Prehospital management and recognition: SIRS, Sepsis and Septic Shock

Riverside County EMS Agency Protocol Update Course 2015
SIRS, Sepsis and Septic Shock
Objectives

- Define systemic inflammatory response syndrome (SIRS)
- Identify SIRS criteria
- Understand pathophysiology of SIRS
- Understand relationships and interplay between SIRS and sepsis
- Identify and describe the spectrum of sepsis
- Discuss Early Goal Directed Therapy
- Identify EMS treatment for SIRS and sepsis
What is SIRS?

- SIRS is Systemic Inflammatory Response Syndrome
  - A clinical response to an insult to the body that is either infectious or noninfectious
    - Can come from ischemia, trauma, infection, inflammation or combined insults
SIRS Criteria

- SIRS has a set of objective identifiers:
  - Heart rate > 90 bpm
  - Respiratory rate > 20 breaths/min or arterial CO₂ of < 32 mmHg
  - Temperature > 100.4°F or < 96.8°F
  - Abnormal WBC count (> 12,000 µL or < 4,000 µL)
  - Serum lactate levels ≥ 4 mmol/L
  - *SBP < 90 mmHg has been added by some facilities
Pathophysiology of SIRS

- Bone’s stage theory (paraphrased)
  - Insult/injury → local inflammatory response → local redness/edema/warmth → localized macrophages for defense → growth factors and systems activated to restore function/repair → system balanced by CARS (Counter inflammatory response syndrome)
  - If unchecked blood vessel integrity is damaged
SIRS and Coagulation
(Pathophysiology continued...)

- SIRS can progress to cause repeated and increased production of thrombin
  - Promoting coagulation
  - Promoting further inflammation as well

- Unchecked this will lead to large amounts of microvascular coagulation and eventual organ dysfunction.
from "Sepsis" courtesy of Bastor Larmon PhD UCLA, David Geffen School of Medicine Professor
Multiple Organ Dysfunction Syndrome (MODS)

- Occurs when there is organ dysfunction
- Organ dysfunction occurs from:
  - Hypoxia
  - Uncontrolled cell death
  - Direct cytotoxicity
  - Immunosuppression (imbalance in SIRS and CARS)
SIRS and MODS

- SIRS can lead to MODS if the origin of the insult or injury isn’t identified and the patient appropriately resuscitated.

- MODS is often irreversible and has a high degree of mortality
  - Prehospital interventions can prevent MODS from occurring.
Infection

- Defined:
  - A microbial presence inside a host’s normal tissues that may or may not cause an inflammatory response.
Sepsis (and SIRS)

- Defined:
  - The organism’s systemic response to infection
    - Perpetuated by response to endotoxin
  - Characterized by the presence of:
    - 2 SIRS criteria
    - Presumed/known infection
Systemic Inflammatory Response Syndrome (SIRS) 
To SEPTIC SHOCK

- BACTERIA
- FUNGI
- PARASITES
- VIRUSES
- OTHER (TRAUMA, BURNS, PANCREATITIS)
- INFECTION
- SEPSIS
- SIRS
- OTHER (BLOOD BORN INFECTION)

- Severe Sepsis
- Septic Shock
  - Sepsis + End Organ Damage
  - SIRS + Infection

- Criteria:
  - Temperature: >38°C or <36°C
  - HR: >90, RR: >20 or PaCO₂ <32
  - WBCs: >12,000 or <4,000 or >10% bands

- Severe Sepsis + Hypotension
Spectrum of Sepsis

- Sepsis → Severe Sepsis → Septic Shock → Irreversible Shock → MODS → Death
SIRS Research

- Prospective study of tertiary care center admissions – 68% of hospital admissions met SIRS criteria.
  - Incidence of SIRS ↑ as patient acuity ↑
    - Of those with SIRS over 25% developed sepsis, 18% developed severe sepsis, 4% developed septic shock within 28 days of admission
- Comstedt et al (2009 Scandinavia) cohort study that showed that 62% of patients presenting to the ER with SIRS had a confirmed infection.
Angus et. al found the incidence of SIRS associated with an infection to be 3 cases per 1,000 population, or 2.26 per 100 hospital discharges.

Wang et. al EMS system (Boston, MA) comparison: EMS provides initial care for more than 1/3 of all ED sepsis patients

Opportunity!!
Sepsis Research

- More than 1.1 million cases annually as of 2008
- Sepsis is the 10th leading cause of death in the US
  - Mortality rates estimated 25-50%
  - Snapshot reference (March – August 2014 at RCH sepsis mortality was 37%)
    - That’s is higher than cardiac arrests, MI or stroke (combined)
How does the hospital deal with sepsis?

