Assessment of Cardiovascular System

Assessment Parameters

- **Cardiac Output**
  - Measures the effectiveness of the heart's pumping abilities.
  - CO is defined as the amount of blood that leaves the heart in one minute.

    CO = Stroke Volume (SV) X Heart Rate (HR)

  - Normal CO: Approximately 4-8 liters/minute
  - Cardiac Index: CO per square meter of BSA
    - CO ÷ body surface area = CI

- **Stroke Volume (SV)**
  - The amount of blood that leaves the heart with each beat or ventricular contraction.
    - Not all blood ejected
    - Normal Adult 70 ml / beat

- Ejection Fraction (EF)
    - The percentage of end-diastole blood actually ejected with each beat or ventricular contraction.
    - Normal adult 55-70% (healthy heart)

Stroke Volume

- Three factors regulate stroke volume:
  - **Preload**
    - The degree of stretch of the ventricle at the end of diastole.
  - **Contractility**
    - Force of ventricular contraction (systole); inotropy.
  - **Afterload**
    - The amount of resistance the ventricular wall must overcome to eject blood during systole.

- **Preload**
  - The degree of ventricular stretch at end-diastole
  - The Frank-Starling Law of the Heart
    - ↑ Preload = ↑ Contractility (to a point)
  - Factors Affecting Preload
    - Circulating volume
    - Body positioning
    - Atrial systole or “kick”
    - Medications
      - Diuretics (i.e. Lasix)
      - ACE Inhibitors (i.e. Vasotec)
      - I.V. Fluids

Stroke Volume Cont.,

- **Contractility**
  - Positive inotropic agents
    - ↑ Force of contraction
  - Negative inotropic agents
    - ↓ Force of contraction
  - Factors that affect contractility
    - Autonomic nervous system (ANS)
    - Medications:
      - Digoxin (Lanoxin)
      - Beta-adrenergic blockers (i.e. metoprolol)
      - Calcium channel blockers (i.e. verapamil)

- **Afterload**
  - Resistance to ventricular ejection during systole
  - Factors that affect afterload
    - High systemic blood pressures (SVR)
    - Aortic valve stenosis
    - High pulmonary blood pressures (PVR)
    - Pulmonary valve stenosis
    - Diameter of arterial vessels
    - Blood characteristics
    - Medications:
      - ACE (angiotension converting enzyme) inhibitors

Laboratory Analysis

- Serum Enzymes
- Blood Chemistry
  - Lipid Studies
  - Electrolytes
  - Renal Function Studies
- Coagulation Studies
- Hematologic Studies

Cardiac enzymes

- **Creatine Phosphokinase (Total CK / CPK)**
  - Non-Specific: enzyme elevated with damage to heart or skeletal muscles and brain tissue.
    - Elevates in 4 to 8 hours
    - Peaks in 15 to 24 hours
    - Returns to normal in 3 to 4 days
- **Creatine Phosphokinase Isoenzyme (CPK-MB)**
  - Specific: isoenzyme of CPK; elevated with cardiac muscle damage.
    - Elevates in 4 to 8 hours
    - Peaks in 15 to 24 hours
    - Returns to normal in 3 to 4 days

Cardiac Enzymes

- **Myoglobin**
  - Non-specific: a heme protein found in muscle tissue; elevated with damage to skeletal or cardiac muscle.
    - Elevates in 2 to 3 hours
    - Peaks 6-9 hours
    - Returns to normal 12 hours
- **Lactic Acid Dehydrogenase (LDH)**
  - Non-specific: enzyme elevated with damage to many body tissues. (i.e. heart, liver, skeletal muscle, brain and RBC's); Not frequently used today.
    - Elevates in 1 to 3 days
    - Peaks in 2 to 5 days
    - Returns to normal 10 to 14 days

Cardiac Enzymes Cont.,

- **Troponin I / T**
  - Specific: a contractile protein released with cardiac muscle damage; not normally present in serum.
    - Elevates in 4 to 6 hours
    - Peaks in 10 to 24 hours
    - Returns to normal in 10 to 15 days
  - Sensitivity superior to CK-MB within the first 6 hours of event.
  - Has replaced LDH for client's who delay seeking treatment.

Other Serum Enzymes

- **C-Reactive Protein**
  - marker of acute inflammatory reactions
- **Homocysteine**
  - presence in serum suggests increased risk of cardio-vascular events.
- **Natriuretic Peptides**
  - released into bloodstream with cardiac chamber distention.

Blood Chemistry Analysis

- **Lipoprotein (Lipid) Profile**
  - Total Cholesterol
    - Normal < 200mg/dl
  - Triglyceride
    - Normal < 150 mg/dl
  - Low Density Lipoproteins (LDL)
    - Normal <130 mg/dl / "Optimal" <100mg/dl
  - High Density Lipoproteins (HDL)
    - Normal: > 40 mg/dl
      > 60 mg/dl cardio-protective

- Serum Electrolytes
  - Na, K, Ca and Mg
  - Glucose / Hemoglobin A1C
- Coagulation Studies
  - PTT / aPTT
  - PT / INR
- Hematologic Studies
  - CBC
- Renal Function Studies
  - BUN
  - Creatinine

Diagnostic Testing

- Electrocardiography *
  - 12-Lead EKG
  - Continuous bedside monitoring
  - Ambulatory monitoring
- Stress Tests
  - Thallium Scans
- Echocardiograms
- Cardiac Catheterizations

Cardiac Stress Tests

- Stressing the heart to monitor performance
- Assists in Determining
  - Coronary artery disease
  - Cause of chest pain
  - Functional capacity of heart
  - Identify dysrhythmias
  - Effectiveness of medications
  - Establish goals for a physical fitness routine

- Thallium Scan
  - Radiological exam to assess how well the coronary arteries perfuse the myocardium.
  - Images are taken 1 to 2 minutes prior to end of stress test and again 3 hours later.
  - Nursing Considerations
    - NPO
    - IV Access

Echocardiogram

- Ultrasound procedure of the heart combined with an electrocardiogram (EKG).
  - Assesses
    - Cardiac (size & shape)
    - Motion of structures (chamber walls / valves)

Echocardiogram Cont.,

- Types of Echocardiograms
  - Transcutanoeous
    - Non-invasive / painless
  - Transesphogeal (TEE)
    - Invasive / Clearer images

Cardiac Catheterization

- “Gold Standard” of cardiac diagnostics
- Invasive procedure to assess
  - Cardiac chamber pressures & oxygen saturations
  - Detect congenital or acquired structural defects
  - Ejection fraction
- Often Includes:
  - Coronary arteriography: to assess coronary artery patency
- Using X-ray technique called fluoroscopy
  - Requiring the use of I.V. contrast / dye

Cardiac Catheterization Cont.,

- Nursing Care
  - Prior to procedure
    - Explain procedure
    - NPO prior to procedure (8 to 12 hours)
    - Check allergies (I.V. dye / shellfish / iodine)
    - Laboratory tests
  - During procedure
    - I.V. access
    - Hemodynamic monitoring
    - Arterial and venous access via catheters (sheaths)
      - Femoral (most common) or brachial

Cardiac Catheterization Cont.,

- Post-Procedure Nursing Care
  - Maintain Client Bedrest for 6 to 8 hours
    - Extremity straight & HOB up $\leq$ 30 degrees
  - Maintain Adequate Hydration
    - IV Fluids (if ordered)
    - Encourage Fluids
  - Frequent Monitoring For Complications
    - Vital signs
    - Puncture site
    - Distal pulses
    - Laboratory results

Great Vessel and Heart Chamber Pressures