GENITOURINARY SYSTEM

KIDNEY

Characteristics:

- Bean-shaped paired organs
- 150 grams
- Right kidney slightly lower than the left
- Receive 20% of cardiac output (at rest)
- Receive 2-4% cardiac output (under stress)

Location:

- Posterior abdominal wall, retroperitoneal
- T12-L3 (iliac crest)

Functions:

- Urine formation
- Excretion of waste products
- Regulation of electrolytes
- Regulation of acid-base balance
- Control of water balance
- Control of blood pressure
- Renal clearance
- Regulation of red blood cell production
- Synthesis of vitamin D to active form
- Secretion prostaglandins
- Regulates calcium and phosphorus balance

❖ **Renal circulation**

Renal Artery (hilum) branches into afferent arterioles

↓

(Glomerular Capillary beds)

↓

Efferent Arterioles

↓

Renal Vein

NEPHRON

❖ Anatomic & functional unit of the kidney
❖ 1 million per kidney
❖ **Process:**
- Urine is formed in the nephrons in a three-step process:
  - ✓ Filtration – transfer of water and waste from blood to glomerulus
  - ✓ Reabsorption – water and necessary ions are transferred back into the blood
  - ✓ Excretion – excess substances and wastes are removed and transferred into urine
- Water, electrolytes, and other substances, such as glucose and creatinine, are filtered by the glomerulus; varying amounts of these substances are reabsorption in the renal tubule or excreted in the urine.

Parts

- **Glomerulus**
  - ✓ Urine filtration (water & solutes except blood, albumin & fibrinogen)
  - ✓ Is a unique network of capillaries suspended between the afferent and afferent blood vessels.
- **Bowman's capsule (Glomerular capsule)**
  - ✓ Collects the filtrate
  - ✓ Epithelial structures that encloses the glomerulus
- **Proximal convoluted tubules (PCT)**
  - ✓ Reabsorption (peritubular capillaries)
  - ✓ Glucose (active transport)
  - ✓ Sodium (active transport)

- ✓ Chloride & Bicarbonate (diffusion)
- ✓ 80% of water (osmosis)

- **Loop of Henle**

✓ Reabsorption
- ➢ Water (osmosis)
- ➢ Chloride (active transport)
- ➢ Sodium (diffusion)

- **Distal convoluted tubule (DCT)**

✓ Reabsorption
- ➢ Sodium (active transport aldosterone)
- ➢ Water (osmosis-ADH)
- ➢ Secretion (active transport)
- ➢ Hydrogen
- ➢ Potassium
- ➢ Ammonia

- **Collecting tubules**

✓ Final osmotic reabsorption of water (ADH)

URETERS

- ❖ 10 -12 inches (25-30 cm)
- ❖ Expands as it enters the kidney to form the renal pelvis (subdivided into calyces each containing renal papillae)
- ❖ Collects urine secreted by the kidney & propels it to the bladder by peristaltic wave

URINARY BLADDER

- ❖ Hollow, spherical, collapsible bag of smooth muscle
- ❖ Behind the symphysis pubis
- ❖ Reservoir for urine
- ❖ Capacity of the adult bladder 300-500 mL
- ❖ Influenced by Automatic Nervous System

URETHRA

- Musculo-membranous tube lined with mucosa opening to urinary meatus

❖ **Female**
- Behind the symphysis pubis
- Anterior to the vagina
- 3-5 cm
- Passageway for expulsion of urine

❖ **Male**
- Extends through the prostate gland and semen

URINE VOLUME CONTROL

❖ Glomerular filtration rate (GFR)
- ❖ Constant (125 ml/min)

❖ **Renin-Angiotensin-Aldosterone-System**
- ❖ Specialized juxtaglomerular cells called densa cells secrete the hormone renin.
- ❖ Renin converts angiotensinogen to angiotensin I.
- ❖ By Angiotensin-converting enzyme (ACE) in lungs, Angiotensin I is converted to Angiotensin II the most powerful vasoconstrictor.
- ❖ Angiotensin II causes the blood pressure to increase.
- ❖ The adrenal cortex secretes Aldosterone in response to poor perfusion or increasing serum osmolality.
- ❖ Aldosterone causes sodium retention and potassium excretion.
- ❖ "Where sodium goes, water follows."
- ❖ The result is an increase in Blood volume and Blood pressure.

❖ Antidiuretic hormone (ADH)
❖ Plasma/Urine osmolarity

NORMAL URINE VALUES

Color: amber/straw (light yellow)
Odor: aromatic
Consistency: clear or slightly turbid
pH: 4.5-8
Specific gravity: 1.010-1.020
WBC/RBC: (-)
Albumin: (-)
E coli: (-)
Mucus thread: few
Amorphous urate: (-)

DISORDERS OF THE GENITO-URINARY TRACT

CYSTITIS

- Infection of urinary bladder
- Usually caused by an ascending bacterial infection (E.coli)
- Most common route is transurethral
- Female (shorter urethra, childbirth, anatomic proximity of urethra to rectum)
- Male (due to epididymitis, prostatitis, renal calculi)
- Predisposing factors:
  - Microbial invasion - E.coli
  - High risk - women
  - Obstruction
  - Urinary retention
  - Increase estrogen levels
  - Sexual intercourse
- **Clinical Manifestation:**
  - Pain- flank area
  - Hematuria
  - Nocturia
  - Dysuria
  - Pyuria
  - Fever
  - Urgency
  - Chills
  - Suprapubic pain
  - Urinary frequency
- **Diagnostic Tests:**
  - Urine culture & sensitivity (+) to E.coli
- **Management**
  - Pharmacologic Management
  - ✓ Antibiotics
    - ➢ Co-trimoxazole - drug of choice
  - ✓ Antispasmodics
  - ✓ Analgesic
- **Nursing Management**
  - ✓ Force fluid / hydration
  - ✓ Diet
    - ➢ Cranberry/orange juice
    - ➢ Avoid urinary tract irritants
    - ➢ (coffee, tea, alcohol)
  - ✓ Warm sitz bath
  - ✓ Empty bladder after sexual intercourse
  - ✓ Good hygiene
  - ✓ Encourage frequent voiding

URETHRITIS

- Inflammation of the urethra
- Causative agents: E. coli, staphylococcus, streptococci, Pseudomonas
- Although inflammatory symptoms are similar to gonorrheal urethritis, sexual contract is not the cause
- May cause prostatitis & epididymitis
- Sign and symptoms:
  - Burning on urination
  - Purulent urethral discharge appear 3-14 days
- Treatment:
  - Tetracycline or doxycycline

NEPHROLITHIASIS/UROLITHIASIS

- Formation of stones at urinary tract
- Types of Stones: Acidic and Alkaline

Acidic Stones	Cause/Diet
Calcium oxalate	Cabbage, beans, spinach, cranberry, nuts, tea, chocolate
Uric Acid	Anchovies, organ meat, whole grain, nuts, sardines
Cystine	Meat, milk, eggs, cheese
Alkaline Stones	
Calcium Phosphate	Dairy products, meat, immobility, obesity, hyperparathyroidism
Struvite	Urea-splitting bacteria

