This month we are going to take a look at the patient with Sepsis. Webster’s defines septic as relating to purification, or the decomposition of organic matter. While decomposition is essential in the grand scheme of things, it is not entirely desirable in a living human. In recent years identification and treatment of septic patients has garnered much attention, but in many cases EMS education has not kept up. (1)

Each year there are about 750,000 cases of sepsis in the United States. More than 2/3rd of those are seen in the Emergency Department. It is the 10th leading cause of death in the U.S. and attributes to about 215,000 per year. Mortality rates are about 25-50%.

Greater than 1/3 of Emergency Department patients with infections and patients with severe sepsis and septic shock receive their initial care from their EMS System. Patients that arrive by EMS have a higher mortality rate as well. Severe sepsis is now considered to be the most common cause of death in the non-coronary intensive care units. (2)

The first step on the path to sepsis is the Systemic Inflammatory Response Syndrome or SIRS criteria. To meet these criteria, your patient must have at least two of the following:

- Pulse >90 bpm
- Respirations >20
- Temperature >38
- White Blood Count: >12,000

Newer versions of the sepsis criteria have added additional items. None of these are diagnostic by themselves, but add more credence to the sepsis picture.

- Decreased urine output
- Elevated Blood Lactate Levels (lactate meters)
- Altered mental status
- Hyperglycemia
- Significant edema
SIRS can be a result from any major insult to the body, such as trauma, severe burns, pancreatitis, ischemia or infections. The most common infections that we see are pneumonia's, UTI's and ear infections in children. If SIRS is not stopped, it will lead to severe sepsis, septic shock, and multiple organ dysfunction syndrome or MODS. Severe sepsis is defined as sepsis with the addition of hypoperfusion. (1)

- Systolic blood pressure <90 mmHg or
- Mean arterial pressure (MAP) <65 or
- Blood lactate >4 mmol/l

Most of our monitors in the EMS community will give us a reading of the MAP or mean arterial pressure, but how many of us remember how to actually come up with this reading? Here is the formula:

$$\text{MAP} = \frac{2 \times \text{Diastolic Pressure} + \text{Systolic Pressure}}{3}.$$  

Or 70/40 would be 40+40+70 / 3 or 50.

Lactate is a measurement that we have discussed in the past with regards to trauma. When a lactate measurement was elevated, it was a very good indicator as to the patient’s outcome because of the damage that has been done to their body. In sepsis, it works in the same way. When the cells do not receive enough oxygen, they convert to anaerobic metabolism. This metabolism creates equal parts of hydrogen and lactate. If the anaerobic metabolism continues, there will be a buildup of hydrogen leading to acidosis. There are meters that work like a glucometer and will give readings of lactate, but these are just making their way into the EMS field.

While not all SIRS criteria mentioned in this article are done in the EMS Setting, most are. With the exception of getting WBC’s, the other SIRS criteria can be determined in the field. You could look to also see if a doctor has prescribed them an antibiotic related to the presentation. Other things may include:(1)

- New or worsening cough
- New onset of weakness or falls in the elderly
- Foul smelling or cloudy urine
- Warm or red areas around surgical sites
- Foul smelling or pus draining from the skin
- Small children pulling on their ears.
In the EMS community, we have started to use the qSOFA score which stands for Quick Sequential Organ Failure Assessment. This was rolled out to the providers in our last protocol update. In the protocol we identify shock and the different types of shock. With Sepsis and Septic shock we identify that this is a life threatening dysfunction due to suspected infection of: lung, urinary tract, gut & skin. This is most frequent in those >65 or < 1 year or with weakened immune systems or chronic medical conditions (cancer, diabetes, kidney disease or catheter use). The criteria for qSOFA are:

- EtCO₂ <25
- AMS (GCS <15)
- Respiratory Rate >22
- Systolic B/P <100

If two or more of these are present in your patient, you have a positive SOFA score.

