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Sepsis Pathophysiology

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Septic Shock

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Introduction

What is Sepsis?

- The body's dysregulated response to an infection that can be life-threatening (Backer et al., 2019).
- A life-threatening organ dysfunction caused by dysregulated host response to infection (Gyawali et al., 2019).

What is Septic Shock?

- Occurs once sepsis has progressed to involve circulatory, cellular, and metabolic abnormalities and is associated with a higher chance of mortality (Backer et al., 2019).
- Sepsis-induced hypotension persisting despite adequate fluid resuscitation (Gyawali et al., 2019).

Why Sepsis?

- Sepsis is one of the most common diagnoses in medical intensive care units (MICUs) worldwide and early identification is key in decreasing negative outcomes.
- It is estimated that $20 billion of United States healthcare expenses annually are from Sepsis (Taeb et al., 2017).
- It is estimated that 30 million people are effected by Sepsis worldwide annually, causing up to 6 million deaths (Gyawali et al., 2019).

Who is at risk for Sepsis?

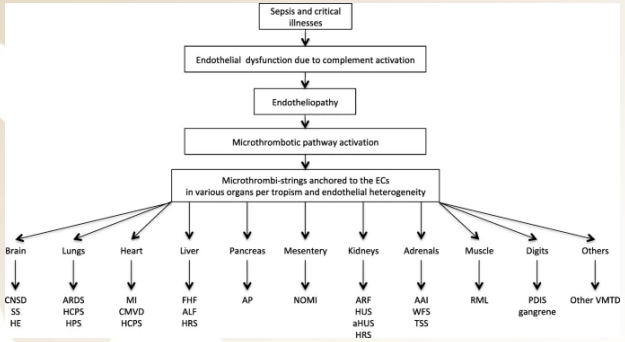
- Elderly (75 and older)
- People with learning disabilities
- Recent surgery, pregnancy, childbirth, or miscarriage
- Anyone with a wound or breach of skin
- Anyone with an indwelling catheter or line
- Anyone with an impaired immune system (Hunt, 2019)

Underlying Pathophysiology

In sepsis, the first step is the activation of innate immune cells via the binding of pathogen-associated molecular patterns (PAMPs) to specific pattern recognition receptors on these cells. Another source is damage-associated molecular patterns (DAMPs) that bind to receptors on monocytes and macrophages. These interactions result in activation of the intracellular signal transduction pathways that causes the release of proinflammatory cytokines. These cytokines cause activation and proliferation of leukocytes, upregulation of endothelial adhesion molecules and chemokine expression, complement system activation, induction of hepatic acute phase reactants, and tissue factor production. Sepsis causes an exaggeration of this response which results in damage and/or death of the host cells and tissue (Gyawali et al., 2019).

There is also an activation of both the inflammatory and coagulation cascades. This interaction has varying results from as severe as disseminated intravascular coagulation (DIC) to mild thrombocytopenia. The hypercoagulability of sepsis is not fully understood but is thought to be driven by the release of tissue factor from disrupted endothelial cells. Tissue factor causes the activation of the clotting cascade resulting in fibrin clots. These clots can cause perfusion deficits which result in tissue hypoxia and organ dysfunction. Sepsis also causes decreased plasma levels of protein C which usually has an anticoagulant effect. These low levels allow for unregulated propagation of the clotting cascade (Gyawali et al., 2019).

Some studies have also suggested that the immune system in septic patients is unable to create an effective response to the secondary infection. While the pathophysiology of sepsis is still not fully understood, there have been significant advancements in the last few years. These advancements have helped in the understanding and treatment of sepsis (Gyawali et al., 2019).



