



**Elmhurst Hospital Center
Emergency Department
Critical Care**

Sepsis

Ideal care of severely septic patients in the ED can be demonstrated by the following case:

A 75 y/o male with 4 days of malaise, cough, and subjective fever presents to the ED. At triage, he is found to have a temperature of 102.6 F, he is tachycardic at 112, and has a blood pressure of 126/62. He is placed into the A-zone and standard labs are drawn as well as blood cultures. Since blood cultures are being drawn, the nurse also draws a venous blood gas syringe in order to get a lactate level. The patient is seen by a resident a short time later, who orders a chest x-ray, UA, Tylenol, and a 500 cc bolus of normal saline.

The patient's lactate returns at 4.4 mmol/L. Recognizing that this patient is severely septic, the resident moves the patient to an open spot in the cardiac room. The patient has a portable chest x-ray, which demonstrates a right middle lobe infiltrate.

The patient is started on appropriate antibiotics for severe community acquired pneumonia. The resident and attending place a sterile central venous line into the right internal jugular vein under full sterile precautions. A CVP reading of 2 mmHg is obtained.

The team begins fluid loading in 500 cc aliquots of lactated ringers in an attempt to get the CVP to above 10 mmHg. The attending places a consult to the RICU fellow to begin making a bed for the patient.

After bolusing, the patient's CVP is now 12; but he begins to get drowsier. The decision is made to intubate the patient. This is accomplished rapidly using ketamine and succinylcholine. After confirming tube placement, ventilator settings are chosen to minimize the potential for ventilator induced lung injury. The patient is started on versed and fentanyl drips, which are titrated to the patient's sedation level using a standardized scale.

The patient's CVP drops to 8 after the initiation of mechanical ventilation; the resident gives more fluid, now aiming for a CVP goal of 12-14 due to the positive pressure ventilation. After this reloading of fluids, the patient's blood pressure is still only 80/50. An infusion of norepinephrine is started, titrated to a MAP of 65-70.

A venous blood gas is drawn from the distal port of the central line. It returns with a saturation value of 61 mm Hg (ScvO₂). An infusion of dobutamine is started at 5 mcg/kg/min.

The RICU resident and fellow see the patient and will have a bed available in about thirty minutes. A repeat central venous blood gas is sent along with an abg. The ScvO₂ is now 76 mm Hg and the ABG values are excellent. The patient is packaged for transfer to the ICU.

He is extubated two days later and goes home five days after his original presentation to the emergency department.

The Bundles

The Institute for Healthcare Improvement (www.IHI.com) is a not-for-profit organization committed to driving the improvement of health by advancing the quality and value of health care. The government looks towards many of the organizations recommendations to determine health care policy.

The Institute for Healthcare Improvement has designed two bundles to allow the easy implementation of the current standard of care for severe sepsis. One bundle relates to the care of severely septic patients in the ICU. The bundle directly relevant to us outlines the best care of these patients in the ED.

Severe Sepsis Bundle for the ED¹

- Serum Lactate Measured
- Blood Cultures Obtained Prior to Antibiotic Administration
- Improve Time to Broad-Spectrum Antibiotics
- Treat Hypotension and/or Elevated Lactate with Fluids
- Apply Vasopressors for Ongoing Hypotension
- Maintain Adequate Central Venous Pressure
- Maintain Adequate Central Venous Oxygen Saturation

The following discussion is quoted and adapted from the IHI's descriptions of each bundle component.

¹ <http://www.ihl.org/IHI/Topics/CriticalCare/Sepsis/Tools/SevereSepsisBundle.htm>

Serum Lactate Measured

An elevated lactate is both diagnostic and prognostic in patients with severe sepsis. Further, the clearance of this elevated lactate is associated with improved outcomes. Because severe sepsis may be present without hemodynamic alterations, unless a lactate is sent in all infected patients, the severity of illness may be underestimated.

Implications

Given the high risk for septic shock, all patients with elevated lactate > 4 mmol/L should enter the early goal-directed therapy portion of the Severe Sepsis Resuscitation Bundle, regardless of blood pressure.

Implementation

All patients who have blood cultures drawn should have an abg syringe of venous blood drawn as well to be sent to the lab for lactate. Because prolonged tourniquet time can falsely elevate lactate levels, every effort should be made to draw the venous lactate as the first tube and place the syringe on ice as quickly as possible.

For more information on how to draw a lactate, go to <http://ehced.org/Misc/lactate.htm>

“If you draw blood cultures, draw a lactate”

Cultures Obtained Prior to Antibiotic Administration

Collecting cultures prior to antibiotic administration offers the best hope of identifying the organism that caused severe sepsis in an individual patient. Failure to check blood cultures prior to antibiotic infusion will perhaps affect the growth of any blood borne bacteria and prevent a culture from becoming positive later. Two or more sets of blood cultures are recommended.

