

Adult Congenital Heart Disease Considerations

Adjusting developmental approach & scoring systems

Pain management- assess developmental level

- Numeric pain scale
- FLACC or FACES if needed

Sedation- continue to assess & document an SBS score; consider using BIS monitoring

Delirium- continue to assess & document a CAPD score at 10am & 10pm

We will transition to the adult scoring system (CAM-ICU) this fall

General Potential Post-operative Complications

- Bleeding
- Arrhythmias
- Stroke

Bleeding

- Might be at increased risk if
 - the patient has been controlled on longstanding anticoagulants
 - the patient had previous sternal incisions
- When calculating blood loss post-operatively consider the total volume of blood rather than only in ml/kg

Arrhythmias

- May be congenital from underlying structural defects or acquired due to surgical scarring and long-term hemodynamic changes
- Chronic hypoxemia and volume/pressure overload contribute to arrhythmia progression over time
- Sudden cardiac death (SCD) is a major concern in adults with congenital heart disease
- Atrial arrhythmias are common and clinically significant due to increased risk of atrial thrombus formation

ARRHYTHMIAS & ASSOCIATED DEFECTS IN ACHD

ARRHYTHMIAS	ASSOCIATED DEFECTS
<i>Tachycardias</i>	
Accessory pathways	Ebstein's anomaly; congenitally corrected transposition of the great arteries (ccTGA)
Twin atrioventricular (AV) nodes	Heterotaxy syndrome
Intra-atrial reentrant tachycardia (atrial flutter)	Postoperative Mustard; post-op Senning, post-op Fontan; Atrial septal defect (ASD); Atrioventricular (AV) septal defect; Epstein anomaly; Eisenmenger physiology
Atrial fibrillation	Mitral valve disease; aortic stenosis; unrepaired single ventricle; ASD; Eisenmenger physiology
Ventricular tachycardia (VT)	Tetralogy of Fallot (TOF); congenital aortic stenosis; Transposition of great arteries (TGA); Epstein, single ventricle; Ventricular septal defect (VSD); pulmonary hypertension (PH)
<i>Bradycardias</i>	
Congenital sinus node dysfunction	Heterotaxy syndrome
Acquired sinus node dysfunction	Post-op Mustard; post-op Senning; post-op Fontan; post-op Glenn; D-TGA
Congenital AV block	Endocardial cushion defects; ccTGA; L-TGA; AVSD
Acquired AV block	Ventricular septal defect (VSD) closure; subaortic stenosis relief; AV valve replacement
<i>Sudden Cardiac Death (SCD)</i>	TOF; TGA; ccTGA; AS; ventricular hypertrophy.

Source: Pediatric Cardiac Intensive Care Society (PCICS), Nursing Resources. "Arrhythmias and Associated Defects in ACHD."

Stroke Recognition

- Use the B.E. F.A.S.T. acronym to aid in stroke recognition

B.E. F.A.S.T.

