encourage adequate hydration	Anticoagulation therapy: IV heparin to maintain therapeutic APTT Sodium prophylactically for high-risk clients Urokinase, t-PA, streptokinase: thrombolytic effect (24 hours) Analgesics: pleuritic pain control
Pulmonary infarction: necrosis of lung tissue due to occlusion of blood supply (less than 10% develop) <i>Potential onset:</i> * 2–72 hours after arterial obstruction	Pulmonary embolism	Hemoptysis Cough Fever 101–102°F Pleural friction rub Pleuritic pain	Prevent thromboembolic pulmonary artery occlusion See prevention of thrombophlebitis	Describe indicative findings to physician Institute relaxation techniques to decrease client's anxiety Administer oxygen Support and comfort client	Antibiotics: prevention of infection
Thrombo-phlebitis: inflammation of vein with clot formation <i>Potential onset:</i> Seventh to fourteenth day	Abnormal vein walls: Varicose veins Previous thrombophlebitis Trauma to vein wall Tight strap on operating room table Surgery on hips or in pelvis Age over 60 years (arteriosclerosis)	Superficial vein thrombophlebitis: Pain, redness, tenderness, and induration along course of vein Palpable “cord” corresponding to course of vein History of trauma including IV site Deep small-vein thrombophlebitis: Increased muscle turgor and tenderness over affected vein Deep muscle tenderness Most frequent site: vessels at calf	Avoid injury to vein wall: Use care when strapping to operating room table Avoid IVs in lower extremities Pad side rails for restless, convulsive, and/or combative client Avoid restraints Avoid venous stasis: Encourage early ambulation Provide feet and leg exercises	Superficial vein thrombophlebitis: Treat symptoms Continue ambulation unless accompanied by deep venous involvement Monitor for progression toward saphenofemoral junction (may need ligation)	Streptokinase: thrombolytic effect (24 hours) Heparin IV or sub q: decrease clotting time (short-term)

◆ Table 8-16 POSTOPERATIVE COMPLICATIONS

Potential Complication	Clients at Risk	Indicative Findings	Prevention	Intervention	Drug Therapy
	Venous stasis: Immobility, long-duration surgery Casts, restrictive dressings Constant Fowler's position Prolonged dependent lower extremities Knee catch elevated Pillows under knees, calves Obesity Abdominal distention Shock Heart failure Hypercoagulability: Surgical stress response Anesthesia Decreased circulation Hypovolemia, dehydration Malignant neoplasms Postpartum Oral contraceptives Insert rectal tube	Affected limb warm to touch with occasional swelling Client complains of tightness or stiffness in affected leg Positive Homans' sign (dorsiflexion of foot leads to calf pain) Fever rarely more than 101°F Major deep vein thrombophlebitis: No superficial signs of inflammation Homans' sign unreliable Femoral vein thrombosis: Pain and tenderness in distal thigh and popliteal region Swelling extends to level of knee	Elastic stockings; sequential-compression devices Increase frequency of exercise for client at risk Prevent client's sitting with legs in dependent position Place pillow between legs while client is lying on side to prevent pressure from upper leg on lower Provide deep-breathing exercises Provide active and passive range of motion Increase velocity of blood flow: No standing Steady IV flow Antiemetic stockings (controversial) Decrease hypercoagulability: Provide adequate hydration Prevent infections Maintain circulation Decrease stress/anxiety	Deep vein thrombophlebitis: Provide adequate bed rest Elastic stockings Sequential-compression devices Elevate foot of bed with 6- to 8-inch blocks Administer warm moist compresses to relieve venospasm and help resolve inflammation Monitor for pulmonary embolism	Nonorthopedic surgery—low-dose sub q heparin (or low-molecular-weight heparin) Coumadin PO: decrease clotting time (long-term) Analgesics: pain control Low-molecular-weight dextran IV on operative day and 2 days postoperative Aspirin 1.2 g/day in divided doses
Ileus: failure of peristalsis <i>Potential onset:</i> First 24–36 hours	All surgical clients Stress response to surgical trauma	No bowel sounds or fewer than 5/min (normal: 5–35 clicks or gurgles/min) Vomiting Abdominal distention	Do not feed until bowel sounds return Offer only sips of water until return of bowel sounds Maintain normal serum potassium level	Monitor for return of normal bowel sounds (enteral feeding following non-GI surgeries will resolve ileus faster) Monitor for distention Monitor for passage of flatus signaling return of peristalsis Monitor signs of hypokalemia	Switch to nonopioid analgesics (opioids slow GI motility), NSAIDs, and acetaminophen
Paralytic ileus: paralysis of intestinal peristalsis <i>Potential onset:</i> First 3–4 days	Intraperitoneal surgery Peritonitis Kidney surgery Decreased cardiac output Pneumonia Electrolyte imbalance Wound infection	No bowel sounds Abdominal distention No passage of flatus or feces Nasogastric drainage green to yellow, 1–2 L in 24 hours Anorexia, nausea Complaints of fullness and diffuse pain	Maintain electrolyte balance, especially potassium Maintain cardiac output Prevent pneumonia Provide early ambulation	Treat cause Maintain nasogastric suction until peristalsis returns Monitor for intestinal obstruction	Potassium chloride if serum level is low Ilopan (dexpanthenol) to stimulate return of peristalsis, total parenteral nutrition (TPN) if indicated

(Continues)