In patients with suspected catheter-related infection, a pair of blood cultures obtained through the catheter hub and a peripheral site should be obtained simultaneously. If the same organism is recovered from both cultures, the likelihood that the organism is causing the severe sepsis is enhanced. In addition, if the culture drawn through the vascular access device is positive much earlier than the peripheral blood culture (i.e., > 2 hours earlier), it may offer support that the vascular access device is the source of the infection.

If the urine is a possible source, urine cultures should be collected and sent prior to antibiotic administration as well. Similarly, if bacterial peritonitis is a possibility, peritoneal cultures should be sent. In suspected meningitis or meningo-encephalitis, a lumbar puncture should be performed as soon as possible, after antibiotic administration.

Indications

Fever, chills, hypothermia, leukocytosis, left shift of neutrophils, neutropenia, and the development of otherwise unexplained organ dysfunction, e.g., renal failure or signs of hemodynamic compromise, are specific indications for obtaining blood for culture. Blood cultures should be taken as soon as possible after the onset of fever or chills.

Implementation

I believe we are already meeting the goals for this element, we merely need to continue our practices.

“If you are about to administer any antibiotic, ask yourself if cultures need to be sent”

Improve Time to Broad-Spectrum Antibiotics

Recommendation:

From the time of presentation, broad-spectrum antibiotics administered within 3 hours for ED admissions

Background:

Once severe sepsis is identified, antibiotics must be started rapidly to treat the underlying infection. Although early antibiotic administration seems to be an intuitive approach, administration of effective therapies is often delayed.

The balance of evidence suggests that early administration of appropriate antibiotics reduces mortality in patients with Gram-positive and Gram-negative bacteremias.

Choice of Antibiotics:

The choice of antibiotics should be guided by the susceptibility of likely pathogens in the community and the hospital, as well as any specific knowledge about the patient, including drug intolerance, underlying disease, the clinical syndrome. The regimen should cover all likely pathogens since there is little margin for error in critically ill patients. There is ample evidence that failure to initiate appropriate therapy promptly (i.e., therapy that is active against the causative pathogen) has adverse consequences on outcome.

Although restricting the use of antibiotics, and particularly broad-spectrum antibiotics, is important for limiting superinfection and for decreasing the development of antibiotic resistant pathogens, patients with severe sepsis or septic shock warrant broad-spectrum therapy until the causative organism and its antibiotic susceptibilities are defined.

Implementation

We should give broad coverage in any patient with severe sepsis. Our current antibiotic choices for broad coverage are extremely limited. We therefore must meet with ID and the medical ICU intensivists to devise an approach to initiation of broad-spectrum antibiotics rapidly in the emergency department.

We must also consider rapid source control in patients with a surgical infection or implanted device.

“Start broad spectrum antibiotics early in every severe sepsis patient”

Treat Hypotension and/or Elevated Lactate with Fluids

In the event of hypotension and/or lactate > 4 mmol/L deliver an initial minimum of 20 ml/kg of crystalloid (or colloid equivalent).

Background

Patients with severe sepsis and septic shock may experience ineffective arterial circulation due to the vasodilatation associated with infection or impaired cardiac output. Poorly perfused tissue beds result in global tissue hypoxia, which is often found in association with an elevated serum lactate level. Patients who are hypotensive or have a lactate greater than 4 mmol/L require intravenous fluids or colloid to expand their circulating volume and effectively restore perfusion pressure.

The bundle does not restrict the amount and extent of an initial fluid challenge, but rather defines a minimum challenge. Subsequent actions in the bundle are undertaken only for hypotension not responding to fluid challenge or for an elevated lactate level as above.

Implementation

Give 20 cc/kg of isotonic fluid as an initial bolus to a patient with severe sepsis.

“Fluid bolus is the first treatment for severe sepsis”

Apply Vasopressors for Ongoing Hypotension

apply vasopressors for hypotension not responding to initial fluid resuscitation to maintain mean arterial pressure (MAP) > 65 mm Hg.

Background:

When an appropriate fluid challenge fails to restore an adequate arterial pressure and organ perfusion, therapy with vasopressor agents should be started. Vasopressor therapy may also be required transiently to sustain life and maintain perfusion in the face of life-threatening hypotension, even when hypovolemia has not been resolved or when a fluid challenge is in progress.

Monitoring:

Because hypotension is a primary feature of septic shock and improving blood pressure is a therapeutic goal, accurate and continuous measurement of blood pressure is essential. It is therefore customary to use an arterial catheter to enable continuous invasive blood pressure monitoring.

