Chemotherapy-Induced Neutropenia

Elisabeth Sosa, MSN, ARNP, AOCNP

Elisabeth Sosa is a certified adult oncology nurse practitioner. She practices within a large private-practice hematology/medical oncology group in Central Florida. She has previously been published in the Clinical Journal of Oncology Nursing (CJON).

ABSTRACT

Neutropenia is a common complication that occurs during treatment with chemotherapy in oncology patients. Some patients are at higher risk of developing neutropenia, based on type of cancer as well as type of treatment. Neutropenia can lead to serious complications, including infections and sepsis. Ensuring patient safety is important in decreasing morbidity and mortality. Neutropenia can be prevented and treated pharmacologically. Once patients are neutropenic, precautions should be taken to minimize risk of infection. These precautions increase patient safety during times of neutropenia. It is important that nurses have an understanding of neutropenia so that patients can be treated appropriately and complications can be avoided.

Keywords: Oncology, Cancer, Neutropenia, Chemotherapy, Neutropenic fever, Neutropenic precautions, Infection, Myelosuppression
Continuing Nursing Education Course Director & Planners
William A. Cook, PhD, Director, Douglas Lawrence, MA, Webmaster, Susan DePasquale, CGRN, MSN, Lead Nurse Planner

Accreditation Statement
NurseCe4Less.com is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

Credit Designation
This educational activity is credited for 1.5 hours. Nurses may only claim credit commensurate with the credit awarded for completion of this course activity.

Course Author & Planner Disclosure Policy Statements
It is the policy of NurseCe4Less.com to ensure objectivity, transparency, and best practice in clinical education for all continuing nursing education (CNE) activities. All authors and course planners participating in the planning or implementation of a CNE activity are expected to disclose to course participants any relevant conflict of interest that may arise.

Statement of Need
Nurses are required to be knowledgeable about how neutropenia occurs, specifically in patients undergoing treatment with chemotherapy. The definition of neutropenia, as well as how to calculate the absolute neutrophil count (ANC) are essential to know when caring for individuals undergoing chemotherapy, in addition to the complications of neutropenia, including sepsis.
Course Purpose

This course will help nurses develop an understanding of the treatment of neutropenia specifically in patients receiving chemotherapy. Participants will also learn about neutropenic precautions in patients undergoing chemotherapy.

Learning Objectives:
1. Define neutropenia (mild, moderate, severe)
2. Calculate the ANC (absolute neutrophil count)
3. Recognize patients who are most at-risk for developing neutropenia
4. Identify complications of neutropenia
5. Discuss two treatment options for neutropenia
6. Discuss various neutropenic precautions that patients should follow

Target Audience: Advanced Practice Registered Nurses, Registered Nurses, Licensed Practical Nurses, and Associates

Course Author & Director Disclosures:
Elisabeth Sosa, MSN, ARNP, AOCNP, William S. Cook, PhD, Douglas Lawrence, MA, and Susan DePasquale, CGRN, MSN; all have no disclosures.

Acknowledgement of Commercial Support: None exists.

Activity Review Information: This has been peer reviewed by Susan DePasquale, CGRN, MSN. Review Date: April 21, 2014.

Release Date: April 22, 2014 Termination Date: April 22, 2017

Please take time to complete the self-assessment Knowledge Questions before reading the article. Opportunity to complete a self-assessment of knowledge learned will be provided at the end of the course.
1. Calculate the ANC (absolute neutrophil count). WBC = 1.6, Neutrophil % = 12%, Lymphocyte % = 80%, Eosinophil % = 3%, Monocyte % = 5%.
   a. 1,280
   b. 48
   c. 272
   d. 192

2. In the above question, what grade is the neutropenia?
   a. Grade 1
   b. Grade 2
   c. Grade 3
   d. Grade 4

3. Which patient is at highest risk for developing neutropenia?
   a. 67-year-old male with acute leukemia undergoing high-dose combination chemotherapy. Has history of diabetes.
   b. 44-year-old female with breast cancer currently receiving single-agent Taxol. Has history of hypertension.
   c. 59-year-old male with prostate cancer receiving radiation to the prostate. Has history of COPD.
   d. 23-year-old female with Hodgkin’s lymphoma who is receiving combination chemotherapy.

