Recognizing and Managing Sepsis

Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection. Sepsis can be triggered by bacterial, viral, or fungal pathogens. Septic shock is a complication of sepsis and is characterized by hypotension requiring vasopressor support to maintain adequate mean arterial blood pressure. Early diagnosis and treatment, within 1-2 hours of presentation, has been shown to improve patient outcomes and decrease overall mortality from sepsis.

Recognition of Sepsis-Related Organ Dysfunction

Sepsis is diagnosed when there is clinical evidence of organ dysfunction in the setting of probable or confirmed infection. Common signs of sepsis include altered mental status, tachypnea, body temperature greater than 38.3 degrees Celsius or less than 36 degrees Celsius, and systolic blood pressure less than 100 mm Hg.

Laboratory evidence of organ dysfunction includes:

- Lactate greater than 2 mmol/L
- WBC less than 4 $x10^9$/L or greater than 10 $x10^9$/L
- Creatinine greater than 2 mg/dL
- INR greater than 1.5 or APTT greater than 60 seconds
- Platelet count less than 100 $x10^9$/L

Sepsis screening tools are designed to help identify sepsis and consist of manual methods or utilization of data in the electronic health record (EHR) to deliver sepsis alerts to clinical staff. Because no screening tool is 100% sensitive for the detection of infection-induced organ dysfunction, clinical judgment and frequent reassessment should be utilized if the diagnosis is uncertain. The 2021 Surviving Sepsis Campaign Guidelines recommends using a performance improvement program for sepsis, which may include screening tools such as Sequential (Sepsis-Related) Organ Failure Assessment (SOFA) Score or the National Early Warning Score (NEWS) score.

Sequential (Sepsis-Related) Organ Failure Assessment (SOFA) Score (Vincent et al., 1996, Fayed et al., 2022)

The SOFA score provides clinical measures to identify organ dysfunction; these criteria can identify infected patients most likely to develop sepsis. The baseline score is assumed to be zero in patients without preexisting organ dysfunction and an increase in score of 2 points or more from baseline represents organ dysfunction. Higher scores are associated with increased risk of mortality.

SOFA Score					
Score	**0**	**1**	**2**	**3**	**4**
Respiration					
PaO_2/FiO_2 mmHg (kPa)	≥ 400 (53.3)	< 400 (53.3)	< 300 (40)	< 200 (26.7) with respiratory support	< 100 (13.3) with respiratory support
Coagulation					
Platelets, x 10^3/uL	≥ 150	< 150	< 100	< 50	< 20
Liver					
Bilirubin, mg/dL (umol/L)	< 1.2 (20)	1.2-1.9 (20-32)	2.0-5.9 (33-101)	6.0-11.9 (102-204)	> 12.0 (204)
Cardiovascular					
Mean arterial pressure (MAP) and vasopressor therapy (ug/kg/min for at least 1 hour)	MAP ≥ 70 mmHg	MAP < 70 mmHg	Dopamine < 5 *or* dobutamine (any dose)	Dopamine 5.1-15 *or* epinephrine ≤ 0.1 *or* norepinephrine ≤ 0.1	Dopamine > 15 *or* epinephrine > 0.1 *or* norepinephrine > 0.1
Central Nervous System					
Glasgow Coma Scale score	15	13-14	10-12	6-9	< 6
Renal					
Creatinine, mg/dL (umol/L)	< 1.2 (110)	1.2-1.9 (110-170)	2.0-3.4 (171-299)	3.5-4.9 (300-440)	> 5.0 (440)
Urine output, mL/day				< 500	< 200

National Early Warning Score (NEWS)

The National Early Warning Score (NEWS) is used for early identification of infected patients who may go on to develop sepsis; it is used to assess mortality risk. This scoring system is an aggregate derived from six physiologic parameters: respiratory rate, oxygen saturation, systolic blood pressure, heart rate, level of consciousness, and temperature (Neviere, 2023).

Management

The Surviving Sepsis Campaign (SSC) Bundle (Evans et al., 2021)

- Initiate promptly upon recognition of sepsis/septic shock.
- Prioritize resuscitation, diagnosis, and treatment by instituting the following interventions:
    - Measure lactate level (repeat lactate if initial lactate elevated [greater than 2 mmol/L]).
    - Obtain blood cultures before administering antibiotics.
    - Administer broad-spectrum antibiotics within 1 hour of recognition of sepsis.
    - Begin rapid administration of 30 mL/kg crystalloid for hypotension or lactate greater than or equal to 4 mmol/L within the first 3 hours.
    - Give vasopressors if hypotensive during or after fluid resuscitation, to maintain mean arterial pressure greater than or equal to 65mm Hg.
    - Follow the trend in lactate level and assessment of capillary refill time to guide additional fluid resuscitation.

Nursing Considerations

A detailed understanding of the specific measures recommended in the sepsis bundle is imperative in facilitating timely interventions and improved outcomes.

