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The Pathophysiological Process of Sepsis

Stefane Adams

stefane.adams@otterbein.edu

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The Pathophysiological Process of Sepsis

Stefane Adams, RN, BSN

Otterbein University, Westerville, Ohio

Introduction and Overview of Sepsis

- Sepsis is a medical emergency and can be a life-threatening illness that results as a complication from a severe infection, which occurs when chemicals that have been released into the bloodstream by the body's defense system work to fight off an infection (Mayo Clinic, 2016).
- One of the leading causes of deaths in patients in the hospital setting worldwide, becoming more common than breast and bowel cancer combined (Nursing Times, 2014).
- Sepsis can affect anyone; however it is more common in the elderly or in individuals with weaker immune systems.
- Health care providers (HCPs) must fully understand this disease process to assure that proper treatment is being implemented. According to Carleo & Vallejos, sepsis has become more common than heart attacks, while claiming more lives than cancer (2016).
- At the national level, morbidity rates for sepsis range from 25 to 50 percent, and more than 220,000 people in the United States die from this illness each year (Butcher, 2016).
- Understanding the pathophysiology of sepsis allows HCPs to provide adequate care and treatment plans to patients.

Signs and Symptoms

- Sepsis can begin anywhere that a bacteria or virus can enter the body.
- Many symptoms must be identified and explored for diagnosis, since there is no single sign or symptom.
- Can be identified as a systemic response to infection that displays two or more of the following symptoms as a result of infection: Temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$, Heart rate $>90\text{bpm}$, Respiratory rate >20 breaths /min or a PaCO₂ $<32\text{mmHg}$ and white blood cell count $>12,000$ cells/mm $<4,000$ cells/mm or $>10\%$ immature (band) forms (Nursing Times, 2014).
- Can display symptoms of infection including: vomiting, diarrhea, sore throat, fever, shivering, pain, shortness of breath, tachypnea, and tachycardia (Centers for Disease Control and Prevention, 2016).
- Past medical history is important for diagnosis. Sepsis can mimic symptoms of other infections or disease processes, resulting in a more difficult diagnosis.
- Individuals who have been receiving antibiotics are sometimes more difficult to diagnose with sepsis because a blood test may produce a false negative.
- Blood tests are performed to look for abnormal numbers of white blood cells, elevated lactate levels, or the presence of infectious agents (U.S. National Library of Medicine, 2016).

Underlying Pathophysiology

- Sepsis is one of the leading causes of mortality and morbidity worldwide; defined as a systemic inflammatory response initiated by a source of infection.
- The pathophysiology of sepsis involves, "the stimulation of the innate immune system, activation of white blood cells, and response of endothelial cells can lead to the release of a number of mediators or cytokines" (Kleinpell, Aitken, & Schorr, 2013, para. 4).
- This leads to a variety of physiological changes including vasodilation, enhanced expression of adhesion molecules, increased capillary permeability, increased clot formation, and decreased fibrinolysis.
- The overactivity of mediators contribute to endothelial cell damage, change in permeability, capillary leak, hypotension, and vasodilation; resulting in the progression of severe sepsis, while influencing the development of multiple organ system dysfunction (Kleinpell, Aitken, & Schorr, 2013).
- Systemic inflammatory response syndrome (SIRS) refers to a collection of signs that the body exhibits to show that it is reacting to a range of injuries or illnesses; not specific to infection.
- In response, the body may express signs of infection by raising the heart or respiratory rate to increase the amount of oxygen, altering body temperature or increasing white cell production in order to overcome infection
- Blood sugar may increase and any altered mental state may present as early signs of metabolic stress or hypoxia.
- Oxygen demands increase along with intravascular losses, which causes hypo-perfusion and ischemia at the cellular levels. When this happens, signs of severe sepsis and evidence of organ dysfunction are present.
- Most patients with sepsis present with hypotension and dehydration that usually responds well to fluid replacement. However, patients presenting with severe sepsis that have no response fluid replacement are in septic shock; if not timely managed, then leads to refractory hypotension, tissue ischemia, circulatory collapse and multi-organ failure.

Above information retrieved from (Nursing Times, 2014).

Pathophysiological Events

Includes changes in the function of endothelial tissue, in the coagulation process, and blood flow, which are caused by the cellular release of pro-inflammatory substances that respond to the infectious microorganisms.



Cytokines interact with endothelial cells, causing injury to the endothelium as well as possible apoptosis of the endothelial cells; which activates coagulation factors.



In the micro-vessels, the coagulation response combined with endothelial damage, can interfere with blood flow and cause the vessels to become leaky. Tissues begin to swell as fluid and microorganisms escape into the surrounding tissues.



Tissue edema in the lungs leads to pulmonary edema, and presents as shortness of breath.



Bleeding can occur if the supply of coagulation proteins becomes overworked.



Cytokines also cause blood vessels to dilate, which results in hypotension.

Above information retrieved from (Encyclopædia Britannica, 2017).