4. All of the following are negative outcomes of neutropenia except:
   a. Increased costs
   b. Hospitalization
   c. Better response to chemotherapy
   d. Death
5. **What should a chemo patient do if he/she has a fever of 100.6 degrees Fahrenheit?**
   a. Stop checking his temperature
   b. Call his oncologist’s office and let them know
   c. Take antibiotics his wife has left over from when she had a UTI
   d. Call 911

6. **You are a nurse in the emergency room caring for a patient who comes in with febrile neutropenia. You should do all of the following except:**
   a. Draw blood cultures after starting IV antibiotics
   b. Collect urine for urinalysis and culture
   c. Ensure that a chest xray is ordered
   d. Ensure that IV antibiotics are ordered

7. **Which foods should a patient avoid when he/she is neutropenic?**
   a. Medium-rare steak
   b. Fresh apple with skin
   c. Golden corral buffet
   d. All of the above

8. **You are caring for a neutropenic patient and reviewing neutropenic precautions. What advice is incorrect?**
   a. Wash hands often, especially before you eat and after you use the bathroom.
   b. You are not allowed to touch your pet dog.
   c. You should stay away from gardening due to exposure to flowers, plants, and soil.
   d. Make sure you avoid crowds and stay away from sick people.
9. **What is the most common side effect of G-CSF (filgrastim, pegfilgrastim)?**
   a. Bone pain
   b. Pain at the injection site
   c. Fever
   d. Fatigue

10. **When is the best time to give G-CSF?**
    a. The same day as chemotherapy so that the patient doesn’t have to come back
    b. 24 hours after chemotherapy
    c. When the patient is neutropenic
    d. The day before the next cycle of chemotherapy
**Introduction**

The following case study is a common occurrence in patients receiving chemotherapy. The objective of this case study is to illustrate how patients commonly present after receiving chemotherapy and how treatment affects the neutrophil count. Suggestions will be made later on in the course on how to treat and prevent neutropenia.

---

**Case Study:**

*Linda is a 62-year-old Hispanic female who was recently diagnosed with Stage III ovarian cancer. After undergoing TAHBSO (total abdominal hysterectomy bilateral salpingo-oopherectomy), the patient is referred to a medical oncologist to discuss treatment with chemotherapy. The oncologist recommends chemotherapy in the form of intravenous carboplatin and paclitaxel administered on day one every three weeks for six cycles. After discussing details of treatment, including risks, benefits, alternatives, and possible side effects, the patient agrees to proceed with chemotherapy. Linda returns to the infusion center for her first treatment. She tolerates treatment well, though she does experience fatigue and decreased appetite for about three days after chemotherapy.*

*By Linda’s fourth cycle, she is feeling more fatigued and has lost about five pounds. Six days after she receives her fourth chemotherapy treatment, she notes a fever of 100.1 degrees Fahrenheit. She has fatigue and generalized weakness. Linda calls her oncologist’s office to report her symptoms and is instructed to come to the office immediately for further evaluation.*
Upon arrival, Linda has her blood drawn and vital signs measured. Her heart rate is 86 bpm, blood pressure is 119/61, and temperature is 99.9 degrees Fahrenheit. Her CBC (complete blood count) notes a WBC (white blood cell) of 1.1, ANC (absolute neutrophil count) of 400, hemoglobin of 11.9, and platelet count of 141,000.

