Myelosuppression
Associated With Novel Therapies in Patients With Multiple Myeloma:
Consensus Statement of the IMF Nurse Leadership Board

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Maria Gavino, RN, BSN, Kathy Lilleby, RN,
and the IMF Nurse Leadership Board

Novel therapies for multiple myeloma include the immunomodulatory drugs lenalidomide (Revlimid®, Celgene Corporation) and thalidomide (Thalomid®, Celgene Corporation) and the proteasome inhibitor bortezomib (Velcade®, Millennium Pharmaceuticals, Inc.). The novel therapies have contributed to better response rates and survival times compared with conventional chemotherapy. However, the agents can cause side effects that, although predictable and manageable, have the potential to be life threatening and to interfere with adherence to optimal therapy and patient quality of life (Celgene Corporation, 2007a, 2007b; Fortner, Houts, & Schwarzberg, 2006; Fortner, Tauer, Zhu, Ma, & Schwartzberg, 2004; Gobrial et al., 2007; Manochakian, Miller, & Chanan-Khan, 2007; Millennium Pharmaceuticals, Inc., 2006; Rajkumar et al., 2005; Richardson & Anderson, 2006; Richardson, Hideshima, Mitsiades, & Anderson, 2007). As with other treatments for multiple myeloma, the novel agents are associated with side effects in the myelosuppression category: anemia, neutropenia, and thrombocytopenia (Celgene Corporation, 2007a, 2007b; Millennium Pharmaceuticals, Inc.). The International Myeloma Foundation’s Nurse Leadership Board, in recognition of the need for specific recommendations on managing key side effects of novel antimyeloma agents, developed a consensus statement for the management of myelosuppression associated with novel therapies to be used by healthcare providers in any type of medical institution (Bertolotti et al., 2007, 2008). The recommendations also are applicable to the management of myelosuppression associated with other therapies for myeloma.

At a Glance
- The immunomodulatory drugs lenalidomide and thalidomide and the proteasome inhibitor bortezomib can cause myelosuppression.
- Because anemia, neutropenia, and thrombocytopenia are expected side effects, patients should be monitored closely and educated about side-effect signs and symptoms.
- Anemia, neutropenia, and thrombocytopenia can be managed with a combination of therapies for side effects and appropriate dose reductions of novel therapies.

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**Issue Statement**

Myelosuppression is a common and expected side effect of novel therapies for multiple myeloma. As a result of myelosuppression, patients may experience anemia, neutropenia, and thrombocytopenia. Depending on their severity, the side effects can have a negative impact on patients’ medical treatment and quality of life by interrupting or reducing therapy and causing life-threatening complications. Neutropenia can result in life-threatening infections (Marrs, 2006). In addition to such physiologic effects, myelosuppression may limit patients’ ability to interact or work outside the home, resulting in depression, anger, financial burden, and a sense of social isolation (Fortner et al., 2004, 2006). Fatigue, the most common side effect of anemia and the most common complaint among patients with cancer, has a significant impact on patients’ quality of life, ability to work, and physical and emotional well-being (Boyer, 2000; Foubert, 2006).

**Novel Therapies and Myelosuppression**

Anemia (hemoglobin ≤ 12 g/dl) is present in 73% of patients at initial diagnosis of multiple myeloma. It can be seen in 97% at some time during the course of the disease. Leukopenia (white blood cell count ≤ 4 x 10^9/L) is seen in 20% of patients at time of diagnosis. Thrombocytopenia (platelet count < 100 x 10^9/L) is seen in 5% of patients at time of diagnosis (Kyle et al., 2003). Myelosuppression is a common and expected side effect associated with novel therapies for treatment of multiple myeloma. Table 1 summarizes the risks of grade 3 and 4 anemia, neutropenia, and thrombocytopenia that have been reported in patients with myeloma treated with the novel therapies lenalidomide, thalidomide, and bortezomib.

**Myelosuppression Definitions**

The National Cancer Institute ([NCI], 2007) defined myelosuppression as “a condition in which bone marrow activity is decreased, resulting in fewer red blood cells, white blood cells, and platelets.” Anemia was defined as abnormally low levels of red blood cells as measured by blood hemoglobin or hematocrit levels. As a result of an imbalance of production versus destruction or loss of red blood cells, the blood has decreased capacity for carrying hemoglobin and oxygen (Foubert, 2006). Neutrophils are the infection-fighting component of the total white blood cell count. Neutropenia is the reduction of circulating neutrophils in the bloodstream, leading to increased risk of infection (Held-Warmkessel, 1998; Marrs, 2006; West & Mitchell, 2004). Thrombocytopenia may result from a lack of production of megakaryocytes or an increase in use of platelets.
Management of Myelosuppression

**General guidelines**: Standardized precautions and interventions related to low blood counts vary among institutions.

**Anemia**: Management of anemia should take into account that some patients tolerate a greater degree of anemia than other patients. Assessment of anemia is more than a one-dimensional evaluation. In addition to the numeric value found in a complete blood count (CBC), symptoms that affect patients’ quality of life also should be assessed (e.g., fatigue). A nursing interview that includes questions regarding performance status, shortness of breath, and chest pain on exertion will aid in determining the need for transfusions. Tools, such as the Brief Fatigue Inventory (Cleeland & Wang, 1999), can assist nurses in assessing patients’ perceptions of fatigue. A patient’s hemoglobin levels and symptoms of anemia leading to a decision to transfuse must be balanced with the risks related to transfusions (i.e., transfusion-acquired infections, transfusion reactions, and transfusion-related lung injury) (Foubert, 2006). Table 3 lists generally accepted medical practices to manage anemia.

