Leukopenia is a decrease in the absolute number of white blood cells, whereas neutropenia is the condition in which the absolute neutrophil count (ANC) is either < 500/mm$^3$ or <1000/mm$^3$ with a predictable decline to <500/mm$^3$ in 24 to 48 hours. Leukopenia and neutropenia can be caused by cancer or by myelosuppression secondary to therapy (chemotherapy and radiation therapy).

Infection is the most common complication associated with neutropenia and the major cause of morbidity and mortality in neutropenic patients with cancer. Important determinants of the risk of infection include the number of circulating neutrophils and the duration of the neutropenia.

*The lower the number of circulating neutrophils is and the longer the neutropenia lasts, the higher the incidence and the more severe the infections are.*

Children and adolescents with severe neutropenia (ANC< 500/mm$^3$) are at risk of life-threatening bacterial, fungal and viral infections. If the patient has febrile neutropenia (A – 1), surveillance cultures and more blood tests should be conducted to determine whether infection is present and, if it is, where it is located.

**Assessment**

Patient assessment must include a careful history and physical examination. Useful historical information includes the following:

- the nature and duration of the cancer treatments,
- the use of prophylactic or broad-spectrum antibiotics [at the time or just prior to presentation],
Effects on the Hematopoietic System:
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Leukopenia/Neutropenia

the types of previous infections, medical procedures, allergies and drug interactions.

Physical examination should also include a search for potentially infected sites such as the gastrointestinal tract, skin, lungs, vascular access device and biopsy sites. Other sites that should be carefully examined and treated as potential sites of infection are skin or mucous membranes whose integrity has been altered. Such sites are those used for intravenous access, bone marrow and lumbar puncture sites, surgical incisions, mouth ulcers and the perirectal area.

Leukopenia, neutropenia or both can be associated with infection. Pain may be the only localized symptom of infection and should be assessed thoroughly. If the patient presents with fever (A – 2), the patient should undergo assessment to identify the possible source and type of infection. Infecting organisms that cause the fever may be bacteria, viruses, fungi or combination of these organisms.

Pulmonary infections such as pneumonia may be manifested as abnormal breath sounds, coughing, chest pains and sputum production. Radiographic examination of the chest (chest X-ray) and culture and sensitivity tests of the sputum are usually done to confirm the diagnosis of pneumonia.

Renal or urinary tract infections can be due to foreign objects such as Foley catheters and can be manifested as tenderness in the abdomen, flank or both, burning and urgency. Chemotherapeutic agents such as cyclophosphamide and ifosfamide can cause hemorrhagic cystitis.

Patients who are constipated because of medications (opioids and vinca alkaloids) or other reasons may develop perirectal lacerations that could lead to perirectal abscesses. Other gastrointestinal side effects of chemotherapy such as diarrhea can cause fissures and denudation of the mucosal lining of the rectal area, making them susceptible to infections.

Fever that is associated with neutropenia should be treated as an emergency because septic shock can easily develop in patients with these 2 conditions. Recommended laboratory evaluation includes analysis of 2 sets of blood samples (1 of peripheral blood and the other from each catheter lumen, if present) to determine whether bacteria, fungi or both are the pathogens.

Possible nursing diagnoses associated with neutropenia/leukopenia are the following.

- High risk of infection
- Pain
- Discomfort associated with fever
- Risk of sepsis with rapid deterioration
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Leukopenia/Neutropenia

Planning

The design of the plan of care should involve the patient, family members and the health care professionals responsible for the patient’s treatment. The overall goal of care should focus on the prevention and efficient management of infections related to leukopenia and neutropenia. Criteria to determine whether this goal is being met include patient outcomes such as the following.

- The patient and family’s increased understanding of the implications of leukopenia and neutropenia
- The ability of the patient to prevent infection by avoiding situations and environments that increase susceptibility to infections
- The ability of the patient and family to identify signs and symptoms of infection
- The compliance of the patient with prophylactic and supportive care measures

Implementation

The patient experiencing febrile neutropenia is usually admitted to the hospital for further observation and treatment. Studies have shown that early intervention is correlated positively with improved outcome of patients with febrile neutropenia.

Treatment of leukopenia and neutropenia includes prevention of neutropenia-related infections through proactive administration of colony-stimulating factors intended to accelerate white blood cell production and maturation. Patients are usually prescribed these factors to prevent an excessive drop in their blood cell counts (time of the chemotherapy drug’s nadir).

The nurse should explain to the patient and family the importance of adhering to the regimen of colony-stimulating factor use. This responsibility can be accomplished in part by explaining the rationale behind the treatment. The nurse should also monitor the response of the patient by carefully monitoring blood cell counts and promptly reporting potential infections. The nurse should teach the patient and family ways to prevent and control infections (A – 3) and emphasize the importance of hand washing (both of the health care provider and the patient and family).

Treatment of infection includes therapeutic administration of anti-infective agents (antibiotics, antifungal agents, antiviral agents or a combination of the three). Broad-spectrum antibiotics are commonly used to fight a variety of bacterial infections. If the infection is not eliminated in a few days, antifungal therapy is usually added. If the patient has severe neutropenia (ANC < 500/mm^3), the patient may receive transfusions of white blood cells (leukocyte transfusions).
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During anti-infective therapy, the nurse should monitor the patient’s response to therapy by the following means:
- carefully assessing and recording vital signs (especially temperature and blood pressure) and immediate reporting of change in clinical status or drop in blood pressure and management of elevated temperatures,
- detecting worsening of infection and/or the occurrence of opportunistic infections such as that caused by Clostridium difficile,
- developing and maintaining an environment and health care actions that will control and prevent further infection (e.g., vigilant care of intravenous lines or sites, appropriate dressing changes).