- Predisposing Factor:
  - Diet- increase Ca & oxalate
  - Hereditary- gout
  - Obesity
  - Sedentary lifestyle
  - Hyperparathyroidism
  - Males (3x) more common
  - Catheterization, infection, urinary stasis
  - Dehydration
- **Signs and Symptoms**
  - Nephrolithiasis
    - ✓ Intense, deep ache in costovertebral region
    - ✓ Hematuria
    - ✓ Pyuria
    - ✓ Acute pain, nausea, vomiting, costovertebral area tenderness (renal colic)
    - ✓ Abdominal discomfort
    - ✓ Diarrhea
  - **Ureterolithiasis**
    - ✓ Acute, excruciating, colicky, wavelike pain, radiating down the thigh to the genitalia
    - ✓ Frequent desire to void, but little urine passed
    - ✓ Hematuria
  - **Urolithiasis**
    - ✓ Hematuria
    - ✓ Symptoms of irritation
    - ✓ Urinary retention
    - ✓ Possible sepsis
- **Diagnostic Test:**
  - Intravenous Pyelogram
  - Kidney Ureter Bladder x-ray
  - Cystoscopic exam
  - Stone analysis
  - Urinalysis
  - Ultrasound

- **Management**
  - **Pharmacologic Management:**
    - ✓ Narcotic analgesic
    - ✓ Antispasmodics
    - ✓ Allopurinol (uric acid)
    - ✓ Diuretics
    - ✓ Antibiotics
  - **Surgical management**
    - ✓ Nephrolithotomy- renal stone
    - ✓ Pyelolithotomy- renal pelvis stone
    - ✓ Ureterolithotomy- ureteral stone
    - ✓ Cystolithotomy- bladder stone
  - **Nursing Management**
    - ✓ I & O
    - ✓ Stain urine using gauze pad & save solid materials for analysis
    - ✓ Exercise
    - ✓ Warm sitz bath - for comfort
    - ✓ Alternate warm compress at flank area
    - ✓ Diet:
      - ➢ Force fluid (3L/day) to help client pass stone
      - ➢ Acidic stones: Alkaline-ash diet
        - ➢ Fruits and Vegetables
        - ➢ Milk
      - ➢ Alkaline stones: Acid-ash diet
        - ➢ Cranberry
        - ➢ Prune
        - ➢ Plum
        - ➢ Meat and poultry
      - ➢ Calcium stone (low calcium, diet; acid-ash diet; decrease dietary protein and sodium intake)
      - ➢ Uric Acid (low purine foods; alkaline-ash diet)
      - ➢ Cystine stone (low methionine; alkaline-ash diet)
      - ➢ Phosphate stone (aluminum hydroxide gel, low in phosphorus)

BENIGN PROSTATIC HYPERPLASIA

- Slow enlargement of prostate gland in men >40 yrs old
- Constriction of urethra & subsequent interference in urination
- Unknown cause
- **Predisposing factors:**
  - Aging process
  - Hormonal imbalance (estrogen, androgen)
- **Clinical Manifestation**
  - Frequency
  - Nocturia
  - Hesitancy
  - Residual Urine
  - Decrease in force of urine steam
- Diagnostic Tests:
  - Digital rectal exam (DRE)
  - Cystoscopy
  - Renal biopsy
  - Prostatic massage
  - Relief of obstruction by insertion of indwelling catheter
- Management:
  - Pharmacologic Management:
    - ✓ Terazosin (Hytrin)
      - ➢ A1 - adrenergic receptor blocker
      - ➢ Relaxes bladder sphincter
    - ✓ Finasteride (Proscar)

- ➢ Inhibits 5- alpha reductase (blocks uptake & & utilization of androgens by the prostate)
- ➢ Reduction of glandular hyperplasia
- ➢ Atrophy of prostate gland

- Balloon Dilation
  - ✓ To relax smooth muscle of the bladder neck and prostate
- Immediate Catheterization
  - ✓ If patient cannot void
- Watchful waiting
  - ✓ To monitor disease progression
- Surgical Management
  - ✓ TURP (Transurethral Resection of the Prostate)
    - ➢ No incision
    - ➢ Prostate resected through urethra
    - ➢ Continuous bladder irrigation (cystoclysis)
    - ➢ No incontinence
    - ➢ No impotence
  - ✓ Suprapubic prostatectomy
    - ➢ Incision over lower abdomen & bladder
    - ➢ With cystostomy tube & 2 - way foley catheter
    - ➢ No incontinence
    - ➢ No impotence
  - ✓ Retropubic prostatectomy
    - ➢ Low abdominal incision
    - ➢ No incontinence
    - ➢ No impotence
  - ✓ Perineal prostatectomy
    - ➢ Impotence
    - ➢ Incontinence or rectal injury my be a complication
- Post-operative Nursing Care:
  - ✓ Increase fluid intake
  - ✓ Maintain patency of the catheter
    - ➢ If drainage is reddish, increase flow rate
  - ✓ Practice asepsis
  - ✓ Us a sterile NSS to prevent water intoxication
  - ✓ Prevent thrombophlebitis
  - ✓ Monitor for hemorrhage
  - ✓ After removal of catheter observed for urinary retention/dribbling
  - ✓ Kegel's exercise
  - ✓ Avoid anti-cholinergics
  - ✓ Antihistamines
  - ✓ Upon discharge avoid the following:
    - ➢ Vigorous exercise
    - ➢ Heavy lifting
    - ➢ Sexual intercourse 3 weeks after discharge
    - ➢ Driving 2 weeks after discharge
    - ➢ Straining w/defecation
    - ➢ Prolonged sitting or standing
    - ➢ Crossing the legs
    - ➢ Long trips

PYELONEPHRITIS

- Infection of kidney
- Bacteria (most common) fungal, viral
- **2 TYPES**
  - **Acute**
    - ✓ Bacterial contamination from urethra by instrumentation (iatrogenic) or hematogenous spread
    - ✓ E. Coli/streptococcus
  - **Chronic**
    - ✓ Idiopathic; obstruction or reflex (stone, tumor, or neurogenic bladder)
    - ✓ Progressive scarring of the kidney resulting in weight loss, hypertension and renal failure

- **Clinical Manifestation**

Acute	Chronic
Fever	Fatigue
Urgency	Headache
Chills	Poor appetite
Hematuria	Polyuria
Nocturia	Excessive thirst
Pyuria	Weight loss
Flank pain	
Urinary frequency	
Costovertebral	
Tenderness	
Dysuria	
malaise	

- Diagnosis Tests:
  - Urinalysis
  - Urine culture & sensitivity
  - Cystoscopy, IVP, ultrasound
  - CT-scan
- **Management:**
  - Pharmacologic management
    - ✓ Antibiotics
    - ✓ Antispasmodics
    - ✓ analgesics
  - **Nursing management**
    - ✓ Complete bed rest
    - ✓ VS, I & O, weight
    - ✓ Diet
      - ➢ Cranberry juice, orange juice
      - ➢ Force fluids (3-4 L/day)
    - ✓ Empty the bladder regularly
    - ✓ Performing recommended perineal hygiene (wipe the perineum from front to back)

ACUTE GLOMERULONEPHRITIS (AGN)/ NEPHRITIC SYNDROME

- Inflammatory & degenerative disorder of the glomerulus
- Damage to both kidney from filtration of trapping of antibody-antigen complexes within the glomeruli resulting to decrease glomerular filtration rate
- **Types:**
  - **Acute Post-Streptococcal**
    - ✓ After 7 - 10 days after streptococcal throat infection
    - ✓ Immune reaction to the presence of an infectious organism (group A beta hemolytic streptococcus/GABHS)
  - **Chronic Glomerulonephritis**
    - ✓ Hypertensive nephrosclerosis
    - ✓ Heat failure
    - ✓ Chronic renal failure

❖ **Signs and Symptoms:**
- Pathognomonic sign: Periorbital edema
- Flank pain, costovertebral tenderness
- Headache, visual disturbance
- Fever, malaise, weakness, fatigue
- Anorexia
- Dyspnea (salt & water retention)
- Tachycardia, hypertension
- Oliguria

