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Nursing Interventions for Managing Neutropenia in Oncology Patients: A Comprehensive Review**Ms. Manisha Agarhari¹**

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Abstract

Neutropenia is a common and potentially life-threatening side effect of cancer therapy. This significantly raises the risk of infection, can lead to febrile neutropenia and can require reduction in or postponement of chemotherapy dose. Oncology nurses are an integral part of the team in preventing complications, recognizing signs of infection early, beginning prompt treatment when febrile neutropenia occurs, informing patients and their families, and facilitating the care of multiple disciplines.

This review gives a summary of the current evidence and clinical recommendations that can be used to create a nursing framework for assessing, preventing and managing neutropenia in the cancer patient. Key nursing interventions are to assess the risk, to monitor the absolute neutrophil count regularly, to take necessary infection prevention precautions, ensure administration of granulocyte colony stimulating factors in line with clinical guidelines, and commence empirical antimicrobial treatment immediately when fever and neutropenia are suspected. There is also a special focus on providing nutritional assistance, psychological care and ongoing patient education. The review also provides clinical practice guidelines and recommendations for further research and development with practical nursing care plans and monitoring checklists.

Keywords: Neutropenia, febrile neutropenia, oncology nursing, G-CSF, infection prevention

Introduction

Neutropenia is typically defined as ANC less than 1,500 cells/ μ L and severe neutropenia is defined as ANC less than 500 cells/ μ L. It is also one of the most clinically important and dose limiting side effects of cytotoxic chemotherapy because a decrease in the number of neutrophils in the blood makes it more difficult to fight bacterial and fungal infections. This means that neutropenia can cause significant morbidity, subsequently prolonging hospital stays, and hindering planned cancer treatment, as well as increasing the risk of treatment-related mortality in oncology patients [1–3].

Patients with fewer neutrophils can be considered to have an oncologic emergency if they develop fever, known as febrile neutropenia. Fever may be the first or only sign of a serious infection in immunocompromised patients due to possibly reduced inflammatory response. If not recognized and treated early, complications can include sepsis, septic shock, organ dysfunction and death. In addition, febrile neutropenia can lead to urgent admission to hospital, extended hospitalisation, greater cost of treatment, reduced dose of chemotherapy and delay the start of further treatment, which can impact on overall treatment outcomes [2,3,6].

Oncology nurses play a key role in the prevention

and management of these complications. Their role is to evaluate the individual risk factors, monitor full blood counts and ANC, recognize early signs of infection, ensure infection prevention measures are kept and to report any deterioration in clinical condition promptly. Nurses are also responsible for the administration of prescribed granulocyte colony-stimulating factors, antimicrobial therapy and for monitoring response to treatment and adverse reactions. They also provide information to patients and family members about hand hygiene, oral and skin care, food safety, avoidance of exposure to infection, monitoring of temperature and symptoms needing prompt medical attention. Good communication and coordination with oncologists, pharmacists, microbiologists, dietitians and other health professionals are important for providing timely and effective care. The recommendations of international organizations like ASCO, ESMO and IDSA, and the evidence of modern oncology nursing reinforce these nursing duties [2,3,5,11,12]. Thus, this review brings together clinical guidelines, results from trials and meta-analyses, and evidence-based nursing practice, to offer a practical approach to the management of neutropenia in those undergoing cancer treatment.

Epidemiology & impact

The risk of developing chemotherapy induced neutropenia varies widely due to the myelosuppressive

activity of the chemotherapy regimen, type and stage of the cancer, intensity of the treatment, and individual patient factors. The patient-related risk factors are important: advanced age, poor performance status, pre-existing comorbidities, renal and hepatic impairment, nutritional deficiency, previous chemotherapy/radiotherapy, and lack of bone marrow reserve. The incidence of febrile neutropenia varies from 20% in patients undergoing myelosuppressive chemotherapy, depending on the type of chemotherapy and patient population. The death rate in febrile neutropenia has been around 10% in some reports, and may be significantly increased with multiple comorbid conditions, uncontrolled infection, organ dysfunction, bacteremia, or septic shock [13,22].

