Judging Adequacy of Volume Resuscitation

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Disclosure / Conflict of Interest

• No Conflict of Interest with respect to this presentation.
The Problem

Typical resuscitation: VASST

ProCESS, ARISE, ProMISe

No EGDT. Oh no! What do we do now?

Approach to fluid resuscitation?
New century, new tools
Subcostal view
Do we know anything?

Septic Shock Early Treatment

- Antibiotics

- Initial fluid resuscitation
  - Which fluid?
  - How much?
  - How do you assess?
  - Vasopressors as part of volume resuscitation

Kumar A et al CCM, 34:1589-1596, 2006
Which Fluid?

Bayer et al.  
*Crit Care Med.*  
40:2543, 2012
New “Early Goal Directed Therapy”
More than one way to skin a cat?

• Is fluid resuscitation adequate?
  – Old: CVP 8-12.
  – New: Fluid responsive. Best approaches?
  – Is more fluid necessary? Organ function.

• Is mean arterial pressure adequate?
  – MAP $\geq$ 65 mmHg. Organ function.

• Is oxygen delivery adequate?
  – Old: $S_{CVo_2} \geq 70\%$
  – New: lactate clearance $> 10\%$ in 6h, Organ function.
Volume Resuscitation

• More than just filling up the tank

Skeletal muscle
Quantum dot angiogram
Control
Microvasculature disrupted in sepsis

Skeletal Muscle Quantum Dot Angiogram 5 hours after LPS infusion
Early volume resuscitation decreases edema formation!

Tissue oxygenation improves (4h)

Organ function improves
Cardiomyocyte function

Fluid resuscitation is good
But how do we judge too little, too much?

Potential problem with too much fluid

Assessing fluid responsiveness

CO > 10-15%, ↑PP > 12-15%

• CVP
  – < 8, Likelihood ratio 2.6 [95% CI 1.4-4.6]
  – > 8, LR 0.50 [0.39-0.65] STOP

• Pulse Pressure Variation > 4-15% (12%)
  – LR 7.9 [4.1-16]
  – LR 0.30 [0.21-0.44] STOP

Vena caval diameter variation

Control ventilation

>15% LR 5.3 [1.1-27]

<15% LR 0.27 [0.08-0.87] STOP

Passive leg raise
Ventilated or spontaneously breathing

>15%  LR  11  [95% CI, 7.6-17]
<15%  LR  0.13  [95% CI, 0.07-0.22]  STOP

Vasopressors

- Vasopressors are also venoconstrictors
- Increase venous return
- Differentially affect the micro-vasculature
Resuscitation
Questions to ask and answer

• Is fluid resuscitation adequate?
  – Old: CVP 8-12.
  – Is more CO necessary? Organ function.

• Is mean arterial pressure adequate?
  – MAP ≥ 65 mmHg. Organ function.

• Is oxygen delivery adequate?
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