◆ Table 8-16 POSTOPERATIVE COMPLICATIONS (Continued)

Potential Complication	Clients at Risk	Indicative Findings	Prevention	Intervention	Drug Therapy
Intestinal obstruction: adhesions, trap or kink in segment of intestine Potential onset: Third to fifth day The lower the obstruction, the more gradual the onset	Abdominal surgery	No postoperative bowel movement Abdominal distention Client complains of periodic sharp, colicky pains Hyperactive, high-pitched, tinkling bowel sounds Abdominal tenderness Nasogastric drainage: dark brown or black	None	Identify condition early Report to physician immediately Reduce client anxiety Maintain patent nasogastric tube Prepare for insertion of intestinal tube Prepare for surgery if necessary	Antibiotic therapy: for prevention of infection (optional) Analgesics: pain control Never give laxative or purgative if obstruction is suspected
Urinary tract infection	Decreased resistance: History of bladder distention Potential onset: Third to fifth day or 48 hours after removal of catheter History of urinary retention Previous urinary tract infection History of prostatic hypertrophy History of catheterization Diabetic Debilitated Immobile	Dysuria Frequency Urgency High fever: up to 104°F with fewer systemic toxic symptoms than would be expected Change in urine odor Pus in urine Sediment May be asymptomatic	Maintain sterile technique with catheterization and catheter removal Provide competent indwelling catheter care Encourage early ambulation to decrease retention and stasis	Encourage fluid intake; cranberry juice to decrease urine pH Increase activity to enhance bladder emptying Encourage voiding every 2 hours while awake Send specimen for culture and sensitivity Monitor for residual urine of more than 100 mL	Urinary anti-septics (sulfonamides); bacterial suppression Antibiotics (ampicillin, tetracycline); bacterial suppression Anticholinergics: antispasmodic Topical urinary analgesic: pain relief
Wound infection	Slow to heal: Obese Diabetic Potential onset: Poor nutrition: Streptococcal: 24–48 hours after contamination Ulcerative colitis Poor circulation: Elderly Hypovolemic Heart failure Lack of oxygen to wound: Vasoconstriction Severe anemia Depressed immunity Cancer Renal failure Preoperative steroid therapy Prolonged complex surgery (stress response leading to increased ACTH) Malnutrition Elderly At risk for transmission Proximity of another client with infection Transmission by hands of personnel	Initial inflammation: 36–48 hours Wound tender, swollen, warm, increased redness Increasing heart rate Increasing temperature (100.4°F or more) Increasing or recurring serous drainage; drainage becomes purulent, foul odor There may be no local signs if infection is deep Elevated WBC Malaise	Practice meticulous hand hygiene and gloving Practice aseptic technique in wound care Separate from infected clients Use special caution for a new wound, easily contaminated Maintain nutrition Provide frequent turning Ambulate as soon as possible Maintain PaO ₂ Increase attention to prevention for clients with depressed immunity Operative site: clip excess hair and cleanse with povidone-iodine (reduces bacterial counts)	Maintain nutrition Maintain oxygenation Maintain circulation and blood volume Maintain pulmonary toilet Cleanse wound or irrigate as ordered Apply wet-to-moist dressings Monitor for systemic response to infection, fever, malaise, headache, anorexia, nausea Treat symptoms	Administer antibiotics as ordered New cyanoacrylate adhesives (Dermabond, Indermil) close wounds and promote healing Send wound drainage specimen for culture and sensitivity

Respiratory Complications

♦ Assessment

- A. Evaluate complaint of tightness or fullness in chest.
- B. Assess for cough, dyspnea, or shortness of breath.
- C. Evaluate increased vital signs, particularly temperature and respiratory rate.
- D. Observe for restlessness.
- E. Assess for decreased breath sounds, crackles.

Implementation

- ◆ A. Turn, cough, hyperventilate at least every 2 hours.
- ◆ B. Have client use incentive spirometer to provide motivation and evaluation of sustained inspiration.
 - 1. Inhale deeply and hold 3 seconds.
 - 2. Repeat hourly.
 - 3. Yawning also accomplishes same goal of stimulating surfactant and opening collapsed alveoli.
- ◆ C. Provide pharmacological therapy (through nebulization or oral route).
 - 1. Antibiotics—to fight infection by causative organism.
 - 2. Bronchodilators—act on smooth muscle to reduce bronchial spasm.
 - a. Sympathomimetics (beta₂ agonists preferred).
 - b. Anticholinergics (atropine sulfate inhalant).
 - c. Theophyllines.
 - 3. Adrenocorticosteroids—to reduce inflammation (Deltasone [prednisone]).
 - 4. Enzymes—to liquefy thick, purulent secretions through digestion.
 - a. Dornavac.
 - b. Varidase (streptokinase).
 - 5. Expectorants—to aid in expectoration of secretions.
 - a. Mucolytic agents reduce viscosity of secretion (Mucomyst [acetylcysteine]).
 - b. Detergents liquefy tenacious mucus (Tergemist, Alevaire).
- D. Medicate for pain to facilitate TCH and use of mechanical devices.

Pneumonia

See page 267.

Atelectasis

Definition: Collapse of pulmonary alveoli caused by mucus plug or inadequate ventilation.