Early Goal Detection Therapy (EGDT) is the direction that most all EMS communities have discussed. Studies have found that there has been a 16% reduction in mortality when they compare it to traditional therapy. We know that early EMS detection has been shown to decrease the time to diagnosis and treatment in hospitals. We have all seen images like this before. Sepsis guidelines are based on the same principals. Early call, detection, treatment and antibiotics.

Our goal is to identify sepsis and start our treatment in the field and notifying the Emergency Departments of our findings. Start an IV and administer a 200ml bolus in rapid succession (to max of 30ml/kg) to SBP >90 (MAP >65) and reassess your patient after each bolus.

If hypotension persists after 500ml IVF: start a second line and administer Dopamine IVPB 5mcg/kg/min and titrate up to 20mcg/kg/min to maintain SBP >90 (MAP >65). We really are looking to get the fluid volume into the patient of 30ml/kg and remember to document that this fluid resuscitation is based on your protocols.
Early fluid administration and early antibiotic administration is one of the keys to the sepsis survival chain. Just like with the cardiac survival chain, the focus is back on the EMS provider to get the sepsis patient recognized and transported quickly for antibiotic treatment.

This study done by Studnek, Artho, Garner and Jones looked at severe sepsis patients and focuses on EMS vs non EMS outcomes. 311 severe sepsis patients were identified. Of those patients 52% were transported by EMS. Patients that had been cared for by EMS had a reduced time to early goal directed therapy (EGDT) of 41 minutes. They also had a 35 minute reduction to the administration of antibiotic care. If EMS diagnosed sepsis in the field, they had a reduction in the time to antibiotics at an average of 52 minutes and an EGDT reduction of 62 minutes. The conclusion of the authors was that relatively simple changes in the care of our sepsis patients can greatly affect their patient outcome.
Another study that was interesting was the Wang, Weaver, Shapiro and Yealy study which looked at opportunities for EMS care to make a difference in the sepsis patient. They looked at 4,613 patients that arrived at a suburban/urban emergency department. 34% of those patients were received by EMS. Mortality rate was identified as 8% for the sepsis patients, but only 2% for the ones treated by EMS. They also identified that 60% of those sepsis patient were much sicker because those patients were likely to have these factors;

- Elderly
- Female
- From a nursing home
- Abnormal vital signs
  - Tachycardia
  - Hypoxia
  - Hypotension
- Higher serum lactate levels
- Higher comorbid conditions
- Organ dysfunction

The authors of this study found that EMS provided 1/3 of the care to sepsis patients, we tend to care for the sickest of the patients and we should be providing advanced sepsis diagnosis and care.

Let’s look at a case study and put all of this to practice. You have been called to a local home at 0735 for a patient with altered mental status. When you arrive you find a 78 y/o female patient lying in bed stating that “I am late for dinner with my husband”. The patient keeps repeating herself over and over. Her husband is there and stated that she has been fighting a cold over the past couple days, but this morning awoke confused. Physical exam is as follows;

- Airway - Open and unobstructed
- Breathing – Rapid and shallow
- Circulation – Strong, tachy with good radial pulse
- Exposure – No signs of trauma
- Weight – 85kg
- Vitals –
  - Skin : Warm and slightly diaphoretic
  - Pupils : Equal and Reactive
  - GCS : 4/4/6
  - B/P: 88/64
  - Pulse: 120
  - Resp rate: 28
  - Sp02 : 94%
  - EtCO2: 28%

Based on her clinical findings, we could suspect sepsis and her qSOFA score would be >2 which would then indicate that we should notify our Emergency Department of a suspected sepsis patient. We do not actually call an alert like a STEMI or Stroke.

Our treatment would be to start an IV and instill our 200ml bolus to get her B/P over 90mmHg and if after 500ml she still was hypotensive, start our second IV to give her Dopamine.
**SHOCK Differential / Hypovolemic - Septic**

Shock: Cellular hypoxia due to a sustained perfusion deficit leading to anaerobic metabolism, metabolic acidosis, and organ failure.

