Left And Right Heart Cath

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Overview

• Right and left heart cath is a procedure where a catheter is inserted into the cardiac chambers and vessels percutaneously.
• Pressure and saturation of each chambers and vessels were usually taken to obtain the diagnosis.
• Angiography is frequently being done to visualize the anatomical structure of the heart and vessels. It may also be used to assess the cardiac function and regurgitation severity.
Indications of Cardiac Cath

• To confirm the presence of clinically suspected condition.
• To define the anatomical and physiological severity of the diseases.
• To determine the presence of associated condition or complication.
• As a routine pre op assessment esp. for elderly patient.
Contraindications

- Absolute contraindications.
  - the refusal of a mentally competent patient to consent the procedure.
  - Incomplete equipments and cath facility.
• **Relative contraindications**
  – Uncontrolled CCF, Hypertension, Arrhythmias.
  – Recent cerebral vascular accident (CVA <1 month).
  – Infection/ fever.
  – Electrolyte imbalance.
  – Acute gastrointestinal bleeding or anemia.
  – On anticoagulation.
  – Pregnancy.
  – Uncooperative patient.
  – Medication intoxication (e.g., digitalis, phenothiazone)
  – Renal failure.
Risk of Complications

• Listed below are the percentage of complication of cardiac catheterization in current era (not including intervention)*
  – Death <0.2%
  – AMI <0.5%
  – Stroke <0.07%
  – Serious Ventricular Arrhythmias <0.5%

Predisposing factors for higher risk of complications

- Known or suspected Left main coronary stenosis
- Severe aortic stenosis
- Severe CCF
- LV dysfunction (EF<35%)
- Diabetes
- Advance age
- Unstable angina
- AMI
- Aortic aneurysm
- Prior CVA
- Renal Impairment
- Uncontrolled hypertension
- Obesity
- Newborn baby
List of Complications of Cardiac Catheterization

- Death
- AMI
- CVA
- Serious arrhythmias.
  - VT, VF, AF, SVT, CHB* & Asystole.
- Vascular injury
  - Hemorrhage (local, retroperitoneal & pelvic), pseudo aneurysm, thrombosis /air embolism, aortic dissection.
- Cardiac Perforation, tamponade.
- Contras reaction /anaphylaxis / nephrotoxicity.
- Infection.
- Vasovagal reaction.
- CCF.

* Take home note beware of patient with LBBB, be prepared for temporary pacemaker insertion when doing Right Heart Cath. It may develop CHB & Asystol
Classification of Complications

• Minor Complication
  – Vascular injury
  – Allergic reaction
  – Bleeding
  – Haematoma

• Major Complication
  – Stroke
  – Death
  – Myocardial Infarction
Defining The Mid Chest Level (Phlebostatic axis)

- Improper leveling will cause erroneous to the pressure measurement, 10cm high or low will cause 7.4mmHg error lower or higher.
- Mid axillary line and 4th intercostals space.
Hemodynamic
Atrial Pressure Waveform

- RA, CVP, LA and PCW, known as sine wave.
- To be reported as A, V, and Mean.
- Normal Mean RA = 2-6 mmHg.
Getting the mean Atrial pressure

- Mean atrial pressure also known as mean ‘a’ wave.
- Equal to ventricular end diastolic pressure.
- Half way between ‘a’ and “x”
Arterial Pressure Waveform.

- AO and PA, triangular in shape.
- To be read as systolic, diastolic and mean.
Ventricular Pressure Waveform

- Known as square or rectangular wave.
- To be read as Systole and EDP,
- no mean pressure.
<table>
<thead>
<tr>
<th>Normal Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RA and CVP</strong></td>
</tr>
</tbody>
</table>
| **Right Ventricle** | Systolic 15 – 30 mmHg  
End Diastolic 1–7mmHg |
| **Pulmonary Artery** | Systolic 15-30 mmHg  
Diastolic 4-12mmHg  
Mean 9-19mmHg |
| **LA and PCW**  | Mean 4-12mmHg |
| **Left Ventricle** | Systolic 90-140mmHg  
End Diastolic 4-12mmHg |
| **Aorta**  | Systolic 90-140mmHg  
Diastolic 60-90mmHg  
Mean 70-105mmHg |
Pressure Curve

ECG

AV opens
Aorta

MV closes

LV

MV opens

LA

S_1

S_2

DIASTOLE

SYSTOLE

DIASTOLE

SYSTOLE

DIASTOLE
Saturations

Normal Range

- Right heart saturation – 65% - 75%
- Left Heart Saturation – 97% - 100%
# Normal Saturation

<table>
<thead>
<tr>
<th>Chambers</th>
<th>Saturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vena Cava (IVC &amp; SVC)</td>
<td>65% - 75%*</td>
</tr>
<tr>
<td>Right Atrium</td>
<td>65% - 75%*</td>
</tr>
<tr>
<td>Right Ventricle</td>
<td>Reduce by 3%-4% of RA *</td>
</tr>
<tr>
<td>Pulmonary Artery</td>
<td>Same as RV*</td>
</tr>
<tr>
<td>Pulmonary Veins and Left Atrium</td>
<td>97%-100%*</td>
</tr>
<tr>
<td>Left Ventricle and Aorta</td>
<td>Same as LA, but may be reduced by 2%-3%*</td>
</tr>
</tbody>
</table>

