Neutropenic sepsis: prevention, identification and treatment


Abstract
Chemotherapy-induced neutropenia may result in significant physical, social and emotional consequences for patients receiving anticancer therapy. Chemotherapy-induced neutropenia also leads to delays in treatment and reductions in dose intensity. In some cases neutropenia may be prevented by the use of granulocyte-colony stimulating factor, but it remains one of the most common side effects of chemotherapy. Patients who are neutropenic have a reduced ability to fight infection and are at increased risk of developing neutropenic sepsis. Nurses need to be able to recognise the signs and symptoms of neutropenic sepsis to ensure early diagnosis and treatment. There are evidence-based pathways for the treatment of patients with neutropenic sepsis and nurses have the potential to develop services and initiatives to support best practice for this group of patients.

Author
Clare Warnock, practice development sister, Weston Park Hospital, Specialist Cancer Services, Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, England. Correspondence to: clare.warnock@sth.nhs.uk

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Aims and intended learning outcomes
This article describes the causes, signs and symptoms of neutropenic sepsis in adult patients after cancer treatment and explores the consequences, treatment and nursing care of neutropenia. The article does not discuss the specialist needs of patients who have developed neutropenia as a consequence of disease processes, such as infiltration of the bone marrow by cancer cells, nor does it address the care of patients with haematological cancers, including following stem cell transplants. After reading this article and completing the time out activities you should be able to:
» Define neutropenia and explain how and when it may occur in patients with cancer.
» Describe the signs and symptoms of neutropenic sepsis and be able to distinguish the stages of the sepsis continuum.
» Discuss the principles of risk stratification and their implications for the treatment of neutropenic sepsis.
» Provide accessible information for patients about neutropenia and neutropenic sepsis.
» Outline the potential physical, social and emotional consequences of neutropenic sepsis for patients and their families.

Introduction
Neutropenic sepsis is a potentially life-threatening complication of chemotherapy. It is considered a medical emergency, requiring immediate assessment and treatment (Okera et al 2011); patients who initially appear stable can quickly deteriorate and become critically ill (Held-Warmkessel 2011). The incidence of neutropenic sepsis is difficult to quantify but it has increased over time. This increase may reflect the increasing use of chemotherapy to treat cancer (National Institute for Health and Care Excellence (NICE) 2012). Neutropenic sepsis has two components: neutropenia, a low
count of circulating neutrophils; and sepsis, a systemic inflammatory response to infection (Royal College of Physicians (RCP) 2014). Many patients develop neutropenic sepsis outside of a specialist cancer centre; therefore all nurses who come into contact with patients with cancer should be able to recognise neutropenic sepsis and initiate the urgent assessment and treatment of the patient (Foulkes 2010).

Complete time out activity

1 Write down what you know about neutropenia. Refer to an anatomy and physiology textbook to find out more. Identify any gaps in your knowledge before proceeding.

2 What observations and investigations are used to diagnose and monitor sepsis? How do you think these might differ in a patient who is neutropenic?

Neutropenia

Neutrophils are white blood cells produced by the bone marrow. They have a vital role in the body’s defence mechanisms since they recognise, attack and kill bacteria by engulfing them through the process of phagocytosis (Blann 2014). Patients who have a low level of neutrophils have an increased susceptibility to infection and a reduced ability to fight it (Coughlan and Healy 2008). The normal neutrophil count is 2.0–7.0x10^9/L (Blann 2014). However, the definition of neutropenia by using neutrophil count can vary (NICE 2012); for example it has been classified as a count of less than 1.0x10^9/L (Okera et al 2011), below 0.5x10^9/L (Chang et al 2013) or less than 1.0x10^9/L and likely to fall below 0.5x10^9/L (de Naurois et al 2010). The differing values in these definitions may reflect the relationship between neutrophil levels and sepsis severity, since the lower the level falls below 1.0x10^9/L, the greater the risk of sepsis severity (Nirenberg et al 2006).

Neutropenia is one of the most common side effects of anticancer therapy, particularly chemotherapy (Teuffel et al 2011). Many chemotherapy drugs affect the bone marrow causing a temporary reduction in the production of blood cells, including neutrophils (Tadman and Roberts 2007). Since it takes time for these blood cells to be replaced, there is a period of time when the neutrophil count is low. This is known as the nadir (Held-Warmkessel 2011). Estimates of when the nadir is most likely to occur vary from five to seven days following chemotherapy (Dunkley and McLeod 2015) to seven to 14 days following chemotherapy (Nirenberg et al 2006). However, patients may also be neutropenic outside these periods, depending on their chemotherapy regimen and the time it takes for the neutrophil count to recover (Foulkes 2010, NICE 2012).

