Objectives

• Define Sepsis
• Epidemiology and Relevance
• Pre-Hospital Impact
• Making the Diagnosis
• Appropriate Treatment

sepsis; Greek: σήψις, "putrefaction, decay"

• The term Σήψις (sepsis) was introduced by Hippocrates in the fourth century BC, and it meant the process of decay or decomposition of organic matter.
Defining Sepsis

- **Sepsis** is a potentially fatal systemic inflammatory response caused by severe infection.
- Systemic response is **not necessarily** a result of the infectious agent, but rather the body's intrinsic response to that pathogen.
- Sepsis is a dynamic disease process that ranges from Systemic Inflammatory response Syndrome (SIRS) to Multi-Organ Dysfunction Syndrome (MODS) and Death.

**SEPSIS STEPS**

- SIRS + confirmed or suspected infection

**SEPTIC SHOCK**

- High output, low cardiac index
- Elevated lactate

**SEPSIS**

- Sign of SIRS
- Organ damage
- Elevated lactate

**SEVERE SEPSIS**

- Severe Sepsis with provincial
- Elevated lactate

**MODS**

- Multi-Organ Dysfunction Syndrome
- Elevated lactate

*Images Courtesy Curtis Merrell, DO*

- Sepsis caused by gram negative bacteria is thought to be largely due to the host's response to lipopolysaccharides, also called LPS or endotoxin, in the cell wall.
- Sepsis from gram positive bacteria are more likely to be caused by their release of exotoxins.
Severe Sepsis & Septic Shock

- Hypoperfusion caused by:
  - Volume depletion
  - Peripheral vasodilation from toxins and inflammatory response
  - Increased oxygen demand to fight infection
- Leads to multi-system organ failure
  - Kidney, liver, heart, brain dysfunction leads to death
The Systemic Impact of Sepsis

Epidemiology and Relevance

- Sepsis occurs in 1-2% of all hospitalizations and accounts for as much as 25% of ICU bed utilization.
- Treatment for sepsis often involves a prolonged stay in the intensive care unit and complex therapies, which incur high costs. It has been estimated that $17 billion is spent annually in the United States to treat sepsis.
- A study of 18 U.S. States found that, amongst Medicare patients in 2011, septicemia was the second most common principle reason for readmission within 30 days.

Traditional Sepsis Management

- Prior to 2001 Sepsis was managed with an “inpatient” strategy
- Sepsis often not recognized as separate process.
- Treatment delayed until exact process/organism identified (pneumonia, UTI etc.)
- Normal fluid resuscitation: 1 liter saline, then vasopressors.
Emanuel Rivers
Henry Ford Hospital, Detroit MI.
New England Journal Of Medicine
2001
Early Goal Directed Therapy for Sepsis (EGDT)
1) Early identification of sepsis
2) Aggressive fluid resuscitation
3) Early antibiotics (1 hour: often before clear source identified)
4) Early blood transfusion
5) Continued monitoring of volume status and BP

Early Goal Directed Therapy (EGDT)

–Mortality reduced from 46% with standard care to 30%
–Average of 5 liters of normal saline in the first 6 hours
Surviving Sepsis Campaign
2002 Society for Critical Care Medicine
Awareness Campaign for ER and ICU docs/nurses
‘GOLDEN HOURS of Sepsis’ Concept
Golden Hour of Trauma (Trauma Alert)
Time is Muscle (Cardiac Alert)
Time is Brain (Stroke Alert)
Early, aggressive fluid administration and early antibiotics were found to be the key difference in mortality

Surviving Sepsis Campaign

Pre-hospital Impact
Opportunities for Emergency Medical Services care of sepsis

Methods
We prospectively studied patients with suspected infection presenting to a 50,000 visit urban, academic ED from September 16, 2005–September 30, 2006. Compared EMS arrival to triage.

Results
Of patients who qualified for protocolized sepsis care in the ED, 99/162 (61.1%) were transported via EMS.
EMS patients had higher sepsis acuity (mortality in ED sepsis score 6 vs. 3, p < 0.001).

Conclusions:
EMS provides initial care for the majority of patients with severe sepsis, septic shock, and those who ultimately die. EMS systems may offer important opportunities for advancing sepsis diagnosis and care.

