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PREHOSPITAL ANTIBIOTICS

South Carolina brings definitive sepsis care into the ambulance

By Jason G. Walchok, NRP, FP-C; Martin E. Lutz, MD, FACEP & Ronald G. Pirrallo, MD, MHSA, FACEP

Medic 29 is dispatched to a college dorm for a female with chief complaint of lower abdominal and flank pain for the past five days.

The dorm room appears clean and well kept. The patient appears to be a typical 18-year-old college student. She's lying on her bed and is responsive to verbal stimuli, hot to touch, and tachycardic with weak and thready radial pulses at 128. She reports painful urinating for the past 48 hours, general malaise, weakness and nausea.

She appears to have labored respirations with a room air SpO_2 reading of 95% and is hypotensive with a systolic blood pressure of 88 mmHg that remains low during transport to the ED. Oxygen is applied at 15 Lpm and IV access is obtained via a 16-gauge catheter with 800 mL of normal saline administered en route.

The working diagnosis in the ED is septic shock secondary to a urinary tract infection. A central line is placed and norepinephrine and IV antibiotics are started while the patient is moved to the ICU.

Over the course of two days, the patient's shock is refractory to treatment leading to multisystem organ failure and the patient's death.

BACKGROUND

Advancements in prehospital care for cardiac arrest, ST elevation myocardial infarction (STEMI) and acute stroke have demonstrated the vital role that EMS has in the identification and early intervention in these life-threatening conditions. One disease that's been overlooked for some time is sepsis; more importantly, severe sepsis and septic shock. Severe sepsis is responsible for long hospital stays and septic shock continues to be a leading cause of in-hospital death, with severe sepsis and septic shock contributing to nearly 40% of the in-hospital mortality rate.[1,2]

In most paramedic education programs, septic shock is only covered briefly, typically as a type of distributive shock. No significant emphasis is placed on prehospital identification or management of sepsis, short of treating

the hypoperfusion with fluids and administering vasopressors as a last resort.

In the last five years, there's been a significant push by the Surviving Sepsis Campaign to identify sepsis early and begin treatment rapidly to decrease mortality. The campaign's approach of promoting treatment bundles has demonstrated the potential to save lives.[3]

EMS providers at all levels are well-trained to identify when a patient is critically ill and are empowered to provide care to correct a wide spectrum of life threats. But do EMS providers know how to identify a patient with severe sepsis, and are they equipped with the knowledge and tools to not only identify but also combat the time-sensitive medical emergency of septic shock?

PREHOSPITAL IMPACT

In South Carolina, Greenville County EMS (GCEMS) began to look closely at the outcomes of severe sepsis patients. It was found that GCEMS paramedics transported 3–4 sepsis patients a day to local EDs.

The time from EMS arrival to identification and treatment of the septic patient ranged greatly, with a mean time of EMS arrival to the delivery of in-hospital antibiotics of 135 minutes and a mean time of ED arrival to the delivery of antibiotics of 101 minutes.

Most of the sepsis patients presented with fever, tachycardia and tachypnea. Protocols allowed treatment of these symptoms but providers were unable to identify patients suffering from sepsis and nor provide any focused intervention. This is typical in many EMS systems and EDs in the United States.

Antibiotics are an important early treatment for severe sepsis. Surviving Sepsis Guidelines suggest a broad-spectrum antibiotic be administered within the first hour after recognition of severe sepsis and septic shock.[3]

Their data shows that the sooner patients received an antibiotic once severe sepsis was identified, the better their outcome, with mortality decreasing by 8%.[4] On average, antibiotic therapy within the first hour of severe sepsis recognition contributed to an 80% survival.[4]

EMS providers are typically taught that antibiotics are for definitive in-hospital treatment and have no role in the prehospital setting. But the data indicates otherwise.

Most medical directors or EMS providers won't argue the importance of EMTs and paramedics administering aspirin in the presence of acute coronary syndrome or even a STEMI. Yet, the number needed to treat (NNT) a STEMI patient with aspirin is 42. That means an EMT or paramedic would have to give aspirin to 42 STEMI patients to prevent 1 death. Broad-spectrum antibiotics in the presence of severe sepsis, however, carries an NNT of 1:3.[5] It could be argued that the only other comparable medication that EMS carries would be epinephrine for the treatment of anaphylaxis.