- Lactate (lactic acid)
    - A byproduct of glycolysis in anaerobic metabolism
    - Considered a surrogate marker of tissue hypoperfusion in sepsis
- Microbiologic cultures
    - Directed at suspected source of infection
    - Should include at least 2 sets of blood cultures (aerobic and anaerobic)
    - Obtain prior to initiation of antibiotics; sterilization of blood occurs within minutes to hours after first does of antibiotics; early cultures increase chance of pathogen identification.
    - Inability to obtain cultures should not delay antibiotic treatment.
- Broad spectrum antibiotics
    - Early initiation is associated with decreased mortality.
    - Controlling the source of infection with antibiotics and with intervention for those infections amenable (wound drainage, debridement, removal of potentially infected device, cholecystitis) is the foundation of treating patients with sepsis or septic shock.
    - Failure to control the source of infection could lead to persisting or worsening sepsis or septic shock.
    - If a patient is not getting better, think “Do we have adequate source control?”
- Fluid resuscitation
    - Supports tissue perfusion
    - *Balanced Crystalloids*, which are intravenous fluids such as lactated ringers solution or Plasma-Lyte, are recommended over normal saline and *colloids,* such

as albumin or hetastarch.
    - Rapidly administer a fluid bolus of 30mL/kg crystalloid.
    - In those patients diagnosed with sepsis, the nurse plays a critical role in accurate administration of fluids as patient transitions between levels of care (i.e., ED to floor, floor to ICU).
- Vasoactive medications
    - Norepinephrine is the recommended first line agent. This is typically started at 2-5 mcg/min and titrated to a MAP greater than 65 mm Hg.
    - If MAP is inadequate despite moderate dose norepinephrine, initiate vasopressin at 0.03 U/min. This medication does NOT get titrated. Epinephrine is the suggested third line agent for refractory shock.
    - If there is cardiac dysfunction and persistent hypoperfusion, consider adding dobutamine.
    - Central venous access is the preferred route for vasoactive infusions, but if central access is unavailable, vasopressors can be infused peripherally (Evans et al., 2021).
    - An arterial line should be placed for continuous blood pressure monitoring.
- Glucocorticoid therapy (Kaufman, 2023)
    - Critical illness induces a state of relative adrenal insufficiency that may worsen shock.
    - Laboratory testing for cortisol levels is unreliable in critically ill patients, therefore glucocorticoid therapy is sometimes given empirically in patients with refractory shock (defined as persistent hypotension for more than one hour after adequate fluid resuscitation and vasopressor administration). For example, hydrocortisone 50 mg IV may be given every 6 hours.
- Ongoing assessment
    - In taking care of a patient with sepsis, it is imperative to reassess hemodynamics, volume status and tissue perfusion regularly.
        - Frequently reassess blood pressure, heart rate, respiratory rate, temperature, urine output, capillary refill, and oxygen saturation.
    - Assess patient each shift for occult or new sources of infection, such as wounds, vascular access sites, and urinary tract infection. Report concerning findings to a provider.
    - Dynamic measurements such as passive leg raising (PLR) are recommended to assess for fluid responsiveness. PLR mimics endogenous volume expansion (equivalent to an approximate 300 mL fluid bolus) and can be thought of as a preload challenge. It is used to predict if a patient will respond to additional fluid bolus. Follow these steps to perform PLR (Mikkelsen et al., 2022):
        - Position the patient in the semi-recumbent position with the head and torso elevated at 45 degrees.
        - Obtain a baseline blood pressure measurement.
        - Lower the patient's upper body and head to the horizontal position and raise and hold the legs at 45 degrees for one minute.
        - Obtain subsequent blood pressure measurement.
        - The expected response to this maneuver in those that are fluid responsive is a 10% or greater increase in cardiac output (CO). Although not considered a validated measure, we often use blood pressure as a surrogate marker of CO in evaluating response to the PLR.

References:

Evans, L., Rhodes, A., Alhazzani, W., Antonelli, M., Coopersmith, C. M., French, C., Machado, F. R., Mcintyre, L., Ostermann, M., Prescott, H. C., Schorr, C., Simpson, S., Wiersinga, W. J., Alshamsi, F., Angus, D. C., Arabi, Y., Azevedo, L., Beale, R., Beilman, G., Belley-Cote, E., … Levy, M. (2021). Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021. *Critical care medicine*, *49*(11), e1063–e1143. https://doi.org/10.1097/CCM.0000000000005337

Fayed, M., Patel, N., Angappan, S., Nowak, K., Vasconcelos Torres, F., Penning, D. H., & Chhina, A. K. (2022). Sequential Organ Failure Assessment (SOFA) Score and Mortality Prediction in Patients With Severe Respiratory Distress Secondary to COVID-19. *Cureus*, *14*(7), e26911. https://doi.org/10.7759/cureus.26911

Kaufman, D.A., (2023, June 7). Glucocorticoid therapy in septic shock for adults*. UpToDate*: https://www.uptodate.com/contents/glucocorticoid-therapy-in-septic-shock-in-adults

Mahapatra S, Heffner AC, Atarthi-Dugan JM. (2023, June 12). Septic Shock (Nursing) In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; https://www.ncbi.nlm.nih.gov/books/NBK568698/

Mikkelsen, M.E., Gajeski, D.F., & Johnson, N.J. (2023, December 8). Novel tools for hemodynamic monitoring in critically ill patients with shock. *UpToDate.* https://www.uptodate.com/contents/novel-tools-for-hemodynamic-monitoring-in-critically-ill-patients-with-shock

Neviere, R. (2023, September 15). Sepsis syndromes in adults: Epidemiology, definitions, clinical presentation, diagnosis, and prognosis. *UpToDate* https://www.uptodate.com/contents/sepsis-syndromes-in-adults-epidemiology-definitions-clinical-presentation-diagnosis-and-prognosis

Society of Critical Care Medicine. (2019, October 10). *Sepsis Campaign Bundles.* https://www.sccm.org/SurvivingSepsisCampaign/Guidelines/Adult-Patients

Vincent, J. L., Moreno, R., Takala, J., Willatts, S., De Mendonça, A., Bruining, H., Reinhart, C. K., Suter, P. M., & Thijs, L. G. (1996). The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. On behalf of the Working Group on Sepsis-Related Problems of the European Society of Intensive Care Medicine. Intensive care medicine, 22(7), 707–710. https://doi.org/10.1007/BF01709751