Neutropenia can pose a risk of life-threatening infection and can interfere with the planned treatment of cancer. Clinicians might have to wait longer between chemotherapy treatments; lower the number of drugs the patient receives or stop the therapy or change the treatment to let bone marrow recover. These changes can lead to less relative dose intensity and can potentially impair treatment effectiveness, especially in cancers where chemotherapy dose and timing is critical to disease control, prevention of recurrence, and survival. Recurrent neutropenic episodes can also lead to patients not having faith in their treatment and to concerns about future chemotherapy sessions.

Neutropenia is an expensive condition. Fever often necessitates immediate evaluation, hospitalisation, laboratory and microbiological investigations, intravenous broad-spectrum antibiotic therapy and careful clinical monitoring. Other expenses may include granulocyte colony-stimulating factor administration, blood products, isolation precautions, extended hospital stays, and post hospitalization treatment. Indirect costs are lost jobs, caregiver duties, transportation costs, and decreased quality of life. Thus, early risk assessment, proper prophylaxis, patient education, and early management of fever are crucial to minimise complication rates, keep chemotherapy intensities, and reduce the clinical and cost burden of neutropenia [7,24].

Pathophysiology

Neutrophils are formed in the bone marrow by differentiation and maturation of myeloblasts, which are myeloid precursors. Since cytotoxic chemotherapy also kills rapidly dividing cells, it can also affect these hematopoietic progenitors, and decrease the production of neutrophils. The absolute neutrophil count (ANC) nadir is the lowest absolute number of neutrophils and occurs approximately 7-14 days after the completion of chemotherapy (specific

drugs, doses, treatment regimen and patient's baseline bone marrow reserve are all factors that determine when and how the ANC nadir occurs). Neutrophil recovery typically occurs when the proportion of blood cells that remain in the marrow returns to normal.

Radiotherapy to the marrow rich areas, including the pelvis, spine, sternum and long bones, may also affect the production of blood cells and aggravate treatment-induced neutropenia. The direct infiltration of bone marrow by hematological and metastatic solid tumors may also affect bone marrow function. There are also some chemotherapeutic drugs that affect the bone marrow in particular, such as alkylating, antimetabolites and some combination therapies. Neutropenia may be more severe and last longer if the person has previously had chemotherapy or radiotherapy, the disease is advanced, the person is not eating well, the person is older, or the person has a pre-existing marrow problem.

This decrease in circulating neutrophils leads to a decrease in the innate immune system, including decreased recognition, containment, and elimination of invading microorganisms. Patients are consequently very vulnerable to bacterial and, in severe or long-lasting neutropenia, to invasive fungal infection. The inflammatory signs can be minimal or absent, because neutrophils play an important role in the production of redness, swelling and purulent discharge. Hence, fever may be the first or only symptom of infection, therefore close monitoring and timely clinical intervention is important.

Risk stratification: Identifying high-risk patients

Risk stratification is crucial for the identification of oncology patients with the highest risk for the development of chemotherapy induced neutropenia or febrile neutropenia. It allows the health care team to tailor preventive care, to decide if granulocyte colony-stimulating factor (G-CSF) prophylaxis is necessary, and to plan for the level of laboratory and clinical surveillance. The risk of febrile neutropenia associated with the chemotherapy regimen should be taken into account, as well as the clinical features of the patient.

Factors to consider are those that carry a high risk of febrile neutropenia after highly myelotoxic chemotherapy (HMC) with a predicted risk of 20% or more), age greater than or equal to 65 years, and a previous febrile neutropenia (FN) event or prolonged severe neutropenia. Patients with renal or hepatic impairment, uncontrolled diabetes, cardiovascular or respiratory disease, poor performance status, malnutrition, pre-existing cytopenias, advanced malignancy or bone marrow involvement are also at risk. Some other factors may include prior chemotherapy or radiotherapy, intensive prior treatment, open wounds or active infection, and

concurrent corticosteroid or other immunosuppressive drugs.