Researchers have identified that EMS transports 34% of all patients diagnosed with sepsis, and 60% of all severe sepsis patients arriving to the ED, and EMS can play a key role in the early identification and treatment of these patients.[6–7] If sepsis is recognized by EMS personnel, the reduction in time to antibiotic and early goal-directed therapy initiation is substantial (69 vs. 131 minutes)[8] and the mortality of severe sepsis patients can be significantly decreased (13.6% vs. 26.7%).[2]

GREENVILLE'S APPROACH

With this evidence in mind, GCEMS collaborated with two of the county's hospital systems to develop a sepsis assessment and treatment tool that utilizes criteria established by the Surviving Sepsis Campaign.[3]

Key to identifying the septic patient is to understand the systemic inflammatory response to an infection. A pathogen can enter the body by a number of routes, such as tissue injury, indwelling catheter or pulmonary. This causes the stimulation of monocytes to produce regulators in an attempt to control and isolate the insult.

These regulators cause local vasodilation and a release of various cytotoxic chemicals, which, in a healthy patient, will destroy the invading pathogen. In some patients, however, the body's normal compensatory mechanisms fail, resulting in an inflammatory cascade that continues throughout the body. Damaged tissue, usually in the capillary lining of the

Once prehospital blood specimens are collected by Greenville County EMS, a broad-spectrum antibiotic is administered along with normal saline at 30mL/kg, or up to 2 liters if the patient exhibits no signs of fluid overload.

vasculature leads to increased vasodilation, hypoperfusion, microcirculatory collapse, end organ failure and eventually death. Understanding this cascade and systemic inflammatory response syndrome (SIRS) lead to the criteria used by GCEMS paramedics to identify the septic patient.

Four SIRS criteria are used:

1. Tachycardia (heart rate > 90 bpm);
2. Tachypnea (respiratory rate > 20) or mechanical ventilation;
3. Hyperthermia (body temperature > 101 degrees F or 38 degrees C) or hypothermia (body temperature < 96.8 degrees F or 36 degrees C); and
4. Signs of poor perfusion (systolic blood pressure < 90 mm/Hg).

Two of these four SIRS criteria in a patient with a known or suspected infection, identified by a thorough history and physical exam, prompts EMS providers to declare a sepsis alert that's called in to the receiving ED and the sepsis protocol for prehospital treatment is initiated.

The goal of prehospital treatment is to support end organ perfusion and deliver an immediate broad-spectrum antibiotic. Prior to antibiotic administration, blood should be collected for in-hospital testing of serum lactate—lactic acid is present in septic patients as a result of anaerobic metabolism (i.e., when oxygen delivery to the tissues is insufficient). This is an indication of organ dysfunction secondary to hypoperfusion to end organs, such as the kidneys.

Measuring blood lactate levels can be obtained by a point-of-care machine or laboratory analysis. Lactate levels of > 2.2 mmol/L in the presence of two SIRS criteria with a source of infection is the definition of "severe sepsis."[3]

Due to the Clinical Laboratory Improvement Amendments requirement of a moderately complex laboratory license, very few point-of-care machines are used by EMS in the U.S., although efforts are being made to make them more widely available. Therefore, GCEMS providers obtain a blood sample in the field prior to fluid administration. Doing this provides the receiving ED physician and admitting team with the ability to measure an initial lactate level prior to further resuscitation of the patient.

The next step in the protocol is blood culture collection. Blood cultures are an important step in confirming the diagnosis of sepsis and directing the appropriate continuing antibiotic treatment. Moreover, blood cultures in suspected severe sepsis are part of the Center for Medicare & Medicaid Services (CMS) core measure treatment bundle.

To be compliant with this core measure, a set of blood cultures (anaerobic and aerobic) must be collected prior to antibiotic administration. The process in which blood cultures are collected isn't unlike drawing other labs, but the potential for contamination was assumed to be high in the prehospital setting due to the working environment. Therefore, prior to implementing this protocol, GCEMS had to prove to the receiving hospitals that our paramedics could consistently draw blood cultures in the field with a low (< 6%) contamination rate before they were authorized to begin administering antibiotics.