Prevention of neutropenia may be achieved for some patients by the prophylactic use of granulocyte-colony stimulating factor (G-CSF) (Chang et al 2013). G-CSF stimulates the bone marrow to produce more white blood cells and it has been shown to reduce the incidence and severity of neutropenia and neutropenic sepsis (Young et al 2009). Not all patients receiving chemotherapy develop neutropenia; G-CSF use has been recommended where there is a 20% or higher chance of neutropenia occurring (American Society of Clinical Oncology 2015). The likelihood of neutropenia occurring is influenced by the potential of the particular chemotherapy drugs in a regimen to cause neutropenia and patient-related factors such as age and comorbidities (de Naurois et al 2010). G-CSF may also be used as secondary prophylaxis after a patient has experienced severe neutropenic sepsis or treatment delays following a previous cycle of chemotherapy treatment (Young et al 2009).

Patients may develop neutropenia without health consequences since the neutrophil count may fall and recover without an infection developing before their next cycle of treatment. However, patients are at increased risk of developing sepsis if infection is present.

Complete time out activity

Neutropenic sepsis

Sepsis is the term used to describe the systemic inflammatory response that occurs in the presence of infection (Steen 2009). It is defined as a continuum of progressing severity that starts with sepsis and may progress to severe sepsis and septic shock (Box 1). Sepsis is a significant cause of death in all patient groups; early identification and effective treatment are essential to improve outcomes (Dellinger et al 2013). Patients who are neutropenic and have an infection are at increased risk of deteriorating along the sepsis continuum as their ability to respond to infection is compromised. This is one reason neutropenic sepsis is considered a medical emergency (Oakley et al 2010).

The physiological processes associated with neutropenia mean that the presenting signs and symptoms of sepsis can be different from those in patients with a normal or raised neutrophil count. The body prepares a defensive action when infection is present, marshalling inflammatory and immune responses involving white blood cells and lymphocytes produced in the bone marrow (Blann 2014). These processes are responsible for many features usually associated with infection, for example redness, swelling, pus and exudate formation and pain (Steen 2009). When white blood cells and lymphocytes are depleted, the
Inflammatory and immune responses may be inhibited and the usual signs of infection may be absent (Dunkley and McLeod 2015).

Patients with neutropenic sepsis may, or may not, develop an elevated temperature. Some patients may present with a raised temperature and no other symptoms of infection. This is often described as uncomplicated febrile neutropenia (NICE 2012). The parameters used to define pyrexia in neutropenic sepsis vary; typically this is described as a temperature above 38.3°C or of 38°C for one hour or more (Bryant et al 2014). However, practice in UK specialist cancer centres varies and the trigger temperatures range between 37.5°C and 38.5°C (NICE 2012).

Patients with neutropenic sepsis may present with a temperature in the normal range or with a low temperature. This may be influenced by the physiological processes described above (Dunkley and McLeod 2015) and/or by medications that may mask an elevated temperature, such as corticosteroids (Foulkes 2010). A low temperature, below 36°C, can be an indicator of severe sepsis (Angus and van der Poll 2013).

**Complete time out activity**

**Patient information**

Patients must be informed about the potential for neutropenia before receiving cancer treatment where this is a potential side effect. For most patients the onset of neutropenia occurs outside of the hospital setting, and they require information that enables them to self-monitor and self-care. Patients receiving anticancer treatment have a lot of information to absorb at a stressful time (NICE 2012). If possible, the patient should be accompanied by a family member or friend to support them when information is provided (Moore 2007). Family members and carers may be more objective than the patient if the patient develops neutropenic sepsis, and notice if they experience signs and symptoms of infection or become unwell (Higgins and Hill 2012). It is important to schedule sufficient time when providing information about neutropenia and neutropenic sepsis, to ensure that the main points can be reinforced and the patient can ask questions and clarify the information received (Moore 2007).