Assessment

- ◆ A. Assess for clinical manifestations that usually develop 24–48 hours postoperatively. (Most common cause of early postoperative temperature increase.)
- B. Assess respiratory symptoms.
 - 1. Observe for asymmetrical chest movement.
 - 2. Auscultate lung sounds. Decreased or absent breath sounds over affected area; crackles; bronchial breathing over affected area.
 - 3. Evaluate shortness of breath.
 - 4. Assess for painful respirations; splinting of diaphragm.
- ◆ C. Assess for increased vital signs: temperature (fever to 102°F [38.8°C]), respiration, pulse (tachycardia).
- D. Observe for anxiety and restlessness.
- E. ABGs: decreased PaO₂.

♦ Implementation

- A. Administer O₂ as ordered.
- B. Encourage sustained inspiration exercises.
- C. Instruct in proper cough technique (splint incision).
- D. Turn frequently (every 2 hours) and position to facilitate expectoration.
- E. Do clapping, percussion, vibration, if ordered.
- F. Do postural drainage every 4 hours.
- G. Administer expectorants and other medications, as ordered.
- H. Suction as necessary.
- I. Encourage oral fluid intake to reduce tenacious sputum and to facilitate expectoration.
- J. Place client in cool room with mist mask or vaporized steam.
- K. Mobilize client as soon as possible.
- L. Medicate for pain to allow for respiratory ventilation.

Deep Vein Thrombophlebitis

See page 243.

Pulmonary Embolism

Definition: The movement of a thrombus from site of origin to lung.

Assessment

- ◆ A. Assess for mild condition (involves smaller arteries).
 - 1. Signs mimic pleurisy or bronchial pneumonia.
 - 2. Transient dyspnea.
 - 3. Mild pleuritic pain.
 - 4. Tachycardia.
 - 5. Increased temperature.
 - 6. Cough with hemoptysis.

- ◆ B. Assess for severe condition (involves pulmonary artery).
 1. Chest pain.
 2. Severe dyspnea leading to air hunger.
 3. Shallow, rapid breathing.
 4. Sharp substernal chest pain.
 5. Vertigo leading to syncope.
 6. Hypovolemia.
 7. Cardiac arrhythmias.
 8. Generalized weakness.
 9. Feelings of doom—severe anxiety.
 10. Hypotension.

Implementation

- ◆ A. Prevention.
 1. Ambulate as soon as possible after surgery.
 2. Range-of-motion exercises.
 3. Pneumatic compression boots.
- ◆ B. Maintain patent airway.
 1. Place in semi- to high-Fowler's position if vital signs allow.
 2. Administer oxygen as needed (nasal cannula).
 3. Assist with intubation as needed.
 4. Auscultate breath sounds every 1–2 hours.
 5. Obtain arterial blood gases to ascertain acid-base imbalance and/or pulse oximetry to monitor SaO_2 level.
 6. Turn as directed by physician; do not do percussion or clapping or administer back rubs.
 7. Encourage client to cough and deep-breathe every 1–2 hours.
- ◆ C. Administer medications as ordered.
 1. Administer anticoagulants (check lab values each day before administering medication, following initial anticoagulation).
 - a. Heparin: 5000–15,000 units IV bolus, then continuous infusion of 1000 units every hour to maintain therapeutic APTT.
 - b. Long-term: Coumadin (warfarin sodium) 5–10 mg daily.
 2. Give narcotics for pain (watch for respiratory depression).
 3. Administer diuretics or cardiotonics, as necessary.
 4. Thrombolytic therapy for acute right ventricular failure or refractory hypoxemia.
 - a. Immediate dissolution of embolus, but danger of bleeding.
 - b. Usual medications: urokinase, tissue plasminogen activator (t-PA), streptokinase.
- ◆ D. Take vital signs every 2–4 hours.
- ◆ E. Maintain bed rest; have client avoid sudden movements.
- ◆ F. Observe for signs of shock.

- ◆ G. Observe for possible extension of emboli or for occurrence of other emboli.
 1. Check urine for hematuria or oliguria.
 2. Check legs, especially calf.
 3. Check sputum for blood.
- H. Prepare for surgical intervention when client is not responsive to heparin therapy.
 1. Surgical intervention carries high risk.
 2. Types of surgery.
 - a. Femoral vein ligation.
 - b. Ligation of inferior vena cava.
 - c. Pulmonary embolectomy.

Fat Embolism Syndrome

Definition: Release of medullary fat droplets into blood-stream following trauma.

Characteristics

- ◆ A. Embolism occurs after long bone or sternum fractures (particularly from mishandling of client or incorrect splinting of fracture).
 1. Fat droplets that are released from the marrow enter the venous circulation and usually become lodged in the lungs.
 2. If the fat droplets become lodged in the brain, the embolism is severe and usually fatal.
 3. Usually occurs within first 24 hours following injury.
- B. Major cause of death from fractures.
- C. Prevent by adequate splinting at accident scene and careful handling of fractured extremity.

Assessment

- ◆ A. Assess for classical sign (occurs 50–60%): petechiae from fat globule deposits across chest, shoulders and axilla. Petechiae do not blanch, but fade out within hours. Can involve conjunctiva.
- ◆ B. Evaluate related pulmonary signs: shortness of breath, leading to pallor, cyanosis, and hypoxemia.
- C. Evaluate related brain involvement.
 1. Restlessness (may be first symptom—occurs within 24 to 72 hours), memory loss, confusion.
 2. Headache, hemiparesis.
- D. Observe for related cardiac involvement.
 1. Tachycardia.
 2. Right ventricular failure.
 3. Decreased cardiac output.
- E. Assess for other signs and symptoms.
 1. Diaphoresis.
 2. Change in level of consciousness.
 3. Shock.
 4. Increased temperature (if involvement of hypothalamus).
- F. Presence of unexplained fever, petechiae, and change in mental status; be alert for possibility of FES.