Chemotherapy And Neutropenia

Chemotherapy plays an integral role in the treatment of patients with cancer. Neutropenia is the most common dose-limiting side effect of systemic chemotherapy. Neutropenia can lead to significant morbidity, mortality, and costs. For example, patients with febrile neutropenia may require hospitalization and broad-spectrum antibiotics (Camp-Sorrell, 2011; Crawford, Dale, & Lyman, 2004; Lyman, Lyman, & Agboola, 2005).

Neutropenia Defined

Neutrophils (also known as polymorphonuclear segmented cells or segs or polys) are a type of white blood cell. They are the body’s first line of defense against infection caused by viruses, bacteria, and other pathogens. Neutrophils make up the majority of white blood cells, usually between 45% and 75% (Cappozzo, 2004; Kurtin, 2012; Nirenberg et al., 2006).
Neutrophils are produced in the bone marrow. This process takes approximately seven to ten days. Once neutrophils are released into the bloodstream, the life span is four to eight hours.

**Causes of Neutropenia**

There are a number of causes for neutropenia. However, treatment with cytotoxic drugs is likely the most common cause of neutropenia in the United States. Because cytotoxic therapy kills rapidly dividing cells, neutrophils are destroyed during treatment. Chemotherapy suppresses the bone marrow and thus affects the production of neutrophils. The *nadir* is the lowest point that the neutrophil count reaches. This typically occurs 7-14 days after chemotherapy is administered (Cappozzo, 2011; Lichtman, Kaushansky, Kipps, Prchal, & Levi, 2011; Nirenberg *et al.*, 2006).

The table below outlines grades of neutropenia, Grade 1 – 5, with Grade 5 representing the most severe adverse response and lowest neutrophil count (below 500/mm^3).

**Table 1. National Cancer Institute Common Terminology Criteria for Adverse Events: Neutropenia**

<table>
<thead>
<tr>
<th>Grade</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;LLN- 1,500/mm^3</td>
<td>&lt;1,500-1,000/mm^3</td>
<td>&lt;1,000-500/mm^3</td>
<td>&lt;500/mm^3</td>
<td>-</td>
</tr>
</tbody>
</table>

LLN- lower limit of normal. (National Cancer Institute, 2009).

**How to calculate the absolute neutrophil count (ANC)**

While most lab reports automatically calculate the absolute neutrophil count (ANC), it is still important to know how to calculate it manually.
The ANC calculation formula is:

\[ \text{WBC (white blood count) multiplied by the percentage of neutrophils (or % of polys + % of bands) multiplied by 10} \]

(Dana Farber Harvard Cancer Center, 2012).

Here is an example of the above formula:

\[
2.3 \times 15 = 34.5 \times 10 = 345
\]

The ANC is 345, which means the patient has grade 4 neutropenia.

| Table |  
|---|---|
| WBC | 2.3 |
| Neutrophil % | 15 |
| Lymphocyte % | 30 |
| Monos % | 55 |
| Hgb | 12.1 |
| Platelets | 175 |

**Risk Factors for Neutropenia**

There are a number of risk factors for myelosuppression, which can be disease-related, patient-related, or treatment-related. When talking about disease-related factors, the type of malignancy is an important consideration. Neutropenia tends to be more common, last longer, and be more severe in hematological malignancies than in solid tumors. Hematological malignancies include leukemia, lymphoma, and multiple myeloma (Kurtin, 2012).

As far as patient-related factors, older patients are at increased risk for neutropenia. They also have a greater risk of infection during periods of neutropenia. Oftentimes, elderly patients have diminished renal and hepatic function. This can affect the metabolism of chemotherapy. Patients with a history of immunosuppression, such as patients with human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS), are also at increased risk.
Individuals at increased risk also include those that have had a splenectomy. Comorbidities such as diabetes and chronic obstructive pulmonary disease (COPD) also raise the risk of neutropenia. Another contributing factor for neutropenia is malnutrition. Adequate nutrition is necessary for the bone marrow to produce blood cells. Use of other medications is yet another risk factor. Thorough medication review is imperative. For example, antibiotics, anti-inflammatory medications, and immunosuppressants can all cause some degree of bone marrow suppression (Cappozzo, 2004; Kurtin, 2012).

