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The Pathophysiology of Sepsis: Early Recognition and Intervention in the Healthcare Setting

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Introduction

Sepsis is the leading cause of death in the United States (Cawcutt and Peters, 2014). There are 750,000 Americans who are diagnosed with sepsis annually and sadly, 220,000 of those diagnosed with the condition die; this makes the mortality rate for sepsis between 25 and 50 percent nationally (Butcher, 2016). Sepsis can affect anyone, however presents a higher risk of occurrence in those who are immunocompromised, individuals with comorbidities, patients with invasive devices, and those at both ends of the age continuum. "That means that just about every acute inpatient throughout a hospital is at risk" (Cawcutt and Peters, 2014, p.18).

"Every clinician should be able to recognize the signs and symptoms of sepsis, along with early management strategies, to expeditiously provide appropriate care and decrease resultant morbidity and mortality" (Cawcutt & Peters, 2014, p. 1572). Nurse anesthetists encounter patients across the entire lifespan in a wide array of settings. The ability to recognize sepsis and competently manage the septic patient is imperative in promoting optimal patient outcomes in the realm of nurse anesthesia.



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Pathophysiology

"Sepsis is an injury to the body resulting from the immune system's attempt to eradicate an infection" (Butcher, 2016, p. 18). The overarching condition of sepsis contains within it varying degrees of severity which include sepsis, severe sepsis, and septic shock (Butcher, 2016).

- Sepsis "is defined as probable (documented or suspected) infection and signs of systemic inflammation" (Jones & Puskarich, 2014, p. 35).
- Severe sepsis includes tissue hypoperfusion or organ dysfunction combined with sepsis (Jones & Puskarich, 2014, p.35).
- Septic shock is "sepsis induced hypotension despite adequate fluid resuscitation" (Jones & Puskarich, 2014, p. 35).

Septic shock is a form of distributive shock (Tazbir, 2012). Vasodilation leads to abnormal distribution of blood in the body and capillary leakage occurs as a result of the release of myocardial depressant factor (Tazbir, 2012).

Additionally, the vasodilation which occurs during septic shock comes as a result of the release of nitric oxide along with endothelium changes on blood vessel walls. "As a result of vasodilation and capillary leakage, the patient exhibits a lower blood pressure that decreases perfusion to vital organs, such as the kidney and brain" (Tazbir, 2012, p. 206).

Hypoperfusion leads to a change to anaerobic metabolism on a cellular level. Furthermore, "this alteration causes changes in the glycolic path and citric acid cycle metabolic pathways, causing high lactate levels and acidosis" (Tazbir, 2012, p. 206). The sodium potassium pump is impaired as cells continue without oxygen; and additionally, the lysosomal membrane ruptures causing cell death to occur (Tazbir, 2012). Patient presentation is directly related to perfusion abnormalities and include: decrease in urine output or deterioration of mental status.

Signs and Symptoms

The following highlights the clinical progression of sepsis throughout its continuum (Cawcutt and Peters, 2014, p. 1573).

SIRS: Meets 2 of the following 4:

- Temperature >38 deg C or <36 deg C
- Heart rate >90 beats/min
- Respiratory rate >30 breaths/min or arterial CO₂ <32mm Hg
- White blood cell count >12,000 or <4000 cells/mL or >10% band forms

Sepsis:

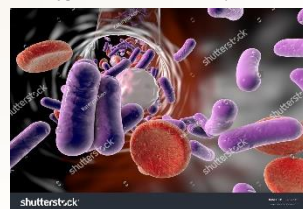
- 1991 definition: SIRS plus documented or suspected infection. Current definition: Documented or suspected infection plus systemic manifestations of infection (any of the SIRS criteria count, in addition other possible manifestations include elevations of procalcitonin, C-reactive protein, hyperglycemia in those without diabetes, altered mental status)

Severe sepsis: Sepsis plus evidence of organ dysfunction

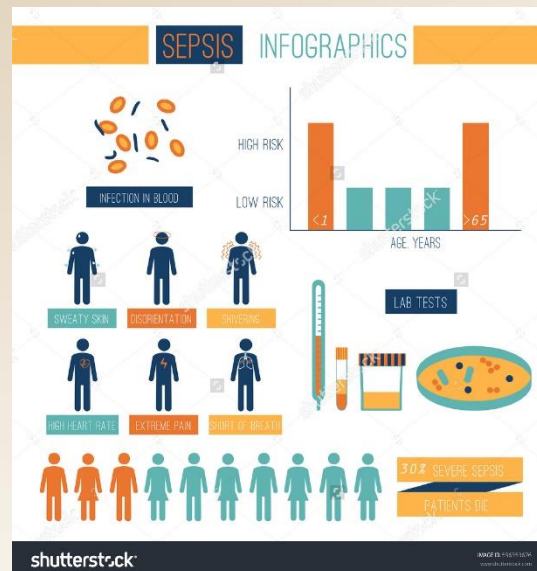
- Arterial hypoxemia (PaO₂/FiO₂<300)
- Acute oliguria (urine output <0.5 mL/kg per hour for at least 2 h despite adequate fluid resuscitation Increase in creatinine >0.5 mg/dL)
- Coagulation abnormalities (INR>1.5, aPTT>60 s, platelets <100,000/mL)
- Hepatic dysfunction (elevated bilirubin)
- Paralytic ileus
- Decreased capillary refill or skin mottling

Septic shock: Sepsis with hypotension refractory to fluid resuscitation or hyperlactatemia.