Balance
Loss

Eye (Vision)
Changes

Face
Drooping

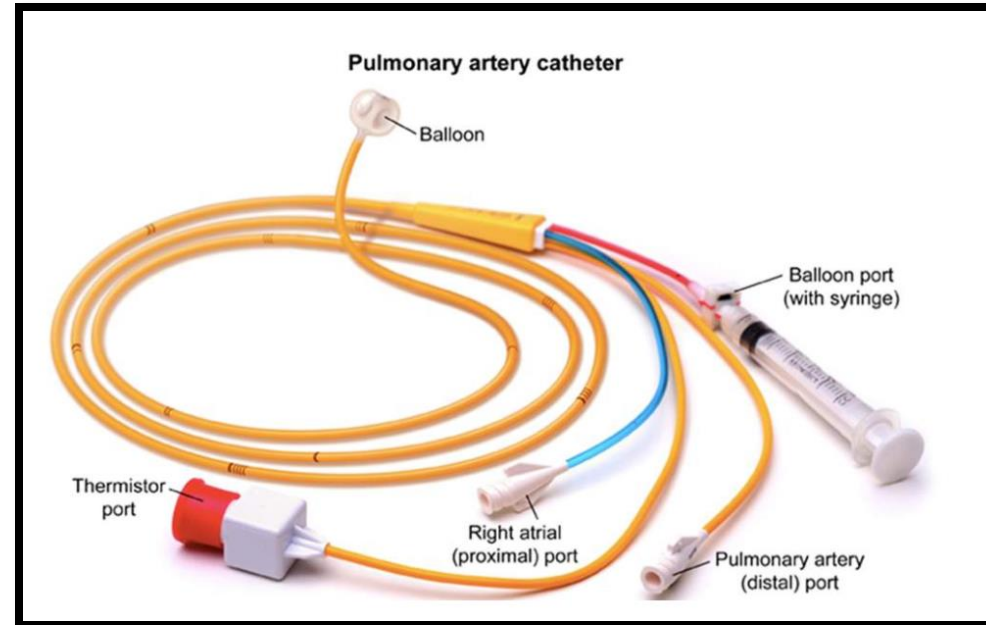
Arm
Weakness

Speech
Difficulty

Time to
Call 911

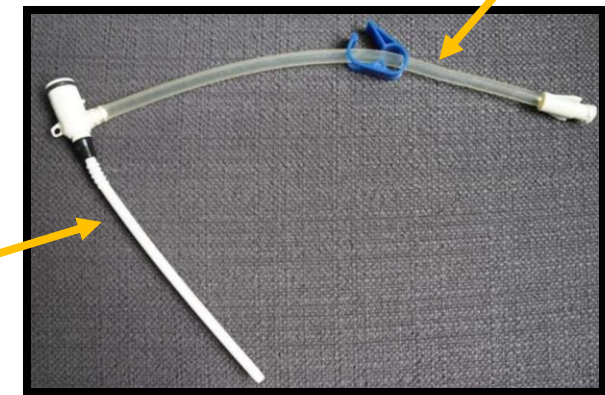
Pulmonary Artery Catheters (Swan – Ganz)

- The pulmonary artery catheter (PAC), also known as a Swan-Ganz is a ballooned catheter advanced into the left/right pulmonary artery
- Used for hemodynamic monitoring including:
 - Direct measurement of **right sided heart function**
 - Direct measurement of **cardiac output**
 - Indirect measurement of **left sided heart function**
- The “introducer cordis” is a large bore catheter in which the PAC is advanced into the vessel.
 - Stays in place with PAC
 - Includes a side infusion port



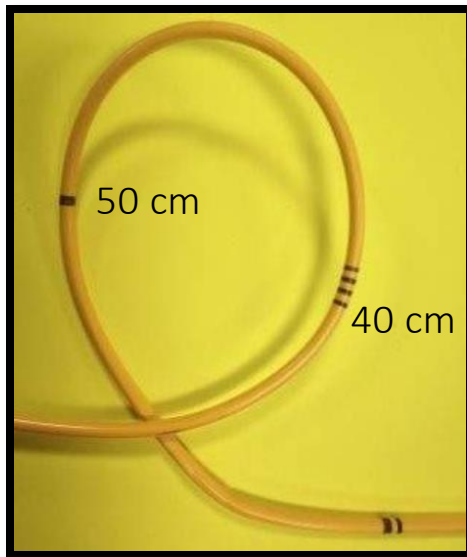
Infusion port – needs to have a KVO running of normal saline

Threaded to patient



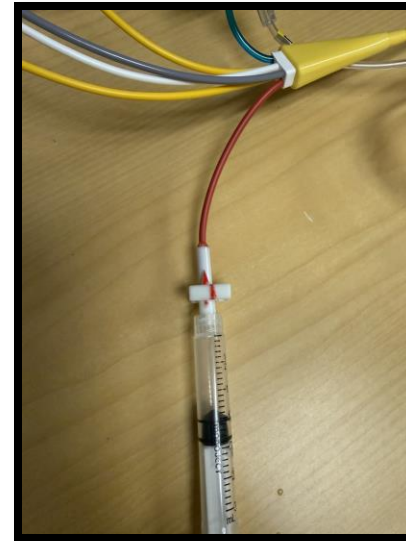
PA Catheter Basics

- Standard catheters are 110 cm long
- Hash marks along the length of the catheter help to verify placement
 - Thin line = 10 cm
 - Thick line = 50 cm
- Should be passed along in report to ID location of PAC

