**Description/Etiology**

Sepsis is a clinical syndrome characterized by a severe infection and systemic inflammatory response syndrome (SIRS). SIRS can occur with or without an infection, but sepsis can only be diagnosed when SIRS occurs with a suspected or confirmed infection. Most infections associated with sepsis are due to Gram-positive or Gram-negative bacteria. Gram-positive bacteria include *Staphylococcus aureus*, *Enterococcus* spp., *Streptococcus* spp., and coagulase-negative *Staphylococcus*. Gram-negative bacteria include *Escherichia coli*, *Pseudomonas* spp., *Klebsiella pneumoniae*, *Rickettsia* (Rocky Mountain spotted fever), and *Haemophilus influenzae*. Other infections associated with sepsis are caused by fungi, viruses, or protozoa.

The bloodstream, the skin, and the respiratory, gastrointestinal, and genitourinary tracts are sites of infection associated with sepsis. Clinical symptoms of sepsis vary depending on the cause of infection, and may mimic other conditions, which can make sepsis difficult to diagnose. Laboratory and diagnostic tests are done to rule out other causes and to determine the cause of infection. Severe sepsis (i.e., sepsis with multiple-organ dysfunction) can lead to septic shock (i.e., severe sepsis with arterial hypotension despite adequate fluid resuscitation).

Treatment for sepsis is intensive antimicrobial therapy. Improved survival for patients who have been diagnosed with septic shock has been demonstrated with early goal-directed therapy (e.g., maintaining adequate urine output, arterial pressure ≥ 65 mm Hg, central venous pressure [CVP] 8–12 mm Hg). Supportive therapies for symptom management, transfusion of blood products, prevention of complications, and intensive patient monitoring are additional components of patient care. Collaboration of an interprofessional team of clinician specialists in infectious disease, critical care, and/or surgery may be necessary; in severe cases, dialysis and/or surgery (e.g., for resection of infectious site, resolution of renal disease) may be indicated. Prognosis depends on the pathogenic cause, site, and severity; the promptness and effectiveness of treatment; the host’s immune response; and whether organ dysfunction or septic shock has occurred.

**Facts and Figures**

Recent hospital discharge data indicate that severe sepsis affects up to 750,000 Americans each year. Incidence is estimated to increase approximately 1.5% each year due to such factors as the aging population, increasing use of implantable devices, and increasing resistance of bacterial microorganisms to antibiotic therapy. Incidence of sepsis in the United States is higher in men than in women and in non-Whites than in Whites. Mortality may be as high as 45% in patients who progress to septic shock.

**Risk Factors**

Risk factors for sepsis and death from septic shock include genetic factors, catheterization, presence of an intravascular or prosthetic device, certain surgeries, urinary tract infection, appendicitis, diverticulitis, Crohn’s disease, cholecystitis, renal disease, prostatitis, meningitis, and complicated obstetric delivery. Children, older adults (65+), and individuals who are immunocompromised are at increased risk for both sepsis and progression to septic shock. Additional risk factors for progression to septic shock include prolonged time between onset of symptoms and initiation of treatment, misdiagnosis of infection, and use of ineffective antibiotics.

**Signs and Symptoms/Clinical Presentation**

- Sepsis – fever or hypothermia, hyperventilation, chills, shaking, warm skin, skin lesions, lethargy, confusion, coma, hyperglycemia, ileus, muscle weakness, increased cardiac output
- Severe sepsis/septic shock – liver dysfunction (e.g., jaundice), cool skin, pancreatitis, renal failure, decreased cardiac output, acute respiratory distress syndrome (ARDS), multiple-organ dysfunction syndrome, encephalopathy, neuropathy, disseminated intravascular coagulation (DIC)

