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

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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 early stages of septicaemia may 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 (Jordahl, Kyrle, & Gollob, 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 more 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).

References


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Pathophysiology

Sepsis is the leading cause of death in the United States (Cawcutt & Peters, 2014). There are 750,000 Americans who are diagnosed with sepsis annually and 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 is defined as a syndrome that 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 bed in this country is occupied by a patient who’s in sepsis risk" (Cawcutt & 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. 1577). Nurse anesthetists encounter patients across the entire lifespan in a wide array of situations that just about every acute inpatient bed in this country is occupied by a patient who’s in sepsis risk (Jones & Peters, 2014, p.1577).

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

"Sepsis is defined as a probable (documented or suspected) infection and signs of systemic inflammation" (Jones & Puskarich, 2014, p. 35).

"Severe sepsis includes tissue hypoperfusion or organ dysfunction with sepsis (Jones & Puskarich, 2014, p.35).

"Septic shock is a sepsis induced hypotension despite adequate fluid resuscitation (Jones & Puskarich, 2014, p. 35).

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

Additionally, the vasodilation which occurs during septic shock comes as a result of the release of nitric oxide along with endothelium derived relaxation on the vessel walls. "As a result of vasodilation and capillary leakage, the patient exhibits adequate systemic perfusion despite decreased perfusion to vital organs, such as the kidney and brain" (Taub, 2012, p. 266).

Hypoperfusion leads to a change to a more anaerobic system that is characteristic of a cellular level. Furthermore, "This alteration causes changes in the glycolytic path and ATP/ADP and ATP/ADP cycles, causing high lactate levels and acidosis" (Taub, 2012, p. 266). The electron potassium pump is impaired as cells continue to produce ATP and react with the lumenal potassium during tissue injury. The loss of the lysosomal membrane ruptures causing cell death to occur (Taub, 2012).

Patient presentation is directly related to perfusion abnormalities and include: decreases in urine output and deterioration of mental status.

Signs and Symptoms

The following highlights the clinical progression of sepsis throughout its continuum (Cawcutt and Peters, 2014, p. 1577).

SIRS:

Meets 2 of the following 4:

• Temperature <38°C or >38°C
• Heart rate >90 beats/min
• Respiratory rate >10 breaths/min or less
• White blood cell count <4,000 or >10,000 cells/mL

Hypoperfusion:

1991 definition: SIRS 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).

Septic shock:

Sepsis plus evidence of organ dysfunction

• Arterial hypotension
• (PaO2/FiO2<300)
• Acute oliguria (urine output <0.5 mL/kg/hour for at least 3 hours despite adequate fluid resuscitation)
• Increase in creatinine >0.5 mg/dL
• Groggality abnormalities (SBP<90, 80<AP<100, 100<MAP<100, 100<MAP<150)
• Hepatic dysfunction (elevated ALT/AST)
• Purpuric class
• Decreased capillary refill or skin mottling

Septic shock: Sepsis with hypotension and systemic inflammatory response syndrome

Refractory hypotension persists despite resuscitation with boluses of crystalloids (30-50 mL/kg)

Hyperlactatemia >1 mmol/L

Peptide-1 (38 mg/L)

Implications for Nursing Care

The implications for nursing care with an understanding of sepsis is enormous. "Sepsis and septic shock (sepsis accompanied by acute organ dysfunction) is a major cause of death in the United States and the most common cause of death among critically ill patients in non coronary intensive care units (ICUs)" (Tendle and Angus, 2014, p. 4). Hypoperfusion can lead to organ dysfunction and failure. "Infections for patients with sepsis is $14 billion in the United States (Tendle and Angus, 2014, p. 4). These factors make sepsis an important public health problem.

Additionally, implications for understanding sepsis with regard to nursing care on the ICU can be outlined. "The overarching goal of sepsis care is to expedite identification and timely treatment" (Farr, 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 sepsis shock and can progress to multi-organ system failure (Nolan, 2012). Furthermore, goals should focus on:

• Reaching lactate acidosis
• Providing optimal oxygen delivery to the tissues
• Intrinsic fluid administration, such as colloids and blood products
• Use of vasoactive drugs when appropriate
• Invasive monitoring as such arterial lines with the use of vasoactive drugs

"It is essential that an arterial line and central venous catheter be placed for a patient with sepsis in order to maintain adequate blood flows, and continuous hemodynamic monitoring in order to achieve the resuscitative goals" (Nolan, 2012, p. 8). Central venous access may also be used to monitor the central venous pressure and to monitor central venous pressure in the septic patient (Cheng, Pepekar, & West, 2008).

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 empirical antibiotics, and performing an inadequate examination.

Additionally, without monitoring of intravascular volume, "increasing pressure can lead to elevated central venous pressure and hypoperfusion which may contribute to failure in the management of patients with sepsis, the nurse anesthetist can effectively incorporate such interventions into practice as deemed appropriate."