The Impact of Emergency Medical Services on the Emergency Department Care of Severe Sepsis

Results
Among EMS patients, if the EMS provider had a written impression of sepsis:
1) There was a shorter time to antibiotics (70 vs. 122 minutes, p=0.003)
2) Shorter time to EGDT initiation (69 vs. 131 minutes, p=0.001)

Identification of Sepsis

- Early Detection and treatment of Patients with Severe Sepsis by Prehospital Personnel
  - Initiated Sepsis Alert and Treatment Protocol
    - SIRS Criteria + Suspected infection + Hypoperfusion (Systolic BP <90, Map < 65, Lactate >4)
    - Mortality for all patients with sepsis = 26%
    - If Sepsis identified by EMS Mortality = 13%
    - When EMS identifies sepsis, starts treatment and calls a Sepsis Alert, mortality from sepsis is cut in half.
Making the Diagnosis

• How do we identify Sepsis in the field?

Sepsis Criteria

• Suspected infection + Systemic Inflammatory Response Syndrome (SIRS) = Sepsis

• Sepsis + Evidence of Hypoperfusion = Severe Sepsis

• Sepsis with refractory Hypotension = Septic Shock

Likely Infection

• Lung
• Urinary
• Abdominal
• Skin
Pneumonia

- Cough
- Grey/green sputum
- Shortness of breath
- Unilateral rales
- Diminished breath sounds

- COPD and patients with recent hospitalization are at increased risk

Urinary Tract Infections

- Cystitis
  - Suprapubic/hypogastric tenderness
  - Painful urination “Dysuria”
  - Urgency
  - Frequency
  - Incontinence
- Pyelonephritis
  - +/- cystitis
  - Flank Pain

- Elderly and pts with indwelling Foley catheters are at increased risk

Peritonitis & abdominal Infections

- Focal Tenderness
  - Cholecystitis
  - Appendicitis
  - Diverticulitis
- Diffuse Tenderness
  - Bowel Perforation
  - Bowel Obstruction
- Abdominal Rigidity or “Guarding”
- Nausea & vomiting are common
Soft Tissue & Skin Infections

- Cellulitis
  - Warm, red appearance - Erythema
  - Tenderness
  - +/- edema
  - Typically unilateral

- Abscess
  - Usually associated with cellulitis
  - Firm/dense tissue – induration
  - +/- central fluctuance

- Diabetics & IVDA are at increased risk

Systemic Inflammatory Response Syndrome

Any 2 of the following
- Temperature: Over 38 C (100.4 F) / Under 36 C (96.8 F)
- Tachycardia: HR over 90
- Tachypnea: Respiratory Rate over 20
- WBC < 4K or >12 K or Bands >10%

Temperature

- Temperature over 100.4 or Under 96.8
- 90% of Septic Patients present with fever
- Check temperature on all sick patients
- Elderly/infants can present with low temperature, though this is rare
Tachycardia

- Heart Rate **Over 90**
- Appropriate cardiac response to hypovolemia
  - Increased metabolic demand during infection
  - Response to vasodilation and microvascular injury - "Distributive shock"
- Usually minimal cardiac dysfunction

Tachypnea

- Respiratory Rate over 20
- Due to:
  - Increased metabolic need for oxygen
  - Fever (increases respiratory rate alone)
  - Possible lung dysfunction (pneumonia)
  - Acidosis causing increased rate to breathe off H⁺ as CO₂ and H₂O

Leukocytosis

- Leukocytes are the WBCs responsible for fighting off infectious disease
  - Elevated during infection as the body increases the number of circulating WBCs to fight a response
  - This number can also be low if the infectious state depletes the available leukocytes
  - Band cells are young immature WBCs that have yet to develop into mature functional WBCs
SIRS & Sepsis Field Diagnosis

- WBCs are not readily available in the field and are therefore not a practical markers for pre-hospital providers.
- Temp, Heart Rate, Tachypnea and Blood Pressure/MAP are all available and are proven reliable predictors for the identification of Sepsis
- Multiple Pre-hospital screening tools have been developed that capitalize on practical pre-hospital measures

When does SIRS become Septic Shock?

- SIRS & Sepsis – Compensated state
- Severe Sepsis – Early decompensation with subtle signs of hypoperfusion
- Septic Shock – Uncompensated with state hypotension and end-organ dysfunction which is refractory to Volume Resuscitation

Severe Sepsis

- Sepsis + Hypoperfusion
- Hypoperfusion?
  - Lactate >4.0
  - End Tidal CO2 <25
  - Altered LOC/Confusion
  - Decreased Urine output – Anuria
  - SBP < 90
  - MAP <65
  - Hypoxia
- Volume resuscitation to assist compensation is critical in severe sepsis
Septic Shock

- Refractory hypotension with end organ dysfunction
- Less responsive to volume resuscitation
- Requires pressor support
- Significantly mortality rate of 25-50%

Mean Arterial Pressure (MAP)