Guidelines for the use of primary prophylaxis for febrile neutropenia currently include G-CSF starting from the first cycle of chemotherapy when the overall risk of febrile neutropenia is 20% or more. Prophylaxis may also be considered for regimens with an intermediate risk of about 10-20%, if there is one or more patient specific risk factor. In cases where the level of risk is low, regular primary prophylaxis is generally not warranted unless there are considerable clinical risk factors.

In cases of febrile neutropenia, prolonged neutropenia or other dose limiting neutropenic event during a previous treatment cycle, secondary G-CSF prophylaxis might be warranted. This is especially relevant if it is important to maintain a planned chemotherapy dose and schedule for optimal control of the disease, and if there is a risk of reducing the dose or delaying therapy that could adversely affect results [5,24].

One of the primary roles of the nurse is to review baseline blood count, document previous neutropenic events, evaluate comorbidities and nutritional status, check for early signs of infection, and reiterate patient education. The timely and accurate risk assessment and prophylaxis can decrease febrile neutropenia, avoid unnecessary hospitalisation, maintain the continuity of cancer treatment and increase patient safety.

Clinical Manifestations and Early Warning Indicators

Patients with neutropenia may demonstrate a reduced inflammatory response; therefore, infection can develop without the usual prominent clinical signs. Even mild or nonspecific symptoms should be considered clinically important and evaluated without delay. Fever is often the earliest—and sometimes the only—indication of infection or febrile neutropenia. It is commonly defined as a single oral temperature above 38.3°C or a temperature above 38.0°C that persists for at least one hour.

Other possible manifestations include chills, rigors, newly developed cough, shortness of breath, sore throat, oral mucositis, and urinary discomfort. However, chills and other typical inflammatory symptoms may be absent. Localized redness, tenderness, swelling, or induration around a central venous catheter, wound, or injection site may indicate infection. Altered mental status, hypotension, and reduced level of consciousness are more serious findings and may represent advanced sepsis. Consequently, nurses should regard any fever in a neutropenic patient as a potential emergency and

initiate the institution's febrile neutropenia protocol immediately [2,3,6,10].

Diagnostic Assessment and Immediate Nursing Priorities

Nursing care should include a quick assessment, stabilization measures, collection of proper diagnostic specimens and early treatment when febrile neutropenia is suspected. The first step is for the nurse to determine the airway, breathing, and circulation status of the patient, and whether there is any hemodynamic instability. Immediate assessment of vital signs, oxygen saturation, level of consciousness and general clinical appearance should be assessed. Side table blood sugar testing may also be necessary as hypoglycemia and hyperglycemia can be a problem during an acute illness and can affect the management. Blood cultures should be taken before the use of antimicrobial agents, preferably from a peripheral vein, from each lumen of a central venous access device without any clinically significant delay.

Urine, sputum, wound, stool or other cultures should be taken based on patient symptoms and/or possible source of infection. The treating physician/oncology team should be notified immediately and the institutional febrile neutropenia pathway should be put into place. Adequate intravenous access should be achieved and nurse should be prepared to administer empirical intravenous antibiotics. Antibiotics should be given preferably within 60 minutes of presentation in clinically stable patients; those with hypotension, sepsis or any signs of instability will need even more urgent antibiotics. Laboratory studies are usually performed as part of the baseline investigations and should include a complete blood count with differential, renal and hepatic function tests, serum electrolytes and lactate if sepsis is suspected.

When there are signs or symptoms of the chest, chest radiography or imaging might be needed. The nurses play a key role in completing this time sensitive care bundle, and recording key points such as when the fever was recognized, when the specimen was taken, when the medical review was made, and when antibiotics were given. Good documentation enhances compliance with recommended door-to-antibiotic quality standards [2,3,23].

