SEPSIS: Seeing Through the Smoke & Mirrors

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Objectives

• Forget everything you have known about sepsis
• Learn new things
Objectives

• Define sepsis
• Explain why “Early Goal Directed Therapy” is no longer advocated
• Identify when to use qSOVA and SIRS to help diagnose sepsis
• Understand why LR is now favored over NS for resuscitation
• Identify targets to monitor volume of resuscitation
What is sepsis?

• Inflammatory state resulting from a systemic response to bacterial infection
• In septic shock there is critical reduction in tissue perfusion leading to acute failure of one or more organs
How I learned to treat sepsis...
How I learned to treat sepsis...

- Harry Potter and the Philosopher's Stone
- The Lord of the Rings: The Fellowship of the Ring
- Monsters, Inc.
- Shrek
- Ocean’s Eleven
- Pearl Harbor
- The Mummy Returns
- Jurassic Park III
- Planet of the Apes
- Hannibal
- A Beautiful Mind
2001 Rivers study...

- Early Goal Directed Therapy
  - CVP
  - MAP
  - ScvO2
  - Dobutamine
  - Blood

Does Central Venous Pressure Predict Fluid Responsiveness?: A Systematic Review of the Literature and the Tale of Seven Mares

Paul E. Marik, Michael Baram and Bobbak Vahid

*Chest* 2008;134;172-178
DOI 10.1378/chest.07-2331
Figure 1. Fifteen hundred simultaneous measurements of blood volume and CVP in a heterogenous cohort of 188 ICU patients demonstrating no association between these two variables ($r = 0.27$). The correlation between ΔCVP and change in blood volume was 0.1 ($r^2 = 0.01$). This study demonstrates that patients with a low CVP may have volume overload and likewise patients with a high CVP may be volume depleted. Reproduced with permission from Shippy et al.\textsuperscript{11}
ScvO2?

\[ \text{ScvO2} \]

\[ \text{O}_2\text{ER} = 100 \times \frac{\text{VO}_2}{\text{DO}_2} \]

\[ \text{VO}_2 = \text{CO} \times [\text{CaO}_2 - \text{CvO}_2] \]

\[ \text{DO}_2 = \text{CO} \times [\text{CaO}_2] \]

\[ \text{CaO}_2 = (\text{Hb} \times 1.34 \times \text{SaO}_2) + 0.003 \times \text{PaO}_2 \]
HgB? (2014 TRISS Trial)

Lower versus Higher Hemoglobin Threshold for Transfusion in Septic Shock

Lars B. Holst, M.D., Nicolai Haase, M.D., Ph.D., Jørn Wetterslev, M.D., Ph.D., Jan Wernerman, M.D., Ph.D., Anne B. Guttormsen, M.D., Ph.D., Sari Karlsson, M.D., Ph.D., Pär I. Johansson, M.D., Ph.D., Anders Åneman, M.D., Ph.D., Marianne L. Vang, M.D., Robert Winding, M.D., Lars Nebrich, M.D., Helle L. Nibro, M.D., Ph.D., et al., for the TRISS Trial Group and the Scandinavian Critical Care Trials Group.*
Lower threshold <7 did better, saved blood
The end of the line for the Surviving Sepsis Campaign, but not for early goal-directed therapy

Patrick A Nee and Emanuel P Rivers

Emerg Med J published online November 9, 2010
The end of the line for the Surviving Sepsis Campaign, but not for early goal-directed therapy

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Sepsis Campaign Updated....
New guidelines......2016

• Check Lactate
• Send Blood Cultures
• Give Antibiotics
• 30mL/kg IVF (if low BP/High Lactate)
New guidelines...2016

• Check Lactate
• Send Blood Cultures
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Re-assess Volume Status and Tissue Perfusion within 6 hours
  * CVP
  * ScvO2
  * Cardiac US (IVC)
  * Passive Leg Raise
New Guidelines...2018

In the first **hour** of recognition thou shalt...

- Measure lactate level. Remeasure if initial lactate is >2 mmol/L.
- Obtain blood cultures prior to administration of antibiotics.
- Administer broad-spectrum antibiotics.
- Begin rapid administration of 30ml/kg crystalloid for hypotension or lactate ≥4 mmol/L.
- Apply vasopressors if patient is hypotensive during or after fluid resuscitation to maintain MAP ≥65 mm Hg.

*“Time zero” or “time of presentation” is defined as the time of triage in the Emergency Department or, if presenting from another care venue, from the earliest chart annotation consistent with all elements of sepsis (formerly severe sepsis) or septic shock ascertained through chart review.

**Figure 1.** Hour-1 Surviving Sepsis Campaign Bundle of Care.
<table>
<thead>
<tr>
<th>Bundle Element</th>
<th>Grade of Recommendation and Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure lactate level. Re-measure if initial lactate is &gt; 2 mmol/L</td>
<td>Weak recommendation, low quality of evidence</td>
</tr>
<tr>
<td>Obtain blood cultures prior to administration of antibiotics</td>
<td>Best practice statement</td>
</tr>
<tr>
<td>Administer broad-spectrum antibiotics</td>
<td>Strong recommendation, moderate quality of evidence</td>
</tr>
<tr>
<td>Rapidly administer 30 mL/kg crystalloid for hypotension or lactate ≥ 4 mmol/L</td>
<td>Strong recommendation, low quality of evidence</td>
</tr>
<tr>
<td>Apply vasopressors if patient is hypotensive during or after fluid resuscitation to maintain mean arterial pressure ≥ 65 mm Hg</td>
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</tbody>
</table>
Petition to retire the surviving sepsis campaign guidelines

Rebel Physician Fighters
SSC Hour-1 Bundle

The Surviving Sepsis Campaign (SSC) Bundle is the core of the sepsis improvement efforts. Applying the sepsis bundle simplifies the complex processes of the care of patients with sepsis. The Surviving Sepsis Campaign Steering Committee and members of the Executive Committee collaborated to revise the bundle based on the 2016 guidelines recommendations. More information on the members of these committees can be found in the About SSC tab.