Implementation

- ◆ A. Preventive measures important: immobilization of fracture with minimal manipulation.
- ◆ B. Maintain oxygenation.
 1. Position client in high-Fowler's position to allow for respiratory exchange. Maintain bed rest.
 2. Administer oxygen to decrease anoxia and to reduce surface tension of fat globules (incentive spirometer may be needed).
- C. Obtain arterial blood gases to maintain sufficient PO₂ levels.
- D. Physician may intubate and place on respirator if respirations are severely compromised.
- E. Institute preventive treatment to avoid further complications, such as shock and heart failure.
- F. Monitor administration of medications.
 1. Cortisone therapy to reduce inflammation.
 2. Restoration of blood volume.

Adult Respiratory Distress Syndrome**Characteristics**

- ◆ A. A medical emergency that may have many causes.
 1. Can be secondary to bacterial or viral pneumonia.
 2. Massive trauma and hemorrhagic shock.
 3. Fat emboli.
 4. Sepsis.
- ◆ B. Pathophysiology—damage to pulmonary capillary membrane that produces a leak, diffuse interstitial edema, and intra-alveolar hemorrhage.
 1. Decrease in surfactant.
 2. Intrapulmonary shunting with decreased oxygen saturation—hypoxia.
 3. Decreased lung compliance.
- C. Multiple organ system failure.

Assessment

- ◆ A. Assess for clinical manifestations. Usually seen within first 24 hours following shock or injury.
- ◆ B. Observe for extreme dyspnea, tachypnea, and cyanosis.
- ◆ C. Assess for pulmonary edema.
- D. Auscultate lungs for atelectasis (many small emboli throughout lungs).
- E. Evaluate blood gas alterations.
 1. PO₂ decreased.
 2. PCO₂ normal or decreased due to tachypnea.
 3. pH normal to slightly alkalotic.

Implementation

- ◆ A. Prevent overhydration in severe trauma cases.
- ◆ B. Provide early treatment of severe hypoxemia (can be life-threatening).
- C. Keep clients "dry," as they have excess fluids in their lungs. (Restrict fluid intake.)

Implementation

- D. Administer medications.
 1. Corticosteroids to reduce inflammation and to prevent further capillary membrane deterioration.
 2. Diuretics to decrease fluid overload.
 3. Sedatives to prevent client from resisting respirator.
 4. Heparin to reduce platelet aggregation.
 5. Antibiotics guided by Gram stains of sputum.
- ◆ E. Maintain adequate ventilation and oxygenation.
 1. Provide intubation and mechanical ventilation with volume respirator.
 2. Obtain frequent arterial blood gases.
 3. Suction frequently with "bagging." Ambu bag increases alveolar expansion.
 4. Prone position improves oxygenation.
- F. Provide tracheostomy care, if appropriate, every 4 hours.
- G. Provide oral hygiene every 4 hours.
- H. Prevent further complications, such as shock and septicemia.
- I. Provide adequate nutrition.

Wound Infections

See also Chapter 6, Infection Control.

Characteristics

- A. Usual causative agents.
 1. *Staphylococcus*.
 2. *Pseudomonas aeruginosa*.
 3. *Proteus vulgaris*.
 4. *Escherichia coli*.
- B. Usually occur within 5–7 days of surgery.

Assessment

- A. Observe for slowly increasing temperature (greater than 100.4°F [38.8°C]), tachycardia, chills, and malaise.
- B. Evaluate pain and tenderness surrounding surgical site.
- C. Observe for edema and erythema surrounding suture site.
- D. Feel for increased warmth around suture site.
- E. Observe for purulent drainage.
 1. Yellow if *Staphylococcus*.
 2. Green if *Pseudomonas*.
- F. Elevated white blood count.

Implementation

- ◆ A. Use meticulous hand hygiene and gloving techniques.
- ◆ B. Take cultures before starting medication; administer specific antibiotics for causative agent.
- C. Irrigate wound with solution as ordered (usually normal saline).

CLIENTS AT RISK FOR POSTOPERATIVE INFECTION

- Uncontrolled diabetes
- Renal failure
- Obesity
- Receiving corticosteroids
- Receiving immunosuppressive agents
- Prolonged antibiotic therapy
- Poor nutrition—protein and/or ascorbic acid deficiencies
- Marked dehydration and hypovolemia
- Decreased cardiac output
- Edema and fluid and electrolyte imbalances
- Anemia
- Preoperative infection

NOTE: See also Chapter 6, Infection Control.

- D. Keep dressing and skin area dry to prevent skin excoriation and spread of bacteria.
- E. Observe standard precautions. Centers for Disease Control and Prevention (CDC) is still recommending sterile technique in changing dressings (wet-to-moist).
- F. If excoriation occurs, use karaya powder and drainage bags around area of wound.

Wound Dehiscence and Evisceration

◆ *Definition:* *Dehiscence* is the splitting open of wound edges. *Evisceration* is the extensive loss of pinkish fluid (purulent if infection is present) through a wound and the protrusion of a loop of bowel through an open wound. Client feels like “everything is pulling apart.”

