Hemodynamics and the Evaluation of Shock

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Objectives

• To review basic circulatory system physiology
• To relate types of shock to hemodynamics
• To pass your PBA!

Shock

• Abnormal perfusion
• Low blood pressure
• Multiple causes
  – Etiology often unclear
  – Therapies directed at causes
• Diagnostics important
My View of the Circulatory System

Teens-20’s/0-5

RA  RV  PA
CVP

LV  LA  PV
BP 8-12

Teens-20’s/10-12
Why Can I Reliably Measure Left Atrial Pressure From the Right Side?

Measure Wedge at End-Expiration

- Spontaneous Breathing: Top of the Curve
- Mechanical Ventilator: Bottom of the Curve

Tracings

- Remember the jugular venous pulse?
- The same thing happens in the wedge position; however this time we are seeing left atrial waveforms
- Abnormalities need to be recognized
PAOP (Wedge) With Same Characteristics as the Jugular Venous Pulse

Wedge Tracing Varies Depending on the Scale Used

Waveforms often change in pathologic states
Cardiac Output

- Thermodilution Method
- Area Under the Curve
  - Calculus
- Cardiac Output (Normal 5 Liters/min)
- Cardiac Index = CO/BSA
  - “Pound for pound” assessment
  - Normal > 2.5

General Formula for Resistance?

Systemic Vascular Resistance
\[ \frac{\text{MAP-CVP}}{\text{CO}} \times 80 \] (WU) Dyn/sec/cm²

It’s a fraction!!!!!

Pulmonary Vascular Resistance
\[ \frac{\text{MPAP-PAOP}}{\text{CO}} \times 80 \] (WU) Dyn/sec/cm²
What is This?

<table>
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<tr>
<th>CVP</th>
<th>RV</th>
<th>PA</th>
<th>PAOP</th>
<th>CI</th>
<th>BP</th>
<th>SVR</th>
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<td>4</td>
<td>24/3</td>
<td>22/12</td>
<td>11</td>
<td>3.5</td>
<td>110/70</td>
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Shock Eval with PA Catheter

- Start at the left atrium and work backward
- Make sure the numbers make sense
  - PAP 30/15; PAOP 25 cannot happen
- Make your hemodynamic diagnosis, then relate it to the clinical scenario
- Look at tracings carefully
- Where pressures go from low to high is usually where the problem is
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<td>40/25</td>
<td>4</td>
<td>1.6</td>
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RA
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PA
CVP
PV
LV
LA
BP
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Hemodynamic Summary

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Types of Shock

- I. Hypovolemic
  - Bleeding
  - Dehydration
  - Etc.
- II. Cardiogenic
  - ACS
  - Valvular
  - Cardiomyopathy
  - Etc.
- III. Extracardiac
  - Obstructive
  - Palm Embolism
  - Cardiac Tamponade
- IV. Distributive
  - Sepsis
  - Etc.
Causes of Distributive Physiology

- Sepsis
- Trauma
- Burns
- Aspiration
- Pancreatitis
- Inhalation Injury
- Neuro Trauma
- Cirrhosis
- Paget’s Disease
- Beri-Beri
- Thyroid Storm
- Toxodromes
- Ovarian Hyperstim

Summary

- Diagnose early!
  - Clinical judgment is important
- Early goal-directed therapy
- For PA Cath
  - Start at left atrium and work backward
  - Remember the bra analogy
- Good Luck With Your PBA!