**HYPOVOLEMIC SHOCK.** Associated with internal or external bleeding/volume loss (ATLS)

<table>
<thead>
<tr>
<th>SxS progressive</th>
<th>Compensated</th>
<th>Uncompensated (Progressive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss</td>
<td>15-30% (750 mL)</td>
<td>40-50% (1500-2000 mL)</td>
</tr>
<tr>
<td>Mental status</td>
<td>WNL, mild anxiety</td>
<td>Coma, delirious</td>
</tr>
<tr>
<td>Skin</td>
<td>Pale, diaphoretic</td>
<td>Pale, diaphoretic, cold</td>
</tr>
<tr>
<td>HR</td>
<td>100-120 (unless elderly, paced rhythm, or on Ca/beta blockers/digitals)</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>WNL, slight increase</td>
<td></td>
</tr>
<tr>
<td>Pulse pressure</td>
<td>WNL</td>
<td>Narrowed</td>
</tr>
<tr>
<td>SBP</td>
<td>&lt;110</td>
<td>&lt;70</td>
</tr>
</tbody>
</table>

**References:**

1) EMS 1.com (EMS and the septic patient.) T. Ryan Mayfield
2) Sepsis – Baxter Larmon, PhD, MICP Professor Medicine David Geffen School of Medicine
3) McHenry Western Lake County EMS Protocols
NAME: ______________________________________   DEPT:  __________________________ DATE: _____________________________

(PRINT CLEARLY)

Circle one:    EMT-B  EMT-P           PHRN

1. What does the term SIRS stand for?  
   a) Stroke Information Response System  
   b) Systemic Inflammatory Respiratory System  
   c) Systemic Inflammatory Response Syndrome  
   d) STEMI Infusion Response Syndrome

2. The term qSOFA stands for?  
   a) Quick Sequential Organ Failure Assessment  
   b) Quality Stacked Optimal Functional Assessment  
   c) Quick STEMI Operating Fluoroscopy Acronym  
   d) Quantitative Study of Focal Assessments

3. What is the MAP that we are trying to achieve with our fluid boluses?  
   a) MAP of 55  
   b) MAP of 65  
   c) MAP of 70  
   d) MAP of 90

4. To have a positive qSOFA score, you must have how many of the criteria identified?  
   a) Only 1  
   b) >3  
   c) 2 or more  
   d) All four

5. To have a positive qSOFA score we are evaluating these 4 things.  
   a) ___________________  
   b) ___________________  
   c) ___________________  
   d) ___________________

6. You have given your patient fluid boluses and it is not bringing the blood pressure up to your desired level. What would be your next treatment of choice?  
   a) Dopamine IV push 2 mcg/kg/min titrated to 12mcg/kg/min  
   b) Dopamine IVPB 5mcg/kg/min titrated to 20mcg/kg/min  
   c) Dopamine IV push 5mcg followed by 10mcg IV push  
   d) Norepinephrine .003 mg IVPB
7. When cells do not receive enough oxygen, they convert to anaerobic metabolism. When this happens we produce?
   a) Hydrogen and Argon
   b) Lactate and Carbon Monoxide
   c) Lactate and Hydrogen
   d) Carbon and Water

8. How do you calculate a MAP?

9. The MAP for a patient with a blood pressure of 68/32 would be?

10. In the McHenry Western Lake County System, you should call the ER with a Sepsis Alert as you are in route.
    a) True          b) False

If you are NOT a member of the McHenry Western Lake County EMS System, Please include your address on each optional quiz turned into our office. Our mailing address is: Northwestern Medicine – McHenry Hospital EMS, 4201 Medical Center Drive, McHenry, Illinois 60050. We will forward to your home address verification of your continuing education hours.

If you ARE a member of our EMS System, your credit will be added to your Image Trend record. Please refer to Image Trend to see your current list of continuing education credits. Any questions regarding this can be addressed to Cindy Tabert at 224-654-0160. Please fax your quiz to Cindy Tabert at 224-654-0165.