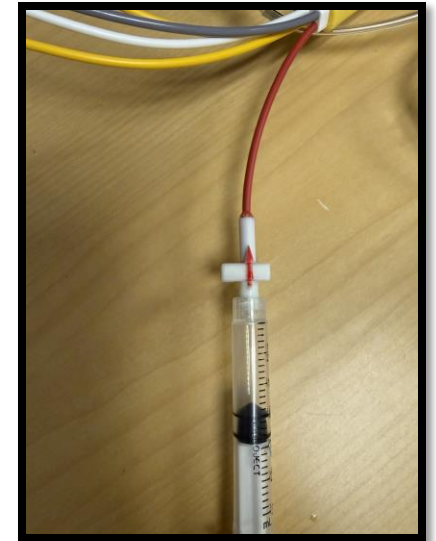


60 cm

- Balloon port of the PAC should **ONLY** be inflated with the **syringe included in the kit**
- Designed to prevent over inflation by only filling with 1.5 mL of air



Safety lock is engaged
"crooked arrow"
Air cannot be injected

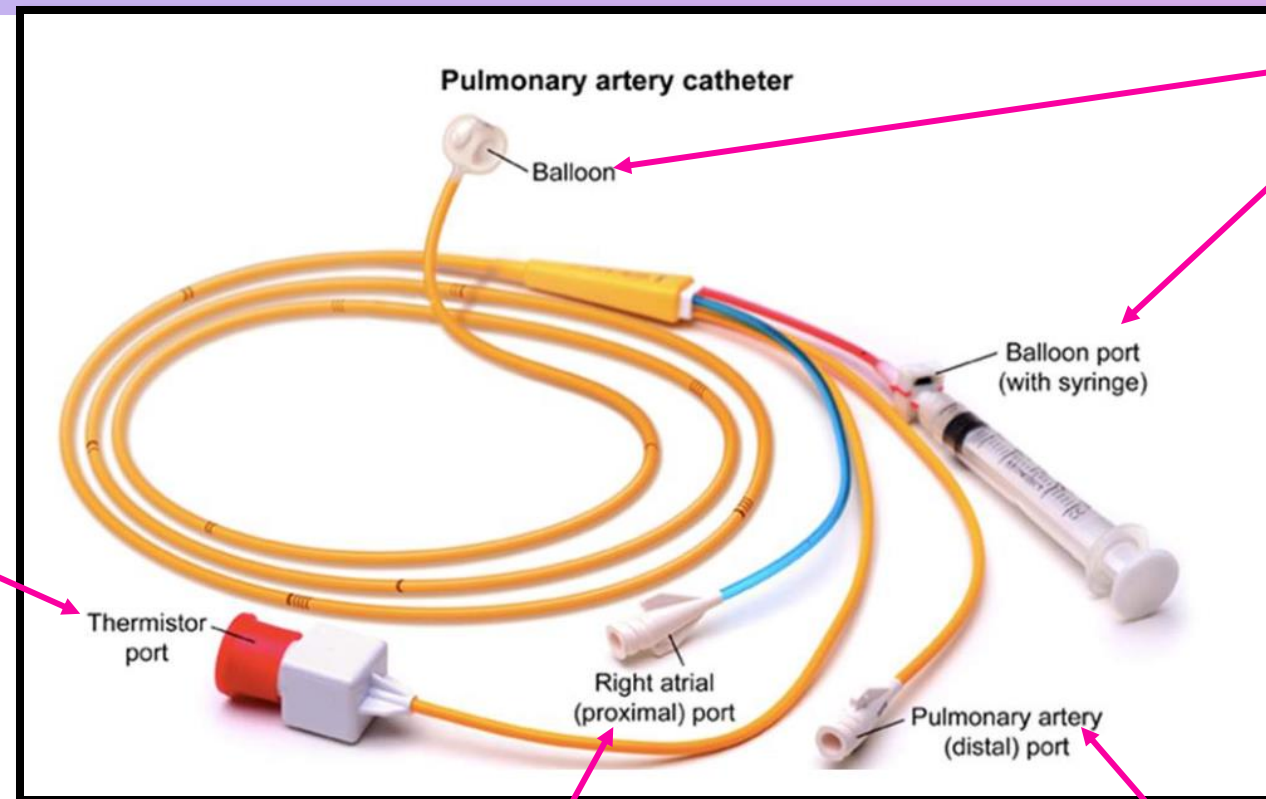


Safety lock is unlocked
Arrow in straight line
PAOP can be evaluated
Providers *only*

