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Identifying Acute Organ Dysfunction as a Marker of Severe Sepsis
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Introduction: The current definition of sepsis is suspected or documented infection plus at least one systemic manifestation of infection. Identifying acute organ dysfunction is a marker of severe sepsis. This topic was chosen after witnessing a number of patients fall into septic shock before severe sepsis was diagnosed and treatment initiated. Diagnosis of severe sepsis is important for specific protocol to be implemented in a timely fashion. The current differentiation between sepsis and severe sepsis is evidence of organ dysfunction. There are a few examples of organ dysfunction that are not commonly considered when doing a patient workup. In cases requiring knowledge of acute organ dysfunction markers could potentially lead to early diagnosis of severe sepsis. The earlier it is diagnosed, the sooner treatment protocols can be initiated. Research showed that if severe sepsis is diagnosed timely, administration of timely and improved cardiovascular performance, lowered the inflammatory response, tissue hypoperfusion and multi-organ injury, and most importantly reduced mortality (Lin, Lee, & Wu, 2013).

Signs and Symptoms: The individual patient response to severe sepsis is dependent on characteristics of both the host (comorbidities and immunosuppression) and the pathogen (infectious and inflammatory load). Coagulation abnormalities form severe sepsis; such as intravascular coagulation and fibrinolysis that result in endothelial dysfunction, microvascular thrombosis, and impaired tissue ischemia. This impairment, combined with the systemic vasodilation and hypoxia, causes tissue hypoperfusion and decreased tissue oxygenation, further complicated by impaired mitochondrial oxygen utilization secondary to oxidative stress. These mechanisms result in further tissue damage and ultimately contribute to multi-organ failure. Signs and symptoms of organ dysfunction commonly include hypoxia, acute respiratory distress syndrome, altered mental status, acute kidney injury, heat, hypoxic dysfunction, disseminated intravascular coagulation, adrenal dysfunction, and encephalopathy. The patient will have multiple indicators of organ dysfunction. Examples include:

- altered consciousness
- confusion
- tachypnea, SPO2 decreased
- decreased oxygen extraction ratio
- lactic acidosis
- jaundice, decreased hepatic function
- increased bilirubin
- oliguria, decreased platelets and renal function

The signs and symptoms of organ function described by the American College of Chest Physicians (Cawcutt & Peters, 2014) are triggered by the infectious agent and are focused on the elimination of the pathogen, whereas the anti-inflammatory processes are triggered by the host to promote tissue repair and healing. An imbalance of these mechanisms lead to tissue injury.

Underlying Pathophysiology:
Severe sepsis and septic shock may be secondary to either community-acquired, health-care associated or hospital-associated infections. The most common underlying causes are pneumonia, intra-abdominal infections, or urinary tract infections. Endotoxins, organ ischemia, barriers with bacteria and fungal injury being predominant. However, Staphylococcus aureus, Staphylococcus epidermidis, Enterococcus species, Streptococcus pneumoniae, Escherichia coli, Pseudomonas aeruginosa, species within the Klebsiella family, and Candida species account for most of the pathogens described (Cawcutt & Peters, 2014). Infection triggers both pro-inflammatory and anti-inflammatory processes that ultimately contribute to the clearance of infection and the tissue damage that lead to organ failure. In general, the pro-inflammatory processes are triggered by the infectious agent and are focused on the elimination of the pathogen, whereas the anti-inflammatory processes are triggered by the host to promote tissue repair and healing. An imbalance of these mechanisms lead to tissue injury.

Significance of Pathophysiology:
Understanding the pathophysiology of severe sepsis is significant to good patient outcomes. The number of septic cases in the United States exceeds 750,000 per year and was recently reported to be rising. Sepsis is the 10th leading cause of death in the United States and the leading cause of death in non-cardiac ICUs. One patient in the United States presents every emergency department minute with severe sepsis and accounts for 20% of all ED admissions (Palleschi, Steinhour, O’Connor, Dunn, & Hansem, 2014). Knowledge of organ dysfunction markers could help identify severe sepsis quickly which means that treatment protocol can be initiated earlier. Comprehending the etiologic origins of sepsis and infectious threats they take, means appropriate anti-infective measures can be implemented and patient outcome improved. One example of the significance of severe sepsis is the symptom of low oxygen extraction ratio. Recent research shows that low oxygen extraction ratio is associated with severe organ dysfunction that resulted in high mortality with severe sepsis and septic shock. When patients had initial abdominal low OER, their in-hospital mortality was higher than in normal OER patients. Therefore, the OER should be considered when attempting to predict the outcome of septic patients (Kim, Lee, Lee, Ha, Min, & Hong, 2015).