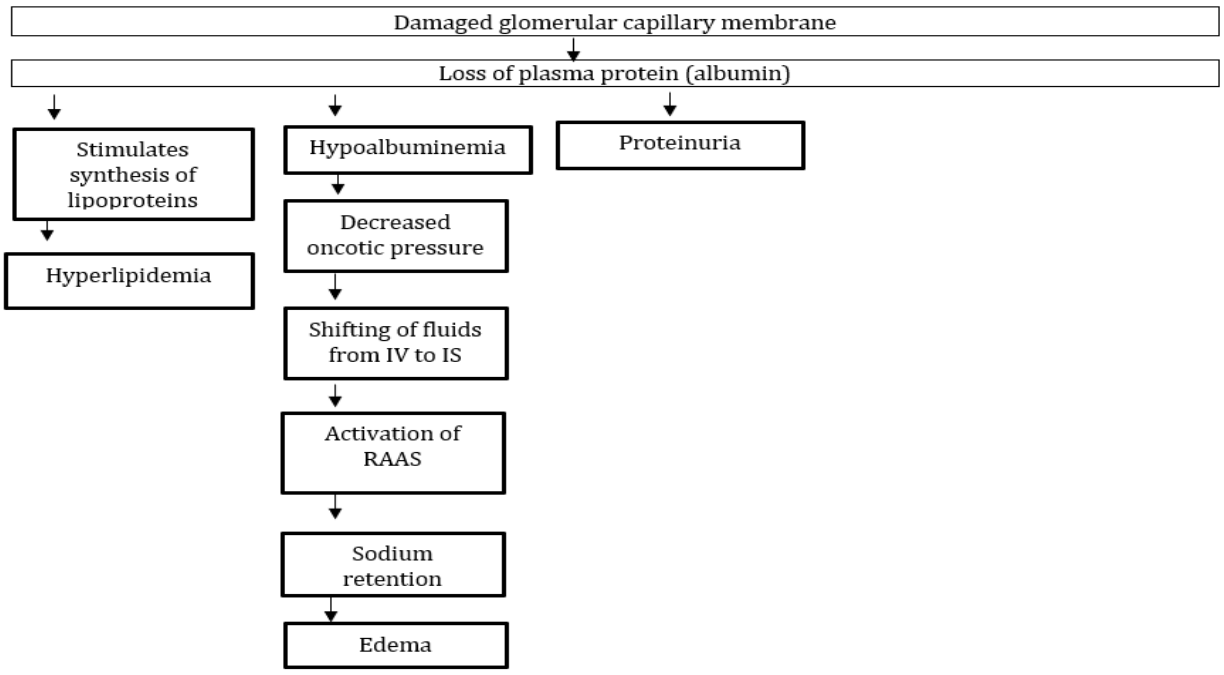
❖ **Assessment and Diagnostic Test:**
- Urinalysis
  - ✓ Hematuria & proteinuria (MOST important indicator of glomerular injury)
  - ✓ Casts
- Elevated BUN & creatinine
- Positive antibody response test for streptococcus
- Elevated Erythropoietin Sedimentation Rate
- Hyponatremia, hypophosphatemia
- Hyperkalemia

❖ **Management:**
- **Pharmacologic management**
  - ✓ Diuretics
  - ✓ Antihypertensive
  - ✓ Corticosteroids
  - ✓ If residual streptococcal infection is suspected, penicillin is the agent of choice
- **Nursing management**
  - ✓ Monitor VS, I & O daily weight & urine specific gravity
  - ✓ Dietary restriction of sodium, fluid & protein
  - ✓ Carbohydrates are given liberally to provide energy and reduce the catabolism of protein.
  - ✓ Provide special skin care
  - ✓ Provide for complication (renal failure, cardiac failure, hypertensive encephalopathy)
  - ✓ Monitor urinalysis, BUN creatinine levels
  - ✓ Promote rest & regular activity when hematuria & proteinuria resolve

NEPHROTIC SYNDROME

❖ Renal pathology characterized by increased glomerular permeability and is manifested by massive proteinuria

❖ **Pathophysiology:**



❖ **Clinical Manifestations**
- Pathognomonic sign: Anasarca (generalized edema)
- Edema (soft and pitting)
- Periorbital edema
- Dependent edema (sacrum, ankle, and hands)
- Ascites
- Irritability
- Headache
- Malaise

❖ **Assessment and Diagnostic Findings:**
- Proteinuria
- Increased WBC in urine
- Needed biopsy of the confirmatory exam

❖ **Complications**
- Infection
- Thromboembolism
- Pulmonary Emboli
- Acute Renal Failure
- Accelerate atherosclerosis

❖ **Management:**
- Pharmacological Management
  - ✓ Diuretics
  - ✓ ACE inhibitors
  - ✓ Lipid lowering Agents
- Nursing Management
  - ✓ Monitor VS, I & O daily weight & urine specific gravity
  - ✓ Dietary restriction of sodium, fluids & protein
  - ✓ Carbohydrates are given liberally to provide energy and reduce the catabolism of protein.
  - ✓ Provide special skin care
  - ✓ Observe for complication (renal failure, cardiac failure, hypertensive encephalopathy)
  - ✓ Monitor urinalysis, BUN & creatinine levels
  - ✓ Promote rest & regular activity when hematuria & proteinuria resolve

ACUTE RENAL FAILURE

❖ Acute tubular necrosis (ATN) renal parenchymal failure, Acute tubule-interstitial Nephritis
❖ Reversible condition characterized by:
- A sudden reduction or cessation of renal function
- Retention of waste products
- Increased UN & creatinine

❖ **Causes of Acute Renal Failure**
- **Pre-renal**
  - ✓ Hypoperfusion of kidney
  - ✓ Volume depletion
  - ✓ Impaired cardiac efficiency
  - ✓ Vasodilation
- **Intra-renal**
  - ✓ Actual damage to kidney tissue
  - ✓ Prolonged renal ischemia
  - ✓ Nephrotoxic agents
  - ✓ Infectious process
- **Post renal**
  - ✓ Obstruction to urine flow
  - ✓ Urinary tract obstruction

- ✓ Calculi (stones), tumors
- ✓ Benign prostatic hyperplasia
- ✓ Blood clots

❖ **Phases of Acute Renal Failure**

- **Onset**
  - ✓ Benign with initial insult and ends when oliguria develops
  - ✓ Initial phase of injury 1-3 days
- **Oliguric phase**
  - ✓ The oliguria period is accompanied by an increase in the serum concentration of substances usually excreted by the kidney
  - ✓ Urine output <400 cc/24 hrs for 3 days – 2 weeks
  - ✓ BUN, creatinine
  - ✓ Edema, hypertension
  - ✓ Hyperkalemia
  - ✓ Hyponatremia
  - ✓ Hyperphosphatemia
  - ✓ Metabolic Acidosis
- **Diuretic phase**
  - ✓ The diuresis period is marked by a gradual increase in urine output, which signals that glomerular filtration has started to recover.
  - ✓ Urine output 3 – 5 L/day for 10 days
  - ✓ Elevated BUN & creatinine
  - ✓ Elevated BP
  - ✓ Hypokalemia
  - ✓ Last- 1 week
- **Recovery phase**
  - ✓ The recovery period signals the improvement of renal function and may take 3 to 12 months
  - ✓ Avoid nephrotoxic drugs
  - ✓ May lead to CRF

❖ **Diagnostic and Laboratory Findings:**

- Hyperkalemia
- Hyperphosphatemia
- Hypocalcemia
- Metabolic acidosis
- Azotemia
- Proteinuria
- Urinalysis (Cast, RBC, WBC)