PA Catheter Basics

Thermistor

- Measures continuous core blood temperature
- Measures cardiac output with thermodilution
- Remove red cap to connects to the monitor cable



Balloon Port

- Controls inflating & deflating balloon during position and measuring pulmonary artery occlusion pressure measurement (PAOP)
- Safety lock engaged: "crooked arrow"
- Providers only

Right Atrial (PROXIMAL) Port

- Monitors RA pressure/CVP
- Can use to administer medications and fluids
 - No blood or titratable medications
- Site of injection for manual CO using thermodilution

Pulmonary Artery (DISTAL) Port

- Terminates in the PA and measures PA pressures
- Transduced with pressure tubing at 3 mL/hr
- NOT AN INFUSION PORT
- Site for SVO_2 draws only

Advanced Hemodynamic Monitoring

Hemodynamic Parameter	Measures	Normal Values
Central Venous Pressure (CVP)	Right Preload	2-6 mmHg
Pulmonary Artery Systolic	Right ventricular systolic ejection	20-30 mmHg
Pulmonary Artery Diastolic	Resistance pressure of pulmonary vascular bed	5-10 mmHg
Pulmonary Artery Mean	Average pressure of pulmonary artery	10-20 mmHg
Cardiac Output (CO) Cardiac Index (CI)	Amount of blood ejected by heart in 1 min. Index- adjusted for body size.	4-8L/minute 2.5-4L/minute/m ²
Venous Oxygenation Saturation (Svo ₂)	Perfusion	60-80%
Pulmonary artery occlusion pressure (PAOP)	Left Preload	4-12 mmHg
Systemic Vascular Resistance (SVR)	Left Afterload	900-1400 dynes·sec/cm ⁵
Pulmonary Vascular Resistance (PVR)	Right Afterload	50-250 dynes·sec/cm ⁵
Stroke Volume Stroke Volume Index	Amount of blood pumped by ventricle in one contraction. Index adjusted for body surface area	60-120mL/beat 33-47mL/beat/m ²

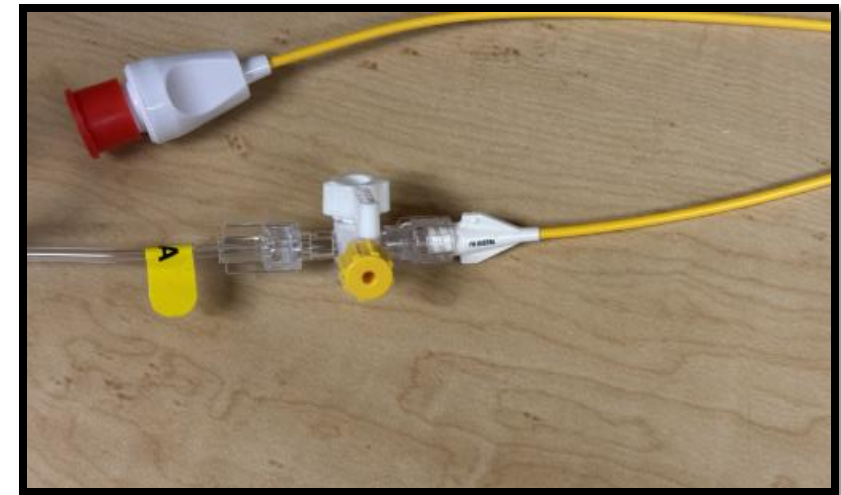
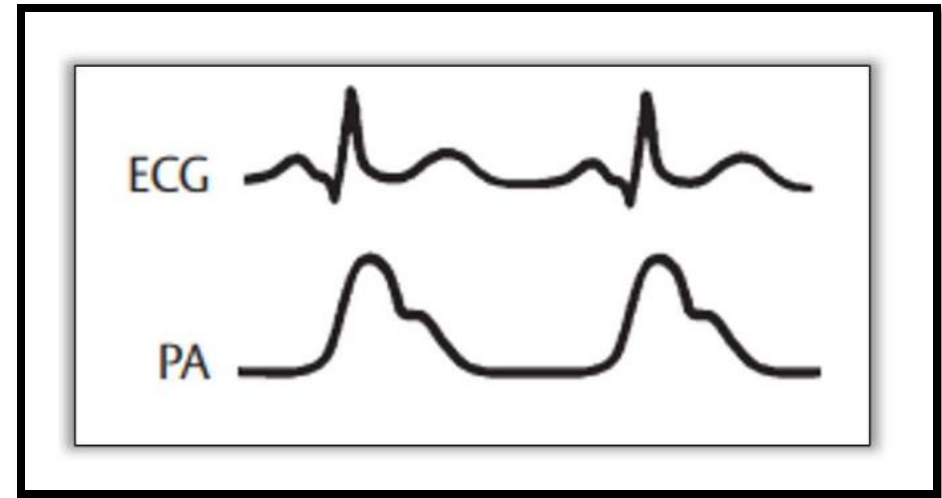
Values per AACN Core Curriculum for Progressive and Critical Care Nursing 8th edition