Once prehospital blood specimens are collected, a broad-spectrum antibiotic is administered along with normal saline at 30mL/kg, or up to 2 liters if the patient exhibits no signs of fluid overload.

IV or interosseous ceftriaxone 1 g is used for suspected pneumonia and piperacillin/tazobactam 4.5 g for all other sources. The antibiotics were chosen for their broad spectrum capabilities and the receiving hospital pharmacies determined community bacteria sensitivities. These antibiotics also represent the standard of care at both receiving hospital systems.

RESULT, OUTCOMES & IMPACT

Since November 2014, GCEMS has treated more than 650 patients using the sepsis alert protocol. After a three-month trial of EMS blood culture collection, antibiotic administration began in February 2015 after which 430 patients were treated with 59% receiving prehospital antibiotics.

Antibiotics were withheld any time a penicillin allergy was identified, blood cultures couldn't be collected or when vascular access was unsuccessful.

ICD-9 admitting diagnoses in the ED confirmed the paramedics' prehospital working assessment in nearly 80% of patients.

In-hospital lactate analysis showed an elevation of lactate greater than 2.2 mmol/L in 44% of patients. Blood cultures contamination rates are currently 5.66%, with zero contaminations in the past two months.

Patient mortality due to sepsis has decreased to among the lowest levels in the hospital systems' history and it's reported that cost savings due to decreased length of hospital stay is approaching $600,000.

CONCLUSION

The Greenville County prehospital sepsis alert protocol shows EMS agencies have an opportunity to have a significant impact on reducing sepsis mortality in their communities. Through collaboration with local hospitals, GCEMS has shown that aggressive sepsis treatment

and prehospital antibiotic administration isn't only possible by paramedics, but should be the standard of care. JEMS

Jason G. Walchok, NRP, FP-C, is the training and education coordinator for Greenville County EMS. He has 14 years of experience in both fire-based and third-service EMS agencies. He was instrumental in the development and implementation of the sepsis alert protocol that's now part of the EMS system in the state of South Carolina. He may be contacted at jwalchok@greenvillecounty.org.

Martin E. Lutz, MD, FACEP, is the chief of emergency medical transport services for Greenville Health System (GHS) and medical control physician for Greenville County EMS, GHS Mobile Care, Eagle Med fixed wing service and GHS Med Trans helicopter service. He's also an associate clinical professor of emergency medicine at the University of South Carolina School of Medicine, Greenville.

Ronald G. Pirrallo, MD, MHSA, FACEP, is an emergency physician and vice chair of academic affairs for the Department of Emergency Medicine in the Greenville Health System. He's also professor of emergency medicine at the University of South Carolina School of Medicine, Greenville, and past president of the National Association of EMS Physicians. He previously served for two decades as the director of medical services for the Milwaukee County EMS system.

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EMS Insider

LEGAL PITFALLS IN THE REALM OF SEPSIS TREATMENT

You are called in the middle of the night to a hotel in a high altitude tourist city. Your patient is a 32-year-old female who arrived from sea level the previous night, and has felt unwell with intractable vomiting since that time.

She has a history of rheumatoid arthritis and is on Prednisone. Her heart rate is 120, her blood pressure 110/60, but she tells you she normally has low blood pressure. Her blood glucose is 92.

The patient has full decisional capacity, but refuses transport when she finds out there is a charge for EMS transportation to the hospital. Hours later, the patient presents to the emergency department via taxi. She is subsequently diagnosed with severe sepsis and, despite aggressive treatment, she dies within 24 hours.

Two years later, you are informed that her parents have filed a lawsuit alleging that EMS failed to properly assess her and educate her on the potential severity of her condition so that she could make a fully informed decision regarding EMS transport.

There are four elements of negligence that a plaintiff must prove in order to recover a monetary award in litigation in these cases. Learn what the elements are and how to protect yourself and your agency from this liability by reading the full article at **jems.com/ems-insider/sepsis-pitfalls.**

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