❖ **Sign and Symptoms:**

- Irritability
- Headache
- Anorexia
- Tingling of extremities
- Lethargy that can progress to stupor & coma
- Sudden dramatic drop in urinary output
- Restlessness, twitching, convulsions
- Skin pallor, anemia & increased bleeding time
- Ammonia odor breath & perspiration
- Generalized edema
- Hypertension which can progress to pulmonary edema & CHF

❖ **Management**

(Correct underlying cause)

- Pharmacologic management
  - ✓ Volume expanders (Dopamine) to restore renal perfusion in hypertensive client
  - ✓ Loop diuretics

- ✓ ACE inhibitors for hypertension
- ✓ H2 blockers to prevent gastric ulcers
- ✓ Kayexalate to reduce potassium
- ✓ Sodium bicarbonate to treat acidosis

- **Nursing Management**
  - ✓ Diet
    - ➢ Moderate protein restriction
    - ➢ High carbohydrates & restricted potassium
  - ✓ Total parenteral nutrition
  - ✓ Monitor I & O
  - ✓ Observe for oliguria followed by polyuria
  - ✓ Weight patient daily & observe for edema
  - ✓ Monitor electrolyte imbalance (acidosis & hyperkalemia)
  - ✓ Assess for sign of overhydration (edema, crackles, headache, distended neck vein, hypertension)
  - ✓ Provide periods of undisturbed rest
  - ✓ Protect client from injury
  - ✓ Observed for early signs of complication
  - ✓ Provide skin care
  - ✓ Assist in peritoneal dialysis or hemodialysis

CHRONIC RENAL FAILURE

- ❖ Irreversible condition of progressive damage to the nephrons & glomerulus
- ❖ Retention of waste product (uremia)
- ❖ Most common cause:
  - **DM nephropathy-leading cause**
  - Hypertension
  - Glomerulonephritis
  - SLE

- ❖ **Stages of Chronic Kidney Failure**
  - Stages are based on the glomerular filtration rate (GFR)
  - The normal GFR-**125 mL/min/1.73 m2**

Stage 1 **GFR:90 mL/min/1.73 m2** **Kidney damage with normal or increased GFR**

Stage 2 **GFR:60-89 mL/min/1.73 m2** **Mild increased in GFR**

Stage 3 **GFR:30-59 mL/min/1.73 m2** **Moderate increased in GFR**

Stage 4 **GFR:15-29 mL/min/1.73 m2** **Severe increased in GFR**

Stage 5/ CKD V **GFR:15 mL/min/1.73 m2** **Kidney failure (end-stage renal disease {ESRD})**

- ❖ **Stages of Chronic Renal Failure**
  - **Diminished renal reserve volume**
  - ✓ Asymptomatic
  - ✓ No accumulation of waste products
  - ✓ Healthier kidney compensation
  - **Renal insufficiency**

- ✓ Metabolic waste accumulation
- ✓ Decrease GFR
- ✓ Symptoms of renal failure

- **End-stage renal disease (ESRD)**
  - ✓ Excessive amounts of metabolic waste
  - ✓ Uremia
  - ✓ Life-threatening condition

❖ **Clinical Manifestation**

- **Gastrointestinal system**
  - ✓ Nausea & vomiting
  - ✓ Stomatitis
  - ✓ Uremic breath/uremic fetor
  - ✓ Diarrhea/constipation
- **Respiratory system**
  - ✓ Kussmaul's respiration
  - ✓ Deep, rapid respiration
  - ✓ Decrease cough reflex
- **Fluid & electrolytes**
  - ✓ Hyperkalemia
  - ✓ Dilutional hyponatremia
  - ✓ Hypermagnesemia
  - ✓ Hyperphosphatemia
- **Integumentary system**
  - ✓ Pruritus
  - ✓ Dry skin
  - ✓ Uremic frost
  - ✓ Edema
- **Cardiovascular system**
  - ✓ Hypertension due to activation of RAAS
  - ✓ Pericarditis due to irritation by uremic toxins
- **Hematologic system**
  - ✓ Anemia
  - ✓ Thrombocytopenia
- **Musculoskeletal system**
  - ✓ Muscles cramps
  - ✓ Loss of muscle strength
  - ✓ Renal osteodystrophy
  - ✓ Bone pain
  - ✓ Bone fractures
- **Reproductive system**
  - ✓ Amenorrhea
  - ✓ Testicular atrophy
  - ✓ Infertility
  - ✓ Decreased libido
- **Neurologic system**
  - ✓ Confusion
  - ✓ Disorientation
  - ✓ Seizures
  - ✓ Burning of soles of feet
  - ✓ Behavior changes

❖ **Management**

- **Pharmacologic management:**
  - ✓ Calcium and phosphorus binders
  - ✓ Antihypertensive and Cardiovascular Agents
  - ✓ Antiseizure agents
  - ✓ Erythropoietin

- **Nursing Management:**
  - ✓ **Nutrition Therapy**
    - ➢ Regulate protein intake
    - ➢ Allow only protein with high biologic value (daily products, eggs, meat)
    - ➢ Fluid intake to balance fluid losses
    - ➢ Fluid allowance (500-600Ml) more than the previous days 24 hour urine output
    - ➢ Some restriction of potassium
    - ➢ Adequate caloric intake and vitamin supplement
  - ✓ **Maintain fluid & electrolyte balance**
    - ➢ Monitor VS & I & O
    - ➢ Weight the patient daily
    - ➢ Assess presence & extent of edema
    - ➢ Auscultate breath sounds
    - ➢ Administer phosphate – binding agent (Amphojel)
  - ✓ **Prevent infection & injury**
    - ➢ Meticulous skin care
    - ➢ Encourage activity but avoid fatigue
    - ➢ Protect from exposure to infectious agent
    - ➢ Avoid aspirin
    - ➢ Soft toothbrush
  - ✓ **Promote comfort**
    - ➢ Analgesic as ordered
    - ➢ Antipruritic
  - ✓ **Assist with coping in lifestyle & self-concept**
    - ➢ Promote hope
    - ➢ Provide opportunity to express feelings
    - ➢ Identify available community
    - ➢ Resources
    - ➢ Prepare client for dialysis or Kidney Transplant

PERITOEAL DIALYSIS

❖ **Principles:**
- Dialyzing solution is introduced via a catheter inserted in the peritoneal cavity
- The peritoneal membrane is used as a dialyzing membrane to remove toxic substances metabolic waste & excess fluid
- Patient can dialyze alone in any location
- Can be used in patients who are hemodynamically unstable
- The peritoneal membrane that covers the abdominal organs and lines the abdominal wall serves as the semipermeable membrane
- Once the cavity, uremic toxins such as urea and creatinine begin to be cleared from the blood through diffusion and osmosis.

❖ Nursing Care:
- **Preparing the patient:**
  - ✓ Consent (patient and the family)
  - ✓ Obtain Baseline vital signs
  - ✓ Explain the procedure
  - ✓ Empty the bladder and bowel to prevent puncture
  - ✓ Administer broad-spectrum antibiotic to prevent infection
  - ✓ Administer heparin to prevent fibrin formation
  - ✓ Warm the dialysate to dilate vessels of peritoneum.
    - Note: Normal color of the drainage fluid is colorless.
      - Cloudy: infection, peritonitis.
      - Bloody: normal at first few exchanges
      - Yellowish: Punctured urinary bladder
  - ✓ Regulate fluid volume & drainage
  - ✓ Promote comfort
  - ✓ Prevent complications
    - Leaks

- Obstruction
- Peritonitis

✓ Drain exit site infection
✓ Monitor urine/glucose levels
✓ Teach client of dialysis & care of peritoneal catheter

HEMODIALYSIS

❖ Client is attached (via a surgically created AV fistula or Graft) to a machine that pumps blood along a semi-permeable membrane, dialyzing solution is on the other side of the membrane, and osmosis, diffusion of waste, toxins, and fluid from the client occurs
❖ Diffusion, osmosis and ultrafiltration are the principles in dialysis
❖ **Hemodialysis Access**
- **AV Fistula**
  - ✓ Commonly in the forearm anastomosis artery to vein either side to side or end to end
  - ✓ It takes at least 14 days to mature
  - ✓ Palpate for thrills, Auscultate for bruits
- **AV Graft**
  - ✓ Can be created by subcutaneously interposing a biologic, semibiologic, or synthetic graft material between an artery and vein
  - ✓ A graft is created when the patient's vessels are not suitable for fistula.
- **Vascular access devices**
  - ✓ Creation of a double-lumen large core catheter into the subclavian, internal jugular or femoral vein.