Treatment-related risk factors include a number of variables, including the type of chemotherapeutic agent being used. Anthracyclines (such as doxorubicin and daunorubicin) and platinum-based regimens have increased risk of neutropenia. High doses and combination treatments put patients at higher risk of neutropenia. Patients receiving radiation with chemotherapy are also at risk, as the radiation area may include areas of marrow-containing bone.

Another important factor is length of treatment. As treatment continues over a prolonged amount of time, such as in patients with metastatic disease, bone marrow fatigue can occur (Cappozzo, 2004; Crawford et al., 2004; Kurtin, 2012; Baden et al., 2013).

The National Cancer Institute (NCI) publishes tables and related documents to help identify and report an Adverse Event (AE), such as appears in Table 2, *Febrile Neutropenia* (below).
Complications Of Neutropenia

Nirenberg, *et al.* (2006) provide us with an understanding of some of the negative outcomes of neutropenia, which are outlined below:

- Hospitalization
- Use of intravenous antibiotics
- Increased costs to patients, their families, and the healthcare system
- Delays or dose-reductions of chemotherapy treatment
- Death due to infection and sepsis

The two major complications of neutropenia include infection and febrile neutropenia. Longer periods of neutropenia and increased severity increase the risk (Kurtin, 2012). Outcomes are unfavorable when patients experience febrile neutropenia. The best way to combat this is by preventing neutropenia (Nirenberg *et al.*, 2006). This will be discussed in greater detail later in the course.
When patients experience febrile neutropenia, action must be taken quickly because the patient’s condition can worsen rapidly. Patients usually present with fever or shaking chills. Patients should be assessed and pan-cultured. This includes blood cultures, urine culture and sensitivity, and chest x-ray to rule out infection. If the patient reports diarrhea, stool cultures, including testing for *clostridium difficile*, should be done (Baden *et al.*, 2013).

The most common sources of infection include the respiratory tract, indwelling catheters, and the gastrointestinal tract. In a significant amount of cases, source of fever is unknown. Intravenous antibiotics should be given in a timely manner according to institutional protocols. Blood cultures should be obtained prior to administering antibiotics (Kurtin, 2012; Nirenberg *et al.*, 2006).

Febrile neutropenia is a serious situation that could lead to septic shock and death. Certain factors are related to poor prognosis in febrile neutropenia. These include requiring admission to the intensive care unit (which indicates that the patient’s condition is more critical), known respiratory infection, duration of neutropenia greater than four days after fever occurs, DIC (disseminated intravascular coagulation), and arrhythmias or EKG (electrocardiogram) changes.

Many oncology patients are treated in the outpatient setting. Therefore, patients and their caregivers should be appropriately educated on the risks of fever. They should be instructed to seek medical attention immediately and protocols should be in place to handle these situations (Kurtin, 2012).
Prevention Of Neutropenia

The body naturally produces granulocyte-stimulating factor (G-CSF). This cytokine controls reproduction, maturation, and activation of neutrophils. G-CSF has been shown to shorten the duration of neutropenia (Cappozzo, 2004).

In the United States, filgrastim and pegfilgrastim are both FDA-approved for prevention of chemotherapy-induced neutropenia. Filgrastim can be given intravenously or subcutaneously. However, it is more commonly given subcutaneously. It can be given daily for several days.

It is ideal to give subsequent doses at the same time each day. The first dose should be given at least 24 hours after chemotherapy. The long-acting version of filgrastim is pegfilgrastim. It is given as a subcutaneous injection after chemotherapy and requires one dose per chemotherapy cycle compared to several doses of filgrastim. Pegfilgrastim should be administered between 24 and 72 hours after chemotherapy. The most common side effect of both medications is bone pain (Cappozzo, 2004; Crawford et al., 2014).

