

# **Critical Care Nursing**

## Hemodynamics

### **Cardiac Output**

Volume of blood pumped by the heart in one minute (in L)

#### Stroke Volume

Volume ejected with each heartbeat

#### **Systemic Vascular Resistance**

Resistance flow blood to returning to the left ventricle

#### Preload

Volume in the ventricle at the end of diastole

## Cardiac Output







SV



diastolic filling

ventricular ejection

#### Pulmonary Artery Flow **Directed Catheters**

contraction

force

Indications cardiogenic shock, MI w/ complications, severe chronic HF, Ddx of puim. HTM

or

### Measurements

PAD pressure + PAWD

#### **Central Venous or Right Atrial** Pressure (CVP)

Measurements right ventricular preload

#### Interpretation

#### high CVP = R ventricular failure or

- volume overload Low CVP = hypovolemia
- A wave atrial contraction
- C wave tricuspid bulge

#### V wave - atrial filling

### Cardiac Index

Cardiac output adjusted for the patient's body surface area (BSA)

Stroke Volume Index

Stroke volume adjusted for BSA

### **Pulmonary Vascular Resistance**

Resistance flow blood to returning to the right ventricle

### Afterload

Pressure the heart must eject blood against during systole (contraction)

## Immersive Pressure Monitoring

### Arterial BP

Indications

acute hypertension + hypotension, resp. failure , shock, neuro injury, or acute sepsis

Measurements systolic, diastolic + mean arterial pressure

Nursing ECG pressure tracings for diminished arterial BP which is an urgent situation

#### **Pressure** Arterial Based **Cardiac Output (APCO)**

#### Indications

to assess a patient's ability to respond to fluids by increasing stroke volume

#### **Measurements**

continuous cardiac output (cco), stroke vol., continuous cardiac index (cci +SBI)

Contraindications children and those on IABP therapy

**Circulatory Assist Devices** 

Low workload on heart and high perfusion

## IABP

low afterload + systolic pressure

A sausage shaped balloon + pump that is controlled by a control panel. Balloon is inserted into the femoral artery then moved to the descending thoracic aorta

Balloon inflates during diastole and deflates during systole

- High diastolic pressure
- High coronary artery perfusion
- Improved O<sub>2</sub> delivery to myocardium Low angina
  - Low ischemia Low afterload
- Peak systolic pressure High stroke volume
- Low preload

Ind: unstable angina w/ unsuccessful drug therapy acute MI, bridge to transplant, heart surgery

C/I: irreversible brain damage, DIC, AAA, thoracic aneurysm, peripheral vascular disease

**Complications:** dislodgement of plague, aortic dissection, low platelets, thrombocytopenia, infection

helps or replaces action of ventricle

Ind: failure to wean from CPB, HF cause by MI, patients awaiting heart transplant

Nursing: observe for bleeding, tamponade, infection, renal failure and thromboembolism implement activity plan. Provide teaching and emotional support to caregiver

## **ET Intubation**

nd: upper airway obstruction, apnea, high risk for aspiration, ineffective secretion clearance + respiratory distress

Nursing: maintain tube placement, maintain proper cuff inflation, monitor oxygenation and ventilation, maintain patency + provide oral care prevent unplanned extubation + aspiration

## Shock

Low tissue perfusion and impaired cell metabolism

### Cardiogenic Inadequate pumping of the heart that result in reduced cardiac output

Systolic dysfunction = ineffective pumping Low SV & Low CO

Diastolic dysfunction = ineffective filling pulmonary edema + high pulm. pressures

S/sx: tachycardia, hypotension, crackles, pallor, cool clammy skin

#### Hypovolemic

Loss of intravascular fluid volume

Absolute

hemorrhage, drainage, diuresis

#### Relative

fluid moves to extravascular space

S/sx: high HR, high RR, low SV, low CVP, low PAWD

#### Distributive

Neurogenic

loss of SNS vasoconstriction which causes massive vasodilation and pooling of blood and low cell metabolism

#### Anaphylactic

- hypersensitivity to an allergen that causes a quick onset of vasodilation and high capillary permeability

**S/sx:** dizziness, flushing, swelling of lips/tongue

#### Septic

subset of sepsis that is used by an infection causes hypotension and tissue hypoxia

#### **Obstructive**

A physical obstruction of blood flow ex.) tamponade, pulmonary embolism

## **Acute Respiration Failure**

Gas exchange is not functioning adequately Hypoxemia = poor o2 exchange low arterial o2 Pa o2 < 60 mmHg

V/Q = ventilation vs. perfusion should be 1:1 V/Q mismatch can impair gas exchange Diffusion limitation = gas exchange is decreased due to a thickened or damaged alveoli Other causes: shunt, alveolar hypoventilation

Hypercapnia = poor co2 removal - high arterial co2 PaCo2> 45 mmHg Alveoli abnormality - COPD + CF CNS abnormalities - opioids or brainstem injury Chest wall abnormalities - fracture or restricted expansion Neuromuscular conditions - resp. muscle weakness

Tx: hydration, CPT, airway suctioning, coughing, o2 therapy incentive spirometry

use O<sub>2</sub> therapy cautiously in COPD pts. because hypoxia is their stimulus to breathe

Blood in

Blood out

Alveoli

0, in

CO, out

## **Problems Patients Face**

## **Anxiety**

Equipment, alarms. intense and brightness can activity, increase anxiety.