Patients need to understand what neutropenia is, when it might occur in relation to anticancer treatment and the warning signs of sepsis (Coughlan and Healy 2008). The seriousness of neutropenic sepsis should be conveyed, so that the patient is aware it can be a life-threatening condition that must be reported immediately (Tadman and Roberts 2007, Held-Warmkessel 2011). Neutropenia and sepsis are complex terms that may sound overly technical to patients (Methven 2010). It is important to provide this information in a way that is accessible and meaningful to patients and to confirm their understanding.

Patients should be advised to monitor their temperature at least daily, especially if they feel unwell. However, they should also be alerted to the possibility that they may or may not have an elevated temperature if they develop sepsis and should report any signs of infection or feeling unwell (Tadman and Roberts 2007). Written information should be provided about neutropenia and neutropenic sepsis that contains a contact number for advice that is available 24 hours a day, seven days a week (National Chemotherapy Advisory Group 2009). It is recommended practice to supplement this with an alert card that includes a summary of the main symptoms of infection and the contact number for advice (Oakley et al 2010). The alert card should provide brief, focused information about the risk and treatment of neutropenic sepsis for healthcare professionals, in case patients are admitted to an emergency department or seek medical advice outside of a specialist cancer centre (Higgins 2008).

**Table 1**

<table>
<thead>
<tr>
<th>Signs and symptoms of the sepsis continuum</th>
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<tbody>
<tr>
<td><strong>Systemic inflammatory response syndrome (SIRS):</strong></td>
</tr>
<tr>
<td>Two or more of:</td>
</tr>
<tr>
<td>• New onset of confusion or altered mental state.</td>
</tr>
<tr>
<td>• Temperature &gt;38.3°C or &lt;36°C.</td>
</tr>
<tr>
<td>• Heart rate &gt;90 beats per minute.</td>
</tr>
<tr>
<td>• Respiratory rate &gt;20 breaths per minute.</td>
</tr>
<tr>
<td>• White blood cell count &gt;12 x 10⁹/L or &lt;4 x 10⁹/L (&lt;1.0 x 10⁹/L in neutropic sepsis).</td>
</tr>
<tr>
<td><strong>Sepsis:</strong> SIRS plus suspected or confirmed infection.</td>
</tr>
<tr>
<td><strong>Severe sepsis:</strong> sepsis plus organ dysfunction.</td>
</tr>
<tr>
<td><strong>Signs of organ dysfunction:</strong></td>
</tr>
<tr>
<td>• Systolic blood pressure &lt;90mmHg or &gt;40mmHg fall from baseline, or mean arterial pressure &lt;65mmHg.</td>
</tr>
<tr>
<td>• Serum lactate &lt;2mmol/L.</td>
</tr>
<tr>
<td>• Altered mental state.</td>
</tr>
<tr>
<td>• Hyperglycaemia in the absence of diabetes.</td>
</tr>
<tr>
<td>• Hypoxaemia, oxygen saturations &lt;93%.</td>
</tr>
<tr>
<td>• Urine output &lt;0.5mL/kg/hour and/or a raised urea or creatinine.</td>
</tr>
<tr>
<td>• Abnormal clotting levels.</td>
</tr>
<tr>
<td><strong>Septic shock:</strong> presence of severe sepsis with hypotension that does not respond to adequate fluid resuscitation.</td>
</tr>
</tbody>
</table>

Patient information should also include advice on infection prevention. Most infections come from the patient’s own flora or normal environment and this should be explained to them (Tadman and Roberts 2007). The importance of simple measures in preventing infection should be emphasised, for example good personal and oral hygiene and hand washing, particularly after going to the toilet and before preparing food or eating (Nirenberg et al 2006). Patients should be advised to protect the skin from injury, including wearing protective gloves for cleaning and outdoor work such as gardening, and using an electric shaver rather than a bladed razor when shaving (Coughlan and Healy 2008). Patients are at risk of cross-contamination and should be advised to avoid people with symptoms of infection (Tadman and Roberts 2007).

**Nursing care**

Nurses have a role in recognising neutropenic sepsis and ensuring patients receive appropriate treatment promptly. The onset of neutropenia often occurs outside of specialist cancer centres, so all nurses who come into contact with patients with cancer need to be aware of the signs and symptoms, and the actions to take if neutropenic sepsis is suspected (Foulkes 2010). All patients with cancer admitted to hospital should be asked about their treatments to determine if they have recently had chemotherapy and are at risk of neutropenia (Held-Warmkessel 2011). In patients who are neutropenic, the usual signs and symptoms, including pyrexia, may not be present and a much greater level of suspicion of sepsis is required (Dunkley and McLeod 2015).

