Right Heart Catheterization

**PA Catheter or Swan Ganz Catheter**
- A 120-cm long, multilumen, balloon-tipped catheter. Usually 7.5 fr.
- Connected to a pressure transducer and temperature sensor.
- Inserted through a central venous line (RJ, J subclavian, femoral vein).
- Appropriate flushing, leveling and zeroing at Phlebostasis axis (Mid axillary line x 4th ICS)
- Time the wave with the ECG. Pressure waveforms are slightly delay after ECG.
- Waveforms rise and fall due to a blood volume or myocardial fiber tension (ie. chamber size)
- Use all numbers together and observed changes or trends, not just the absolute number.
- Go beyond the number
- Waveforms rise and fall
- Time the wave with the ECG.
- Appropriate flush
- Insert

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### Right atrium

- RA (6 mmHg)
- Venous waveform (2 up, 2 down per cardiac cycle)
  - A: Atrial systole
  - B: Increased in RV infarct, PS, PE, Pul HTN
  - C: Giant Cannon a waves in A-V dissociation, 3’AV block, VT
  - X: atrial relaxation

- RA (6 mmHg)
- Venous waveform followed by a rapid downstroke. Rising during diastole

- RV (24/6 mmHg)
- Rapid upstroke followed by a rapid downstroke. Rising during diastole

- PA (24/12 mmHg)
- Rapid upstroke with dicrotic notch on down slope, down rending during diastole

- PCWP (12 mmHg)
- Venous waveform
- PCWP is assume to be equal to LA and LVEDP

#### Complication

- **Misinterpreted data:** wrong data is worse than no data
- **Insertion:** complication of vasc access, arterial puncture, pneumo/hemothorax, air embolism, ventricular arrhythmias, RBBB (3’ AV block in preexisting LBBB, knoting
- **Maintenance:** PA rupture, pul infarct, infection, thrombus formation. Do not over wedge.

#### Pressures:
- All pressures (mmHg) are directly measured.
- Measure at an end expiration. High point in patient with spontaneous breathing.
- Subtract 1/2 PEEP from the values.

#### Flow:

- Cardiac output (CO, L/min) are commonly indirectly “measured” by

<table>
<thead>
<tr>
<th>Parameter and relations</th>
<th>Normal value and unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V = 1R</td>
<td>Δ BP = CO x SVR</td>
</tr>
<tr>
<td>CO</td>
<td>= 5 L/min</td>
</tr>
<tr>
<td>BSA</td>
<td>= 2 m2</td>
</tr>
<tr>
<td>CI = CO</td>
<td>= 2.5 L/min/m2</td>
</tr>
<tr>
<td>HR</td>
<td>= 70 bpm</td>
</tr>
<tr>
<td>SV = CO</td>
<td>= 70 ml/beat</td>
</tr>
<tr>
<td>SVI = SV x BSA</td>
<td>= 35 ml/beat/m2</td>
</tr>
<tr>
<td>SVR = (MAP – CVP) x 80</td>
<td>= 1300 dynes/sec/cm5</td>
</tr>
<tr>
<td>PVR = (mPA – PCWP)</td>
<td>= 1 wood unit</td>
</tr>
<tr>
<td>PTPG</td>
<td>= 5 mmHg</td>
</tr>
<tr>
<td>PAd</td>
<td>= 120/80 mmHg</td>
</tr>
<tr>
<td>A 02sat</td>
<td>= 95–100 %</td>
</tr>
<tr>
<td>Mixed V 02sat</td>
<td>= 75 %</td>
</tr>
<tr>
<td>A–V 02 content difference</td>
<td>= 20 – 15 = 5 ml/dL</td>
</tr>
<tr>
<td>EF = LVEDV/LVESV</td>
<td>LVEDV</td>
</tr>
<tr>
<td>LSVSWI = SVI x (MAP-PCWP) x 0.0136 = 50 – 62 g/m2/beat</td>
<td></td>
</tr>
<tr>
<td>RVSWI = SVI x (mPA-CVP) x 0.0136 = 5–10 g/m2/beat</td>
<td></td>
</tr>
</tbody>
</table>

#### Hemodynamics: Know the unit, understand the relations (formula)

- **CO by thermodilution:**
  - Indicator dilution method
  - Injecting known amount and temp of fluid to a proximal port and measure Δ temp at distal port. Reverse area under the curve to calculate CO
  - Log in

- **CO by Fick:**
  - Constant of mass. “Gold standard”
  - Calculated CO from product of O2 contents and extraction. Need to know SaO2, MvO2sat, Hb.
  - CO = O2 consumption / A-V O2 difference
  - 10 x 1.34Hb(SaO2 – MvO2sat)
  - Limit in shunt
  - Most cath lab use assumed VO2 ➔ inaccurate assumption of VO2 (circ 2014;129:203)

#### Shunt Study “Sat run”:

- O2 saturations were measured from multiple site of the heart.
- A step-up in O2sat of >7% (RA level), 5% (RV or PA level) indicate left to right shunt.
- Inpatient with shunt
  - CO by TD is inaccurate when there is a shunt
  - CO by Fick need to use calculated mixed venous sat

- **Shunt calculation**
  - MvO2Sat = [LSVC + LVC] / 4
  - Qs = (O2 consumption) / (13.4 x Hgb x (AO2 - MvO2sat))
  - Qp = (O2 consumption) / (13.4 x Hgb x (PVO2 - PAO2sat))
  - Simplified Qp/Qs = (AO2 – MvO2sat) / (PVO2 – PAO2sat)