Assessment

- A. Observe for usual causes.
 - 1. General debilitation.
 - a. Poor nutrition.
 - b. Chronic illness.
 - c. Obesity.
 - 2. Inadequate wound closure.
 - 3. Wound infection.
 - 4. Severe abdominal stretching (by coughing or vomiting).
 - 5. Immunosuppression.
- B. Evaluate wound daily. Condition occurs about seventh postoperative day.
- C. Assess for sensation of “giving” at the incision, pain, and saturated dressing with clear, pink drainage.
- ◆ D. Protrusion of viscera through wound edges (evisceration).

Implementation

- A. Wound dehiscence.
 - 1. Apply butterfly tapes to incision area.
 - 2. Increase protein in diet.

- 3. Observe for signs of infection and treat accordingly.
- 4. Apply abdominal binder when ambulating.
- 5. Keep client on bed rest.

◆ B. Evisceration.

- 1. Lay client in supine or low-Fowler’s position.
- 2. Cover protruding intestine with moist, sterile, normal saline packs; change packs frequently to keep moist.
- 3. Notify physician.
- 4. Take vital signs for baseline data and detection of shock.
- 5. Notify operating room for wound closure.
- 6. Provide patent IV.
- 7. Keep client NPO; place NG tube if ordered.

Disseminated Intravascular Coagulation

◆ *Definition:* Simultaneous activation of the thrombin (clotting) and fibrinolytic system.

Characteristics

- ◆ A. Excessive intravascular thrombin is produced, which converts fibrinogen to fibrin clot.
 - 1. After fibrinogen is depleted, circulating thrombin continues to be present and will continue to convert any form of fibrinogen to fibrin.
 - 2. Fibrinogen enters system by transfusion or by body production of fibrinogen. This process intensifies the hemorrhagic state.
- B. Disseminated intravascular coagulation (DIC) is associated with extracorporeal circulation seen in obstetric complications and disseminated cancer.
- C. Major defect is widespread microvascular thrombosis.

Assessment

- ◆ A. Observe for excessive bleeding (caused by depletion of clotting factors) through genitourinary tract, following injections, etc.
- B. Evaluate lab results for low hemoglobin, low platelets.
- C. Evaluate arterial blood gases for acidosis.
- D. Observe for skin lesions, such as petechiae, purpura, subcutaneous hematomas.

Implementation

- ◆ A. Treat cause of DIC symptomatically.
 - 1. Antibiotics for infections.
 - 2. Fluids and colloids for shock.
 - 3. Steroids for endotoxins.
 - 4. Dialysis for renal failure.
- B. Administer heparin IV to stop cycle of thrombosis—hemorrhage. Usage is controversial

because it often promotes bleeding; used in combination with fluid replacement therapy.

1. Neutralizes free circulating thrombin.
 2. Inhibits blood clotting in vivo, due to effect on factor IX.
 3. Prevents extension of thrombi.
 4. Keep clotting time two to three times normal.
 5. Give 10,000–20,000 units every 2–4 hours.
- ◆ C. Give transfusion of platelets, cryoprecipitate, and fresh frozen plasma to replace clotting factors.
1. Monitor blood transfusion carefully.
 2. Be alert for fluid overload—increasing CVP; slow, bounding pulse.
- D. Administer oxygen as needed.
- E. Take precautions to prevent additional hemorrhage.
1. Avoid chest tube “milking.”
 2. Take temperature orally or axillary, not rectally.
 3. Avoid administration of parenteral medications if possible.
 4. Avoid trauma to mucous membranes.
 5. If nasogastric tube inserted, prevent bleeding by administering antacids and keeping NG tube connected to low suction. Do not irrigate unless absolutely necessary.

FLUID REPLACEMENT THERAPY

Fluid Replacement Solutions

- ◆ A. Types of IV solutions.
- ◆ 1. Hypertonic solution—a solution with higher osmotic pressure than blood serum.
 - a. Cell placed in solution will crenate.
 - b. Used in severe salt depletion, very rare.
 - c. Used in intracranial pressure therapy—reduces edema by rapid movement of fluid out of ventricles into bloodstream.
 - d. Used as a nutrient source (10% dextrose [D]).
 - e. Common types of solution: normal saline (NS), dextrose 10% in saline, dextrose 10% in water, and dextrose 5% in saline.
 - f. Should not be administered faster than 200 mL/hr.
 - ◆ 2. Hypotonic solution—a solution with less osmotic pressure than blood serum.
 - a. Causes cells to expand or increase in size.
 - b. Used to correct diarrhea and dehydration.
 - c. Common types of solution: dextrose 5% in half-strength (0.45%) NS; dextrose 5%; one-third strength (0.33%) NS; and dextrose 5% in water.
 - d. Should not be administered faster than 400 mL/hr.

- ◆ 3. Isotonic solution—a solution with the same osmotic pressure as blood serum.
 - a. Cells remain unchanged.
 - b. Used for replacement or maintenance (expands extracellular volume); especially used to expand circulating intravascular volume.
 - c. Common type of solution: lactated Ringer's solution; 5% dextrose in NS, 5% D in water.
- ◆ B. Choice of fluid replacement solution—depends on client's needs.
 1. Fluid and electrolyte replacement only.
 - a. Saline solution.
 - b. Lactated Ringer's solution.
 2. Calorie replacement—dextrose solutions.
 3. Restriction of dietary intake, such as low sodium.
 4. IV medications that are insoluble in certain IV fluids.
 5. Rate of administration of IV solution to correct fluid imbalance.
 6. Dextrose plays no part in tonicity. It is metabolized off.
- C. Purpose of fluid and electrolyte therapy.
 1. To replace previous losses.
 2. To provide maintenance requirements.
 3. To meet current losses.