❖ **Nursing Management**
- **Protecting vascular access**
  - ✓ Evaluate venous access site for bruit or thrill
  - ✓ Absence means blockage or clotting
- **Taking precautions During IV**
  - ✓ The rate of the administration must be as slow as possible
- **Monitoring symptoms of uremia**
  - ✓ **Deleting Cardiac and Respiratory Complications**
    - ➢ Assessment must be conducted frequently
  - ✓ **Controlling electrolyte levels and diet**
- **Managing discomforts and pain**
  - ✓ Antihistamine for pruritis
  - ✓ Use bath oils, superfatted soap, cream of lotion
  - ✓ Keep nails trimmed to avoid scratching and excoriation
  - ✓ Applying lotion to the skin instead of scratching also promotes comfort.
- **Monitoring blood pressure**
  - ✓ Antihypertensive agents must be withheld before dialysis to avoid hypertension due to the combined effect of the dialysis and the medications.
- **Preventing infection**
  - ✓ **Caring for the catheter site**
    - ➢ Performed during showering or bathing
    - ➢ Exit site should not be submerged in bath water
    - ➢ Liquid soap is recommended
    - ➢ Make sure that the catheter remains secure to avoid tension and trauma.

❖ **Vascular Access Complications:**
- Poor blood flow
- Clotting
- Infection
- Pseudoaneurysm / aneurysm
- Ischemia of the hand
- May contribute to congestive heart failure

RENAL TRANSPLANT

❖ Kidney transplantation involves transplanting a kidney from a living donor or deceased donor to a recipient who are longer has renal function
❖ Philippines' Organ Donation Act of 1991

- Republic Act 7170

"Any individual, at least 18 years of age and of sound mind, may give by way of legacy, to take effect after his death, all or part of his body for the purpose of medical or dental education, research advancement of medical or dental science, therapy or transplant".

"In all donations, the death of a person from whose body organ will be removed after his death for the purpose of transplantation to a living person, shall be diagnosed separately by two (2) qualified physicians neither of whom shall be:

- A member of the team of medical practitioners who will affect the removal of the organ from the body
- Lead of hospital or designated officer authorizing the removal of the organ"

❖ **Where do organs come from?**
- **Living related donors**
- **Living unrelated Donors**
  - ✓ Emotionally related donors
  - ✓ Husband/wife
  - ✓ Best friend
- **Decreased Donor**
  - ✓ Acute head/neurological trauma
  - ✓ vehicular crash; gunshot wound
  - ✓ blunt head injuries
  - ✓ Cerebrovascular accidents
  - ✓ aneurysm
  - ✓ cerebral anorexia
  - ✓ drowning; Hanging
  - ✓ primary brain tumors

❖ Pre-operative Nursing Care
- Complete physical examination is performed
  - ✓ Tissue typing
  - ✓ Blood typing
  - ✓ Antibody screening
  - ✓ Psychosocial evaluation
- Patient teaching
  - ✓ Post-operative pulmonary hygiene
  - ✓ Pain management options
  - ✓ Dietary restrictions
  - ✓ Early ambulance
- **No BLOOD TRANSFUSION** for at least **2 weeks** prior to transplantation
  - ✓ Commercially prepared erythropoietin used as substitute for management of anemia

❖ **Post-operative Nursing Care**
- Immunosuppressive agents are administered
- Assessing the patient for Transplant rejection
  - ✓ Oliguria
  - ✓ Edema
  - ✓ Fever
  - ✓ Increasing blood pressure weight gain
  - ✓ Swelling or tenderness over the transplanted kidney
  - ✓ Increase in serum creatinine level.
- Preventing Infection
  - ✓ Signs and symptoms:
    - ➢ Shaking chill
    - ➢ Fever
    - ➢ Tachycardia
    - ➢ Tachypnea
    - ➢ Increase or decrease in WBC
  - ✓ Attention to hand hygiene
- Monitor Urinary Function
- Addressing psychological concerns
  - ✓ Assessment of the patient's stress and coping.

- Monitoring and managing potential complications
  - ✓ Breathing exercises
  - ✓ Early ambulation
  - ✓ Care of the surgical incision

❖ **Detecting Rejection**
- Ultrasonography may be used to detect enlargement of the kidney
- Percutaneous renal biopsy (most reliable) and x-ray techniques are used to evaluate transplant rejection

❖ **Renal Transplant Rejection**
- **Hyperacute**
  - ✓ Within hours after surgery
  - ✓ Antibody-antigen reaction
  - ✓ No urine output
  - ✓ Blue, flaccid kidney
  - ✓ Transplanted kidney must be removed
  - ✓ Client resumes hemodialysis
- **Acute**
  - ✓ Days to month after surgery
  - ✓ Body mounts an immune system defense against donor kidney
  - ✓ Urine output drops sharply
  - ✓ Increased BUN and creatinine
  - ✓ Fever, graft tenderness, swelling
  - ✓ Increased dosage of immunosuppressant drugs
- **Chronic**
  - ✓ Months to years after surgery
  - ✓ Unclear cause
  - ✓ Gradual decline in kidney function
  - ✓ No specific treatment

FLUIDS, ELECTROLYTES AND ACID BASE

FLUIDS AND ELECTROLYTES

DEFINITION OF TERMS

FLUIDS AND ELECTROLYTES

❖ Comprisesapproximately 60% of body weight

BODY FLUIDS

❖ Necessary for chemical reactions and transport
❖ Contained in the body in several compartments separated by semi-permeable membranes.
❖ The major compartments are:
- **Intracellular**—the area inside the cell membrane, containing 65 percent of body fluids
- **Extracellular**—the area in the body that is outside the cell, containing 35 percent of body fluids
- Tissues or **interstitial** area—contains 25 percent of body fluids

❖ Blood plasma and lymph—represents 8 percent of body fluids
❖ Blood plasma is contained in the intravascular spaces
❖ Transcellular fluid—includes all other fluids and represents 2 percent of body fluids (e.g., eye humor, spinal fluid, synovial fluid, and peritoneal, pericardial, pleural, and other fluids in the body)

ELECTROLYTES

❖ Charged molecules contributes to fluid concentration
❖ Allows fluid movement from one compartment to another

MAJOR ELECTROLYTES IN THE ICF

❖ Potassium and Phosphorus

MAJOR ELECTROLYTES IN THE ECF

❖ Sodium and Chloride

NORMAL LABORATORY VALUES FOR ELECTROLYTES

- Sodium — 135-145 mEq/L
- Potassium — 3.5-5.5 mEq/L
- Calcium - 4.5-5.5 mEq/L or 8.5-10 mg/dL
- Phosphorus — 1.7-2.6 mEq/L
- Chloride — 98-108 mEq/L
- Magnesium — 1.5-2.5 mEq/L

MOVEMENT OF FLUIDS AND ELECTROLYTES

- DIFFUSION — movement of SOLUTE; high to low concentration
- OSMOSIS — movement of SOLVENT; low to high concentration
- HOMEOSTASIS — balance of fluid in the body

FACTORS THAT AFFECT FLUID AND ELECTROLYTE BALANCE

- GENDER
  1. MALES — 60%; FEMALES — 50%
     - Males - more muscle (muscle is 80% water)
     - Females - more adipose tissue (fat is only 15% water)
- AGE
  1. INFANTS — 80%
  2. ELDERLY — less muscle; thirst center diminished
     - BOTH are at risk for fluid and electrolyte imbalance!

