• 80 y/o male presents with 2 day history of general malaise
• BP 95/45, RR 18, HR 85, SpO2 100% RA

• With use of bedside ultrasound you will evaluate the patient for emergent causes of hypotension.
EARLY GOAL DIRECTED THERAPY

- Supplemental oxygen ± endotracheal intubation and mechanical ventilation
- Central venous oximetry catheter and continuous arterial pressure monitoring
- Sedation, paralysis (if intubated), or both
  - **CVP**
    - $< 8\text{ mm Hg}$
    - 8-12 mm Hg
    - $\geq 65\text{ mm Hg}$ $\leq 90\text{ mm Hg}$
  - **MAP**
    - $< 65\text{ mm Hg}$ $> 90\text{ mm Hg}$
  - **ScvO}_2$
    - $< 70\%$
    - $\geq 70\%$
    - $\geq 70\%$
- Goals Achieved
  - Yes: Hospital Admission
  - No: Vasoactive Agents
  - Crystalloid
  - Colloid
  - Transfusion of red cells until hematocrit ≥ 30%
  - Inotrope Agents

**Ultrasound**
WHAT ABOUT LV FUNCTION?
DETERMINATION OF LEFT VENTRICULAR FUNCTION BY EMERGENCY PHYSICIAN ECHOCARDIOGRAPHY OF HYPOTENSIVE PATIENTS.

- Prospective, observational study
  - 51 adult patients with symptomatic hypotension
- LVF categorized
  - normal (> 55%)
  - depressed (25-55%)
  - severely depressed (< 25%)
- 84% agreement with cardiologist
- Kappa 0.86 b/w EP and cards
  - Kappa 0.84 b/w cardiologists

Moore, C et al. Acad Emerg Med 2002;
IS MY HYPOTENSIVE PATIENT VOLUME DEPLETED?
IS MY HYPOTENSIVE PATIENT VOLUME DEPLETED?
USING M-MODE TO MEASURE CAVAL INDEX AT RA AND IVC JUNCTION
“SNIFF TEST” MEASURE CAVAL INDEX DURING INSPIRATION AND EXPIRATION
Have patient sniff and measure greatest and smallest distance; This represents max and min diameter of IVC, difference is “caval index”
## IS MY HYPOTENSIVE PATIENT VOLUME DEPLETED?

<table>
<thead>
<tr>
<th>IVC measurement</th>
<th>% IVC collapse during inspiration</th>
<th>Estimated central venous pressure (CVP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1.5cm</td>
<td>&gt; 50%</td>
<td>0 – 5mm Hg</td>
</tr>
<tr>
<td>1.5 – 2.5cm</td>
<td>&gt; 50%</td>
<td>5 -10 mm Hg</td>
</tr>
<tr>
<td>1.5 – 2.5cm</td>
<td>&lt; 50%</td>
<td>10 – 15 mm Hg</td>
</tr>
<tr>
<td>&gt; 2.5cm</td>
<td>Little</td>
<td>15 – 20+ mm Hg</td>
</tr>
</tbody>
</table>

Adapted from Jones Handbook of Ultrasound in Trauma and Critical Care Illness, 2003.
IS MY HYPOTENSIVE PATIENT VOLUME DEPLETED?

<table>
<thead>
<tr>
<th>IVC</th>
<th>cm</th>
<th>insp collapse</th>
<th>CVP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probably needs fluid load</td>
<td>&lt; 1.5</td>
<td>Complete</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Possible Right Heart Failure</td>
<td>&gt;2.5</td>
<td>No Collapse</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>


NONINVASIVE ESTIMATION OF RIGHT ATRIAL PRESSURE FROM THE INSPIRATORY COLLAPSE OF THE INFERIOR VENA CAVA.

“Caval Index” (% collapse with inspiration)

- < 20%
  - 38% sensitive, 100% specific for RAP > 10
- > 80%
  - 98% sensitive, 14% specific for RAP < 10

INTENSIVIST USE OF US TO MEASURE IVC COLLAPSIBILITY IN ESTIMATING INTRAVASCULAR VOLUME STATUS: CORRELATIONS WITH CVP

- IVC exams performed by intensivists
  - 3 hours of didactics
  - 25+ proctored exams
  - Compared to invasive CVP catheters
- Best correlation with low and high collapsibility ranges
  - Correlation was significant in all three ranges measured (<20%, 20-60%, >60%)

A COMPARISON BY MEDICINE RESIDENTS OF PHYSICAL EXAMINATION VERSUS ULTRASOUND FOR ESTIMATION OF RIGHT ATRIAL PRESSURE.

- Limited training session
  - 4 hours didactic
  - 20 bedside exams
- 40 patients had RA Pressure estimated
  - Ultrasound 90% accurate
  - JVD 63% accurate
  - Cardiac cath performed within 1 hour of exam as gold standard

Brennan et al. Amer J Card 2007
CHANGES IN CARDIAC FUNCTION DUE TO SEPSIS

A. Decrease in volume due to third spacing
   (*Improve by volume resuscitating*)

B. Decrease in contractility, decrease SV, CO
   (*Improve with pressors*)