Evidence-Based Therapeutic Interventions Empiric Antimicrobial Therapy

Immediate treatment is necessary with broad-spectrum intravenous antibiotic with activity against *Pseudomonas aeruginosa* for high-risk febrile neutropenia. The agents recommended are usually cefepime, piperacillin-tazobactam or a suitable carbapenem. The choice should depend on local antimicrobial resistance, patient's history of allergy,

recent antimicrobial usage, clinical condition, likely source of infection, and organ function [3,21].

Whenever possible, use institutional antibiograms for empirical antibiotic prescribing. Refer to infectious disease specialists may be helpful in the following cases: patients with severe sepsis, resistant organisms, persistent fever, unusual infections, and unresponsive to initial therapy. Nursing duties encompass making sure antibiotics are given when they are not avoidably delayed, verifying allergy status, checking for infusion-related and hypersensitivity reactions, observing clinical response and facilitating therapeutic drug monitoring if needed.

Granulocyte Colony-Stimulating Factors

The granulocyte colony-stimulating factors (G-CSF) such as filgrastim and pegfilgrastim are used to stimulate the production of neutrophils and can shorten and lessen the effects of neutropenia caused by chemotherapy. Under certain conditions, these can also provide a means of reducing the number of febrile neutropenic episodes and hospitalisations in appropriate high-risk patients.

Primary G-CSF prophylaxis is usually recommended for chemotherapy regimens with an estimated overall risk for febrile neutropenia of $\geq 20\%$ and/or patient-related factors. It can also be used with intermediate-risk regimens if there is more clinical risk. Secondary prophylaxis is generally indicated following a first occurrence of febrile neutropenia, or any other neutropenic complication such as other chemotherapy dose-limiting complications, especially when dose intensity is a major factor in the treatment of malignancy [5,24].

Nurses administer G-CSF at the recommended time, which is usually after a suitable period following chemotherapy and in line with manufacturer's instructions. They should be looking for bone pain, reactions at the injection site, leukocytosis and other side effects. Patients and caregivers may also need to be taught how to store medicines, how to give an injection, when to give one, how to dispose of needles and syringes safely, and what signs to watch for that indicate the medicine should be given.

Antimicrobial Prophylaxis

Antibacterial, antifungal, or antiviral prophylaxis may be considered for certain patients who have chronic or severe neutropenia. This treatment may decrease the chance of developing some infections, but there are potential side effects from the drug, such as interactions with other drugs, toxicity, resistance to the drug, and the cost of the drug.

Nurses need to evaluate for adherence, look for any complications that can occur with the medication and

remind patients that prophylaxis doesn't mean they can't get infected. However, any fever or other warning signs should be reported promptly due to the possibility of breakthrough infections.

Nursing-Led Infection-Prevention Measures

Nurse's structured infection-prevention bundles are essential to the prevention of infection for neutropenic patients. Hand hygiene is the most critical preventive measure by healthcare providers, patients, carers and visitors.

The patient's surroundings should be kept clean and frequently touched surfaces should be routinely disinfected. Fresh flowers, plants, raw foods and other foods that could be contaminated with microorganisms may be limited depending on institutional policies and level of immunosuppression.

All invasive procedures should be performed in an aseptic manner and central venous access devices should be handled in an aseptic manner. Appropriate antiseptic (e.g. chlorhexidine unless contraindicated) should be used for skin preparation, according to protocol. Regularly check catheter sites, keep dressings clean and in good order, and re-evaluate the necessity of every invasive device each day.

Oral hygiene is required to minimise the injury to the mucosa, the oral colonisation and local infection. Treatment can involve flushing the mouth out gently, soft toothbrushes, drinking plenty of fluids and topical preparations that can be prescribed. Patients should be monitored periodically for ulceration, bleeding, pain, candidiasis and mucositis.

