RIGHT HEART CATHETERIZATION

BASICS OF PRESSURES, GRADIENTS AND INDICES

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PULMONARY VASCULAR RESISTANCE

\[ \text{PVR} = \frac{\text{meanPAP} - \text{PCWP}}{\text{CO}} \]

- PVR is the recommended parameter for differentiating subtypes of PH (preferred over Trans-Pulmonary Gradient, TPG*, and Diastolic Pulmonary Gradient, DPG**).
- PH (mean PAP>20) subtypes are identified based on PVR & PCWP:
  - PVR ≥ 3: Combined Pre-capillary PH (CpcPH)
  - PVR < 3: Isolated Post-capillary PH (IpPH)

\[
\begin{array}{c|c|c|c}
\text{PCWP} & \geq 15 & < 15 \\
\text{PVR} & \geq 3 & \text{WU}^* & \text{WU}^* \\
\text{WU}^* & \text{Combined Pre-capillary PH (CpcPH)} & \text{Isolated Pre-capillary PH} & \\
\text{PVR} & < 3 & \text{WU}^* & \text{Consider high flow state} \\
\end{array}
\]

PULMONARY ARTERY PULSATILITY INDEX (PAPI)

\[ \text{PAPI} = \frac{sPAP - dPAP}{RPA} \]

- PAPI ≤ 0.9 predicts RV failure and in-hospital mortality in inferior MI.
- PAPI < 1.85 predicts RV failure in patients with LVADs.

RAP/PCWP RATIO

- A ↑ RA/PCWP correlates with RV dysfunction. e.g., RA/PCWP > 0.8 indicates RV dysfunction in patients with cardiogenic shock.
- RA/PCWP > 0.54 (EUROMACS) / >0.63 (Kormos et al.) predicted RV dysfunction in patients with LVADs.

\[
\begin{align*}
\text{TPG} &= \text{mPAP} - \text{PCWP} \\
\text{DPG} &= \text{dPAP} - \text{PCWP} \\
\text{†} &= \text{Differentiation of subtypes may also require provocative testing} \\
\text{‡} &= 1 \text{ WU} = 80 \text{ dynes-sec/cm}^2
\end{align*}
\]

CARDIAC POWER OUTPUT (CPO)

\[ \text{CPO} = \frac{\text{MAP} \times \text{CO}}{451} \]

- Reflects hydraulic energy delivered by the LV.
- CPO of <0.6 was the strongest independent hemodynamic correlate in the SHOCK trial registry for in-hospital mortality in patients with cardiogenic shock.

LV TRANSMURAL FILLING PRESSURE

\[ \text{LV Filling Pressure} = \text{PCWP} - \text{RAP} \]

- Reflects the pressure difference between the LV and its external forces, and influences LV filling.
- Increases in RAP or pericardial pressure can reduce LV filling, stroke volume, and forward flow. e.g., PE, right heart failure.

CARDIAC OUTPUT (CO, N: 4 – 8 l/min)

\[ \text{CARDIAC INDEX (CI, N: 2.5 – 4 l/min/m}^2 = \frac{\text{CO}}{\text{BSA}} \]

- Shock + CI <2.2 usually indicates a “COLD” profile.
- Bedside clue to a low CI: The proportional pulse pressure ((SBP-DBP)/SBP) of less than 25% suggests a cardiac index of less than 2.2 L/min/m².

THERMODILUTION (TD)

Principle: washout of a temperature change induced by injection of a defined fluid volume cooler than the body temperature. The faster the circulation or flow (↑ cardiac output), the quicker the neutralization of the temperature change.

\[ \text{TD is EASY to perform (compared to Direct Fick) but technique-dependent} \]
\[ \text{Less accurate in patients with irregular rhythms.} \]
\[ \text{Was previously thought to be less accurate in severe TR and extremes of CO. However, studies have shown good correlation between TD and Direct Fick in severe TR and extremes of CO.} \]

DO NOT FORGET: the measured pressures also provide valuable clinical information. e.g., Central Venous Pressure (CVP) was shown as one of the predictors of SCAI profile and mortality in the Cardiogenic Shock Working Group registry.