LABORATORY TESTS INDICATING FLUID IMBALANCE

- **Urine Specific Gravity**
  - The normal range for specific gravity is 1.010-1.020.
  - As fluid volume in the blood increases leads to a more dilute urine, which causes the specific gravity of the urine to decrease (below 1.010).
  - Conversely, as the fluid volume in the blood decreases, as occurs in dehydration, the water excreted in the urinedecreases, making it more concentrated and causing the specific gravity of the urine to increase (above 1.020).
- **Hematocrit**
  - Indirectly indicates fluid volume in the blood. The test measures the number of blood cells per volume of blood
  - Increased fluid in the blood will dilute the blood cells and cause the hematocrit level to decrease. The normal range of values for men is 39 to 49 percent and for women is 35 to 45 percent
  - Consequently, too little fluid in the blood will cause hemoconcentration and result in a high hematocrit level.
- **Serum Osmolality**
  - Measures the concentration of particles dissolved in blood.
  - Sodium is a major contributor to osmolality in extracellular fluid.
  - Generally ranges from 285 to 295 mOsm/kg of H2O or 285 to 295 mmol/kg (SI units).
  - As fluid volume decreases, as in dehydration, serum osmolality increases. Conversely, as fluid volume increases, as in fluid overload, serum osmolality decreases.
- **Urine Osmolality**
  - Measures the concentration of particles dissolved in the urine. The test can show how well the kidneys are able to clear metabolic waste and excess electrolytes and concentrate urine.
  - In a random urine sample, the normal range is 50-1200 mOsm/kg of H2O or 50-1200 mmol/kg.

POTASSIUM

- Major cation INSIDE the cell.
- Critical to neuromuscular function because it plays an important role in action potentials, nerve polarization/depolarization and excitability.

HYPOKALEMIA

- May be caused by the use of diuretic medications that result in the excretion of potassium in the urine and by the loss of potassium through diarrhea or excessive sweating.
- Deficient dietary intake of potassium and magnesium (which causes potassium to move into the cells) could contribute to the development of hypokalemia.

Symptoms the nurse may notice include:

- Irregular heart rhythm and cardiac dysrhythmia: hypokalemia (prominent U wave, flat T wave)
- General discomfort or irritability

- Muscle weakness
- Paralysis
- Hyperglycemia (check glucose levels; hypokalemia=decreased insulin release, decreased insulin sensitivity)
- Rhabdomyolysis (i.e., disintegration of muscle fibers with myoglobinuria owing to hypokalemia, which can reduce blood flow to skeletal muscles)
- Renal impairment owing to prolonged hypokalemia with dilute urine (inability to concentrate urine), polyuria, nocturia, and polydipsia

HYPERKALEMIA

- Results most commonly from decreased excretion of potassium owing to renal failure
- May result from excessive intake or overaggressive treatment of potassium deficit with potassium supplements.
- In addition, acidosis also can cause hyperkalemia by causing a shift of hydrogen ions into the cell and potassium ions out of the cell and into the blood.
- Transfusion of hemolyzed blood also can result in high potassium levels.
- Leukemic patients may demonstrate hyperkalemia owing to leukocytosis that occurs with the condition.
- The nurse should assess the heart because potassium excess can cause heart rhythm (pulse) and ECG changes, including
  - ✓ Ventricular fibrillation
  - ✓ Prolonged PR interval; peaked, narrow T waves;and shortened QT interval progressing to a widened/prolonged QRS complex as potassium level rises

Signs and Symptoms

- Tingling in the extremities
- Weakness
- Constipation
- Lethargy
- Cardiac dysrhythmia

SODIUM

❖ Major cation in the extracellular fluid and spaces.
❖ Concentration of sodium across the cellular membrane plays an important part in neuromuscular cell activity.

Risk factors for sodium imbalance

- Recent trauma (surgery, or shock that might cause fluid loss (triggers the rennin— angiotensin—aldosterone mechanism)

Drugs that may increase sodium levels, including some of the following:

- Anabolic steroids
- Antibiotics
- Clonidine
- Corticosteroids
- Cough medicines
- Laxatives
- Methyldopa
- Estrogens
- Carbenicillin

Drugs that may decrease sodium levels, including:

- Carbamazepine
- Diuretics
- Sodium-free IV fluids
- Sulfonylureas
- Angiotensin-converting enzyme (ACE) inhibitors
- Captopril
- Haloperidol
- Heparin
- Nonsteroidal anti-inflammatory drugs
- Tricyclic antidepressants
- Vasopressin

HYPONATREMIA

- ❖ Most often results from excessive fluid retention or infusion that dilutes the sodium in the blood.
- ❖ Patients with conditions that result in excessive retention of fluid, such as the syndrome of inappropriate antidiuretic hormone (SIADH), also should be observed for a dilutional hyponatremia.

Assessment

- General fatigue
- Weakness
- Nausea
- Headache
- Confusion
- Seizure
- Coma
- Death

HYPERNATREMIA

- ❖ Results from excessive sodium intake or sodium retention with excessive loss of water owing to diarrhea, diuretic medication use, vomiting, sweating, heavy respiration, or severe burns.

Symptoms the nurse may note:

- Signs of dehydration
- Dry skin and mucous membranes
- Slow skin turgor
- Complaints of thirst
- Neurologic changes, including
- Twitching
- Irritability
- Delirium

CHLORIDE

- ❖ Most of the chloride in the body comes from the salt (sodium chloride) ingested and absorbed in the intestines as food is digested.

HYPOCHLOREMIA

- ❖ Often results from diarrhea, vomiting, gastric suctioning (resulting in loss of acid and metabolic alkalosis),chronicrespiratory disease (causing respiratory acidosis), and any condition that causes a loss of sodium owing to decreased reabsorption of sodium and chloride.

Symptoms the nurse might note in patients with hypochloremia include:

- Hyperexcitability of the muscles and nerves
- Shallow respirations
- Low blood pressure (hypotension)
- Tetany

HYPERCHLOREMIA

- ❖ Can result from dehydration and other conditions, including renal disease and excess parathyroid hormone (PTH).
- ❖ Also results from metabolic acidosis owing to the loss of base and respiratory alkalosis that occurs with hyperventilation.

Symptoms the nurse might note in patients with hyperchloremia include:

- Lethargy
- Weakness
- Deep breathing

CALCIUM

- ❖ Mineral necessary for clotting (factor IV)
- ❖ Has a role in cardiac muscle contraction and excitability
  - Skeletal muscle: **Stimulant**
  - Smooth and cardiac muscle: **Inhibitor**

HYPOCALCEMIA

Low calcium levels can result from:

- Decreased parathyroid gland function (i.e., hypoparathyroidism)
- Decreased dietary intake of calcium
- Decreased levels of vitamin D
- Magnesium deficiency
- Elevated phosphorus
- Acute inflammation of the pancreas
- Chronic renal failure
- Calcium ions becoming bound to protein (alkalosis)
- Bone disease
- Malnutrition
- Alcoholism

The nurse may note the following signs of hypocalcemia:

- Nervousness
- Excitability
- Cramps
- Trousseau's sign (carpopedal spasm)
- Chvostek's sign
- Laryngospasm
- Tetany
- ECG: Prolonged QT interval

HYPERCALCEMIA

❖ Most commonly from increased parathyroid function often owing to a tumor or from cancer in the bones that releases calcium into the bloodstream.