Sepsis leading to Organ Failure
Sepsis, severe sepsis, and septic shock may be secondary to either community-acquired, health-care associated or hospital-associated infections. The most common underlying causes are pneumonia, intra-abdominal infections, or urinary tract infections. Endotoxins, organ ischemia, barriers with bacteria and fungal injury being predominant. However, Staphylococcus aureus, Staphylococcus epidermidis, Enterococcus species, Streptococcus pneumoniae, Escherichia coli, Pseudomonas aeruginosa, species within the Klebsiella family, and Candida species account for most of the pathogens described (Cawcutt & Peters, 2014). Infection triggers both pro-inflammatory and anti-inflammatory processes that ultimately contribute to the clearance of infection and the tissue damage that lead to organ failure. In general, the pro-inflammatory processes are triggered by the infectious agent and are focused on the elimination of the pathogen, whereas the anti-inflammatory processes are triggered by the host to promote tissue repair and healing. An imbalance of these mechanisms lead to tissue injury.

Nursing Considerations:
Increased nursing knowledge of organ dysfunction markers could improve severe septic patient outcomes. The earlier the patient is identified as severe sepsis, the sooner they can receive appropriate treatment. Recent studies show that nurses play a key role in the initial image and care of patients with potentially life-threatening sepsis. Researchers showed the impact of a nurse-initiated emergency department sepsis protocol to initial antibiotic administration, and had an impact on in-hospital mortality rates (Bruce, McFadden, & Freulon, 2015). A recent study by Galas and colleagues described the nursing clinical relevance by showing that elapsed time from triage to administration of unmodified oxygen and the primary determinant of mortality of patients with severe sepsis and septic shock (Galas et al., 2012). The knowledge of a severe sepsis screening tool significantly decreased the mean time to antibiotics to patients presenting to the ED with suspected severe sepsis or septic shock (Palleschi, Turner, & Curo, 2015). The research demonstrated that increased nursing understanding of sepsis and severe sepsis markers can significantly improve patient outcomes and care.

Conclusion:
Despite advances in the development of numerous drugs and supportive care therapies, severe sepsis remains an unacknowledged challenge for clinical investigators and physicians with an unacceptably high mortality rate of 28% to 50%. Sepsis is the most common cause of death in the non-cardiac intensive care unit (Mingmeng, Zhao, Mon, Zhao, Jh, & Jheng, 2015). Treatment protocol differs when a patient is determined to have severe sepsis as opposed to sepsis. For this reason, it is significant that health care professionals be familiar with the markers of organ dysfunction as a sign of severe sepsis. Knowledge of these markers and the pathophysiology associated with severe sepsis can improve patient outcomes significantly.

<table>
<thead>
<tr>
<th>Table 1: ORGAN DYSFUNCTION DEFINITIONS</th>
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<tbody>
<tr>
<td>Organ</td>
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<tr>
<td>Cardiovascular (systolic blood pressure)</td>
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<tr>
<td>Pulmonary (oxygen levels)</td>
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<td>Neutrophil (WBC)</td>
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<td>Coagulation (platelet count)</td>
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<td>Renal (creatinine, eGFR)</td>
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<td>Liver (bilirubin)</td>
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References
Ganea, D., Fikker, J., Ban, A. B., Fine, J., Star, F., et al. (2011). Impact of time to antibiotics on survival in patients with severe sepsis or septic shock in whom early goal-directed therapy was initiated in the emergency department. Critical Care Medicine, 38, 1045-1053. doi:10.1097/CCM.0b013e31821e8424