Side Effects of G-CSF

G-CSF side effects are outlined below (Crawford et al., 2014):

- Bone pain
- Pain/tenderness at injection site
- Rupture of the spleen
- Allergic reactions (skin rash, urticaria, dyspnea, wheezing, anaphylaxis)
• Acute respiratory distress syndrome (ARDS)

Note: There is another type of injection known as sargramostim, which is a GM-CSF (granulocyte-macrophage stimulating colony factor). This medication is mainly used in patients with AML (acute myelogenous leukemia) and in the stem cell transplant setting.

While G-CSF is helpful in preventing chemotherapy-induced neutropenia, prophylaxis is not indicated for all patients receiving chemotherapy. Risk factors need to be assessed. As you may recall, these risk factors include patient risk factors (age, comorbidities), chemotherapy regimen (drugs used, dosage), and type of cancer. Patients with a 20% or higher risk of febrile neutropenia should receive G-CSF prophylactically. Of note, patients who are receiving radiation during the same time as chemotherapy should not receive G-CSF (Crawford et al., 2014; Cappozzo, 2004).

Tips for Administering G-CSFs

The following are tips in the standard administration of G-CSFs (Memorial Sloan Kettering Cancer Center, 2014):

• Filgrastim and Pegfilgrastim should both be stored in the refrigerator. Do not freeze.
• If the medication becomes frozen, thaw it out in the refrigerator.
• If the medication vial freezes more than once, do not use it.
• Medication can be left unrefrigerated for 24 hours.
• Keep the medication out of direct sunlight.
• Remove medication 30 minutes prior to administration so that it can reach room temperature.
• Do not shake the medication.
• Rotate injection sites.
• When administering the injection, do so slowly.

It is ideal to prevent neutropenia before it happens. Once neutropenia occurs, patients can be treated with G-CSF. However, it is important to note that treatment with G-CSF is not as useful (Cappozzo, 2004). In addition, severe neutropenia puts patients at risk for serious infections and life-threatening complications, as was discussed previously.

**Patient Education: Neutropenic Precautions**

When patients are neutropenic, the health care provider plays an important role in keeping the patient safe. Education is a priority. Patients and their caregivers should be properly educated about symptoms to report immediately, such as fever, chills, and signs of infection.

Signs of infection include sore throat, cough, pain or burning when urinating, diarrhea, and swelling or redness at a wound site. Patients should also be advised to check their temperature regularly (Nirenberg et al., 2006). The health care provider should also educate patients and their caregivers about neutropenic precautions, which will be discussed in this section.

Hand washing is one of the most important tactics to prevent the spread of germs. Patients should wash their hands frequently, especially after using the bathroom and before eating. Good personal hygiene and oral care are also important. In patients with mucositis (oral lesions), breakdown in the oral cavity can lead to infection (Nirenberg et al., 2006).
During neutropenia, patients should avoid contact with flowers, plants, and soil. Patients should also avoid contact with the water that flowers sit in due to the fact that the plants and/or water can be a haven for germs. In addition, neutropenic patients should be careful around animals. Patients should wash their hands immediately after touching animals. Patients should also not be in contact with animal feces or urine, as well as the litter box (Nirenberg et al., 2006). Neutropenic patients have a compromised immune system. They should avoid contact with people who are ill with a contagious disease or who have symptoms of illness. Patients should avoid people with respiratory symptoms, such as sneezing, coughing, and runny nose (Nirenberg et al., 2006).

Diet is yet another concern in patients with neutropenia. This topic is a bit controversial and there is ongoing research as to what foods should be avoided and whether this precaution is useful. Generally speaking, neutropenic patients should avoid fresh fruits and vegetables, fresh fruit juices (unpasteurized), and raw eggs. Meat and fish should be well cooked. Patients should also avoid salad bars, buffets, and sidewalk food carts. Patients should check expiration dates on perishable foods. Leftovers should be eaten within three days. The refrigerator should be kept between 34 - 40 degrees Fahrenheit, and the freezer should be kept below 0 degrees Fahrenheit (DeMille, Deming, Lupinacci, & Jacobs, 2006; Nirenberg et al., 2006).

