

+

## **+Severe Sepsis – EMS Spearheads the Attack against a Devastating Syndrome**

**By Andrew Garlisi MD MPH MBA VAQSF**

### **CASE PRESENTATION**

You are called to the residence of a 74 year-old female who has experienced “mental status change.” The frantic husband tells you that the patient has “not been acting right”. While your partner attends to the patient, you obtain a brief history. The patient became disoriented within the past couple of hours. She had seen her primary care doctor 2 days prior for treatment of cough and cold symptoms. She has a history of hypertension and Type II diabetes. She is on Lisinopril, Metformin and recently prescribed Zithromax. She had taken Tylenol earlier in the afternoon. She had no drug allergies.

The patient, on exam, is awake and spontaneously breathing. She responds to verbal stimulation and command but is lethargic and disoriented to date, and circumstances. Her blood pressure is 86/48, heart rate 115, respiratory rate 20. Her temperature is 99. Oxygen saturation is 91% on room air. Her skin is cool, pale and damp. She has dry mucous membranes. Her lungs reveal crackles in the right base. Heart sounds are fast, but regular. The abdomen is flat and nontender. Her neurological exam reveals no focal deficits.

You reach for the oxygen, lifepak and IV tubing. Your partner mentions to you that he is concerned about stroke, dehydration and hypoglycemia in the differential diagnosis. You agree but add a more likely diagnosis; a deadly and often missed condition which mimics other syndromes **and is the most commonly missed form of shock –Septic Shock.**

### **INTRODUCTION**

EMS has experienced a remarkable transformation in the past three decades. In 1981, when I started working in the ED, paramedics could do very little in the field without calling in for medical direction. Now, EMTs have evolved into entirely different service providers from their predecessors. EMTs are able to perform, interpret and transmit high quality EKGs to the ED. Paramedics are utilizing CPAP and performing Rapid Sequence Intubation. They can diagnose and treat STEMI on the fly, identify early stroke signs and symptoms, reverse severe asthma, COPD exacerbations, anaphylactic shock and dozens of other serious conditions. EMTs can receive specialized training through Advanced Medical Life Support, which provides the EMT with focused training on the use of differential diagnostic skills.

EMS has been on the forefront of every major campaign directed against acute diseases with devastating consequences. Consider the positive impact EMS has had on STEMI, Stroke, Cardiac Arrest and Multisystem Trauma. Early identification and treatment in the field has saved countless thousands of lives across our great nation.

Now it is time to turn our attention to another serious and devastating disease syndrome –**Sepsis**. There is a national “Surviving Sepsis” Campaign. *In my opinion*, EMS must be on the forefront of our concerted efforts to fight this disease complex which has an extremely high mortality rate. Depending on the region and population studied, **the mortality rate** for severe sepsis and septic shock can be as high as 65%. Every hour of delay in treatment of severe sepsis causes an 8% reduction in survival! **Patients at risk** include neonates, patients with **Diabetes**, COPD, CHF, Immune Deficiency, and Cancer. **Nursing home residents** are susceptible, as well as those who have undergone invasive procedures (**surgery**, bladder instrumentation, placement of indwelling catheters, and tubes). IV drug abusers, chronic alcoholics and **dialysis** patients are also at risk for Sepsis. The incidence of Sepsis is difficult to determine, but it is estimated that 750,000 Americans annually suffer from Sepsis. The **vast majority of these are adults**. **Neonates** account for 75% of pediatric sepsis. The economic burden is staggering; over \$30 billion dollars yearly is spent on Sepsis.

## **IMPORTANT DEFINITIONS**

It is **essential** that the **EMT understands the following terminology and definitions** in order to communicate clearly and precisely when dealing with septic patients:

- **SIRS (Systemic Inflammatory Response Syndrome)**—diffuse inflammation in the body which *can* be secondary to infection, *but not necessarily*. There are some conditions such as Pancreatitis, Burns, Multiple Trauma which can precipitate SIRS, but the majority of cases are due to **infection (usually by bacteria** more so than viruses or fungi). The diffuse body inflammation is caused by the bacterial toxin and **our own immune responses** and **chemical cascades** which occur in our bodies as the result of the infection or illness. **How do you know clinically if a patient has SIRS? Answer: if two or more of the following occur → fever, tachycardia, respiratory rate ≥ 20, ↑ White Blood Cell Count.**
- **Sepsis – SIRS plus proven or suspected microbial infection (SIRS + Infection = Sepsis)**
- **Severe Sepsis: Sepsis + signs of ORGAN DYSFUNCTION.** The organs most likely to suffer from Septic complications are Lungs, Brain, Gut, Kidneys, Cardiovascular and Blood Cells. There can also be **Metabolic Dysfunction** resulting in **high blood glucose** and **Metabolic Acidosis**. So how can an EMT determine if there is organ dysfunction?
  - **Brain dysfunction** will manifest as acute confusion, agitation, disorientation, lethargy or any acute change in mental status.
  - **Lung dysfunction** will create respiratory distress, hypoxemia, abnormal lung sounds, and tachypnea
  - Gut dysfunction** can appear as vomiting, diarrhea and abdominal pain and/ or distension.

- Kidney dysfunction** will result in decreased urinary output
- Cardiovascular dysfunction** will result in tachycardia or inappropriate bradycardia, hypotension, and CHF
- Metabolic dysfunction** appears as hyperglycemia (or hypoglycemia) and Metabolic Acidosis (specifically, **Lactic Acidosis**)

\*\*\*IMPORTANT TO KNOW THAT ORGAN DYSFUNCTION IS ULTIMATELY CAUSED BY LACK OF PERFUSION (LACK OF BLOOD AND OXYGEN SUPPLY) TO THE ORGAN

Obviously some of the signs and symptoms of acute organ dysfunction are readily apparent, such as **respiratory distress** and **acute mental status change**. Other signs of organ dysfunction *may not be so readily apparent* (decreased in urinary output may not be noticed by the patient or caregiver). Still others require a laboratory test or point of care test for detection (the glucometer will provide the blood glucose level, and a **portable lactate measuring device** can be obtained for use by EMTs to measure **lactic acid levels** in the field).

- **Septic Shock: Sepsis + hypotension** (less than 90 mm systolic, or 40 mm less than patient's normal blood pressure) for at least one hour despite **adequate fluid resuscitation**, or need for vasopressors to maintain blood pressure.

**What is "adequate fluid resuscitation"? This cannot be accurately determined without the use of a central venous pressure measurement or a device to measure cardiac output and stroke volume (NICOM device). An optimal central venous pressure is 8 to 12 cm H2O. So, without measuring the Central Venous Pressure, or measuring the Cardiac Output and Stroke Volume, we can only clinically estimate the amount of fluids that are required for resuscitation of the patient in shock.** Sometimes we underestimate and give only 2 liters, when in fact 5 liters might have been more appropriate, sometimes we overestimate and cause fluid overload and pulmonary edema because the heart cannot handle the volume given. In the field, 20 cc's per kg of normal saline bolus is a recommended starting point for the septic shock patient.

If the blood pressure cannot be stabilized in the septic shock patient despite adequate fluids and vasopressors, the patient **has Refractory Septic Shock** and will likely die.

It might be helpful to think of Sepsis as a syndrome with varying degrees of severity:

**Sepsis** → → → **Severe Sepsis (organ dysfunction)** → → → **Septic Shock** → → → **Refractory Septic Shock**

## PATHOPHYSIOLOGY

I have already mentioned that SIRS (widespread inflammation in the body) can be caused by non-infectious conditions (Pancreatitis, Multiple Trauma, and Burns) and infectious conditions. If a patient has **SIRS + Infection**, we have by definition a **Septic patient**. Remember, I mentioned that SIRS is defined by **Tachycardia, Tachypnea, Fever and increased white blood count** (at least two of these must be present for SIRS). Obviously, the EMT cannot check a white blood cell count in the ambulance (at least as of yet), but certainly the EMT can detect tachycardia, tachypnea and fever. So, how and why does the body become acutely and highly “inflamed”? The answer is complex and the details are extensive and not necessary for the purpose of this discussion. The big picture is this: a pathogen, most likely a bacteria, invades the body. Where and how does the bacterial pathogen gain access to the blood stream and organs? The infection may start out in a number of ways, and the EMT should examine the patient carefully for clues to infection (pneumonia, cellulitis, skin abscess, urinary tract infection, etc).