”Norepinephrine for ongoing hypotension after fluids”

Maintain Adequate Central Venous Pressure

Achieve central venous pressure (CVP) of > 8-10 mm Hg (12-15 if the patient is intubated)

By monitoring for and maintaining an adequate CVP, hypotension and/or ongoing lactic acidosis will be treated in a way that maximizes organ perfusion. Without this monitoring, clinicians may be falsely reassured by “normal” blood pressure readings, especially in the face of vasopressor use.

Implementation

The recommendations above imply the presence of central access; this recommendation requires it. Further, in order to accurately monitor CVP, a subclavian or internal jugular catheter is required. The presence of the new vessel finder will make this goal easier. We must be cognizant that early on, the increased number of procedures coupled with potentially inexperienced housestaff will likely increase the number of mechanical complications.

In addition, both nursing and resident education will need to be created in order to train the staff on the setup and use of pressure monitoring devices. I have already been in contact with Biomed and we have added a number of pressure monitoring modules to the cardiac and trauma room.

For a how-to on setting up a cvp monitor, go to <http://ehced.org/Misc/pressure.htm>

“Keep CVP at goal throughout the ED stay using fluids and blood”

Maintain Adequate Central Venous Oxygen Saturation

Corresponding Bundle Element:

In patients with septic shock and/or lactate > 4 mmol/L achieve central venous oxygen saturation (ScvO₂) of > 70 percent.

Importance of Early Therapies:

The resuscitation of severely septic individuals with lactate > 4 mmol (36 mg/dl) or in septic shock must start early. It seems that the longer the resuscitation is delayed, the less likely a beneficial effect will be accrued. This makes sense, as the purpose of resuscitating a patient is to prevent further organ dysfunction and failure. If the resuscitation is delayed until after cellular dysfunction and death is present, then strategies designed to provide the cells with more oxygen are unlikely to be helpful. It is unclear however when the transition from reversible cellular dysfunction to irreversible cellular dysfunction occurs. At present, the only strategy that we can employ is to provide the resuscitation at the earliest stage possible.

Maintaining ScvO₂:

Techniques to maintain ScvO₂ include two principal strategies. In carrying out early goal directed therapy, if a patient is both hypovolemic and the hematocrit is less than 30%, it is appropriate to transfuse **packed red blood cells** provided that the fluid resuscitation has achieved a CVP > 10. If CVP > 10 has not been achieved, additional fluid challenges are needed

The second strategy involves attempting to improve the patient's hemodynamic profile with inotropes. Provided that the patient has been adequately resuscitated and the CVP is > 8 mmHg, it may be that cardiac output remains insufficient to meet metabolic needs of certain tissue beds despite an adequate circulating volume. In some cases, cardiac output itself may be diminished due to sepsis induced cardiac dysfunction. In these cases, **dobutamine infusion** (up to a maximum of 20 mcg/kg/min) should be employed to increase oxygen delivery to the periphery and prevent further organ dysfunction due to hypoperfusion and ischemia. If dobutamine infusion results in hypotension, norepinephrine should be used to counteract the vasodilatory effects of dobutamine.

Implementation

A central line with CVP apparatus will already be in place from the previous steps; a venous blood gas can be drawn from the distal port and sent to the laboratory

*“ScvO₂ equates to perfusion;
perfusion equates to survival”*

Implementing the bundle as a whole

In order to make this work in our ED, we will need to concentrate on three areas:

- Education
- Quality Assurance
- Integration and Coordination with the RICU

If we go forward with adoption of the sepsis bundle, I will begin to plan implementation in these three areas with your guidance.

“Early, aggressive therapy saves lives”

Additional Elements for the Elmhurst ED Protocol

Two additional therapies and one method of care should be stressed in our adoption of the bundle:

Steroids

Patients with septic shock who remain hypotensive after adequate fluid resuscitation and high dose vasopressors may have relative adrenal insufficiency. If your patient's CVP is > 10 and on levophed 20 mg/kg and still remains with a MAP < 65 , steroids should be administered. We are now recommending hydrocortisone 100 mg IV Q 8 hours.

Ventilator Settings

Any hypoxemic patient with severe sepsis should be intubated. Once we initiate mechanical ventilation, we should adhere to a lung-protective ventilatory strategy. This involves minimizing pressure and volume trauma as a result of our ventilator settings. In addition patients should not be placed in a supine position to minimize the risks of aspiration.

Sterile Technique

Another of the IHI initiatives is the reduction of central line infections. All of the CVCs placed in the ED should be performed under strict sterile conditions, unless placed emergently. This includes cap, mask, gown, and full body drape.