Evaluation

Successful achievement of care goals includes prevention and appropriate management of infections associated with leukopenia and neutropenia.
Related Helpful Web Links

St. Jude Children's Research Hospital, Memphis, TN

Infection and Your Child
Patient education regarding infections and the importance of preventing them
http://www.stjude.org/stjude/v/index.jsp?vgnextoid=e3de6f9523e70110VgnVCM1000001e0215acRCRD&vgnextchannel=e57ad290e3133110VgnVCM1000001e0215acRCRD

National Nosocomial Infections Surveillance System
Center for Disease Control and Prevention, Atlanta, GA
http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5110a2.htm

St. Jude Children’s Research Hospital, Memphis, TN
Nutrition and Your Child
Patient education regarding dietary modification to prevent infection. Check out Low Bacteria Diets
http://www.stjude.org/stjude/v/index.jsp?vgnextoid=3810bfe82e118010VgnVCM1000000e2015acRCRD

St. Jude Children’s Research Hospital, Memphis, TN
Infection and Your Child
Patient Education materials on the different types of infection that could occur; also on how to prevent them and signs and symptoms of infections
http://www.stjude.org/stjude/v/index.jsp?vgnextoid=faefbfe82e118010VgnVCM1000000e2015acRCRD

The National Comprehensive cancer Network:
Fever and Neutropenia Guidelines

Related Cure4Kids Seminars on Hand Washing

Seminar #493 Hand Hygiene for Health Care Professionals
The importance of proper hand hygiene is explained and demonstrated in terms of prevention of infection and the protection of the health of the child.
http://www.cure4kids.org/seminar/493

Seminar #494 Higiene de Manos para Profesionales de la Salud (Spanish version):
http://www.cure4kids.org/seminar/494

Seminar #495 Hand Hygiene for Family Members and Care Providers
http://www.cure4kids.org/seminar/495

Seminar #496 Higiene de Manos para Familiares y Proveedores de Cuidado (Spanish version):
http://www.cure4kids.org/seminar/496
APPENDIX

A – 1 Laboratory Tests to Assess a Febrile Neutropenic Patient

Blood cultures to detect aerobic or anaerobic microbes or both
  • If the patient has a central venous catheter, draw blood from all lumens, and a peripheral vein.
  • If the patient does not have a central venous catheter, draw blood from a peripheral vein.
Urinalysis and urine culture (Do not catheterize or "bag" a patient unless patient is unable or urinate. Catheterization or “bagging” can introduce microbial pathogens into the urinary tract).
Chest x-ray, if clinically indicated.
Throat culture and skin cultures, if clinically indicated.
Stool cultures for pathogens such as Clostridium difficile, if clinically indicated.
Lumbar puncture, if clinically indicated.

Baseline values for the complete blood count, the electrolyte panel, and the liver and renal panels should be obtained. Subsequent values should be obtained every 2 to 3 days.

A – 2 Fever

Fever is defined as an oral temperature ≥ 38.3°C or an oral temperature ≥ 38.0°C that lasts for at least an hour. Rectal temperature measurement is not recommended in neutropenic patients because it may cause bacteremia, especially in patients with mucositis, hemorrhoids, fissures and other localized lesions.
A – 3 Ways That Patients and Families Can Prevent and Control Infection

a. Use proper hand washing techniques.
   1. Wash hands before eating and after using the bathroom.
   2. Wash hands after touching public telephones, money and pets.
b. Practice good mouth and oral care. Use a soft-bristle toothbrush especially if the patient is also thrombocytopenic.
c. Avoid crowds. Example of crowds are: parades or community gatherings such as “fiestas”, movie theater, crowded malls and others.
d. Avoid extreme changes in temperature.
e. Modify the diet appropriately.
   1. Cook food; do not eat raw food.
   2. Thoroughly wash and peel fruits and vegetables.
   3. Only eat meals that have been prepared freshly; avoid leftovers.
f. Avoid persons with infections.
g. Avoid children, especially those with chicken pox or the flu.
h. Avoid swimming areas, unless the physician has granted permission to swim.
i. Avoid stray or unhealthy pets.
j. Maintain a clean environment.
   1. Use disinfecting solutions when the patient’s room is cleaned.
   2. Keep the patient away from dust.
   3. Prevent mold build-up in bathrooms and kitchens.
   4. Regularly disinfect the patient’s toys.
k. Avoid “live” vaccines.
   1. Examples of live vaccines are those for smallpox, mumps, measles and tuberculosis.
   2. Avoid anyone who has received a live vaccine within a specified period of time.
l. Wear a protective mask. Implement ways to maintain the self-image of the patient who wears such a mask. For example, use colorful or funny masks.
m. Avoid contact sports, and engage in quiet activities only. Examples are reading, watching TV or playing computer games.
n. Encourage friends and relatives not to send fresh flowers, live plants and toys that are not washable.
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