- Refractory hypotension persists despite resuscitation with bolus intravenous fluid of 30 mL/kg
- Hyperlactatemia >1 mmol/L



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Significance of Pathophysiology

The septic patient may not always be easy to identify as early stages of the condition can present in a subtle manner. Early signs and symptoms may, for example, present as a common cold or flu (Snyder et al., 2012). Additionally, compensatory mechanisms of the body during earlier stages of sepsis can mask the underlying severity of the condition. Being aware of risk factors can help the practitioner hone in on patients who are at high risk for sepsis (Snyder, Kivlehan, & Collopy, 2012). Furthermore, by recognizing the septic patient early on, better patient outcomes can be achieved.

In addition to being able to recognize sepsis, it is important that the advanced nurse practitioner be knowledgeable of the pathophysiological process involved. Since its formulation, the Surviving Sepsis Campaign has attempted to increase awareness of sepsis through the establishment of guidelines for use in clinical practice (Jones & Puskarich, 2014). An encompassing theme of the campaign involves early recognition and treatment of sepsis and septic shock. Such early recognition can be achieved by the advanced nurse practitioner most effectively through an understanding of the underlying pathophysiological processes of sepsis. Furthermore, a move for decreased mortality in the septic patient can be achieved through a familiarity with updated sepsis guidelines and research. "In recent decades, advances in the management of patients with severe sepsis and septic shock have demonstrated a great reduction in mortality from greater than 80% to approximately 20% to 30%" (Cawcutt & Peters, 2014, p. 1577).

Implications for Nursing Care

The implications for nursing care with an understanding of sepsis is paramount in providing optimal patient outcomes and reducing mortality. "Sepsis and severe sepsis (sepsis accompanied by acute organ dysfunction) are leading causes of death in the United States and the most common cause of death among critically ill patients in non-coronary intensive care units (ICU)" (Yende and Angus, 2014, p. 4). Recent data suggest that the cost of hospital care annually for patients with septicemia is \$14 billion in the United States (Yende & Angus, 2014, p. 4). These factors make sepsis an important public health problem.

Additional implications for understanding sepsis with regard to nursing care can be seen in the following examples (Faro, 2014). An inadequate approach to working up a septic patient carries a broad range of potential detrimental possibilities which include failing to recognize when infection is present, administering inappropriate empiric antibiotics, and performing an inadequate examination. Additional interventions signaling poor clinical judgement include sending off incorrect laboratory studies or cultures and failure to allow for surgical intervention in a timely manner as to allow for optimal treatment (Faro, 2014).

In regards to the management of the septic patient in the perioperative setting, "anesthesia practitioners should anticipate this cascade of events, noting the importance of starting perioperative, goal directed therapy" (Nolan, 2012, p. 7). Hypotension, for example, is an ominous sign of septic shock and can progress to multi-system organ failure (Nolan, 2012). Furthermore, goals should focus on:

- resolving lactic acidosis
- providing optimal oxygen delivery to the tissues
- intravenous fluid administration, such as colloids and blood products
- use of vasoactive drugs when appropriate
- Invasive hemodynamic monitoring such as arterial lines with the use of vasoactive drugs

"It is essential that an arterial line and central venous catheter be placed pre- or intraoperatively for volume resuscitation, frequent lab draws, and continuous hemodynamic measuring in order to achieve the resuscitative goals" (Nolan, 2012, p. 8). Central venous access may be used for the administration of vasopressors and to monitor central venous pressure in the septic patient (Cheng, Peakcock, & West, 2008). By having a thorough understanding of sepsis, the nurse anesthetist can effectively incorporate such interventions into practice as deemed appropriate.

Conclusion

Ongoing advancements in the management of sepsis along with the established guidelines put forth by the Surviving Sepsis Campaign have provided tools for practitioners to use in their fight against sepsis. "Increasing compliance is associated with a statistically significant decline in mortality rates" (Levy, Phillips, Rhodes, Schorr, & Townsend, 2014, p. 1632). An understanding of the pathophysiology of sepsis can allow for early detection and intervention which are both key factors involved in optimizing its management (Jones & Puskarich, 2014). An awareness of the implications for nursing care with regards to sepsis should be appreciated. Furthermore, knowledge of guideline treatment of the septic patient would undoubtedly assist the nurse anesthetist to fulfill his role as a competent provider in the perioperative setting and in the realm of anesthesia.

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