Nursing Considerations

- PAC should be treated as a central line
 - Assess hash marks at the exit site
 - Assess insertion site for infection, bleeding, dressing integrity
 - Ensure sterile sheath is intact and without blood
- Ensure components are locked in place, tubing connected appropriately, and line is secure (not hanging)
- Zero'ing the catheter is the same as a CVP or Arterial Line
 - Beginning of shift, change in position, changed in pressure values, etc.
 - Level to the phlebostatic axis (4th intercostal space)
 - Be accurate → every inch off = 2-4 mmHg difference
- Do not administer blood products or albumin through the PAC – may occlude the catheter
- IV medications through the PA proximal lumen only
- NEVER flush when a balloon is wedged
- PA catheter placement is not a contraindication to mobility
 - Measurements should be done at the same position
 - ex: head of bed to 30 degrees

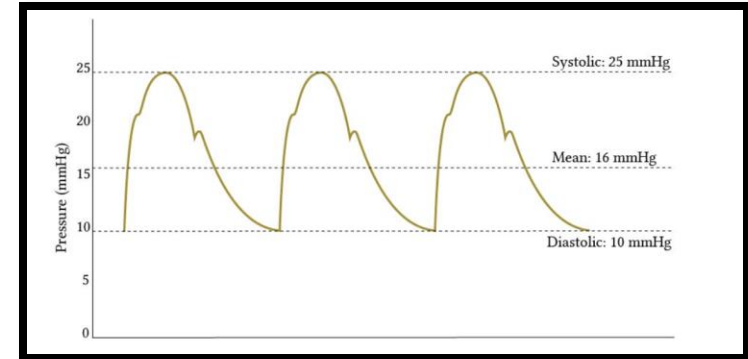
Pulmonary Artery Pressure (PAP) Monitoring & Waveforms

- Obtained from the PAC **DISTAL** lumen which terminates in the pulmonary artery
 - Left ventricle preload indicator
 - Waveform: smooth upstroke and dicrotic notch from pulmonic valve closure
- Utilize pressure tubing at 3mL / hr to maintain waveform (normal saline)
- Do not use the stopcock: place a dead-end cap on the syringe port
- Systolic Range: 20-30 mmHg
- Diastolic Range: 5-10 mmHg
- Mean: 10-20 mmHg