* Unique to each facility
  
  0 Implement and follow “Surviving Sepsis Campaign Guidelines for Management of Severe Sepsis and Septic Shock”
    
    0 Team approach with a structured process
      
      0 Checklist and “code team activations”
        
        0 Often called “code sepsis”
    
    0 Early Goal Directed Therapy (EGDT)

Surviving Sepsis Guidelines were updated in 2012
EGDT

- Early Goal Directed Therapy
  - Structured interventions that have fluids, vasopressors, steroids and antibiotics administered to the patient at critical time intervals.
  - Largest overwhelming goal:
    - Broad spectrum antibiotics administered IV to patient within 60 minutes of recognition of sepsis
      - Blood cultures drawn before antibiotics
Sepsis is a medical emergency

Patient survival rate (%)

Patients with effective antibiotic therapy

Time to antibiotics

Made for World Sepsis Day by lingruen-gmbh.com
EGDT in EMS

- EMS can play an active role in the beginnings of sepsis treatment
  - #1 priority is recognition of this patient type
  - Sepsis patients can present in the covert compensated state to the overt decompensated state
    - i.e. stable with sepsis, to the decompensating unstable septic shock patient
SEPSIS STEPS

SIRS
- T: >100.4°F
- <98.6°F
- RR: >20
- HR: >90
- WBC: >12,000
- <4,000
- >10% bands
- PCO2 < 32 mmHg

SEPSIS
- 2 SIRS
- Signs of End Organ Damage
- Hypotension (SBP <90)
- Lactate >4 mmol

SEVERE SEPSIS
- Sepsis +
- Signs of End Organ Damage
- Hypotension
- Lactate >4 mmol

SEPTIC SHOCK
- Severe Sepsis with persistent:
- Hypotension
- Signs of End Organ Damage
- Lactate >4 mmol

Slide Courtesy Curtis Merritt, DO
EMS Treatment\Recognition

- Assess patient for SIRS criteria (it just takes two):
  - HR > 90 bpm
  - RR > 20 breaths/min
  - Capnography readings < 32 mmHg
    - Particular attention should be given when this reading is < 25 mmHg as this is highly suggestive of an elevated lactate
  - Temperature > 100.4°F
  - SBP < 90 mmHg
EMS Treatment\Recognition

- If patient meets SIRS criteria (only two are needed) then next:
  - Evaluate for infection (known/suspected)
    - Look for common sources/sites for infection
    - Physical exam findings
- If an infection is known/suspected + SIRS criteria are met then notify the hospital early of your suspicions
- Treat life threats appropriately
EMS Treatment\Recognition

O Mortality is most decreased by:
  O Establishing and maintaining the patient’s airway
    O Supplemental O2 to advanced airway placement
      – as clinically indicated/required.
  O Maintaining circulating blood volume
    O Appropriate vascular access (IV or IO)
    O Fluid resuscitation – appropriate bolus repeated
      as needed to maintain perfusion
    O **Assess your patient’s response to therapy**
      O Intervene as often as patient condition demands
Reminders:

- Sepsis becomes septic shock if untreated or under-managed
- Septic shock is a distributive shock
  - DBP ↓↓ as condition worsens
  - Pulses will often be bounding to compensate
  - Large amounts of fluid resuscitation are often needed – repeat boluses!
    - Assess your patient’s response to therapy
- Not all patients are febrile! (aspirin anyone)
28 year old female patient, calls 911 for lower quadrant abdominal and flank pain. HR 110 bpm, RR 24 breaths/min, skins are hot to the touch. She describes dysuria, with blood present intermittently.

- Does this patient meet SIRS criteria?
- Is there evidence to support a known/suspected infection?
Knowledge Check:

- SIRS? YES
- Known/suspected infection? YES
Case Review #2

- 74 year old male patient calls 911 for dyspnea. The patient is found pale, cool, diaphoretic with an irregular heartbeat @ 114; RR of 36, labored; and BP is 80/30. Lung sounds reveal fine crackles, physical exam shows dependent edema.
  - Does this patient meet SIRS criteria?
  - Is there evidence to support a known/suspected infection?
Knowledge Check:

- SIRS? YES
- Known/suspected infection? NO
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QUESTIONS?
References

- NCHS Data Brief No. 62 June 2011 “Inpatient Care for Septicemia or Sepsis: A Challenge for Patients and Hospitals”
- [www.cdc.gov/sepsis](http://www.cdc.gov/sepsis)
- [www.survivingsepsis.org](http://www.survivingsepsis.org)
- Baxter Larmon Ph.D. “Sepsis” Instructional Presentation ([www.cpc.mednet.ucla.edu](http://www.cpc.mednet.ucla.edu))
- Riverside County Prehospital Liaison Nurses, data collection for individual statistics reporting.