# Diagnostic Procedures Knowledge Base

## Laboratory Diagnostics

### Complete Blood Count (CBC)

- **White Blood Cell Count (WBC)**: 4,500-11,000/μL
- Neutrophils: 50-70% (bacterial infections)
- Lymphocytes: 20-40% (viral infections, malignancy)
- Monocytes: 2-8% (chronic inflammation)
- Eosinophils: 1-4% (allergies, parasites)
- Basophils: 0.5-1% (allergic reactions)
- **Red Blood Cell Count (RBC)**:
- Men: 4.7-6.1 million/μL
- Women: 4.2-5.4 million/μL
- **Hemoglobin (Hgb)**:
- Men: 14-18 g/dL
- Women: 12-16 g/dL
- **Hematocrit (Hct)**:
- Men: 42-52%
- Women: 37-47%
- **Platelet Count**: 150,000-450,000/μL

### Basic Metabolic Panel (BMP)

- **Sodium (Na+)**: 136-145 mEq/L
- **Potassium (K+)**: 3.5-5.0 mEq/L
- **Chloride (Cl-)**: 98-107 mEq/L
- **$CO_2$**: 22-28 mEq/L
- **Blood Urea Nitrogen (BUN)**: 7-20 mg/dL
- **Creatinine**: 0.6-1.2 mg/dL
- **Glucose**: 70-100 mg/dL (fasting)
- **Anion Gap**: 8-16 mEq/L

### Liver Function Tests (LFTs)

- **Alanine Aminotransferase (ALT)**: 7-56 U/L
- **Aspartate Aminotransferase (AST)**: 10-40 U/L
- **Alkaline Phosphatase (ALP)**: 44-147 U/L

- **Total Bilirubin**: 0.3-1.2 mg/dL

- **Direct Bilirubin**: 0.0-0.3 mg/dL

- **Albumin**: 3.5-5.0 g/dL

- **Prothrombin Time (PT)**: 11-13 seconds

- **International Normalized Ratio (INR)**: 0.8-1.1

## Cardiac Biomarkers

- **Troponin I**: <0.04 ng/mL

- **Troponin T**: <0.01 ng/mL

- **CK-MB**: 0-6.3 ng/mL

- **B-type Natriuretic Peptide (BNP)**: <100 pg/mL

- **NT-proBNP**: <125 pg/mL (age <75), <450 pg/mL (age ≥75)

## Lipid Panel

- **Total Cholesterol**: <200 mg/dL (desirable)

- **LDL Cholesterol**: <100 mg/dL (optimal)

- **HDL Cholesterol**: >40 mg/dL (men), >50 mg/dL (women)

- **Triglycerides**: <150 mg/dL

## Thyroid Function Tests

- **TSH**: 0.4-4.0 mIU/L

- **Free T4**: 0.8-1.8 ng/dL

- **Free T3**: 2.3-4.2 pg/mL

- **Anti-TPO**: <35 IU/mL

- **Thyroglobulin**: <55 ng/mL

# Arterial Blood Gas (ABG) Analysis

## Normal Values

- **pH**: 7.35-7.45

- **PaCO2**: 35-45 mmHg

- **PaO2**: 80-100 mmHg

- **HCO3-**: 22-26 mEq/L

- **Base Excess**: -2 to +2 mEq/L

- **SaO2**: >95%

## Acid-Base Disorders

- **Respiratory Acidosis**: pH <7.35, PaCO2 >45 mmHg
- **Respiratory Alkalosis**: pH >7.45, PaCO2 <35 mmHg
- **Metabolic Acidosis**: pH <7.35, HCO3- <22 mEq/L
- **Metabolic Alkalosis**: pH >7.45, HCO3- >26 mEq/L

## Compensation

- **Respiratory Compensation**: Change in PaCO2 to offset metabolic disorder
- **Metabolic Compensation**: Change in HCO3- to offset respiratory disorder
- **Winter's Formula**: Expected PaCO2 = 1.5 × [HCO3-] + 8 ± 2

# Urinalysis

## Physical Examination

- **Color**: Yellow (normal), amber (concentrated), red (blood)
- **Clarity**: Clear (normal), cloudy (infection, crystals)
- **Specific Gravity**: 1.003-1.030
- **Odor**: Mild (normal), fruity (ketones), foul (infection)

## Chemical Examination

- **pH**: 4.6-8.0
- **Protein**: Negative to trace
- **Glucose**: Negative
- **Ketones**: Negative
- **Blood**: Negative
- **Bilirubin**: Negative
- **Urobilinogen**: 0.2-1.0 mg/dL
- **Nitrites**: Negative
- **Leukocyte Esterase**: Negative

