Septic Shock

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Goals:

1) Understand the epidemiology of shock and how the to categorize of inflammatory response
2) Understand the general clinical approach to treating septic shock
3) Familiarize yourself with the nuance involved in septic shock resuscitation

Shock: Definition

• “Rude unhinging of the machinery of life”
• Inadequate delivery of oxygen and nutrients

Shock: Epidemiology

Systemic Inflammatory Response Syndrome (SIRS)

1) Temperature: < 96.8°F or > 100.4°F
2) Heart Rate: > 90 beats/min
3) Respiratory Rate: > 20 resp/min or PaCO₂ < 32mmHg
4) WBC: < 4.0/L or > 12.0/L or >10% bands
SIRS Classifications

1) SIRS (≥ 2 criteria)
2) Sepsis (SIRS + source)
3) Severe Sepsis (Sepsis + organ dysfunction)
4) Septic Shock (hypotension refractory to IV fluid resuscitation)

Take Home #1

- Septic Shock is the most common cause of shock
- SIRS criteria are used to categorize the severity of the inflammatory response
- Presence of SIRS criteria does not confirm infection
- Absence of SIRS does not rule out septic shock
Severe Sepsis/Septic Shock

A little history: Early Goal Directed Therapy

Invasive Interventions

Correct vasomotor tone

Volume Expansion

Monitor for continued delivery deficits
Take Home #2

- Early aggressive treatment of septic shock has become the standard of care
- Care involves stabilization, volume expansion, vasomotor support and continued monitoring of tissue perfusion

Severe Sepsis/Septic Shock

EGDT: guidelines not rules to live by

Original Article
A Randomized Trial of Protocol-Based Care for Early Septic Shock
The ProCESS Investigators

Original Article
Goal-Directed Resuscitation for Patients with Early Septic Shock
The ARISE Investigators and the ARISE Clinical Trials Group

ProCESS and ARISE: what now?
1. Early identification and antibiotic administration
2. Volume expansion with IVF
   CVP
   IVC ultrasound
   Lactate
3. Vasopressors
4. Continued monitoring
   Lactate Clearance
   ScvO₂

Severe Sepsis/Septic Shock

Early identification and antibiotic administration

Types of shock

- Distributive (Septics)
- Cardiogenic
- Hypovolemic
- Obstructive
- Diffuse intravascular coagulation

Severe Sepsis/Septic Shock

Empiric Antibiotic Treatment Reduces Mortality in Severe Sepsis and Septic Shock From the First Hour. Critical Care Medicine, 42(8), 1749–1755. doi:10.1097/CCM.0000000000000330
Take Home #3

- Have a low threshold for suspecting infection in patients with shock
- Give early and broad empiric antibiotics

Severe Sepsis/Septic Shock
Volume expansion—why?

Volume expansion

Severe Sepsis/Septic Shock
Volume expansion

Severe Sepsis/Septic Shock
Volume expansion: Methods of monitoring

- Measures pressure in SVC
- Requires central venous catheter: either IJ or SC
- Inherent variability in measuring
- Measurements affected by patient physiology

Severe Sepsis/Septic Shock
Volume expansion: IVC ultrasound


Severe Sepsis/Septic Shock
Volume expansion: Lactate

Severe Sepsis/Septic Shock
Volume expansion: Lactate

I know it’s bad. If it’s getting better, then there’s less bad.
Take Home #4

- Surviving Sepsis recommends 30cc/kg IVF bolus to start
- Each monitoring technique has limitations, but can provide some data to help decide if further IVF will be beneficial
- You will likely see all of these modalities used in the ED at some point

Severe Sepsis/Septic Shock

Vasoactive agents

Norepinephrine
- α-agonist (primary)
- β1-agonist (secondary)

Phenylephrine
- α1-agonist

Epinephrine
- α-agonist
- β-agonist

Dopamine
- β1-agonist (primary)
- α-agonist (secondary)

Vasopressin
- V1 smooth muscle receptors

Severe Sepsis/Septic Shock

Continued monitoring:

ScvO2

- Oxygen saturation taken from the SVC
- Requires central venous catheter: either IJ or SC
- Can be continuous with “Sepsis Catheter”
- Affected by the extraction of oxygen by the tissues—high or low values (>49 or <70 can be abnormal and predict adverse outcomes)

Severe Sepsis/Septic Shock

Continued monitoring: Lactate Clearance

Comparison of Dopamine and Norepinephrine in the Treatment of Shock

Dorit Shorr, M.D., Robert M. Goodwin, M.D., Christian Mull, M.D., Peter W. Phelan, M.D., Raymond Maier, M.D., Lynne A. Hallett, M.D., John E. Pappas, M.D., and Larry A. Kehagias, M.D., for the Upstate II Investigators*
Severe Sepsis/Septic Shock
Continued monitoring: ScvO2 vs Lactate Clearance

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lactate Clearance</th>
<th>Proportion Difference (95% Confidence Interval)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-hospital mortality, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intent to treat</td>
<td>26 (17)</td>
<td>34 (23)</td>
<td>6 (4 to 15)</td>
</tr>
<tr>
<td>Per protocol</td>
<td>26 (17)</td>
<td>33 (22)</td>
<td>5 (3 to 16)</td>
</tr>
</tbody>
</table>

Take Home #5

- Continue to monitor patients with shock physiology
- Lactate clearance and ScvO2 can both be used to monitor the course of resuscitation and determine if further interventions are necessary.

Severe Sepsis/Septic Shock
Summary

1) Have a low threshold for suspecting infection and giving antibiotics
2) Aggressively resuscitate patients with IVF and continue to assess volume status to optimize cardiac output
3) Add vasopressor agents when hypotension persists after initial resuscitation (my general starting point is 2L IVF)
4) Continue to monitor blood pressure and lactate