Visitor screening, masking, cohorting or temporary restrictions may be warranted during times of high-community transmission of respiratory infections. To focus on avoiding undercooked meat, unpasteurized milk products, raw eggs, and under-cleaned fruit/vegetables should be covered in food safety education. Clinical and institutional quality improvement data suggest that application of these preventive interventions by nurses regularly can reduce infection-related complications [11,14,23].

Nursing Assessment and Monitoring

A monitoring plan is used to identify early the presence of neutropenia and infection. Prior to chemotherapy, a full blood count and differential, renal and liver function tests, nutrition status assessment, comorbidities, and previous neutropenic events should be assessed.

Patients should be monitored more closely during the time when they are expected to be at their lowest point, typically 7-14 days after most chemotherapy

treatments. Monitoring includes daily assessment of symptoms, daily temperature and repeat blood counts as per treatment plan and clinical condition. The time of the nadir and time of infection risk should be communicated to patients who are cared for as an outpatient.

In hospitalized patients, nursing observation plan may consist of:

- Taking temperature readings at least four times a day and reporting high temperatures when they reach a threshold set by the institution.
- Tracking the trend of the ANC from pre- to post-inflection point.
- Checking peripheral and central vascular-access points on each shift.
- Evaluating oral mucosa on shift change, and oral care at regular intervals.
- Regular assessment of skin integrity, wounds, pressure areas and dressings.
- Assessing fluid, urine output, hydration and electrolyte levels.
- Evaluating pain: including bone pain associated with G-CSF therapy.
- Monitoring for signs of respiratory, urinary, gastrointestinal, neurological and hemodynamic disturbance.

The use of these assessments on the standardized flowsheet in the electronic health record (EHR) may be more effective for consistency, communication, and early detection of deterioration.

Patient and Caregiver Education

Education of patients and caregivers is one of the most powerful nursing interventions that can help reduce the risk of a delay in treatment for febrile neutropenia. Information should be standardized, well documented and repeated through treatment and not given in one spot.

Patients should be taught how and when to take their temperature, and be reminded to return to the oncology service as soon as they reach 38.0°C or the temperature limit in the institution where they are being treated. They should not delay in calling the clinical team for assistance because they think there is not enough of a fever and do not try to stop the fever.

Regular hand hygiene and avoiding close contact with people who are sick should also be taught, as should minimising exposure to crowded and poorly ventilated spaces during the neutrophil nadir. Food safety information should include proper food storage and preparation, and avoid foods that are known to be a risk for foodborne illness. Practical instructions to patients and caregivers should be provided about oral hygiene, skin protection, perineal care, wound care,

and care of the central line. Any ulcers in the mouth, prolonged pain, redness, swelling, discharge or abnormalities related to the catheter must be reported immediately.

All education should cover the schedule, how to inject, storage instructions, and common side effects of G-CSF, which include bone discomfort and injection site soreness, for patients receiving G-CSF at home. Educating on taking medicines and attending regular tests and review appointments should also be highlighted.

Use teach-back to verify comprehension. This can increase confidence and adherence with written instructions, emergency contact numbers, educational materials in the patient's preferred language, and follow-up via telehealth.

Psychosocial Support and Quality of Life

Neutropenia may have a negative impact on mental health and quality of life. Patients may have fears of infection, anxiety about the treatments being interrupted, isolation from family and community, frequent hospital visits, financial concerns, and questions about the future. Protective measures can also limit usual social interactions and lead to feelings of loneliness or distress.

Nurses should offer emotional support, share concerns, and dispel misconceptions about neutropenia and infection. Counselling, psycho-oncology, social work, financial assistance services or peer support programs may be appropriate. Where feasible, screening for anxiety, depression and concerns with treatment should be included in routine health care. Psychoeducational interventions may help to lower fear and increase protective behaviours [12].