Implementation

- A. Check circulation of immobilized extremity.
- B. Check label of solution against physician's order.
- C. Check rate of infusion.
- D. Observe vein site for signs of swelling.
- E. Take vital signs at least every 15 minutes for replacement fluid administration.

Intravenous Calorie Calculation

- A. 1000 mL D₅W provides 50 g of dextrose.
- B. 50 g of dextrose provides 4 calories per gram (actually 3.4 calories).
- C. 1000 mL D₅W provides 200 calories.
- D. Usual IV total/day is 2000–3000 mL (400–600 calories/day).

Intravenous Regulation

- ◆ A. Calculation of drip factor.
 1. Microdrip—60 gtt/mL fluid.
 2. Adult drop factor usually depends on administration set—10 to 20 gtt/mL fluid.
- ◆ B. General formula.

$$\text{Drops/min} = \frac{\text{Total volume infused} \times \text{drops/mL}}{\text{Total time for infusing in minutes}}$$

Example: Ordered 1000 mL D₅W administered over 8-hour period of time.

1. With microdrip, it is easy to remember that the number of drops per minute equals the number of milliliters to be administered per hour.

$$\text{Example: } \frac{1000}{8} = 125 \text{ mL/hr}$$

$$\text{Using formula: } \frac{[\]}{(8 \times 60)} \frac{1000 \times 60}{480} = \frac{60,000}{480} = \frac{125}{\text{gtt/min}}$$

2. With administration set that delivers 10 gtt/min.

$$\frac{(1000 \times 10)}{480} = \frac{10,000}{480} = 20.8 \text{ or } 21 \text{ gtt/min}$$

3. With administration set that delivers 15 gtt/min.

$$\frac{(1000 \times 15)}{480} = \frac{15,000}{480} = 31 \text{ gtt/min}$$

◆ C. Calculation of medication as dose per hour.

Example: Add 2 g lidocaine to 500 mL D₅W. Give 1000 units/hr, using a 20 gtt/mL set.

$$\frac{1000 \text{ units}}{60} \times \frac{500 \text{ mL}}{20,000 \text{ units}} \times \frac{20 \text{ gtt/mL}}{1}$$

$$\begin{array}{r} 25 \\ 50 \\ \hline 1000 \\ 60 \\ \hline 3 \\ \end{array} \times \begin{array}{r} 1 \\ 500 \\ \hline 20,000 \\ \end{array} \times \begin{array}{r} 1 \\ 20 \\ \hline 1 \\ \end{array} = \frac{25}{3} = 8 \text{ gtt/min}$$

$$\begin{array}{r} 40 \\ \hline 40 \\ \end{array}$$

$$\begin{array}{r} 2 \\ \hline 1 \\ \end{array}$$

◆ D. Calculation of medication as dose per minute.

Example: Add 2 g lidocaine to 500 mL D₅W. Give 2 mg/min, using a 60 gtt/mL set.

$$\begin{array}{r} 2 \text{ mg} \\ 1 \\ \hline \end{array} \times \begin{array}{r} 500 \text{ mL} \\ 2 \text{ g} \\ \hline \end{array} \times \begin{array}{r} 60 \text{ gtt/mL} \\ 1 \\ \hline \end{array}$$

$$\begin{array}{r} 1 \\ 2 \\ \hline 1 \\ \end{array} \times \begin{array}{r} 500 \\ 20,000 \\ \hline \end{array} \times \begin{array}{r} 60 \\ 1 \\ \hline \end{array} = 30 \text{ gtt/min}$$

