Septic Shock

To read an excellent review of septic shock, see the following *eMedicine* article:

> Filbin, Michael R.. Shock, Septic. Dec. 17, 2008. *eMedicinemedscape.com*. Retrieved January 28, 2009 from http://emedicine.medscape.com/article/786058-overview.

The following abbreviated points on symptoms and Emergency Department Care come from this article.

Physical

In 1992, The American College of Chest Physicians/Society of Critical Care Medicine defined meeting SIRS criteria as having at least two of the following four abnormalities:

- Temperature higher than 38°C or lower than 36°C
- Respiratory rate greater than 20 breaths per minute
- Heart rate greater than 90 beats per minute
- WBC count higher than 12,000/mm^3 or lower than 4,000/ mm^3 or with more than 10% immature forms (bands)

Emergency Department Care

Early Goal Directed Therapy (EGDT) protocol for patients with septic shock quoted from the above article:

"EGDT is basically a 3-step protocol aimed at optimizing tissue perfusion.

- The first step involves titrating crystalloid fluid administration to CVP by administering 500-mL boluses of fluid until the CVP measures between 8 and 12 mm Hg. CVP is a surrogate for intravascular volume, as excess circulating blood volume is contained within the venous system. Patients with septic shock will frequently require 4-6 L or more of crystalloid to achieve this goal. Clinical signs of volume overload should be monitored as well, including developing periorbital or extremity edema, crackles on pulmonary examination, increasing oxygen requirement, or increased difficulty breathing. In patients who are mechanically ventilated, the target CVP goal is 12-15 mm Hg due to increased intrathoracic pressure.
- The second step, if the patient has not improved with fluid alone, is to administer vasopressors to attain a mean arterial pressure (MAP) greater than 65 mm Hg. It is important to first administer an adequate crystalloid fluid challenge (at least 2 L normal saline) before administering vasopressors, unless the patient is in extremis and requires immediate vasopressor support.
- The third step is to evaluate the central venous oxygen saturation ($ScvO_2$), which is measured from the CV line in the superior vena cava. $ScvO_2$ is the oxygen saturation of blood returning from tissue capillary beds, and it reflects the difference between overall oxygen supply and demand. Similar to lactate, $ScvO_2$ is an indicator of adequate tissue oxygenation. An SvO_2 of less than 70% is considered abnormal and indicative of suboptimal oxygen delivery compared with oxygen demand.

    - Adequate oxygen delivery is first achieved by administering supplemental oxygen by face mask, increasing intravascular circulating volume, and increasing mean arterial pressure, or namely the first two steps of EGDT.
    - Additional means of increasing tissue oxygen delivery are to maximize oxygen delivery to the alveoli (mechanical ventilation with FiO_2 1.0), maximize the hemoglobin concentration (transfuse pRBCs if anemic), and augment cardiac output (dobutamine to increase inotropy once preload has been optimized). The protocol by Rivers et al called for a blood transfusion for hematocrit <30%.
    - As a last step in the protocol, dobutamine infusion was started (increasing cardiac output) if $ScvO_2$ <70% despite all the above measures being optimized.
- $ScvO_2$ >70 mm Hg is therefore the target goal of EGDT, indicating adequate oxygen delivery. Rivers et al measured $ScvO_2$ by means of a fiberoptic sensor at the tip of the CV catheter and a stand-alone monitor that displayed $ScvO_2$ continuously. This concept was based on earlier work that targeted treatment goals that were based on increasing tissue oxygen delivery. An alternative to continuous $ScvO_2$ measurement is to send a venous blood gas from the CV line for oxygen saturation, measured by a standard blood gas analyzer."