Implications for Nursing Care

- A clear understanding of the pathophysiology of sepsis is important for APNs.
- Managing the disease process appropriately by implementing effective therapies and treatments is part of good practice. By the use of appropriate sepsis protocols and treatment guidelines, the patient prognosis is increased.
- Obtaining a detailed history and physical is important to rule out disease processes.
- Identification of the source of infection is important for APNs to assure patients are treated in a timely manner.
- Implementation of sepsis care bundles has been proven to improve patient outcomes.
- If sepsis is diagnosed, early treatment includes the delivery of all elements of Sepsis Six within one hour of identification. This includes: full blood counts, blood cultures, strict monitoring of urinary output, oxygen therapy, fluid resuscitation, and administration of broad spectrum antibiotics (Nursing Times, 2014).
- In worst case scenarios, nursing care should also include giving consideration to the patients who are unlikely to respond to treatment and providing them with good end-of-life care (Nursing Times, 2014).

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SEPSIS STEPS

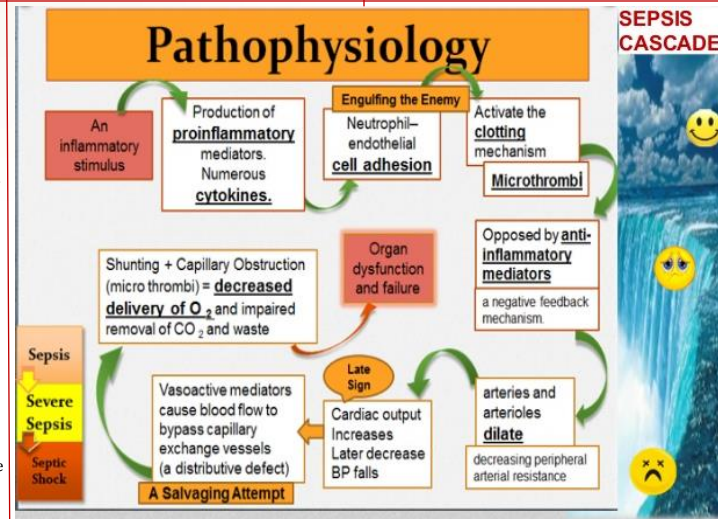
SIRS T: $>100.4\text{F}$ $<96.8\text{F}$ RR: >20 HR: >90 WBC: $>12,000$ $<4,000$ $>10\%$ bands PCO ₂ $<32\text{mmHg}$	SEPSIS 2 SIRS + Confirmed or suspected infection	SEVERE SEPSIS Sepsis + Signs of End Organ Damage Hypotension (SBP <90) Lactate $>4\text{mmol}$	SEPTIC SHOCK Severe Sepsis with persistent: Signs of End Organ Damage Hypotension (SBP <90) Lactate $>4\text{mmol}$
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Slides Courtesy of Curtis Merritt, D.O.

(Merritt, Curtis. (2016). *Difference between Sepsis and Septic Shock*. Retrieved from <http://pediaa.com/difference-between-sepsis-and-septic-shock/>)

Significance of Pathophysiology

- It is important for APNs to understand the signs and symptoms of sepsis. When a diagnosis is made in a timely manner, complications are decreased and prognosis is increased.
- Severe sepsis may lead to permanent organ damage, making early identification of sepsis crucial. Understanding the pathophysiology of this disease process and starting appropriate treatment is an important aspect of being a patient advocate.
- Nurses play a very important role in spotting the signs and symptoms of sepsis, especially since sepsis can be identified during routine observations.
- Understanding the significance of the pathophysiology of sepsis is vital. With this understanding, health care providers are aware that severe sepsis will not respond to fluid replacement. Depending on how septic the patient is, many alternative medication therapies may be required for treatment (Mayo Clinic, 2016).
- Since sepsis can be life threatening, providers should always be looking for organ dysfunction as well as the source of infection anytime infection is suspected (Society of Critical Care Medicine, 2016).
- With sepsis being a major cause of hospitalizations worldwide, mortality rates are also steadily increasing (Society of Critical Care Medicine, 2016).
- Sepsis screening tools are essential to the outcome of patient's health. Early identification by the use of systematic screening tools can be helpful for diagnoses and urgent treatments.



Rosa, Jessica. (2015). *Sepsis Pathophysiology*. Retrieved from <https://www.slideshare.net/JessicaDeLaRosa5/sepsis-dec-2015-sample>

Conclusion

- The pathophysiology of sepsis is complex and diagnosis can be difficult. Implementing quality measures and protocols for the care of patients with sepsis is top priority.
- Sepsis, severe sepsis, and septic shock represent progressive stages of the same illness, which is a systemic response to infection mediated via macrophage derived cytokines (World Journal of Medicine and Medical Science, 2013).
- Biomarkers and other lab tests can be beneficial for early detection of sepsis.
- With immediate diagnosis and treatment, overall prognosis is increased and better patient care is achieved (Weissman, 2016).
- Timely diagnosis, treatment and follow-up care by the APN is critical in the management and outcome of sepsis.

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