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Chemotherapy Induced Neutropenia and Increased Risk for Sepsis

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Introduction

Available treatment options for patients diagnosed with cancer include surgery, the administration of chemotherapeutic agents, radiation therapy, or a combination of these modalities. Chemotherapeutic agents utilized to treat cancer have a variety of potential side effects. One of the most common and well known side effects associated with the administration of chemotherapeutic agents is neutropenia. An estimated 60,000 cancer patients require hospitalization each year due to chemotherapy induced neutropenia related to standard treatment regimens (Demshar, Vanek, & Mazanec, 2011). While the criteria defining neutropenia varies among institutions, neutropenia may typically be defined as an absolute neutrophil count (ANC) less than 1500 cells per microliter with severe neutropenia defined as an ANC less than 500 cells per microliter (White & Ybarra, 2014). Neutropenia places oncology patients at an increased risk of contracting infections which may lead to a life threatening complication known as sepsis. Sepsis is an extremely dangerous oncologic emergency requiring prompt medical treatment. Failure to recognize symptoms associated with sepsis in the neutropenic patient and initiate appropriate medical treatment significantly increases the risk of patient mortality. White and Ybarra (2014) explain that the mortality risk in neutropenic patients with uncontrolled infection varies inversely with the severity of neutropenia; therefore, the mortality risk in patients with an ANC less than 500 cells per microliter is markedly increased. The aim of this research project is to aid in further educating health care professionals on the pathophysiological process and implications for nursing practice associated with caring for patients with chemotherapy induced neutropenia and their increased risk for sepsis.

Underlying Pathophysiology

- In healthy individuals, the immune process is well regulated and the balance between counteracting forces maintains a localized inflammatory response to the area of initial insult (Laszlo, Trasy, Molnar, and Fazakas, 2015).
- Important phagocytic cells of the innate immune system, including neutrophils, are produced from multipotent stem cells within the bone marrow throughout the lifespan (Held-Warmkessel, 2011; Kovach & Standiford, 2012).
- Neutrophils are released into the blood stream from the bone marrow as fully mature cells and circulate throughout the system where they adhere to the endothelial wall and move to the site of an infection (Kovach & Standiford, 2012; Vioral & Wentley, 2015).
- Neutrophils are the first phagocytic cell to arrive at the site of an infection, function to fight against bacterial infections, guard against progression of infection, and produce common signs and symptoms of an infection including redness, swelling, and purulent drainage (Held-Warmkessel, 2011; Vioral & Wentley, 2015).



ivfluidspic.jpg [Online image]. (2011). Retrieved June 30, 2016 from <http://www.subhralife.com/images/ivfluidspic.jpg>

Significance of Pathophysiology

Bone marrow suppression and subsequent neutropenia significantly increases a patient's risk for bacterial infections that can rapidly progress to sepsis (Legrad et al., 2012). Sepsis may be defined as "...a progressive, injurious, inflammatory response to overwhelming infection associated with tissue hypoperfusion and multiorgan dysfunction" (Kovach & Standiford, 2012, p. 321). Deficiency in the number of functioning neutrophils increases sepsis-mediated morbidity and mortality further emphasizing the consequences related to alterations in neutrophil response (Kovach & Standiford, 2012). Kovach and Standiford (2012) further argued that impaired neutrophil function leads to defective innate immunity culminating in septic patients.