Neutropenic sepsis should be considered in any patient with cancer at risk of neutropenia who becomes unwell, develops pyrexia or has any symptoms of infection or signs consistent with sepsis, because of their potential for rapid deterioration (NICE 2012). Infection prevention measures by the healthcare team and monitoring for signs of sepsis are crucial where patients are at risk of, or have, neutropenia (Box 2) (Coughlan and Healy 2008).

**Treatment of neutropenic sepsis**

In the 1970s and 1980s chemotherapy was more widely used to treat haematological cancers and aggressive regimens resulted in significant and prolonged episodes of neutropenia in patients who were more likely to become critically ill (Klastersky and Paesmans 2013). As a consequence, all patients with neutropenic sepsis were perceived to be at high risk of becoming critically ill, and treatment was focused on immediate hospitalisation and administration of intravenous antibiotics (Teuffel et al 2011).

More recently, the use of chemotherapy has increased in the treatment of solid tumours. However, many of these regimens have resulted in less severe and shorter periods of neutropenia with a lower risk of serious complications (Klastersky and Paesmans 2013). These changes have led to the recognition that febrile neutropenia is a heterogeneous condition associated with a range of potential outcomes in terms of severity and clinical complications (Lalami et al 2006, Lee and Lockwood 2013).

**Risk stratification**

Risk stratification can be used to categorise patients as being at low or high risk of developing serious complications as a consequence of neutropenia. It can help to identify those who require hospitalisation and intensive treatment and those who may be managed with oral antibiotics, early discharge and self-monitoring (Innes et al 2008, Lee and Lockwood 2013). This approach to treatment has benefits for patients and healthcare services, including reduced risk of toxicity from prolonged antibiotic treatment and healthcare-acquired infections for the low risk group (Teuffel et al 2011, Lee and Lockwood 2013).

A range of factors may increase the risk of developing serious complications as a result of neutropenic sepsis (Box 3). These relate to the type of cancer, cancer treatment, the general health of the patient and the

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**Box 2**

**Monitoring and infection prevention measures when caring for patients who are neutropenic**

- Monitor vital signs every four hours, increasing the frequency according to the patient’s condition, for example, triggers on their early warning score.
- Perform daily full blood count monitoring.
- Observe the patient for any signs or symptoms of infection, including cough, diarrhoea, urinary symptoms, chills and shivers, and rigors.
- Send any specimens indicated by ongoing assessment of symptoms for culture and sensitivity testing.
- Be meticulous in adhering to good hand hygiene practices including hand washing and the use of alcohol hand gel.
- Perform a daily oral assessment, using an oral assessment tool.
- Carefully examine venous access devices and remove them promptly when they are no longer required.
- Avoid invasive procedures including use of suppositories or enemas, or use them with caution.
- Do not allow visitors with symptoms of infection.

neutropenic episode (Chang et al 2013). Some factors cannot be used to predict potential outcomes as they are not known at the time of initial assessment, for example, duration of neutropenia. However, other factors have been used to develop predictive tools such as the Multinational Association for Supportive Care in Cancer (MASCC) risk index, which identifies patients with febrile neutropenia who are at lower risk of serious complications (de Naurois et al 2010). This index includes items associated with the clinical severity of the neutropenic episode, such as hypotension, dehydration and symptom severity, along with those relating to the underlying cancer or health status of the patient (Table 1).

The MASCC risk index, first published in 2000, has been validated in several reviews and studies (Klastersky and Paesmans 2013). It has been used as a tool to guide clinical practice and in the development of outpatient or early discharge pathways using oral antibiotics in some specialist cancer centres (Innes et al 2008). However, risk stratification may not be appropriate for all cancer types and chemotherapy regimens. For example, there is less evidence available to support outpatient management in patients with haematological cancer, particularly with high intensity regimens (Worth et al 2011).