SCCM and ACEP Release Joint Statement About the SSC Hour-1 Bundle

The Society of Critical Care Medicine (SCCM) and the American College of Emergency Physicians (ACEP) acknowledge concerns expressed about the recently released Surviving Sepsis Campaign (SSC) Hour-1 bundle and the appropriateness of implementation in the United States. Both organizations understand the importance of prompt and optimal sepsis diagnostics and treatment. SCCM and ACEP along with other involved international experts are organizing a meeting as soon as possible to carefully review the recommendations, and provide guidance on bundle implementation and care of potentially septic patients who present to emergency departments in the United States. We recommend that hospitals not implement the Hour-1 bundle in its present form in the United States at this time.

Please direct questions to ssc@sccm.org.

Hour-1 Bundle Overview

The guidelines and the bundle integrate identified decision points and courses of action that when combined with clinical judgment, can make a difference in patient outcomes. Note that the updated bundle is not mandated but rather serves as a guide and should be implemented within the first hour of sepsis recognition.

As explained in the article linked below, more than one hour may be required for resuscitation to be completed, but the Campaign encourages the prompt initiation of resuscitation and treatment, such as obtaining blood for measuring lactate and blood cultures, administration of fluids and antibiotics, and in the case of life-threatening hypotension, initiation of vasoressor therapy. Treating sepsis as a medical emergency.
Back to basics
Back to basics

1. Recognition
Recognition:

**SIRS Criteria (need 2/4):**
1. $T > 38$ or $< 36$
2. $HR > 90$
3. $RR > 20$
4. $WBC > 12$ or $< 4$

**Q-SOFA Criteria (need 2/3):**
1. Alter mental status (GCS $< 15$)
2. $SBP < 100$
3. $RR > 22$
Recognition:

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Update on sepsis! New definitions for sepsis and septic shock 2016

IUCriticalCare
Published on Apr 10, 2016

Watch our AWARD WINNING VIDEO
Best of ATS Video Lecture Series
First place 2016
Back to basics

1. Recognition
2. Identification
Blood cultures

• Proper selection of antibiotics to
  • Decrease side effects
  • Decrease resistance rates
  • Decrease costs
  • Gain epidemiologic information
Other blood tests...

- Lactate
- CMP
- CBC w/ diff
- Procalcitonin?
  - Not good in: ESRD, hypothermia, trauma
  - Better for stopping abx then not starting – esp in septic appearing pts
Back to basics

1. Recognition
2. Identification
3. Resuscitation
What fluid and how much?

What fluid to give?

How do we know if our patient has been “adequately fluid resuscitated”? 
NS is not “normal”!!!

• Hypertonic
• Causes hyperchloremic acidosis
• LR is safe in hyperkalemia – NS may not be
• NS can cause kidney injury
  • Hyperchloremia causes renal vasoconstriction
  • SALT-ED trial NEJM 2018 - 13,300 pts median 1L NS vs. LR
    • 37.6% vs 28% adverse kidney events (p<0.001)
  • SMART trial NEJM 2018 – 15,800 pts
    • 15.4% vs. 14.3% death or renal injury (p<0.04)
get **SMART**: stop using saline
Algorithm for fluid selection

Hypovolemia with unknown or reasonably normal electrolytes*

Severe neurologic injury?

No

Lactated Ringers
(≈ Hartman’s Solution)

Yes

Plasmalyte
(= Normosol)
How much is too much?
The Ultimate Goal!
The Ultimate Goal!

**Oxygen Content** (CaO2) = [Oxygen on Hgb] + [Oxygen in plasma]
CaO2 (mL O2/dL) = (1.34 x hemoglobin concentration x SaO2) + (0.0031 x PaO2)

**Oxygen Delivery** (DO2) = Cardiac Output x Oxygen Content
DO2 (mL/min) = Q x CaO

**CO** = HR x SV
Malperfusion Clinical Exam Signs

- Cap refill
- Skin mottling
- Mental Status
- Blood Pressure
- Urine Output
- Heart Rate
Resuscitation targets

- Urine Output: 0.5 ml/kg/hr
- Mean Arterial Pressure
- SVV 10-12 “Stroke Volume Variation”
- Central Venous Pressure / Preload
- IVC US
- Lactate

**PERFUSION**

Lactate Dehydrogenase

\[
\begin{align*}
\text{NADH} + H^+ &\rightarrow \text{NAD}^+ \\
\text{pyruvate} &\rightarrow \text{lactate}
\end{align*}
\]
SVV
Ultrasound of the IVC

- Spontaneous breathing
- Positive pressure ventilation
- Normo or hypervolemic patient
- Hypovolemic patient
What about Vitamin C?

- Marick et al (2016 CHEST) EHR retrospective study
- Treatment: vitamin c, hydrocortisone, thiamine within 24 hrs ICU sepsis admission
- Findings:
  - No treatment group pts died from sepsis complications
  - Promising results but only a hypothesis generating study – needs external validation before routine implementation
Conclusion

1. Recognition
2. Identification
3. Resuscitation