Signs and Symptoms

- Patients with neutropenia do not produce a sufficient number of mature neutrophils to mount an appropriate immune response against microorganism invasion (Vioral & Wentley, 2015). Therefore, neutropenic patients do not always present with classic signs and symptoms of infection.
- Often, the earliest and only response to an infection in the neutropenic patient is a fever (Bow, 2013). A single oral temperature greater than 101 degrees Fahrenheit or a persistent (longer than one hour) oral temperature of 100.4 degrees Fahrenheit represents a fever in a patient with neutropenia (Vioral & Wentley, 2015). In patients with severe neutropenia, there may be substantial difficulty producing an immune response. Fever may not be exhibited and the patient may present with a temperature that is below normal, namely temperatures below 96.8 degrees Fahrenheit (Bow, 2013; O'Leary, 2014).
- The patient may also display alterations in vital signs, indicating progression towards sepsis and the presence of a systemic inflammatory response. Criteria concerning for the presence of systemic inflammatory response include elevated or subnormal temperatures, heart rate greater than ninety beats per min, or a respiratory rate greater than twenty breaths per minute (Bow, 2013; O'Leary, 2014). Additionally, patients may rapidly develop symptoms of hypotension, altered mental status, and rigors (Demshar, et al., 2011).



1-neutrophil-engulfing-tb-bacteria-sem-jpg [Online image]. (2013). Retrieved June 30, 2016 from <http://images.fineartamerica.com/images-medium-large/1-neutrophil-engulfing-tb-bacteria-sem-jpg>

Implications for Nursing Practice

- Patients should be educated on the necessity and timing of the administration of preventative vaccinations such as the influenza and pneumococcal vaccines. Vioral and Wentley (2015) recommended that patients complete vaccinations at least two weeks prior to the beginning of chemotherapeutic medications.
- Infection prevention measures that nurses should discuss with patients at high risk for neutropenia include the use of only electric razors for shaving, use of soft toothbrushes and importance of frequent oral care (at least three to four times daily), meticulous skin care (emphasizing the importance of good hand hygiene), proper central venous access device care, perianal cleansing after toileting, safe food handling and preparation, refraining from cleaning up animal excreta, avoiding contact with soil or plants, refraining from contact with people who have received recent live vaccines, and avoidance of anyone with colds, respiratory infections, and/or large crowds of people (Vioral & Wentley, 2015).
- Patients should be educated on the importance of monitoring their temperature multiple times daily and reporting any fever of 101 degrees Fahrenheit or persistent fevers greater than or equal to 100.4 degrees Fahrenheit to their healthcare provider. Education should also include signs and symptoms of infection such as redness, warmth, edema, and tenderness. Should preventative measures fail to provide adequate protection against infection, and concern for infection arises, it is important that nurses educate patients on when to seek medical assistance.
- Hawley, Loney, and Wiece (2011) stressed that "...nurses need to offer patients tangible education and take-home tools to reinforce what to do when potentially neutropenic to minimize delays in seeking medical attention and the risk of life-threatening sepsis" (p. E53).
- When febrile neutropenia is suspected or confirmed, hospitalization is warranted and management requires rapid initiation of sepsis protocols to improve patient outcomes.
- Nurses should anticipate that neutropenic patients with suspected sepsis will need to have lactate levels and blood cultures obtained (additional cultures such as urine, sputum, and stool may also be collected), aggressive fluid resuscitation will be initiated, and broad spectrum antibiotics will be administered within three hours of presentation to the department (O'Leary, 2014).
- The removal of indwelling catheters should be requested and preformed when there is suspicion of catheter related bloodstream infections (Legrand et al., 2012).
- Frequent monitoring of patient vital signs and continued physical assessments are important to assess patient response to treatment (Held-Warmkessel, 2011).
- When aggressive fluid resuscitation fails to restore hemodynamic stability and the need for the administration of vasopressors arises, nurses should advocate for patients to be transferred to intensive care units for closer monitoring.

Conclusion

Neutropenia in patients receiving chemotherapeutic medications for the treatment of cancer can place patients at risk for potentially life threatening immune dysfunction. Prevention of infection, early detection of symptoms, and prompt intervention when concerns for infection arise are vital for positive patient outcomes. Vioral and Wentley (2015) noted that "nurses are integral in the prevention, identification, treatment, and management of these high mortality complications of immunosuppressive therapies" (p. 173). Ensuring that clinicians are well versed in their understanding of the pathophysiological process and implications for nursing care further contribute to improvements in the quality of care received by the neutropenic patient.

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