**Complete time out activity 4**

**TREATMENT PATHWAYS**

**Severe sepsis and septic shock** It is important to distinguish between uncomplicated febrile neutropenia, severe sepsis and septic shock to ensure patients receive appropriate treatment (NICE 2012). All patients with potential neutropenic sepsis require immediate assessment to determine severity, prevent deterioration and initiate appropriate treatment (McClelland and Moxon 2014). The first step in the assessment is to observe vital signs, preferably using an early warning system (RCP 2013). These findings are evaluated against the signs and symptoms of the sepsis continuum (Box 1). Immediate intervention is required if signs of sepsis are present (RCP 2014). The Surviving Sepsis Campaign has developed comprehensive guidelines to direct care, summarised as the Sepsis Six care bundle (NHS England 2015). Immediate care focuses on six interventions (McClelland and Moxon 2014, NHS England 2015):

- Intravenous antibiotics.
- Blood tests.
- Intravenous fluids.
- Accurate measurement of urine output.
- Intravenous fluids.
- Blood tests.
- Intravenous fluids.
- Accurate measurement of urine output.

**BOX 3**

**Factors linked to a high risk of developing serious complications associated with neutropenic sepsis**

- Signs of severe sepsis, for example hypotension, tachypnoea.
- Duration of neutropenia.
- Chemotherapy regimen – specific drugs and regimens that are more likely to result in prolonged or severe neutropenia.
- Severity of neutropenia: patients with lower neutrophil counts are at higher risk.
- Burden of illness: moderate to severe symptoms.
- Type of cancer, for example leukaemia and lung cancer.
- Poor performance status.
- Comorbidities, for example lung, cardiac, renal, liver disease. The risk increases in patients with more than one significant comorbidity.
- Type of infection, for example respiratory infection, gram negative and positive, fungal infections, multi-resistant organisms and microbiologically proven infection, as compared with unknown source.
- Temperature greater than 39°C.
- Thrombocytopenia.
- Inpatient at time of presentation.
- Presence of central venous access device.
- Aged over 60.
- Receiving antibiotics at time of onset of febrile neutropenia.
- Poor nutritional status.


**TABLE 1**

**Multinational Association for Supportive Care in Cancer risk index for patients with neutropenia who are at low risk of serious complications**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burden of illness: no or mild symptoms.*</td>
<td>5</td>
</tr>
<tr>
<td>No hypotension.</td>
<td>5</td>
</tr>
<tr>
<td>No chronic obstructive pulmonary disease.</td>
<td>4</td>
</tr>
<tr>
<td>Solid tumour or no previous fungal infection.</td>
<td>4</td>
</tr>
<tr>
<td>No dehydration.</td>
<td>3</td>
</tr>
<tr>
<td>Burden of illness: moderate symptoms.*</td>
<td>3</td>
</tr>
<tr>
<td>Outpatient status at onset of fever.</td>
<td>3</td>
</tr>
<tr>
<td>Age less than 60 years.</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total score**

A score greater than 21 indicates the patient is at low risk of serious complications. The maximum theoretical score is 26. *Points attributable to burden of illness are not cumulative – a patient can score for either mild or moderate symptoms but not both. (Klastersky and Paesmans 2013)
These six interventions should be delivered within one hour of diagnosis of severe sepsis (RCP 2014).

Blood cultures should be taken before antibiotic administration unless sampling is likely to significantly delay antibiotic administration (Daniels 2011). If the patient has a central venous access device, or vascular access device that has been in place for 48 hours or longer, two sets of blood cultures should be taken: one from each lumen of the access device and one from the peripheral circulation (Bryant et al 2014).

Immediate treatment with broad spectrum intravenous antibiotics should be initiated according to local protocols, without waiting for the results of blood tests, including neutrophil count (Dunkley and McLeod 2015). Antibiotics should be administered within one hour of the identification of severe sepsis or septic shock (Tazbir 2012). The patient’s clinical records should be checked for past microbiology results, particularly the presence of antibiotic resistant organisms (de Naurois et al 2010).

Blood tests should be taken; the Sepsis Six care bundle focuses on lactate and full blood count (Daniels 2011). Other recommended blood tests include renal and liver function, C-reactive protein (NICE 2012) and coagulation screen (de Naurois et al 2010). Blood glucose should also be tested (RCP 2014).

To assess for signs and symptoms of infection, send appropriate specimens, such as stool, sputum or urine, as indicated for culture and sensitivity (Held-Warmkessel 2011).

Urine output should be measured in patients with sepsis. Urinary catheters should not be used routinely in patients with neutropenia and their use should be carefully risk-assessed on an individual patient basis because of the potential for introducing infection (Coughlan and Healy 2008).

Intravenous fluids, including fluid challenges, should be administered to treat hypotension, improve cardiac output, prevent or treat acute kidney injury and for dehydration (Angus and van der Poll 2013, McClelland and Moxon 2014).