$$\begin{array}{r} 40 \\ \hline 40 \\ \end{array}$$

$$\begin{array}{r} 2 \\ \hline 1 \\ \end{array}$$

PERIOPERATIVE CARE CONCEPTS REVIEW QUESTIONS

1. Evaluating the effectiveness of preoperative teaching before colostomy surgery, the nurse expects that the client will be able to
 1. Describe how the procedure will be done.
 2. Exhibit acceptance of the surgery.
 3. Explain the function of the colostomy.
 4. Apply the colostomy bag correctly.
2. The nurse understands that it is important to obtain baseline vital signs for her client preoperatively to
 1. Establish a baseline postoperatively.
 2. Inform the anesthetist so he can administer appropriate preanesthesia medication.
 3. Judge the client's recovery from the effects of surgery and anesthesia when taking postoperative vital signs.
 4. Prevent operative hypotension.
3. The physician tells a client that he will need exploratory surgery the next day. As the nurse determines the preoperative teaching plan, which one of the following interventions is most important?
 1. Answer questions the client has about his condition or the forthcoming surgery.
 2. Explain the routine preoperative procedures: NPO, shower, medication, shave, etc.
 3. Describe the surgery and what the client will experience following surgery.
 4. Assure the client there is nothing to worry about because the physician is very experienced.
4. Before a client goes to surgery, it is necessary to sign an operative permit. The most appropriate sequence for signing the permit is to
 1. Have the client sign the permit as soon as he is admitted, so he will know what surgery he will be having.
 2. Prepare the client for surgery, give the preoperative narcotics, and have him sign the permit before he goes to sleep.
 3. Ensure that the surgeon has explained the surgery to the client, answer his questions, have him sign the permit, and then complete the final preparations for surgery.
 4. Have the client sign the operative permit and then notify the physician that the permit has been signed.
5. While the nurse is orienting a client scheduled for surgery in the morning, the client states that she is afraid of what will happen the next day. The most appropriate response is to
 1. Assure her that the surgery is very safe and problems are rare.
 2. Let her talk about her fears as much as she wishes.
 3. Explain that she has an excellent doctor and she has nothing to worry about.
 4. Explain that worrying or anxiety has been proven to prolong hospitalization.
6. A client scheduled for surgery is given a spinal anesthetic. Immediately following the injection, the nurse will position the client
 1. On his abdomen.
 2. In semi-Fowler's position.
 3. In slight Trendelenburg position.
 4. On his back or side, with head raised.
7. Following spinal anesthesia, a client is brought into the postanesthesia unit. The assessment data that indicate a complication of anesthesia has developed include
 1. Hiccoughs.
 2. Numbness in legs.
 3. Headache.
 4. No urge to void.
8. A client has just arrived at the postanesthesia unit from surgery. The priority assessment is to
 1. Assess the client's need for oxygen.
 2. Check the gag reflex.
 3. Assess vital signs.
 4. Assess airway for patency.
9. Assessing a postoperative client who has developed unresolved atelectasis, the priority assessment will be
 1. Hemorrhage.
 2. Infection.
 3. Pneumonia.
 4. Pulmonary embolism.

- 10.** Following surgery, the client's surgeon orders a Foley catheter to be inserted. Which one of the following interventions would the nurse carry out first?
1. Clean the perineum from front to back.
 2. Check the catheter for patency.
 3. Explain to the client that she will feel slight, temporary discomfort.
 4. Arrange the sterile items on the sterile field.
- 11.** Following surgery for repair of an inguinal hernia, the nurse establishes a postoperative fluid intake goal for the client. The most appropriate amount would be _____ mL/day.
- 12.** Following abdominal surgery, which clinical manifestation is indicative of negative nitrogen balance?
1. Poor skin turgor from dehydration.
 2. Edema or ascites of the abdomen and flank.
 3. Pale color to skin.
 4. Diarrhea.
- 13.** Hemorrhage is a major complication following oral surgery and radical neck dissection. If this condition occurs, the most immediate nursing intervention would be to
1. Notify the surgeon immediately.
 2. Treat the client for shock.
 3. Put pressure over the common carotid and jugular vessels in the neck.
 4. Immediately put the client in high-Fowler's position.
- 14.** A client has sustained multiple injuries and fractures in a motor vehicle accident (MVA). During which period would the nurse be most vigilant in assessing for the development of a fat embolism?
1. During the first 24 to 48 hours after the MVA.
 2. 72 to 96 hours after the MVA.
 3. During the first week after the MVA.
 4. During the second week after the MVA.
- 15.** Assessing the client following abdominal surgery, the nurse observes pinkish fluid and a loop of bowel through an opening in the incision. The first nursing action is to
1. Notify the physician.
 2. Notify the operating room for wound closure.
 3. Cover the protruding bowel with a moist, sterile, normal saline dressing.
 4. Apply butterfly tapes to the incision area.
- 16.** Following laminectomy surgery, the client returns from the recovery room to the surgical unit. The nurse would anticipate that the most common complication following anesthesia would be
1. Atelectasis.
 2. Pneumonia.
 3. Paralytic ileus.
 4. Edema.
- 17.** Following a missed abortion, a client has developed disseminated intravascular coagulation (DIC). The most critical nursing intervention for this client is to
1. Administer ordered medications.
 2. Allay anxiety—provide emotional support.
 3. Administer oxygen at 6 L/min.
 4. Encourage fluid intake.
- 18.** Following surgery for an abdominal hysterectomy, a 50-year-old client is unable to void. She was catheterized 8 hours ago in the recovery room and she is now complaining that she has the urge to void frequently but voids only a few mL of urine each time. The nurse will plan the next intervention based on the understanding that this symptom is most commonly associated with
1. Bladder damage.
 2. Kidney infection.
 3. An inadequate intake of fluids.
 4. Retention of urine with overflow.
- 19.** A client recently had outpatient surgery on his knee and has just been admitted to the emergency department with the following symptoms: marked shortness of breath, tachycardia, chest pain, and severe anxiety. The nurse will recognize that these symptoms must be reported immediately to the physician. The next intervention will be to prepare to administer
1. Oxygen.
 2. Heparin.
 3. Urokinase.
 4. Coumadin (warfarin).
- 20.** Which of the following statements regarding postoperative nutrition is correct?
1. Clients may have water on awakening from major surgical procedures.
 2. Clear liquid diets are provided for 2–3 days following minor surgical procedures.
 3. Soft diets are initiated the first postoperative day for major surgical conditions.
 4. Clear liquids are started after bowel sounds are assessed following major surgical procedures.

PERIOPERATIVE CARE CONCEPTS ANSWERS WITH RATIONALE

- 1.** (3) Successful teaching can be validated when the client is able to repeat the information. A description of the surgery is irrelevant and application of the bag will be done later. Acceptance of the surgery is an emotional issue.