Additional causes of hypercalcemia include:

- Hyperthyroidism
- Bone breakage with inactivity
- Sarcoidosis
- Tuberculosis
- Vitamin D excess
- Kidney transplant

Symptoms the nurse might note in patients with hypercalcemia include:

- Anorexia
- Nausea
- Vomiting
- Muscle weakness
- Somnolence
- Coma
- ECG: Shortened QT interval

MAGNESIUM

❖ Found primarily in the intracellular environment and is bound to adenosine triphosphate (ATP).
❖ It is important in almost all the body's metabolic functions.

HYPOMAGNESEMIA

❖ May be noted in patients with conditions that cause excessive urinary loss of magnesium, including poorly controlled diabetes and alcohol abuse,or in patients using drugs such as loop and thiazide diuretics (e.g., Lasix, Bumex, Edecrin, and hydrochlorothiazide), Cisplatin (which is used widely to treat cancer), and the antibiotics gentamicin, amphotericin, and cyclosporine.
❖ Result from conditions resulting in chronic malabsorption such as occurs with diarrhea and fat malabsorption (which usually occurs after intestinal surgery or infection) or problems such as Crohn's disease, gluten-sensitive enteropathy, and regional enteritis.
❖ The nurse may note many symptoms, including the following signs of hypomagnesemia:
  - Neuromuscular weakness
  - Irritability
  - Convulsions

- Tetany (owing to low calcium metabolism)
- ECG changes
- Neurologic changes, including delirium

HYPERMAGNESEMIA

- ❖ May result from an excessive intake of magnesium, specifically found in antacids, as well as from renal failure owing to decreased excretion of magnesium
- ❖ The nurse may note the following signs of hypermagnesemia:
  - Mental status changes
  - Nausea
  - Diarrhea
  - Appetite loss
  - Muscle weakness
  - Difficulty breathing
  - Extremely low blood pressure
  - Irregular heartbeat

PHOSPHATE

- ❖ Necessary to maintain acid base balance (through the buffer system)
- ❖ Phosphate levels represent the phosphorous that is inorganic, or not part of another organic compound.
- ❖ **High Phosphate=Low Calcium; Low Phosphate=High Calcium**

HYPOPHOSPHATEMIA

- ❖ May result from poor absorption such as occurs with ingestion of antacids that bind to phosphate. Phosphate may be decreased withreducedrenalreabsorptionoften secondary to high levels of parathyroid hormone (PTH or in high calcium levels and vitamin D deficiency.
- ❖ The nurse may note respiratory distress in patients with hypophosphatemia owing to weakness of respiratory muscles, particularly the diaphragm, which may cause respiratory failure and difficulty in weaning the patient from mechanical ventilation, and in patients with an increased tendency for hemoglobin to cling onto oxygen, resulting in less oxygen availability to tissues. Cardiacmuscle weakness with low blood pressure and dysrhythmias also may be noted, as well as neurologicsymptoms, includingdelirium, seizures, and peripheral neuropathy.

HYPERPHOSPHATEMIA

- ❖ Owing to the release of phosphate from the bones by tumors. Sarcoidosis; acromegaly owing to growth hormone deficiency; renal failure; cell injury such as occurs in trauma, severe infection, rhabdomyolysis, and hemolytic anemia; and conditions of hypoparathyroidism and hypocalcemia, vitamin D intoxication,hyperalimentation, thyrotoxicosis, and acidosis may predispose a patient to hyperphosphatemia.
- ❖ The nurse may observe central nervous system (CNS) symptoms, including altered mental status with paresthesias, delirium, convulsions, seizures, and coma, as well as muscle cramping, tetany, and hyperexcitability (Chvostek and Trousseau signs). In addition, hypotension and heart failure, as well as a prolonged QT interval, may be noted. Long-term hyperphosphatemia can result in vascular wall calcification and arteriosclerosis with increased blood pressure and ventricular hypertrophy.

ARTERIAL BLOOD GASES

- ❖ NORMAL BLOOD PH: 7.35-7.45
- ❖ PCO2: 35-45 mmHg
- ❖ P02: 80-100 mmHg
- ❖ Bicarbonate: 22-26

Decreased Blood PH = acidosis
Increased Blood PH = alkalosis

Dehydration

- Fluid loss without electrolyte loss

Assessment

- Thirst
- Weight loss
- Elevated Temperature
- Dry mouth and throat
- Warm, flushed, dry skin
- Soft, sunken eyeballs

FLUID VOLUME DEFICIT (HYPOVOLEMIA)

- **Description**: Fluid volume deficit (FVD), or hypovolemia, occurs when loss of ECF volume exceeds the intake of fluid ratio of serum electrolytes to water remains the same
- **Causes:**
  - Vomiting
  - Diarrhea
  - GI suctioning
  - Sweating
  - Third-space fluid shifts- movement of fluid from the vascular system to other body spaces
    - ✓ With edema formation in burns
    - ✓ Ascites with liver dysfunction
  - Diabetes insipidus
  - Adrenal insufficiency
  - Osmotic diuresis
  - Hemorrhage
- **Clinical Manifestations:**
  - Acute weight loss
  - Decreased skin turgor
  - Oliguria
  - Concentrated urine
  - Orthostatic hypotension due to volume depletion
  - A weak, rapid heart rate
  - Flattened neck veins
  - Increased temperature
  - Thirst
  - Decreased or delayed capillary refill
  - Decreased central venous pressure
  - Cool,clammy ,pale skin related to peripheral vasoconstriction
  - Anorexia
  - Nausea
  - Lassitude
  - Muscle weakness
  - Cramps
- **Diagnostic Findings:**
  - BUN elevated out of proportion to the serum creatinine
  - Urine specific gravity is increased
  - Decreased urinary sodium and chloride.
  - Urine osmolality can be greater than 450 mOsm/kg
- **Management**

  Fluid Replacement:
  - **Isotonic electrolyte solutions**
    - ✓ Lactated Ringer's solution 0.9% sodium chloride
      - ➢ Frequently used to treat the hypotensive patient with FVD because they expand plasma volume
    - ✓ Hypotonic electrolyte solution
      - ➢ 0.45%sodiumchlorideis often used to provide both electrolytes and water for renal excretion of metabolic wastes.
- **Nursing Management**
  - The nurse monitors and measures fluid I&O at least every 8 hours
  - Vital signs are closely monitored.
  - The nurse observes for a weak, rapid pulse and orthostatic hypotension
  - Skin and tongue turgor are monitored on a regular basis
  - Measuring the urine specific gravity monitors urine concentration.
  - When possible, oral fluids are administered to help correct FVD
  - The nurse assists with frequent mouth care and provides nonirritating fluids
  - Thepatientmay be offeredsmall volumes of oral rehydration solutions
    - ✓ Rehydralyte
    - ✓ Elete
    - ✓ Cytomax

- If nausea is present, antiemetics may be needed before oral fluid replacement can be tolerated.
- Enteral or parenteral nutrition if oral rehydration are no tolerated until adequate circulating blood volume and renal perfusion are achieved.