**Neutropenic precautions**

The education of patients about neutropenic precautions are highlighted below:

- Wash hands often (patients and their caregivers)
- Good hygiene and oral care
- Stay away from animals and flowers/plants/soil
- Stay away from sick people
- Neutropenic diet
- Remind patients to check temperature and notify the doctor if fever occurs

**Summary**

Chemotherapy-induced neutropenia is a common occurrence in patients receiving oncology treatment. Neutropenia can lead to dose delays as well as dose reductions. Neutropenia can also lead to serious, even life-threatening infections. Patients may require hospitalization and intravenous antibiotics. Some patients may even require intensive care. Sepsis can occur and can lead to serious morbidity and mortality.

Going back to Linda (Case study at beginning of course):

*Linda presents to her oncologist’s office. Her heart rate is 86 bpm, blood pressure is 119/61, and temperature is 99.9 degrees Fahrenheit. Her CBC (complete blood count) notes a WBC (white blood cell) of 1.1, ANC (absolute neutrophil count) of 400, hemoglobin of 11.9, and platelet count of 141,000.*

*Linda’s ANC of 400 is consistent with Grade IV neutropenia. She has a low-grade fever. She denies cough, shortness of breath, runny nose, sore throat, diarrhea, or burning when she urinates. Inspection of her skin reveals no open wounds or sores.*
Linda is given a dose of filgrastim and is scheduled to return to the office tomorrow for an additional injection of filgrastim. The physician also plans to administer G-CSF prophylactically during Linda’s subsequent cycles of chemotherapy.

The office nurse discusses neutropenic precautions with Linda and reminds her to call right away if she has a fever or any changes in her symptoms. After two doses of filgrastim, Linda’s CBC is repeated and reveals a white blood count of 5.3 with an ANC of 1.9. She does not require any additional doses of filgrastim at this time and has had no further fevers.

As a nurse, you play an integral role in keeping these patients safe. By recognizing at-risk patients, you can help identify which patients may be candidates for prophylactic therapy with filgrastim or pegfilgrastim. Nurses are very important as they often serve as a patient advocate.

Nurses are also in an excellent place to provide patient education. Patients receiving chemotherapy should be instructed on signs and symptoms to report. It is also helpful to ensure that the patient has a thermometer at home. In patients with neutropenia, you must educate the patients and their caregivers regarding precautions to take to prevent further harm. Neutropenia can be a very serious complication. Through proper education and working together as a team, patient outcomes can be optimized.

Please take time to help the NURSEC4LESS.COM course planners evaluate nursing knowledge needs met following completion of this course by completing the self-assessment Knowledge Questions after reading the article. Correct Answers, page 23.
1. Calculate the ANC (absolute neutrophil count). WBC = 1.6, Neutrophil % = 12%, Lymphocyte % = 80%, Eosinophil % = 3%, Monocyte % = 5%.
   a. 1,280
   b. 48
   c. 272
   d. 192

2. In the above question, what grade is the neutropenia?
   a. Grade 1
   b. Grade 2
   c. Grade 3
   d. Grade 4

3. Which patient is at highest risk for developing neutropenia?
   a. 67-year-old male with acute leukemia undergoing high-dose combination chemotherapy. Has history of diabetes.
   b. 44-year-old female with breast cancer currently receiving single-agent Taxol. Has history of hypertension.
   c. 59-year-old male with prostate cancer receiving radiation to the prostate. Has history of COPD.
   d. 23-year-old female with Hodgkin’s lymphoma who is receiving combination chemotherapy.

