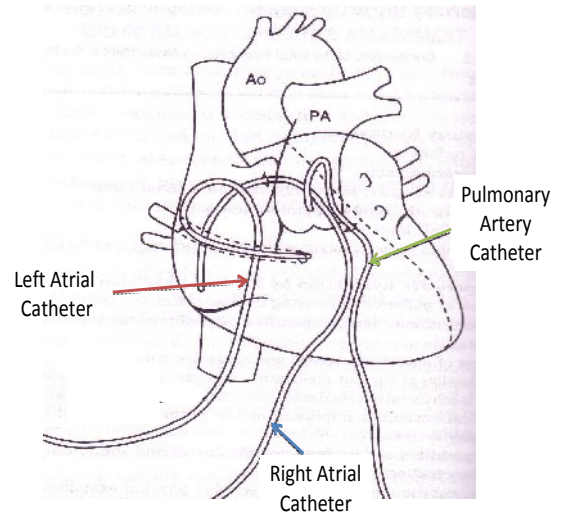


## Hemodynamic Monitoring

### TRANSTHORACIC LINES

#### A. General Guidelines

1. Label all lines carefully.
2. Secure all lines with occlusive transparent dressing, stress loop, and do not cover site.
3. All lines need to be continuously transduced with ALARMS ON.
4. All lines are zeroed at least once a shift and with position changes.
5. All lines should have either heparinized saline or D5W infusing.
6. Avoid infusing blood products through RA due to the potential of clots.
7. Observe for waveform changes; may indicate displacement into heart or wedging.
8. Notify CV surgery immediately if you are unable to withdraw blood from the line.
9. Never use LA for infusions or bolus medications.
10. Vigilant observation for AIR.



Roth, S. 1998

#### B. Line Removal

1. All lines are removed by CV surgery. Check tip to make sure there is no breakage in the catheter.
2. Check most recent coagulations (PT, PTT, INR, Platelets).
3. Ensure adequate IV access prior to removal.
4. Ensure patency of chest tubes.
5. Evaluate need for sedation/analgesia. Awake, active children may elevate pressures
6. Have blood at bedside in cooler, 6 cups of ice in bag per cooler, ensure sensor is on blood and sensor is not red. Change ice every 6 hours, checking temperature sensor on blood each time.
7. Blood can be kept at bedside, in ice cooler, with normal sensor, up to 24 hrs.
8. Do not return blood to BB until Hct is checked one hour post and no S & S of bleeding or tamponade.
9. Stay at bedside after removal, monitor for bleeding, tamponade (esp with PA, LA, RV lines).
10. Ensure patency of chest tubes.

### Cardiac Tamponade

#### Causes

1. Blood or fluid collects within the pericardium. This prevents the ventricles from expanding fully, so they cannot adequately fill or pump blood.
2. Often associated with pericarditis caused by bacterial or viral infections. Heart surgery, dissecting aortic aneurysm (thoracic), end-stage lung cancer, acute MI can lead to cardiac tamponade.

#### Signs

1. Tachycardia, tachypnea
2. Narrow pulse pressure

3. High atrial pressures
4. Bleeding (increased blood in chest tubes)
5. Neck veins distention
6. Faint heart sounds, and weak or absent peripheral pulses
7. Pulsus paradoxical effect when blood pressure falls with inhalation

**Cardiac Emergency:** In the event of possible cardiac tamponade, notify MD immediately and be prepared to follow emergent open chest procedure.

**RIGHT ATRIAL LINE – RA**

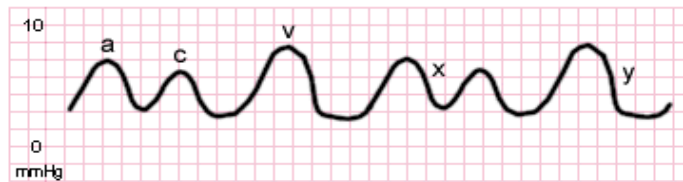
1. Measures pressure in RA, reflects preload or RVEDP
2. Indicates RV and tricuspid function
3. Normal range 1-6, large portion of CHD require higher pressures 5-10.
4. Catheter exits right side (medial to LA) of chest, usually double lumen.

Low RA Pressures

- dampened waveform
- hypovolemia
- vasodilatation

High RA Pressures

- pronounced a and v waves
- hypervolemia
- tamponade
- pericardial effusion
- PHTN
- RV dysfunction
- tricuspid regurg or stenosis



a wave	<ul style="list-style-type: none"> <li>■ Rise in pressure due to <i>atrial contraction</i>.</li> <li>■ a waves are larger in the presence of any resistance to RV filling, (tricuspid stenosis, RV failure, cardiac tamponade) because resistance will increase pressure as the atrium attempts to contract and eject blood.</li> </ul>
x descent	<ul style="list-style-type: none"> <li>■ Fall in pressure due to <i>atrial relaxation</i>.</li> </ul>
c wave	<ul style="list-style-type: none"> <li>■ Rise in pressure due to ventricular contraction and <i>bulging of the closed tricuspid valve</i>.</li> </ul>
v wave	<ul style="list-style-type: none"> <li>■ Rise in pressure during <i>atrial filling</i>.</li> </ul>
y descent	<ul style="list-style-type: none"> <li>■ Fall in pressure due to the opening of the tricuspid valve and the beginning of ventricular filling</li> </ul>

**LEFT ATRIAL LINE – LA**

1. Measures LAP, reflects preload or LVEDP
2. Indicates LV function, waveform indicates MV function

3. Normal range 5 – 10 (LAP = diastolic PAP)
4. Intracardiac or transthoracic catheter enters LA from R pulmonary vein or the L appendage, exits far right side of chest, single lumen.

#### Low LA Pressures

- hypovolemia
- vasodilatation

#### High LA Pressures

- hypervolemia
- LV dysfunction
- tamponade
- pericardial effusion
- MV stenosis or insufficiency
- atrial stenosis
- loss of AV conduction

### **COMMON ATRIAL LINE – CA**

1. Monitors preload and ventricular function in single ventricle physiology
2. Indicates AV valve function and cardiac rhythm
3. Intracardiac placed in common atrium
4. Catheter exits R side of chest usually double lumen
5. Normal range 5 – 8
6. Low CA Pressures: hypovolemia
7. High CA Pressures: increased ventricular load, poor ventricular function

### **PULMONARY ARTER LINE – PA**

1. Measures pulmonary pressures, reflects PVR and venous pressure in lungs
2. Indicates RV function and RVOT patency
3. Can measure mixed venous saturation
4. Reflects LA filling pressures
5. Determines gradient on removal between RV and PA
6. PAP Mean determines afterload for RV
7. Unifocalizations use RV lines to monitor systolic force on anastomoses and sutures, assess RV function, do NOT reflect PVR
8. Can be transthoracic inserted via RA or RV, through RVOT and PA into the RPA or LPA
9. Exits L side of chest, single lumen, may be fiberoptic connection
10. Normal range: 15-25/ 8-10, higher in neonates

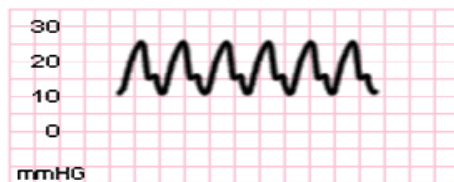
#### Low PA Pressures

- Vasodilators

#### High PA Pressures

- hypervolemia
- ↑ PVR (pulm disease, PHTN, hypoxia, PE)
- ↑ pulm venous press (MV failure, LV failure)
- ↑ PBF (Intracardiac shunts L-R)

PA Waveform:



Hemodynamic Monitoring

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