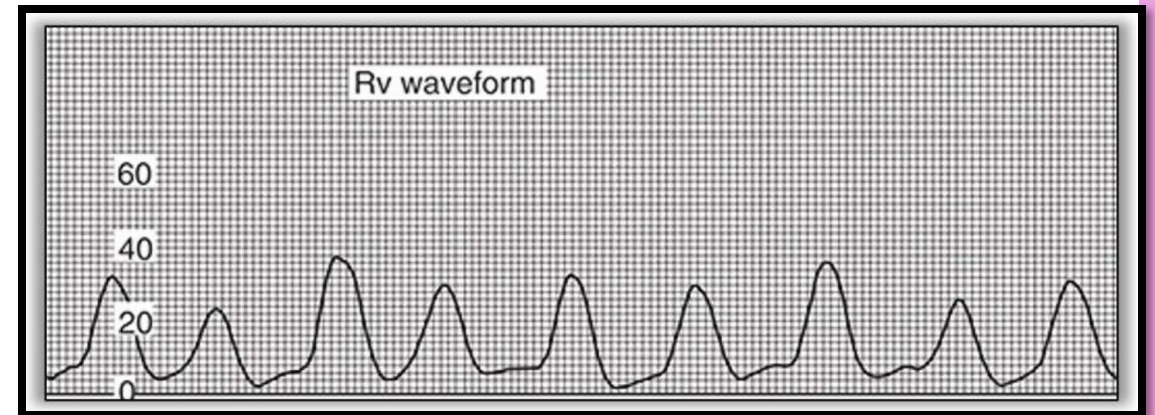


Pulmonary Artery Pressure (PAP) Troubleshooting

- If catheter unexpectedly **migrates back** into the **right ventricle**, the waveform will look similar to **ventricular tachycardia**
- What to do next:
 - Note the PAC location at the exit site to evaluate if PAC was pulled back (hash marks)
 - Notify the provider to reposition the catheter
 - This is why the sterile sheath is on
 - If instability with catheter (v-tach, arrhythmias, etc.)
 - Provider will pull back PAC until a CVP waveform appears

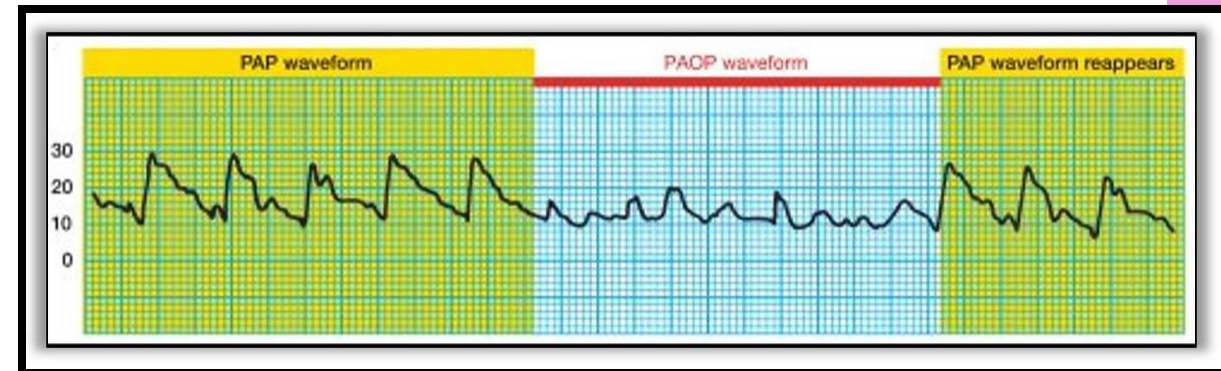
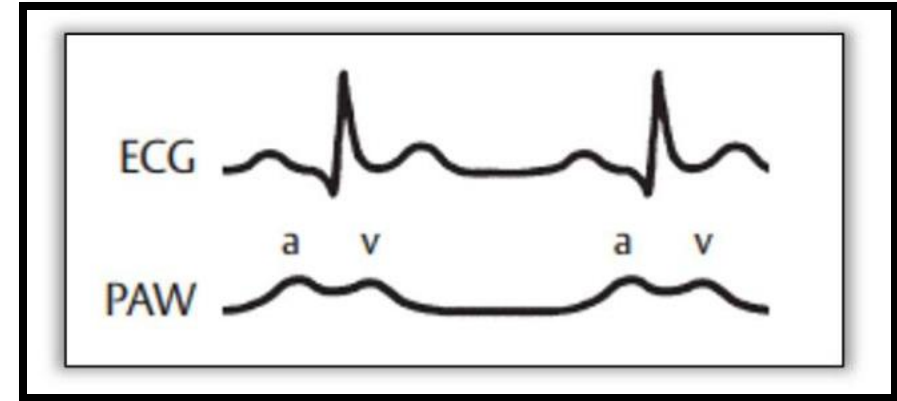


If it goes from looking like this (above) to this (below) then the catheter moved into the RV