A management plan is required that includes the level and frequency of observations, review schedule, treatment goals, guidance on parameters that require escalation and instructions that set out when senior and critical care review is required (RCP 2014).

**Complete time out activity**

**Uncomplicated febrile neutropenia** Where risk assessment tools are used, some patients who present with uncomplicated febrile neutropenia may be identified as at high risk of developing complications and treatment with intravenous antibiotics commenced (de Naurois et al 2010). Factors that increase the risk are listed in Box 3. Other patients may be evaluated as low risk and commence a lower risk management pathway. However, as discussed earlier, treatment based on risk stratification may not be appropriate for all cancer types and chemotherapy regimens and treatment pathways should be tailored to these differences (Worth et al 2011).

There is no conclusive evidence to support a definitive treatment pathway for patients at low risk of complications, since specialist cancer centres use different approaches (Teuffel et al 2011). These differences include whether to commence oral antibiotics immediately or after a period of intravenous treatment; how long to monitor the patient in hospital; and the criteria for discharge (Teuffel et al 2011). A review of 80 neutropenic sepsis protocols in the UK found that 23 (29%) included the use of oral antibiotics for patients at low risk of complications. Some of these centres discharged the patient on the same day they were assessed while others admitted and monitored them for 24 hours (NICE 2012).

Despite variation between specialist cancer centres in low risk management pathways, there are recommendations for patient assessment checklists and services that need to be in place before patients who are still neutropenic are discharged home (Worth et al 2011). Patient-related factors are listed in Box 4. Service provision includes (Innes et al 2008, Worth et al 2011, NICE 2012):
Assessment of risk of developing complications of sepsis using a validated risk scoring tool. This should be carried out by a healthcare professional with competence in managing the complications of cancer treatment.

- 24-hour telephone advice from the cancer treatment centre. This can be delivered by experienced and trained oncology or haematology nurses.
- 24-hour emergency medical assessment available for early review of patients who are discharged and who develop symptoms requiring assessment.
- Follow-up assessment such as daily telephone contact.
- Written patient information explaining neutropenic sepsis, the signs and symptoms to monitor and when to call for advice.

Potential consequences of neutropenia and neutropenic sepsis

Patients with neutropenia or neutropenic sepsis experience physical, social and emotional consequences that extend beyond the challenges associated with severe sepsis and septic shock. Treatment delays and dose reductions as a result of neutropenic episodes can have a significant negative influence on cancer treatment outcomes, including disease free and overall survival (Higgins and Hill 2012). This can be a source of fear and anxiety to patients as they become concerned about the consequences of neutropenia for the efficacy of their treatment (Methven 2010).

Admission to hospital or changes to the treatment plan increase the number of hospital visits for patients and may cause significant disruption to work, social and other life activities (Fortner et al 2004). Social and family events are often planned around the period in the treatment cycle when the patient may feel their best; attendance to these can be affected by treatment delays because of neutropenia (Methven 2010). Social events have an important role in helping patients maintain a positive outlook, since they provide a sense of control and normality and are something for the patient to look forward to (Methven 2010). Concerns about infection may limit the range of social activities that patients engage in, when following advice to avoid large groups of people or busy public spaces (Tadman and Roberts 2007). Curtailing or missing social events and interactions may contribute to patients feeling socially isolated (Methven 2010). Nurses are well placed to support patients as they manage the consequences of neutropenia and neutropenic sepsis. Nurses should be aware of social factors, alongside the physical care required during neutropenic episodes, and provide practical advice and emotional support.

Developing services for neutropenic sepsis

Patients receiving chemotherapy are at risk of developing life-threatening side effects including neutropenic sepsis. Initiatives such as acute oncology services have been implemented to support patients who present with acute complications related to cancer or its treatment outside specialist cancer centres (National Cancer Action Team 2011, Gabriel 2012). Developing care pathways and guidelines that meet local service needs for common acute oncology presentations, including neutropenic sepsis, is a core function of acute oncology services (Gabriel 2012). Nurses should be aware of any pathways and guidelines available in their area to ensure patients with neutropenic sepsis receive the right care in the right place at the right time.