FLUID VOLUME EXCESS (HYPERVOLEMIA)

- **Description**:It refers to an isotonic expansionof theECF caused by the abnormal retention of water and sodium in approximately the same proportions in which they normally exist in the ECF.
- **Causes**:
  - Renal failure
  - Heart failure
  - Liver Cirrhosis
- **Clinical manifestations:**
  - Edema
  - Distended neck veins
  - Crackles (abnormal lung sounds)
  - Tachycardia
  - Increased blood pressure, pulse pressure, and central venous pressure
  - Increased weight
  - Increased urine output
  - Shortness of breath and wheezing.
- **Diagnostic Findings:**
  - BUN and hematocrit are decreased because of plasma dilution
  - The urine sodium level is increased if the kidneys are attempting to excrete excess volume.
  - Chest x-raymay reveal pulmonary congestion.
- **Management:**
  - Management of FVE is directed at the cause
    - ✓ Excessive administration of sodium-containing fluids, discontinuing the infusion may be all that is needed.
  - Diureticsareprescribedtoreduce edema by inhibiting the reabsorption of sodium and water by the kidneys.
    - ✓ Thiazide diuretics-block sodium reabsorption in the distal tubule
    - ✓ Loop diuretics- can cause a greater loss of both sodium and water because they block sodium reabsorption in the ascending limb of the loop of Henle
      - ➢ Furosemide (Lasix)
      - ➢ Bumetanide (Bumex)
      - ➢ Torsemide (Demadex)
- Potassium supplements can be prescribed to avoid hypokalemia from the use of diuretics (Potassium-wasting)
- Hyperkalemia can occur with diuretics that work in the last distal tubule (eg, spironolactone)
- Hemodialysis or peritoneal dialysis may be used to remove nitrogenous wastes and control potassium and acid—base balance, and to remove sodium and fluid.
- Dietary restriction of sodium.
  - ✓ An average daily diet not restricted in sodium contains 6 to 15 g of salt
  - ✓ Low-sodium diets can range from a mild restriction to as little as 250 mg of sodium per day
- Patients are instructed to read food labels carefullyto determinesalt content.
- Protein intake may be increased in patients who are malnourished or who have low serum protein levels in an effort to increase capillary oncotic pressure and pull fluid out of the tissues into vessels for excretion by the kidneys.
- The patient is weighed daily.
  - ✓ Weight gain of 2.2 lb (1 kg) is equivalent to a gain of approximately 1 L of fluid.
- Breath sounds are assessed at regular intervals in at-risk patients
- The nurse monitors the degree of edema in the most dependent parts.
  - ✓ Pitting edema is assessedby pressing a finger into the affected part, creating a pit or indentation that is evaluated on a scale of 1 (minimal) to 4 (severe).
  - ✓ Peripheral edema is monitored by measuring the circumference of the extremity with a tape marked in millimeters
- Avoid over-the-counter medications because these substances may contain sodium.
- Regular rest periods may be beneficial, because bed rest favors diuresis of edema fluid
- If dyspnea or orthopnea is present, the patient is placed in a semi-Fowler's position to promote lung expansion.
- Patient is turned and repositioned at regular intervals because edematous tissue is more prone to skin breakdown than normal tissue.

METABOLIC ACIDOSIS

❖ Expected blood gas changes include a low pH (less than 7.35) and a low bicarbonate level (less than 22 mEq/L)

Causes

- There may be an overproduction of hydrogen ions
- Lactic acidosis in fever or seizure, diabetic ketoacidosis, starvation, alcohol or aspirin intake
- Deficient elimination of hydrogen ions
- Deficient production of bicarbonate ions (renal failure, pancreatic insufficiency)
- Excesseliminationofbicarbonateions (diarrhea).

Clinical Manifestations

- Lethargy due to increased hydrogen ion concentration in blood
- Tachycardia early in acidosis; later, cardiac electrical conduction slows, causing bradycardia and increasing risk for heart block or arrhythmia
- Hypotension due to vasodilation
- Rapid, deep breathing (hyperventilation) as body attempts to compensate
- Hyperkalemia may accompany metabolic acidosis as a result of the shift of potassium out of the cells, Later, as the acidosis is corrected, potassium moves back into the cells and hypokalemia may occur

Treatments

- Administer bicarbonate if bicarbonate levels are low.
- Correct the underlying condition that is causing the imbalance
- Administer insulin and fluids in diabetic ketoacidosis
- Hemodialysis if necessary to restore normal balance in system or remove offending substance.

Nursing Interventions

- Monitor intake and output
- Monitor vital signs for changes
- Monitor lab test results.
- Monitor ABG results

METABOLIC ALKALOSIS

❖ Evaluation of arterial blood gases reveals a pH greaterthan 7.45 and a serum bicarbonate concentration greater than 26 mEq/L.

❖ The acid-base balance of the blood is basic because of either a decrease in acidity or an increase in bicarbonate

❖ Alkalosis is often associated with decreased levels of potassium or calcium

Causes

- Excess intake of antacids,
- Long-term parenteral nutrition
- Prolonged vomiting or nasogastric suctioning
- Use of thiazide diuretics

Clinical Manifestations

- Muscle weakness due to neuromuscular changes and hypokalemia
- Musclecrampingandtwitching due to electrolyte changes
- Serum potassium low, chloride low

Treatment

- Sufficient chloride must be supplied for the kidney to absorb sodium with chloride (allowing the excretion of excess bicarbonate).
- In patients with hypokalemia, potassium is administered as KCI to replace both K and CI losses
- Monitor arterial blood gases and electrolyte levels.
- Administerfluids and electrolytes as necessary.
- Administer supplemental oxygen if necessary.
- Administer electrolyte replacement as indicated.

Nursing Interventions

- Monitor vital signs for changes.
- Monitor cardiovascular status for changes in heart rate, rhythm.
- Monitor intake and output.
- Assessintravenoussiteforsignsof infiltration.
- Check neurological status for changes.

RESPIRATORY ACIDOSIS

❖ Respiratory acidosis is a clinical disorder in which the pH is less than 7.35 and the PaCO2 is greater than 45 mm Hg

Cause

- Respiratory acidosis is always due to inadequate excretion of CO2 with inadequate ventilation, resulting in elevated plasma CO2 concentrations and, consequently, increased levels of carbonic acid.
  Acute respiratory acidosis occurs in the following situations, such as:
  - Aspiration of a foreign object
  - Atelectasis
  - Pneumothorax
  - Overdose of sedatives
  - Sleep apnea
  - Acute respiratory distress syndrome

  Respiratory acidosis can also occur in diseases that impair respiratory muscles, such as:
  - Muscular dystrophy
  - Myasthenia gravis
  - Guillain- Barre syndrome

Clinical Manifestations

- Increased pulse and respiratory rate
- Feeling of fullness in the head. An elevated PaCO2, greater than 60 mmHg
- Hyperkalemia may result as the hydrogen concentration overwhelms the compensatory mechanisms and H moves into cells, causing a shift of potassium out of the cell.

Treatment

- Treatment is directed at improving ventilation
- Adequate hydration (2 to 3 L/day) is indicated to keep the mucous membranes moist and thereby facilitate the removal of secretions. Supplemental oxygen is administered as necessary.

RESPIRATORY ALKALOSIS

❖ Respiratory alkalosis is a clinical condition in which the arterial pH is greater than 7.45 and the PaCO2 is less than 35 mm Hg.

Causes

- Respiratory alkalosis is always caused by hyperventilation, which causes excessive "blowing off" of CO2 and, hence, a decrease in the plasma carbonic acid concentration
- Extreme anxiety
- Gram-negative bacteremia

Assessment

- Lightheadedness due to vasoconstriction and decreased cerebral blood flow
- Evaluation of serum electrolytes is indicated to identify any decrease in potassium, as hydrogen is pulled out of the cells in exchange for potassium

Management

- Treatment depends on the underlying cause of respiratory alkalosis.If the cause is anxiety, the patient is instructed to breathe more slowly to allow CO2 to accumulate or to breathe into a closed system.