Transfusions are to be given at the discretion of a patient’s healthcare provider. Blood products should be leukocyte-reduced to decrease the risk of febrile reactions, human leukocyte antigen alloimmunization, and cytomegalovirus infection (American Association of Blood Banks, America’s Blood Centers, & American Red Cross, 2006). Transfusion policies and availability of blood products vary among institutions. General transfusion guidelines are available from the American Association of Blood Banks, America’s Blood Centers, and American Red Cross and from Cable et al. (2002).

**Neutropenia**: Neutropenic patients are at greater risk of infection. Not all patients who are neutropenic become febrile. Handwashing by patients and all caregivers is the single most important factor for preventing infection (West & Mitchell, 2004). Nursing assessment and education of patients play a vital role in detecting risk factors and providing anticipatory guidance.

A goal of > 12.0 g/dl is not recommended because of risk of significant cardiovascular events. Concomitant use of ESAs with some antymyeloma therapies may increase the risk of thromboembolic events (Amgen Inc., 2007a, 2007b). Concomitant neutropenia is an independent risk factor for thromboembolism in hospitalized patients with cancer, including those with hematologic malignancies (Khorana et al., 2006). Rome et al. (2008) addresses these topics in detail.
Table 5. Specific Recommendations for Monitoring and Managing Myelosuppression in Patients Receiving Novel Agents for Treatment of Myeloma

<table>
<thead>
<tr>
<th>AGENT AND MYELOSUPPRESSIVE SIDE EFFECT</th>
<th>RECOMMENDATIONS</th>
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<tbody>
<tr>
<td><strong>Thalidomide</strong></td>
<td></td>
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<tr>
<td>Neutropenia</td>
<td></td>
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<tr>
<td>If grade 3 or 4 toxicity occurs that is judged to be related to lenalidomide</td>
<td>Hold treatment; restart at the next lower dose level when toxicity has resolved to grade 2.</td>
</tr>
<tr>
<td>Neutropenia</td>
<td></td>
</tr>
<tr>
<td>If the absolute neutrophil count falls to &lt; 1.0 x 10^9/L</td>
<td>Interrupt lenalidomide treatment, consider granulocyte colony-stimulating factor, and follow complete blood counts weekly. When the absolute neutrophil count returns to 1.0 x 10^9/L and neutropenia is the only toxicity, resume lenalidomide at 25 mg daily, or at previous dose if lower. However, do not dose below 5 mg daily. When the absolute neutrophil count returns to &gt; 1.0 x 10^9/L and other toxicities are present, resume lenalidomide at 15 mg daily, or at previous dose if lower. However, do not dose below 5 mg daily.</td>
</tr>
<tr>
<td>For each subsequent drop of absolute neutrophil count to &lt; 1.0 x 10^9/L</td>
<td>Interrupt lenalidomide treatment. When the absolute neutrophil count returns to 1.0 x 10^9/L, resume lenalidomide at 5 mg less than the previous dose. However, do not dose below 5 mg daily.</td>
</tr>
<tr>
<td>Thrombocytopenia</td>
<td></td>
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<tr>
<td>If platelet count falls to &lt; 30 x 10^9/L</td>
<td>Interrupt lenalidomide treatment; follow complete blood counts weekly. When platelets return to 30 x 10^9/L, restart lenalidomide at 15 mg daily.</td>
</tr>
<tr>
<td>For each subsequent drop of platelets to &lt; 30 x 10^9/L</td>
<td>Interrupt lenalidomide treatment. When platelets return to 30 x 10^9/L, restart lenalidomide at a dose that is 5 mg less than the previous dose. However, do not dose below 5 mg daily.</td>
</tr>
<tr>
<td><strong>Lenalidomide</strong></td>
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<tr>
<td>Anemia</td>
<td></td>
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<tr>
<td>At the onset of any grade 4 hematologic toxicity, including anemia</td>
<td>Interrupt lenalidomide treatment. Consider granulocyte colony-stimulating factor, and follow complete blood counts weekly. When the absolute neutrophil count returns to 1.0 x 10^9/L and neutropenia is the only toxicity, resume lenalidomide at 25 mg daily, or at previous dose if lower. However, do not dose below 5 mg daily. When the absolute neutrophil count returns to &gt; 1.0 x 10^9/L and other toxicities are present, resume lenalidomide at 15 mg daily, or at previous dose if lower. However, do not dose below 5 mg daily.</td>
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<td>Thrombocytopenia</td>
<td></td>
</tr>
<tr>
<td>At the onset of any grade 4 hematologic toxicity, including thrombocytopenia</td>
<td>Hold treatment; restart at the next lower dose level when toxicity has resolved to grade 2.</td>
</tr>
<tr>
<td>If the platelet count falls to &lt; 25 x 10^9/L</td>
<td>Bortezomib should be held. Once toxicity has resolved, bortezomib may be restarted at a 25% reduced dose.</td>
</tr>
</tbody>
</table>