**Assessment**

- **Physical Findings of Particular Interest**
  - In adults, systolic blood pressure may be < 90 mm Hg or reduced at least 40 mm Hg from baseline with a mean arterial pressure < 70. Systolic blood pressure in children may be less than 2 standard deviations below normal for age
- **Laboratory Tests That May Be Ordered**
  - Blood cultures may be positive for bacteria; Gram stain may determine type of bacteria; daily tests may be indicated
- CBC may reveal a ↑ or ↓ WBC, a low platelet count, and/or anemia
- BUN, serum creatinine, myoglobin, osmolality, bilirubin, and lactate may be ↑; serum albumin may be ↓; liver enzymes may be ↑
- UA may show ↑ urine creatinine; urine culture may be positive for bacteria
- Coagulation studies may reveal prolonged PT, prolonged PTT, and ↓ fibrinogen, which may indicate DIC
- ABGs may reveal metabolic (lactic) acidosis, ↓ blood oxygen levels, or respiratory alkalosis
- Cytologic analysis of cerebrospinal fluid (CSF) may indicate meningitis

Other Diagnostic Tests/Studies
- Chest X-ray may be ordered to rule out pneumonia
- Ultrasound, CT scan, or MRI may be ordered to identify the site of infection

Treatment Goals
- **Support Goal-Directed Therapy and Promote Return to Normal Physiologic Function**
  - Antimicrobials are ordered to treat infection; type of medication used will depend on type of bacteria or other organism and site of infection; combination therapy may be ordered
    - Broad-spectrum antibiotics should be initiated as quickly as possible (ideally within the first hour) in patients who present with sepsis-like symptoms, even before diagnosis of sepsis is confirmed and/or the source of infection is identified
  - Vasopressors (e.g., dopamine, norepinephrine, vasopressin) and/or inotropics (e.g., dobutamine) may be ordered to treat hypotension
  - Corticosteroids (e.g., hydrocortisone) may be ordered to reduce systemic inflammation
  - Sodium bicarbonate may be ordered to treat acidosis
  - Prophylactic medications may be ordered to prevent complications, including
    - heparin to prevent deep vein thrombosis (DVT)
    - H2 receptor antagonists to prevent stress ulcers
  - If applicable, remove source of infection (e.g., catheter); drainage of abscess or debridement at site of infection may be ordered
  - Maintain patent airway and provide supplemental oxygen as ordered; mechanical ventilation or intubation may be ordered
  - Infuse prescribed intravenous fluids (e.g., normal saline, Ringer’s lactate solution) or colloids (e.g., albumin) to maintain electrolytes and restore circulating fluids
  - Transfuse prescribed blood products (e.g., whole blood, plasma products or packed red blood cells) and monitor closely for adverse reaction
  - Recombinant human activated protein C may be ordered to treat coagulopathy, if present

- **Monitor Patient Closely for Potential Complications and Provide Emotional Support**
  - Use aseptic techniques for care according to facility protocol; maintain skin integrity
  - Frequently monitor vital signs, oxygen levels, cardiac output, neurologic status, skin color, laboratory values, urine output, and glucose level
  - Monitor for complications, including organ failure, DIC, respiratory distress, and DVT
  - Ensure patient has adequate bed rest; provide enteral nutritional support, as ordered
  - Follow facility pre- and posttreatment protocols if patient becomes a candidate for dialysis or surgery; reinforce pre- and posttreatment education and ensure completion of facility informed consent documents; closely monitor patients for treatment complications
  - Assess anxiety level/coping ability; educate about sepsis/septic shock pathophysiology, potential complications, treatment risks and benefits, and individualized prognosis

Food for Thought
- Treatment with recombinant human activated protein C has been proven to decrease absolute mortality from septic shock by 6%
- Prolonged (≥ 5 days) low-dose (≤ 300 mg hydrocortisone or equivalent) corticosteroids have been shown to reduce 28-day mortality (Annane et al., 2009)
- Enteral administration of a supplement containing key pharmaconutrients has been shown to promote more rapid organ function recovery

Red Flags
- Closely monitor for tachycardia when using vasopressor or inotropic therapy
- Severe sepsis is the most common cause of death in noncoronary critical care units

What Do I Need to Tell the Patient/Patient’s Family?
- Provide discharge instructions and ensure understanding of the medication regimen, including potential adverse effects; educate about the need for continued medical surveillance

References