The bacteria may release a **toxin**. The body responds to the invading organisms and mounts an **immune and chemical mediator response** which is exaggerated and causes a series of events which lead to multiple small **blood clots** which plug the small blood vessels and **reduces flow of blood and oxygen** to tissues and organs. This lack of blood supply to the organs results in **acute organ ischemia and dysfunction**. **In addition, the blood vessels are damaged and become “leaky” and dilated, which causes pooling of blood and hypotension**. **In summary, Septic Shock is characterized by infection, organ ischemia /dysfunction, leaky dilated blood vessels and hypotension.**

## SIGNS AND SYMPTOMS

As I have already stated, key symptoms and signs of sepsis include fever (or history of recent fever), tachycardia, pallor, increased respiratory rate / respiratory distress, cyanosis, acute mental status change, decreased urinary output, vomiting, diarrhea, presence of petechiae, hyperglycemia and metabolic (lactic) acidosis. **Look for evidence of infection such as Pneumonia, UTI, Cellulitis (red, hot inflamed skin and soft tissues), Septic Arthritis (red swollen joint), Diarrhea, Abdominal Distension, Wound Infection, Meningitis, Indwelling Catheters or tubes** which are all susceptible to infection. If pneumonia is the primary cause of sepsis, the patient may exhibit hypoxia, wheezing, rhonchi and rales (abnormal lung sounds). On the extreme end of the spectrum, the patient in septic shock will be hypotensive. *The elderly patient may not exhibit fever, and may even be relatively hypothermic.* In the emergency department certain ancillary tests are helpful to solidify the clinical diagnosis. An elevated white blood count (the elderly may actually have a low white blood count due to dysfunction of the immune system), acidosis with increased lactic acid levels, presence of pneumonia on chest x-ray or CT scan, evidence of bacteruria or pyuria (white blood cells in the urine), findings of pus or bacteria in the spinal fluid (if lumbar puncture is performed), and positive blood cultures are confirmatory studies for the presence of Sepsis.

## TREATMENT

As with STEMI, Stroke, and Trauma -----> “time is tissue, time is life”. In other words, **early** identification, stabilization and definitive treatment will prevent disability and death. This is why I believe it makes sense for **EMS providers to be the initial focal point of the Sepsis Team. We will be adding an addendum to the EMS Protocols with a page dedicated to the treatment of Severe Sepsis/Septic Shock.**

Once you have identified / suspected that the patient has severe sepsis or **septic shock** the following **treatment guidelines** are employed:

- Maintain Airway Do whatever is necessary to ensure oxygenation and ventilation
- High flow oxygen → CPAP→Invasive Airway Management
- **ResQGard** for *spontaneously breathing hypotensive patient* (Impedence Thershold Device) – quickly improves venous return to the heart and cardiac output. High flow oxygen can be delivered thru the port.
- IV or IO fluid bolus (2 lines in the hypotensive patient)
- **Saline bolus** (one liter or 20cc/kg)
- 12-lead EKG → transmit
- Glucometer
- Lactic Acid level –if you have access to the device

**In the ED**, CBC, blood cultures, chest x-ray, Arterial Blood Gas, urinalysis and urine culture, CT of the head, and lumbar puncture are some of the additional tests performed. Combination antibiotic administration within one hour is vital to reduction of mortality. Continued fluid/vasopressor therapy to maintain perfusion is critical. In addition, hemodynamic monitoring via arterial line, central venous catheter and NICOM device may be performed in the ED or ICU.

## SUMMARY

Like STEMI, Stroke and Multiple Trauma, SEPSIS Syndrome is a major cause of death. As a result, it is essential that we learn the language of Sepsis, and become familiar with the terminology so we all “speak the same language” when it comes to communication of issues regarding the septic patient. Sepsis, as a syndrome, has a spectrum of severity ----all the way to refractory septic shock. It is important to include **Severe Sepsis** in your list of differential diagnoses in the patient with acute mental status change—**especially if they have had recent fever, tachycardia, and acute respiratory symptoms.** Initial treatment will include airway support, ResQGard for the hypotensive, spontaneously breathing patient and IV fluid bolus. We will make an addendum to the EMS protocols to include a page dedicated to identification and treatment algorithm for Severe Sepsis/Septic Shock. Finally, we are considering performing a research study to determine if this septic protocol reduces the patient time in the ICU and mortality. If we are able to conduct such a study for publication, we would attempt to obtain portable Lactic Acid measuring devices for the squads participating in this study.