- More accurate measure of perfusion than systolic BP
- The average pressure seen by the organs.
- Places more weight on diastolic blood pressure than just the average of the two numbers

- MAP = (DBP + DBP + SBP) / 3
  - Blood Pressure 90/60
  - MAP = (60 + 60 +90) / 3 = 70
  - Blood Pressure 80/50
  - MAP = (80 + 50 + 50) / 3 = 60
- Cutoff for hypotension is MAP of 65

Early Goal Directed Therapy

- Early Identification
- Aggressive fluid resuscitation
- Early antibiotic therapy
- Continuous hemodynamic monitoring
Early Identification

• Requires Good Clinical Skills
  – Meaningful historical details
  – Thorough Examinations for possible infection
  – Complete vital signs with temperature in suspected cases
• Pre hospital Sepsis Alert
  – Ensures early identification
  – Can prompt an in-hospital Sepsis alert which pulls additional resources to the ED
    • Pharmacy
    • IV therapy
    • Lab tech
    • Nursing resources

Oxygen!

• Provide supplemental oxygen by nasal cannula or non-rebreather to maintain oxygen saturation over 96%
• Severe Sepsis and Septic Shock is usual a state of failed oxygen delivery at the end-organ site, excessive O2 saturation will not enhance delivery
• Optimizing the hemoglobin saturation curve is the goal of oxygen supplementation
  ◆ Pulmonary infection and underlying pulmonary disease can impair oxygen absorption and may require higher Fio2 levels to achieve the target of 96-99%

Fluids!

• This is the #1 way to make a difference
• Septic patients are on average 4-6 Liters fluid down
• Two Large bore IVs= 20g OK, 18g preferred
• If no access, consider IO line if patient sick, altered or intubated.
Fluids!

- At least 10cc/kg bolus in patients with Sepsis
- 20cc/kg in patients with signs or symptoms of Severe Sepsis
- The standard volume in the ED for Sepsis is 30cc/kg

- Reporting your total volume in the prehospital setting is critical to ongoing care.

- 50 kg patient – 110lb
  - 20cc/kg = 1000cc
- 75 kg patient – 165lb
  - 20cc/kg = 1500cc
- 100kg patient – 220lb
  - 20cc/kg = 2000cc
- 115kg patient – 250lb
  - 20cc/kg = 2300cc

Fluids!

- Can't that much fluid cause a problem?
- Yes: If history of congestive heart failure or renal failure
- However:
  - 1) Even these patients are still usually very volume down
  - 2) Reassessment after each 500cc makes this safe

Pressors!

- Dopamine
  - Dose dependent response
  - 2-5mcg/kg/min – associated with peripheral vasodilation to the kidneys and bowel
  - 5-10mcg/kg/min – primarily cardiac effects of inotropy + chronotropy
  - 10-20mcg/kg/min – systemic vasoconstriction
Dopamine

• Most readily available vasopressor in the prehospital setting

  - Increases risk of tachyarrhythmias
  - Greater 28 day mortality rates compared to Norepinephrine

KEEP CALM AND BLAME Dopamine!

Dopamine Drip Rate Chart (gtts/min)
Concentration: 400mg/500cc = 800mcg/ml
200mcg/250cc = 800mcg/ml

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60gtts/mL tubing
10gtts/mL tubing

⚠️ Do not initiate pressor therapy until your patient has been adequately volume resuscitated with at least 20cc/kg.
Summary

• Think like a clinician…
• Find the infection!
• A robust history and physical exam is your greatest tool in making the diagnosis
• If you do nothing in the field/can do nothing in the field remember that relaying the message of sepsis with tx of care has a positive impact
• Fluids, fluids, fluids!

Question #1

• Which of the following vital sign abnormalities is NOT part of the SIRS criteria?
  • A) HR 95
  • B) RR 25
  • C) Temp 102.0
  • D) BP 85/65

Question #2

• Which of the following clinical findings might suggest a state of hypoperfusion?
  • A) altered mental status
  • B) cool skin & mottling of the hands and feet
  • C) decreased urine output
  • D) all of the above
Question #3

- Which vital sign might suggest Severe Sepsis?
- A) Systolic BP <95 mmHg
- B) BP 92/65
- C) HR 120
- D) BP 100/45

Question #4

- What is the most critical component of making a sepsis diagnosis?
- A) abnormal vital signs
- B) hypovolemia
- C) presumed or confirmed source of infection
- D) Hx of Diabetes or COPD

Question #5

- What is the correct prehospital total volume of IVF to administer to a 150kg patient with severe sepsis?
- A) 1 liters
- B) 2 liters
- C) 500 cc
- D) 3 liters
Special thanks to
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