NP:E; CN:H; CL:C

- 2.** (3) It is important to have presurgery vital signs so that the client's progress can be monitored to assure that his postoperative condition is stable. A baseline is completed presurgery for evaluation postsurgery.

NP:A; CN:PH; CL:C

- 3.** (1) It is most important to begin at the client's level of understanding, so answering questions is more essential than giving explanations until the client is ready to listen. Describing the surgery (3) is not the nurse's responsibility, and giving false reassurance by assuring the client there is nothing to worry about (4) is nontherapeutic.

NP:P; CN:S; CL:A

- 4.** (3) Informed consent by a client who is mentally competent is required to have an operative permit signed. This means the physician must talk to the client and the client must not be under the influence of narcotics. The operative permit does not have to be witnessed.

NP:P; CN:S; CL:C

- 5.** (2) Allowing the client to express her fears results in a decrease in anxiety and a more realistic and knowledgeable reaction to the situation. Answers (1) and (3) close off communication because they are false reassurance. Answer (4) may increase her anxiety.

NP:I; CN:PS; CL:A

- 6.** (3) Usually, the client is positioned on the back following the injection. If a high level of anesthesia is desired, the head and shoulders can be lowered to slight

Trendelenburg position. After 20 minutes the anesthetic is set, and the client can be positioned in any manner.

NP:I; CN:PH; CL:A

- 7.** (3) When spinal fluid is lost through a leak or the client is dehydrated, a severe headache can occur, which may last several days. Numbness (2) and no urge to void (4) would be expected with spinal anesthesia unless it continues for several hours postop. The complication of hiccoughs (1) can be associated with abdominal surgery, but is not attributable to spinal anesthesia.

NP:A; CN:PH; CL:A

- 8.** (4) The priority assessment is to determine if the airway is patent. All of the other nursing actions will follow this assessment: need for oxygen (1), gag reflex (2), and vital signs (3).

NP:A; CN:PH; CL:A

- 9.** (3) Pneumonia is a major complication of unresolved atelectasis and must be treated along with vigorous treatment for atelectasis. Hemorrhage (1) and infection (2) are not related to this condition. Pulmonary embolism (4) could result from deep vein thrombosis.

NP:A; CN:PH; CL:AN

- 10.** (3) It is necessary to give the client an adequate explanation for any procedure. This will result in less anxiety and more cooperation from the client.

NP:I; CN:PH; CL:A

- 11.** The answer is 2000–3000 mL/day, maintenance level postsurgery. The client's body will require additional fluids over the minimum due to fluid loss and the recovery process after surgery. Minimum fluid intake is considered 1500 mL per day.

NP:P; CN:PH; CL:C

- 12.** (2) Edema is due to insufficient nitrogen for synthesis. When this occurs, it leads to a change in the body's osmotic pressure, resulting in oozing of fluids out of the vascular space. This phenomenon results in the formation of edema in the abdomen and flanks.

NP:AN; CN:PH; CL:AN

- 13.** (3) Putting pressure over the vessels in the neck may be life-saving because a severe blood loss can occur rapidly, leading to shock and death. The surgeon would be notified as soon as possible.

NP:I; CN:PH; CL:A

- 14.** (1) Approximately 85% of cases of fat embolism occur within 48 hours of injury, making this the most critical time for monitoring the client for manifestations of this complication.

NP:P; CN:PH; CL:A

- 15.** (3) The first nursing action, before notifying the physician (1), is to cover the open wound. Evisceration will eventually have to be closed in the operating room, but this is a later step. Butterfly tapes (4) would be applied to the wound area to prevent further dehiscence.

NP:I; CN:PH; CL:A

- 16.** (1) Even before pneumonia (2), atelectasis may occur as a result of the alveoli not being expanded. This leads to an alteration in gas exchange. Paralytic ileus (3) could result from any surgery, especially if the client ingests food before the bowel is functioning properly.

NP:AN; CN:PH; CL:C

- 17.** (1) In DIC, the client begins to hemorrhage after the initial hypercoagulability uses up the clotting factors in the blood. Administering heparin, therefore, is a critical nursing intervention. Heparin prevents clot formation and increases available fibrinogen, coagulation factors, and platelets. The other actions have lesser priority. Oxygen would be administered at 2 to 3 L/min.

NP:P; CN:PH; CL:A

- 18.** (4) Ten to 15% of postoperative clients who have undergone general anesthesia require urinary catheterization. Urinary retention must be treated immediately to prevent a urinary tract infection.

NP:P; CN:PH; CL:AN

- 19.** (3) The client's condition suggests pulmonary embolism (PE), which is not uncommon following orthopedic surgery on the knee. The physician will order urokinase delivered through a PICC to dissolve the clot (the primary goal in treating PE). Heparin (2) and Coumadin (the oral form of warfarin) (4) are anticoagulants and will only prevent further clots from forming. Oxygen (1) may well be ordered, but the critical intervention is the thrombolytic agent, which must be given within a few hours of the onset of the symptoms.

NP:I; CN:PH; CL:AN

- 20.** (4) Liquids are not started until bowel sounds have returned; if there is no motility in the bowel, blockage could result. Clear liquid diets are started as soon as bowel sounds return. Diet protocol following major surgery begins with clear liquid to full liquid to soft to regular diet as tolerated.

NP:P; CN:PH; CL:C