To decrease anxiety:

- Encourage pt/caregiver to ask questions
- Give anxiolytics as ordered
- and explain all procedures Implement relaxation techniques musical and
- therapy

### Pain

Pain should be assessed when possible and sedation/analgesics should be used as ordered ex) propofol or fentanyl

## Impaired communication

Communication can be impaired when a patient is intubated or sedated therefore nonverbal communication is very important.

The nurse should:

- Speak directly to the patient if they're responsive
- Use picture boards or а computer keyboard
- Encourage caregiver to talk to the patient

#### Sleep

Sleep can be disturbed by alarms, procedures, pain, anxiety and general noise.

As the nurse you should promote a normal sleep cycle by providing an eye mask or ear plugs, dimming the light at night. Benzos can be used as ordered when necessary

## Sensory Problems

Delirium is common in ICU patients because of alterations in LOC, restlessness, lethargy and discomfort.

- Nursing interventions include: Assess for delirium often orient with clocks
- Encourage early mobility limit over-sensitization

### Nutrition

Inadequate nutrition is linked to high mobility and mortality. enteral/parenteral nutrition can combat malnutrition. Enteral is preferred d/t low complications and high GI health

## **How to Support Caregivers**

- Use active listening and recognize their feelings Consult chaplains, psychologists and social workers to support
- Provide frequent updates and assess the caregiver's knowledge of the patient's status and treatment plan
- Avoid restricting visitation and ensure the patients advanced directive is being followed
- The first time the caregivers visit you should describe the patient's appearance and prepare them
- Allow family members to be present during like CPR to promote the grief process if death occurs

## Invasive Pressure Monitoring

Equipment must be referenced and zero balanced for accuracy. Referencing = zero reference point at atria. You should use the phlebostatic axis as the landmark for the transducer

		4th	Intercostal	
Zeroing Stopcock			Phlebos	static axis Midches
- 114	nouucci			

To zero the pressure, you should open the stopcock to room air so the monitor can adjust to the atmospheric pressure

Zeroing should occur during initial insertion, after transducer disconnection and when the accuracy of readings are questioned

## Nursing Actions **Square Wave Test**



Should be performed Q 8-12 hours to ensure a distortion free signal for all pressure monitoring

### **Aerial BP Insertion Site**

sure to immobilize Be the insertion site to prevent dislodgement or kinking

#### **High and Low Pressure** Alarms

Ensure the high and low pressure alarms are set based on the patients orders

### **Monitor for and Prevent** complications

- To ensure ulnar circulation perform an allen test before inserting a radial line
- Apply pressure to both ulnar and radial artery + ask the patient to open + close the hand. Release pressure on ulnar artery + check for pinkness to return w/i 6 sec.

To maintain patency and limit thrombi assess the flush system Q1-4 hours, ensure pressure bag is inflated to 300 mmHg + flowing at ~ 3m/hr

neurovascular status Assess distal to the arterial site every hour

To prevent infection, change tubing, pressure bag and transducer 096 hrs.

Square Wave Test

Dicrolic Notch

Systolic **End Diastolic** Arterial Pressure Tracing



#### Aerial Pressure - Based **Cardiac Output (APCO)**

determine continuous Can cardiac output (cco) and can also be used assess responsiveness to fluids via stroke volume variation (ssv)

Is commonly used with a central venous oximetry catheter

## **Pulmonary artery flow-directed catheter** (swan - ganz)

#### Insertion

- Before insertion, assess the patient's electrolytes, AB6s, O2 and coagulation. Level and zero the system based on the phlebostatic axis
- Witness and ensure informed consent has been obtained
- Monitor the patient's vitals as the catheter is inserted through the venous system to the right side of the heart
- Monitor the ECG for dysrhythmias especially when the cath reaches the R ventricle
- Ensure a normal pulmonary artery wedge pressure PAWP tracing is observed and balloon is deflated

An O<sub>2</sub> saturation measurement from a PA cath is called mixed venous 02 sat (SvO2)

ECG	mh
Arterial	
PAWP	

## Venous Oxygen Saturation

Normal ScVO2 or SvO2 = 60 - 80%

Measure o2 in venous circulation to determine if O2 is being delivered to tissues

This is called central venous 02 Sat Scv02

High SvcO2 or SvO2 80-90%	High O2 supply Low O2 demand	<ul> <li>Patient is receiving too much O2</li> <li>Seen in anesthesia hypothermia and sepsis (muscles movement) (low metallic demand) (low use of O2)</li> </ul>	
Normal SvcO2 or SvO2 60-80%	Normal 02 supply and demand	- Balanced supply/demand	
Low SvcO2 or SvO2 <60%	Low O2 supply d/t - low Hgb - low SaO2 - low Co - high O2 demand	<ul> <li>Can be d/t bleeding, anemia or low CO</li> <li>Can be d/t hypoxemia or lung disease</li> <li>Shivering,seizures,hyperthermia and excessive activity can also cause this</li> </ul>	