4. All of the following are negative outcomes of neutropenia except:
   a. Increased costs
   b. Hospitalization
   c. Better response to chemotherapy
   d. Death
5. **What should a chemo patient do if he/she has a fever of 100.6 degrees Fahrenheit?**
   a. Stop checking his temperature
   b. Call his oncologist’s office and let them know
   c. Take antibiotics his wife has left over from when she had a UTI
   d. Call 911

6. **You are a nurse in the emergency room caring for a patient who comes in with febrile neutropenia. You should do all of the following except:**
   a. Draw blood cultures after starting IV antibiotics
   b. Collect urine for urinalysis and culture
   c. Ensure that a chest xray is ordered
   d. Ensure that IV antibiotics are ordered

7. **Which foods should a patient avoid when he/she is neutropenic?**
   a. Medium-rare steak
   b. Fresh apple with skin
   c. Golden corral buffet
   d. All of the above

8. **You are caring for a neutropenic patient and reviewing neutropenic precautions. What advice is incorrect?**
   a. Wash hands often, especially before you eat and after you use the bathroom.
   b. You are not allowed to touch your pet dog.
   c. You should stay away from gardening due to exposure to flowers, plants, and soil.
   d. Make sure you avoid crowds and stay away from sick people.
9. What is the most common side effect of G-CSF (filgrastim, pegfilgrastim)?
   a. Bone pain
   b. Pain at the injection site
   c. Fever
   d. Fatigue

10. When is the best time to give G-CSF?
    a. The same day as chemotherapy so that the patient doesn’t have to come back
    b. 24 hours after chemotherapy
    c. When the patient is neutropenic
    d. The day before the next cycle of chemotherapy
**CORRECT ANSWERS:**

1) Calculate the ANC (absolute neutrophil count). WBC= 1.6,
Neutrophil %= 12%, Lymphocyte %= 80%, Eosinophil %= 3%,
Monocyte %= 5%:
   
   **d. 192**

2. In the above question, what grade is the neutropenia?
   
   **d. Grade 4**

3. Which patient is at highest risk for developing neutropenia?
   
   **a. 67-year-old male with acute leukemia undergoing high-dose combination chemotherapy. Has history of diabetes.**

4. All of the following are negative outcomes of neutropenia except:
   
   **c. Better response to chemotherapy**

5. What should a chemo patient do if he has a fever of 100.6 degrees Fahrenheit?
   
   **b. Call his oncologist’s office and let them know**

6. You are a nurse in the emergency room caring for a patient who comes in with febrile neutropenia. You should do all of the following except:
   
   **a. Draw blood cultures after starting IV antibiotics**

7. Which foods should a patient avoid when he/she is neutropenic?
   
   **d. All of the above**

8. You are caring for a neutropenic patient and are reviewing neutropenic precautions. What piece of advice is incorrect?
   
   **b. You are not allowed to touch your pet dog.**

9. What is the most common side effect of G-CSF (filgrastim, pegfilgrastim)?
   
   **a. Bone pain**

10. When is the best time to give G-CSF?
   
   **b. 24 hours after chemotherapy**
REFERENCE SECTION

The reference section of in-text citations include published works intended as helpful material for further reading. Unpublished works and personal communications are not included in this section, although may appear within the study text.


The information presented in this course is intended solely for the use of healthcare professionals taking this course, for credit, from NurseCe4Less.com.

The information is designed to assist healthcare professionals, including nurses, in addressing issues associated with healthcare.

The information provided in this course is general in nature, and is not designed to address any specific situation. This publication in no way absolves facilities of their responsibility for the appropriate orientation of healthcare professionals. Hospitals or other organizations using this publication as a part of their own orientation processes should review the contents of this publication to ensure accuracy and compliance before using this publication.

Hospitals and facilities that use this publication agree to defend and indemnify, and shall hold NurseCe4Less.com, including its parent(s), subsidiaries, affiliates, officers/directors, and employees from liability resulting from the use of this publication.

The contents of this publication may not be reproduced without written permission from NurseCe4Less.com.