## Microscopic Examination

- **RBCs**: 0-2/hpf
- **WBCs**: 0-5/hpf
- **Epithelial Cells**: Few
- **Bacteria**: None to few
- **Casts**: Occasional hyaline
- **Crystals**: Few, type depends on pH

# Cerebrospinal Fluid (CSF) Analysis

## Normal Values

- **Opening Pressure**: 70-180 mmH2O
- **Appearance**: Clear, colorless
- **Cell Count**: <5 WBCs/μL, 0 RBCs/μL
- **Protein**: 15-45 mg/dL
- **Glucose**: 50-80 mg/dL (60-70% of serum glucose)
- **Gram Stain**: Negative

## Pathological Findings

- **Bacterial Meningitis**: High WBCs (neutrophils), high protein, low glucose
- **Viral Meningitis**: Moderate WBCs (lymphocytes), normal/high protein, normal glucose
- **Fungal Meningitis**: High WBCs (lymphocytes), high protein, low glucose
- **Subarachnoid Hemorrhage**: RBCs, xanthochromia

# Electrocardiography (ECG)

## Normal Values

- **Heart Rate**: 60-100 bpm
- **PR Interval**: 120-200 ms
- **QRS Duration**: <120 ms
- **QT Interval**: <440 ms (men), <460 ms (women)
- **QTc**: <450 ms (men), <470 ms (women)

## Lead Placement

- **Limb Leads**: I, II, III, aVR, aVL, aVF
- **Precordial Leads**: V1-V6
- **Lead II**: Most commonly used for rhythm strips

## Common Abnormalities

- **Atrial Fibrillation**: Irregularly irregular rhythm, no P waves
- **Atrial Flutter**: Sawtooth pattern, regular rhythm
- **Ventricular Tachycardia**: Wide QRS, rate >100 bpm

- **Heart Blocks**: Prolonged PR (1st degree), dropped beats (2nd degree), AV dissociation (3rd degree)

## STEMI Patterns

- **Anterior**: V1-V6 (LAD territory)
- **Inferior**: II, III, aVF (RCA territory)
- **Lateral**: I, aVL, V5-V6 (LCX territory)
- **Posterior**: Tall R waves in V1-V2

# Pulmonary Function Tests (PFTs)

## Spirometry Values

- **FVC**: Forced vital capacity (normal >80% predicted)
- **FEV1**: Forced expiratory volume in 1 second (normal >80% predicted)
- **FEV1/FVC**: Ratio (normal >70%)
- **PEFR**: Peak expiratory flow rate

## Patterns

- **Obstructive**: FEV1/FVC <70%, reduced FEV1
- Examples: Asthma, COPD, bronchiectasis
- **Restrictive**: FEV1/FVC >70%, reduced FVC
- Examples: Pulmonary fibrosis, chest wall deformity
- **Mixed**: Features of both patterns

## Additional Tests

- **DLCO**: Diffusion capacity (normal >75% predicted)
- **Lung Volumes**: TLC, RV, FRC
- **Bronchodilator Response**: >12% and 200 mL improvement in FEV1

# Echocardiography

## Standard Views

- **Parasternal Long Axis**: LV, LA, aortic root, mitral valve
- **Parasternal Short Axis**: LV cross-section, papillary muscles
- **Apical Four Chamber**: All four chambers, mitral and tricuspid valves
- **Apical Two Chamber**: LV, LA, mitral valve

- **Subcostal**: Four chambers, IVC

## Measurements

- **Left Ventricular Ejection Fraction (LVEF)**: >55% (normal)
- **Left Atrial Size**: <4.0 cm (normal)
- **Aortic Root**: <3.7 cm (normal)
- **Wall Thickness**: <1.1 cm (normal)

## Doppler Studies

- **Color Doppler**: Blood flow direction and velocity
- **Pulse Wave Doppler**: Specific location flow assessment
- **Continuous Wave Doppler**: High velocity flow measurement
- **Tissue Doppler**: Myocardial motion assessment

# Stress Testing

## Exercise Stress Test

- **Indications**: Chest pain evaluation, functional capacity
- **Protocols**: Bruce protocol (most common), modified Bruce
- **Endpoints**: Target heart rate, symptoms, ECG changes
- **Positive Test**: ST depression >1 mm, chest pain, hypotension

## Pharmacologic Stress

- **Dobutamine**: Increases heart rate and contractility
- **Adenosine/Regadenoson**: Coronary vasodilation
- **Dipyridamole**: Coronary steal phenomenon
- **Indications**: Unable to exercise adequately

## Nuclear Stress Testing

- **Tracers**: Technetium-99m, thallium-201
- **SPECT**: Single photon emission computed tomography
- **Perfusion Defects**: Fixed (scar) vs reversible (ischemia)