Hemodynamics

J. K. Anderson RN, MSN

Cardiovascular System

- Exists to provide tissue perfusion
  - Provide oxygen
  - Provide nutrients
  - Remove metabolic wastes

How Does The Blood Move?

- Structure and Function
- Arteries
- Veins
- Pump (Heart)

Controlling Blood Pressure

- What is blood pressure?
- Review of the 6 physiological mechanisms
  - Blood volume
  - Endocrine
  - Input and output

Controlling Blood Pressure

- Review of the 6 physiological mechanisms cont.
  - Peripheral resistance
  - Renin-angiotensin
  - Baroreceptor

Hemodynamic Measurements

- Mean arterial Pressure (MAP)
  - MAP = {Systolic + 2 x Diastolic} / 3
- Preload
  - Central venous pressure (CVP) – Right side
  - Pulmonary artery wedge pressure (PAWP) – Left side

Hemodynamic Measurements

- Afterload
  - Pulmonary vascular resistance (PVR) – Right heart
  - Systemic vascular resistance (SVR) – Left heart
- Contractility

Hemodynamic Measurements

- Stroke volume (SV) affected by preload, contractility, and afterload
  - SV = CO/HR x 1000
- Cardiac output (CO)
  - C0 = SV x HR

Additional Concepts

- Starling's Law
- Poiseuille's Law
- Ejection fraction

Normal Ranges

- MAP = 70 – 105 mm Hg
- Preload
  - CVP = 2-8 mm Hg
  - PAWP = 6-12 mm Hg

Normal Ranges

- Afterload
  - PVR < 250 dynes/sec/cm-5
  - SVR = 800 – 1200 dynes/sec/cm-5
- Other
  - SV = 60 - 150 mL/beat
  - CO = 4 – 8 L/minute

Invasive Monitoring

- Arterial line
- Central venous pressure
- Pulmonary artery flow-directed catheter

Invasive Monitoring

- Transducer
- Zero-referencing
- Phebostatic axis
  - Transducer above
  - Transducer below

Arterial Monitoring

- Allen's test
- MAP
- Complications
  - Hemorrhage
  - Ischemia
  - Skin & digit necrosis
  - Thrombosis
  - Air embolism

Arterial Line Management

- Asepsis
- Transducer calibrated & Leveled
- Flush bag
- No air bubbles
- Dressing
- Label
- Alarms
- Limb assessment
- Never flush a blocked line

Central Venous Pressure (CVP) Monitoring

- Fluid status (volume)
- Vascular tone
  - CVP = 2-8 mm Hg
  - Low CVP =
  - High CVP=
  - Multiple factors affect CVP – use in conjunction with urine output and BP
- Other uses
  - Administer large fluid volume, parenteral nutrition, & irritant drugs

CVP Line Management

- Complications
  - Pneumothorax
  - Hemorrhage
  - Hematoma
  - Infection
  - Air embolism
  - Embolism/thrombosis
  - Cardiac arrhythmias
  - Puncture

CVP Line Management

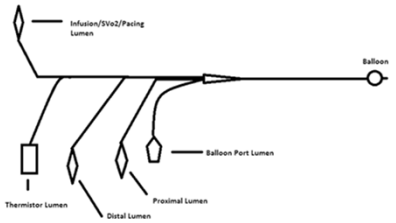
- Asepsis
- Transducer calibrated & Leveled
- Flush bag
- No air bubbles
- Dressing
- Label
- Alarms
- Never flush a blocked line

Pulmonary Artery Flow-Directed Catheter

- Specialized training
- Lumens
  - Balloon port lumen – inflate/deflate balloon & measures pulmonary artery wedge pressure (PAWP)
  - Proximal lumen – measures CVP
  - Distal lumen – pulmonary artery pressure (PAP)
  - Thermistor lumen – temp sensor to measure CO
  - Additional lumen – infusion/pacing/SVo2 etc..

Pulmonary Artery Flow-Directed Catheter

- Swan-Ganz (Fig. 66-7)



Pulmonary Artery Flow-Directed Catheter

- Indications
  - Impaired cardiac function and/or pulmonary hypertension
  - Optimizes fluid management
  - Optimizes drug therapy
  - Optimizes oxygen delivery

Pulmonary Artery Flow-Directed Catheter

- Insertion
  - Complications
    - Ventricular arrhythmias
    - Pneumothorax
    - Arterial puncture
    - Air embolism
    - Myocardial perforation

Pulmonary Artery Flow-Directed Catheter

- RN responsibilities during insertion
  - Prepare equipment & ensure asepsis
  - Patent fully aware of procedure
  - Position patient
  - Observe pressure wave forms
  - Observe for arrhythmias
  - Monitor VS
  - Assist MD
  - Give explanation to patent during procedure

Pulmonary Artery Flow-Directed Catheter

- Management of existing Swan-Ganz
- Complications
  - Kinking of the tube
  - Sepsis
  - Thrombosis
  - Line embolus
  - Pulmonary infarction

Pulmonary Artery Flow-Directed Catheter

- RN responsibilities in managing an existing Swan-Ganz
  - Calibrate & Level equipment
  - Always ensure pulmonary artery wave form present on monitor
  - Observe insertion site
  - Prevent kink in catheter
  - Correct flushing

Pulmonary Artery Flow-Directed Catheter

- Wedge pressure (PAWP)
- Systemic vascular resistance (SVR)
- Pulmonary vascular resistance (PVR)
- Cardiac output (CO)

Pulmonary Artery Flow-Directed Catheter

- Central Venus Pressure (CVP)