### Significant step-up chart

<table>
<thead>
<tr>
<th>Level of Shunt</th>
<th>Criteria for Significant Step-Up</th>
<th>Approximate Minimal $Q_p/Q_s$ Required for Detection (Assuming $SBFI = 3 l/min/m^2$)</th>
<th>Possible Causes of Step-Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial (SVC/IVC to RA)</td>
<td>$0_2% \text{ Sat} \geq 7$</td>
<td>$1.5 - 1.9$</td>
<td>Atrial septal defect; partial anomalous pulmonary venous drainage; ruptured sinus of Valsalva; VSD with TR; coronary fistula to RA</td>
</tr>
<tr>
<td></td>
<td>$0_2% \text{ Vol} % \geq 1.3$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$0_2% \text{ Sat} \geq 11$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$0_2% \text{ Vol} % \geq 2.0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventricular (RA to RV)</td>
<td>$\geq 5$</td>
<td>$1.3 - 1.5$</td>
<td>VSD; PDA with PR; primum ASD; coronary fistula to RV</td>
</tr>
<tr>
<td></td>
<td>$\geq 1.0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 10$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 1.7$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great vessel (RV to PA)</td>
<td>$\geq 5$</td>
<td>$1.3$</td>
<td>PDA; aorta-pulmonic window; aberrant coronary artery origin</td>
</tr>
<tr>
<td></td>
<td>$\geq 1.0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 5$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 1.0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any level (SVC to PA)</td>
<td>$\geq 7$</td>
<td>$1.5$</td>
<td>All of the above</td>
</tr>
<tr>
<td></td>
<td>$\geq 1.3$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 8$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\geq 1.5$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SVC and IVC, superior and inferior vena cavae; RA, right atrium; RV, right ventricle; PA, pulmonary artery; VSD, ventricular septal defect; TR, tricuspid regurgitation; PDA, patent ductus arteriosus; PR, pulmonic regurgitation; ASD, atrial septal defect; SBFI, systemic blood flow index; $Q_p/Q_s$, pulmonary to systemic flow ratio.

Shunt Calculation

- Shunt Calculation, QP/QS = \( \frac{A_{\text{O}}_{\text{sat}} - M_{\text{V}}_{\text{sat}}}{P_{\text{V}}_{\text{sat}} - P_{\text{A}}_{\text{sat}}} \)
  
  (normal QP/QS = 1)

- Resting mix venous (MV), calculation = \( \frac{(3S_{\text{VC}} + 1I_{\text{VC}})}{4} \)

- Some authors use SVC alone as Mix venous.

Cardiac Output and Cardiac Index

- Cardiac output is the amount of blood ejected from the ventricle in one minute.
- Two components multiply to make the cardiac output: heart rate and stroke volume (amount of blood ejected with each contraction).
- Normal range (resting): 4.5-8L/M. Varies very much with the position and activities.

- Cardiac index is the cardiac output adjusted for body surface area (BSA).
- Normal average cardiac Index: **3.5/L/min/M2**
Vascular resistance

• Is the resistance offered by blood vessels against the flow of the blood.
• Vascular resistance can be reported in 2 different units,
  1. Wood units = Hybrid resistance units (HRU) = mmHg/L/min.
  2. Absolute units = Dyne sec cm⁻⁵ = (Wood units × 80).
    - Normal value
      - SVR/ PVR = 12:1
    - Normal range
      1. SVR = 10 – 20 Wood unit*
      2. PVR = 0.6 -1 Wood unit*
      * Todd CV
Calculation Formula

• PVR calculation = \[ \text{Mean PA} - \text{Mean LA} \]
  
  QP (Pulmonary blood flow)
  
  QP Calculation = \[ \frac{O_2 \text{ consumption}}{(\text{LA Sat.} - \text{PA Sat.}) \times 1.36 \times \text{Hgb} \times 10} \]

• SVR calculation = \[ \text{Mean AO} - \text{Mean RA} \]
  
  QS (Systemic blood flow)
  
  QS calculation = \[ \frac{O_2 \text{ consumption}}{(\text{SA Sat.} - \text{MV Sat.}) \times 1.36 \times \text{Hgb} \times 10} \]
Data interpretations
What is the most possible diagnosis?

ASD L to R

99-71 = 28 = 2
99-85 14
QP/QS = 2
What is the most possible diagnosis?

PDA with Lt. to Rt. Shunt
QP/QS = 2.5
What is the most possible diagnosis?

ASD with Rt. To Lt. Shunt
Qp/Qs = 0.5
Pressure Data Interpretations
Diagnosis?

Aortic Valve Stenosis
- LV to AO pullback

HOCM
Diagnosis?
Supra systemic RV pressure
Diseases Pattern

1. 

LV
AO

2. 

LV
AO

3. 

LV
PAW

4. 

LV
PAW
Pulse Types

1. Pulsus tardus - AS
2. Corrigan's Pulse - AR
3. Bisferiens Pulse - HOCM
4. Pulsus Alternans - CHF
5. Pulsus Bigeminus - Bigeminy
Angiogram
SUMMARY

• Cardiac catheterization is a very important diagnostic tool in cardiology, nevertheless it is not without risk.

• There are many information can be obtained such as hemodynamic characteristic, shunt flow, vascular resistance and angiograpical morphology. It also can offer therapeutic interventions at the same sitting. All of these have made cardiac catheterization much more superior than the other diagnostic modalities.