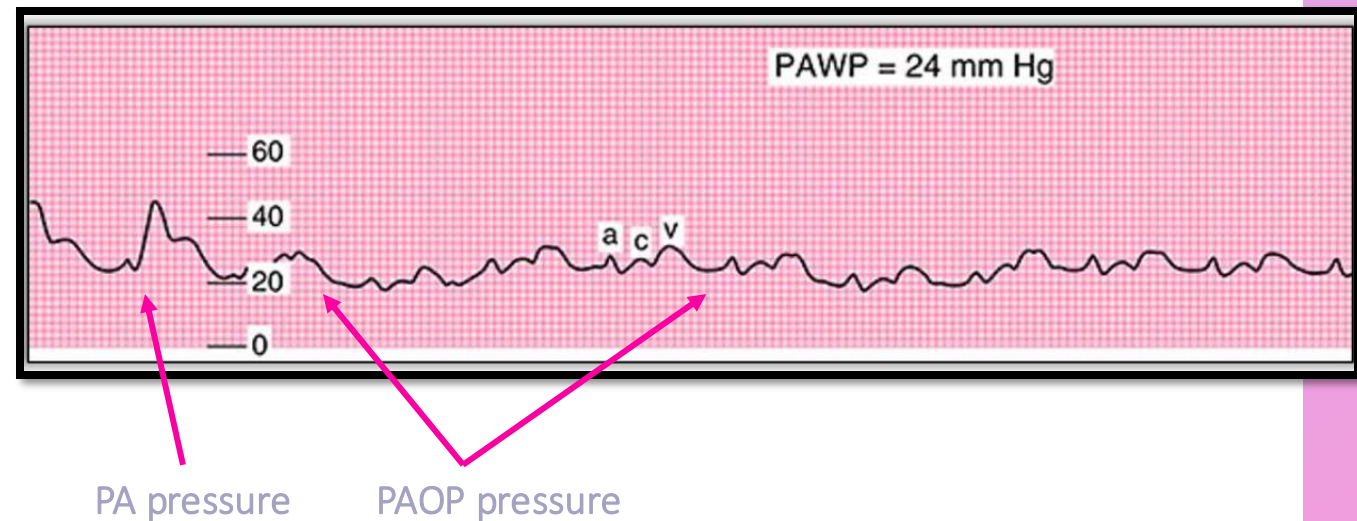
Pulmonary Artery Occlusion (wedge) Pressure

- Obtained from the PAC **DISTAL** lumen which terminates in the pulmonary artery
- Balloon momentarily wedges the catheter in a small PA branch to isolate blood flow
 - Pressure is transmitted from LA and reflective of LV filling pressure
- Patients are at **risk for PA rupture** when balloon is wedged → physicians/APPs ONLY can inflate balloon
 - PA balloon should be inflated for only 8-15 seconds
- PA pressure will change to a PAOP/PAW pressure
- Normal PAOP: 4-12 mmHg
 - PAOP is normally within 1-4 mmHg less than pulmonary artery diastolic → close correlation present, use PAD rather than PAOP procedure