Nurses have the potential to develop services that provide a safe and effective framework for the care of patients with neutropenic sepsis. Examples of good practice include: developing evidence-based tools, guidance and pathways to embed good practice (Young et al 2009, Oakley et al 2010); teaching and training for staff who provide care for patients with neutropenic sepsis across a range of settings (Higgins 2008); audit and service review to evaluate the effectiveness of and compliance with policies and guidance (Higgins and Hill 2012); and developing specialist nursing roles, such as acute oncology and telephone triage (Singh and Warnock 2013). Nurses may take the lead in research that helps to understand patients’ experiences of neutropenic sepsis and the types of support that they find helpful (Oakley et al 2010, NICE 2012). Nurses have an opportunity to work collaboratively with the multiprofessional team to adopt and promote practices that ensure patients receive safe care and to improve the services delivered to patients with neutropenic sepsis (Young et al 2009).

Conclusion

Neutropenic sepsis is a potentially life-threatening condition that requires immediate investigation and treatment. Patients need to be given information to enable them to understand neutropenia and the early signs of sepsis so they can act immediately if symptoms occur. Evidence-based pathways have been
developed to stratify patient risk and to ensure they receive targeted and effective treatment that is appropriate to their needs. Nurses have a central role in providing physical, emotional and practical support to help patients manage this challenging side effect of chemotherapy.

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Neutropenic sepsis
TEST YOUR KNOWLEDGE BY COMPLETING SELF-ASSESSMENT QUESTIONNAIRE 841

1. Neutropenic sepsis:
   a) Is not life-threatening
   b) Is experienced by all patients receiving chemotherapy
   c) Requires immediate intervention
   d) Is always managed in hospital

2. What is the neutrophil count in a healthy adult?
   a) 1.0x10^9/L
   b) 2.0-7.0x10^9/L
   c) Less than 0.5x10^9/L
   d) More than 9.0x10^9/L

3. Which factor increases the risk of complications resulting from neutropenic sepsis?
   a) Particular chemotherapy drug used
   b) Aged over 60
   c) Presence of comorbidities
   d) All of the above

4. A sign of sepsis plus organ dysfunction is:
   a) Temperature less than 36°C
   b) Infection
   c) Altered mental state
   d) Heart rate greater than 90 beats per minute

5. At which point on the sepsis continuum is a patient with hyperglycaemia in the absence of diabetes?
   a) Systemic inflammatory response syndrome
   b) Sepsis
   c) Severe sepsis
   d) Septic shock

6. Patients with uncomplicated febrile neutropenia present with:
   a) Temperature less than 36°C
   b) An elevated temperature and no other symptoms of infection
   c) A high risk of developing complications
   d) Nausea and vomiting

7. Which Multinational Association for Supportive Care in Cancer risk index score indicates the patient is at low risk of serious complications?
   a) Less than 5
   b) 15
   c) 20
   d) 25

8. The Sepsis Six care bundle to manage severe sepsis:
   a) Includes oral antibiotics
   b) Should be delivered within 15 minutes of diagnosis
   c) Involves administration of pain relief
   d) Requires blood cultures to be taken

9. Patients with neutropenic sepsis at high risk of complications:
   a) Require intensive treatment
   b) May be managed with oral antibiotics
   c) May be managed by self-monitoring
   d) May be discharged early

10. What advice about neutropenia should be given to patients receiving chemotherapy?
    a) To monitor their temperature every six hours
    b) To protect their skin from injury to prevent infection
    c) To interact with others who have symptoms of infection
    d) To self-medicate

How to use this assessment
This self-assessment questionnaire (SAQ) will help you to test your knowledge. Each week you will find ten multiple-choice questions that are broadly linked to the CPD article. Note: there is only one correct answer for each question.

- You could test your subject knowledge by attempting the questions before reading the article, and then go back over them to see if you would answer any differently.
- You might like to read the article to update yourself before attempting the questions.

How to use this assessment

When you have completed your self-assessment, add it to your professional portfolio. You can record the amount of time it has taken, Space has been provided for comments.

You might like to consider writing a reflective account, see page 62.

Report back
This activity has taken me _______ hours to complete.
Other comments:

Now that I have read this article and completed this assessment, I think my knowledge is:
Excellent
Good
Satisfactory
Unsatisfactory
Poor

As a result of this I intend to:

The answers to this questionnaire were compiled by Noreen Begley

The answers to SAQ 839 on medication for schizophrenia, which appeared in the April 13 issue, are:
1. c 2. a 3. d 4. b 5. d
6. c 7. a 8. c 9. a 10. d