Outpatient Care and Telehealth

Some patients who are at low risk for febrile neutropenia can be treated at home, which could decrease hospitalizations and increase comfort. But outpatient treatment is viable only after careful clinical assessment and risk assessment. Complications may be limited to a safe level of care and the use of validated tools like Multinational Association for Supportive Care in Cancer risk index can help identify these patients for outpatient intravenous treatment [2,6].

Nurses participate in risk assessment, triage, discharge planning, remote symptom evaluation and follow up coordination. Utilization of telehealth consultation, e-symptom reporting, and home thermometers could aid in earlier recognition of fever and prompt timely intervention. Patients who are chosen for outpatient treatment should be able to receive and understand the treatment, receive caregiver support, and have reliable

transportation and access to emergency services.

Challenges in Clinical Implementation

There are a number of obstacles that can obstruct the optimal management of neutropenia. There can be variations between hospitals, regions and clinical teams with respect to how the guidelines are implemented. Limited resources may be available for the use of G-CSF, microbiological testing, isolation facilities, specialist review, or prompt empirical antimicrobial therapy.

Different knowledge and confidence in nursing also can make the febrile neutropenia difficult to be recognized and emergency protocol being activated. Another challenge is that antimicrobial resistance can make it harder to treat patients because the effectiveness of standard empirical treatment may be reduced because of local resistance patterns.

The barriers to meeting these needs include locally adapted institutional policies, ongoing nursing education, emergency training using simulation, access to essential medicines, periodic clinical audits, and working with antimicrobial-stewardship teams [9,11,16].

Nursing Education, Protocols, and Competency

Healthcare institutions should have evidence based febrile neutropenia protocols that are adapted to local microbiology, resources and international guidelines. Reduced delays in investigation and treatment can be achieved through standing orders and clearly defined escalation pathways. Nurses should have completed competency-based education on neutropenia assessment, recognizing the need for fever, screening for sepsis, collecting cultures, giving antimicrobials, and emergency response.

Simulations can build confidence and readiness for nurses to deal with an acutely deteriorating patient. Patient-education resources should be easy to understand, culturally appropriate and translated into local languages.

If declining ANC levels, periods of low blood counts, and medications with a high risk of decreasing blood counts are reported electronically, it can also facilitate prompt intervention. Knowledge improvement and protocol compliance as well as patient outcomes have been linked to education programs geared towards nurses [9,11,12].

Research Priorities

Research is needed to assess the safety and effectiveness of nurse-led febrile neutropenia services

in the outpatient setting in various healthcare environments. Future research is also needed to determine if the use of telehealth, wearable devices and remote temperature monitoring technologies decreases treatment delays, hospital utilization and severe complications.

Other priorities involve identifying safe approaches for antimicrobial de-escalation, minimizing inappropriate antibiotic use and improving antimicrobial stewardship without risking patient safety. There is a need for implementation research to identify ways of improving adherence to guidelines and nursing competence in low and middle income countries in particular.

Broader economic evaluations of G-CSF prophylaxis versus the costs of hospitalization and emergency treatment would also help to guide the allocation of health care resources [17,22].

Conclusion

Neutropenia remains a significant side effect of chemotherapy and has serious implications for the safety of patients, quality of chemotherapy care, cost of healthcare and quality of life. Keeping nurses at the centre of risk assessment, prevention of infection, early recognition of clinical deterioration, rapid management of febrile neutropenia and educational support of patients and carers.

Consistent use of evidence-based interventions - such as G-CSF prophylaxis for appropriate patients, prompt empirical antimicrobial therapy upon development of febrile neutropenia, and adherence to strict infection control measures - is essential for optimal care. To achieve the best possible results, standardized procedures, ongoing nursing education, accurate documentation and good teamwork between different disciplines are necessary. Future research should address nurse-led outpatient care, telehealth monitoring, antimicrobial stewardship, and implementation strategies which facilitate high-quality neutropenia care in a variety of clinical settings.

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