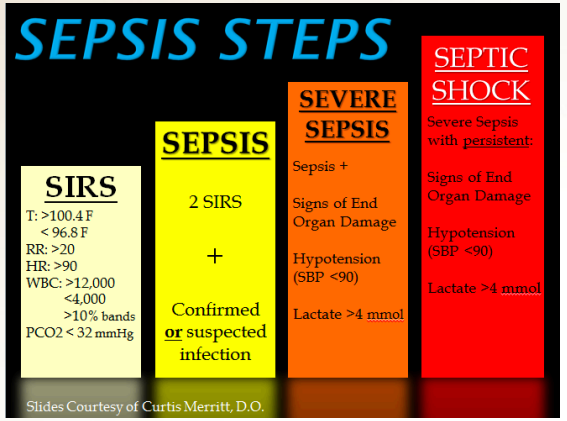
(Chang, 2019)

Significance of Pathophysiology

- Sepsis should be considered a medical emergency. Immediate and appropriate management is crucial in promoting positive patient outcomes and preventing further progression of the pathophysiological process.
- It is important to understand that any infection can cause sepsis. Because of this, blood cultures prior to antibiotic administration are extremely important in helping to identify the source. Once the source is identified, proper antibiotics can be utilized to eliminate the source. However, broad spectrum antibiotics are a must in the meantime to control the spread (Taeb et al., 2017).
- Advancements in the understanding of sepsis pathophysiology have led to the development and refining of protocols to treat sepsis. Therefore decreasing the mortality rates associated with sepsis and septic shock.

Signs & Symptoms

- White blood cell count greater than 12,000/mm^3 or less than 4,000/mm^3
- Heart rate greater than 90 beats per minute
- Respiratory rate greater than 20 breaths per minute
- Temperature greater than 38°C or less than 36°C (Taeb et al, 2017)
- Altered Mental Status
- Systolic blood pressure less than 90 mmHg (or a drop of 40 mmHg)
- No passage of urine in the past 18 hours or less than 30 ml/hour of urine if a catheter is in place
- Lactate greater than 2 mmol/L
- A new or increased need for oxygen to maintain and oxygen saturation greater than 92%
- Non-blanching rash, mottled/ashen/cyanotic (Hunt, 2019)



(Merritt, 2018)

Treatment

Sepsis treatment revolves around bundles where timely implementation is the focus. The previous 3- and 6-hour bundles have most recently been complied into a 1-hour bundle, further proving that early intervention is key.

Time Zero for this bundle is defined as the time of triage in the Emergency Department. If the patient is presenting as a transfer, time zero is associated with the earliest chart annotation consistent with the elements of sepsis (Levy et al., 2018).

1 Hour Bundle

- Measure a lactate level, if greater than 2 mmol/L, remeasure
- Obtain blood cultures prior to administration of antibiotics
- Administer broad spectrum antibiotics
- Begin rapid administration of crystalloid (30ml/kg) for hypotension or lactate greater than 4 mmol/L
- If patient is hypotensive during or after fluid resuscitation, start vasopressors to maintain a mean arterial pressure (MAP) > 65 (Levy et al., 2018)

Implications for Nursing Care

As nurses, we are often the most closely involved in our patients care and the most sensitive to patient changes. It is important to notice these subtle changes in a patient as early recognition and treatment are vital in the management of sepsis.

Some changes to assess for are:

- A change in breathing rhythm or rate
- Change in functional ability
- Change in behavior or mood
- Change in appetite
- Sleepiness or lethargy
- Feeling of impending doom
- A change in temperature (high or low)
- Reduced urine output
- Discolored skin
- Flu-like symptoms (Hunt, 2019)

If it is decided that a patient needs to be treated for sepsis, quick implementation of the bundle is necessary and should be prioritized in nursing care. It is also imperative for nurses to communicate with the interdisciplinary team about how the patient is responding to treatment. For example, if a patient remains hypotensive or becomes hypotensive despite adequate fluid resuscitation, it is necessary to communicate this change quickly and start pressors to prevent further organ damage.

It is important to consider that while the guidelines provide a standard approach to treatment, each patient needs to be treated as an individual. The guidelines may need to be adjusted to fit each specific patient situation dependent on comorbidities and patient wishes.

Conclusion

In conclusion, sepsis is one of the most common diagnoses in medical intensive care units worldwide. While there are many debates current only what fluids are best for resuscitation, if the addition of Vitamin C is beneficial, pressor choice, beta-blocker use, etc., it remains consistent through all studies that early recognition and intervention are crucial in promoting positive patient outcomes. The advancements in understanding of sepsis along with the increased attention to prompt intervention have helped in lowering mortality rates. However, there is a large responsibility places on providers to notice subtle changes in a patient's condition that can be indicative of the sepsis. Recognition of these subtle changes can help prevent further advancement of the pathophysiological process of sepsis and save lives.

Additional References

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