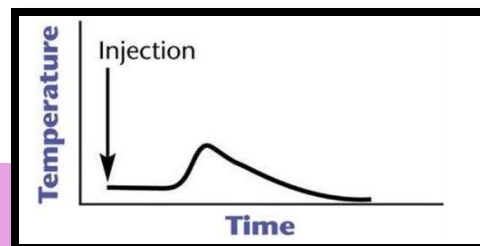
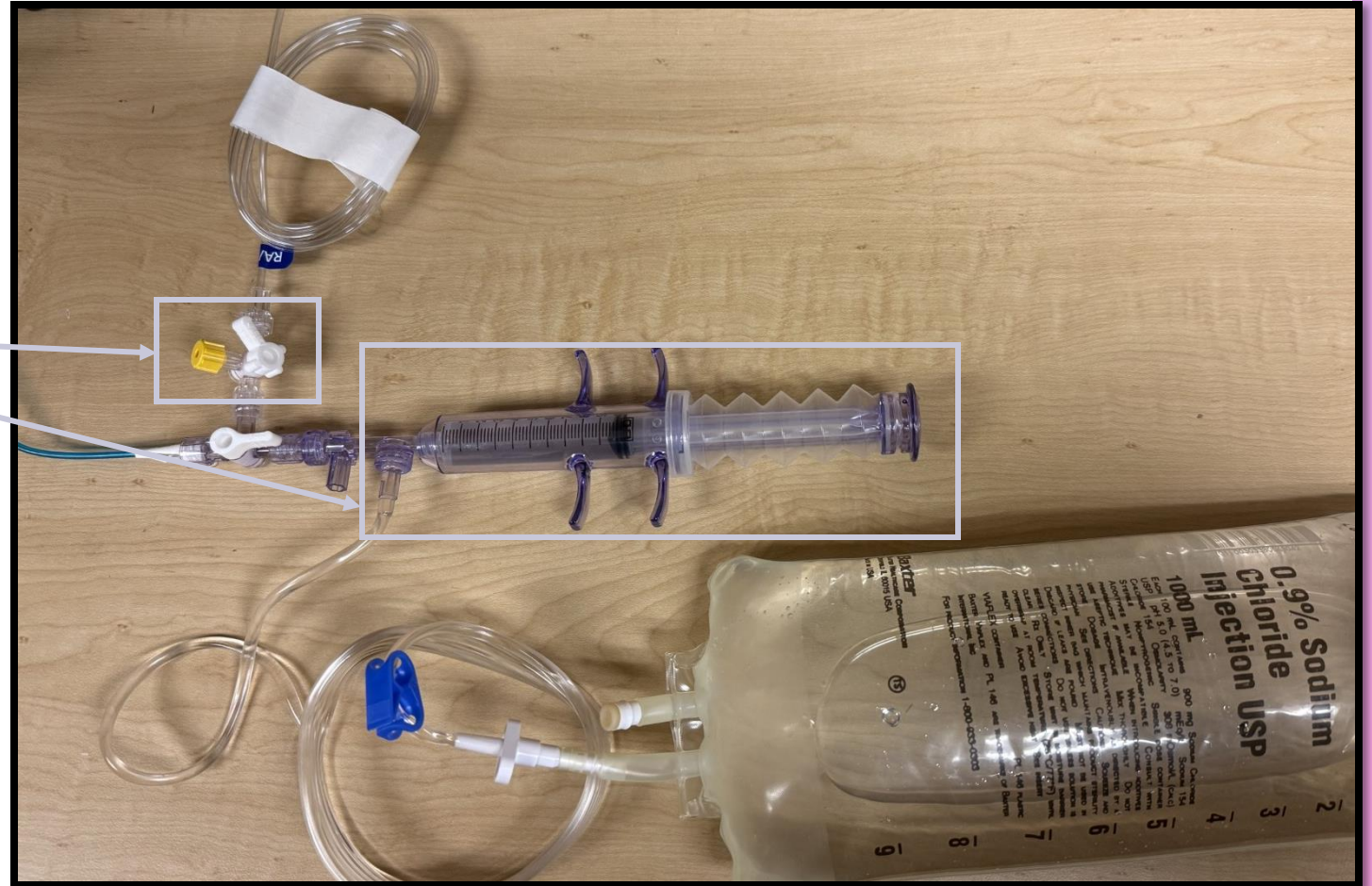
Pulmonary Artery Occlusion (wedge) Pressure: Troubleshooting

- Patients are at **risk for PA rupture** when balloon is wedged → physicians/APPs ONLY can inflate balloon
- Waveform elevates towards the systolic peaks and flattens; this means the balloon is over wedged
 - Needs to be deflated immediately
 - Ensure PA waveform returns
- PA waveform spontaneously changed to PAOP waveform
 - Immediately call for a physician/provider
 - Disconnect balloon syringe
 - Adjust patient position → shoulders back and ask to cough to help float catheter out of wedge position
 - Never flush a PAC when wedged



Cardiac Output: Thermodilution

- Room temperature injectate (normal saline) is injected into the right atrium via the **PROXIMAL** lumen
 - Consistent positioning of the patient is recommended for CO measuring (ex: HOB 30 degrees)
- Ensure CVP stopcock is turned to the “off” position
- Withdraw 10 mL of saline into the injectate syringe
- Turn injectate stopcock to “off” toward the CVP
- Wait for message on the monitor to inject solution
 - Tip: keep the catheter and syringe path as straight as possible
- Inject rapidly and smoothly, starting at the end of expiration
- Repeat up to 5 times (typically average the 3 with the best waveform) and document fluid in I&O
- Ensure CO is saved and turn stopcock to resume CVP monitoring



Waveform should look like this

Resources

- Abiomed, Inc. (n.d.). Heart recovery: Impella training modules [PowerPoint slides]. Abiomed.
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