**Note.** Based on information from Celgene Corporation, 2007a, 2007b; Millennium Pharmaceuticals, Inc., 2006.

Role in reducing the risk of febrile episodes, as does prompt intervention in the event of a febrile episode. In the absence of neutrophils, fever may be the only sign of an active infection. Multiple organ systems can be affected by infection, including respiratory, urinary, and gastrointestinal (Held-Warmkessel, 2000; Marrs, 2006). Assess patients for fever and associated symptoms such as chills, myalgias, malaise, nausea, hypotension, and hypoxia (Nunez & Liebman, 1999; West & Mitchell). Observe the oral mucosa and skin for any breaks in tissue and signs of infection. If a patient has a central venous access device, assess the exit site for erythema or exudate. A complete nursing assessment of all systems may reveal the source of a potential or actual infection (Held-Warmkessel, 2000). An accurate patient history also can provide information indicating...
whether a patient is at high risk of infection when neutropenic. Previous exposures to bacteria, viruses, and fungal contaminants through travel, pets, and childhood infections can reactivate when patients are neutropenic. When a patient is at risk for neutropenia or becomes neutropenic, initiate institutional precautionary standards. Notify the patient’s healthcare provider for medical intervention for neutropenia and neutropenic fever. Table 4 lists generally accepted medical management for medical intervention for neutropenia and neutropenic patients. IV hydration and antipyretics also should be administered in a timely manner if prescribed (Burney; Held-Warmkessel, 1998; Nunez & Liebman).

**Thrombocytopenia:** When platelet counts drop below normal (150–400 × 10^9/L) to levels less than 100 × 10^9/L, patients are classified as thrombocytopenic and are at greater risk of bleeding (Fukuyama & Itano, 1999). Life-threatening hemorrhage may occur when platelet levels decrease below 50 × 10^9/L (grade 3 or 4). In addition to reviewing CBCs, nursing assessment should include a thorough patient history that covers any mucosal or gastrointestinal bleeding, increased bruising, or difficulty stopping bleeding. Physical examination should include evaluation of the mucous membranes and sclerae for signs of bleeding. Observe the skin for petechiae, multiple and large areas of bruising, and oozing from the exit site of a central venous catheter. A neurologic assessment also should be incorporated to monitor for symptoms of intracranial bleeding (Fukuyama & Itano; Held-Warmkessel, 1998, 2000).

Generally accepted practices to manage thrombocytopenia include the following.
- Initiate institutional precautionary standards for thrombocytopenia.
- Minimize invasive procedures.
- Transfuse platelets prior to any necessary invasive procedures.
- Transfuse if signs of bleeding are present.

**Recommendations for Monitoring Complete Blood Counts**

All patients receiving novel therapies should have their CBCs monitored closely. Monitoring of serum creatinine levels also is important because decreased renal function may result in more severe anemia (Pandit & Vesole, 2003). If prolonged myelosuppression persists after dose modification or delay, further evaluation is recommended to rule out other possible causes, such as a reaction to another medication or progressive disease. The novel therapies bortezomib, lenalidomide, and thalidomide have specific recommendations for blood count monitoring, as follows.
- **Thalidomide:** Prescribing information recommends that blood count and differential be monitored on an ongoing basis, particularly in patients who may be prone to neutropenia (Celgene Corporation, 2007b).
- **Lenalidomide:** CBCs should be checked every two weeks for the first 12 weeks, then at least monthly thereafter (Celgene Corporation, 2007a).
- **Bortezomib:** Prescribing information recommends that blood counts be monitored prior to each dose of bortezomib (Millennium Pharmaceuticals, Inc., 2006).

Specific recommendations for monitoring and managing myelosuppression associated with thalidomide, lenalidomide, and bortezomib are presented in Table 5.

**Recommendations for Patient and Caregiver Education**

Healthcare providers should educate patients and their caregivers on the basic concepts of myelosuppression (see Figure 1). Education should occur prior to patients becoming myelosuppressed and should be reinforced frequently (West & Mitchell, 2004).
Conclusions

Although anemia, neutropenia, and thrombocytopenia are expected side effects of novel therapies for multiple myeloma, they are manageable with careful monitoring of patients' blood counts, dose adjustments when indicated, prophylactic treatment, and concomitant therapies as necessary. Nursing assessment, intervention, and education of patients and caregivers play a vital role in promoting patient adherence and maintenance of prescribed therapy, thereby enhancing patient outcomes.

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References


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Patient Education Sheet: Managing Myelosuppression From Novel Agents for Multiple Myeloma

KEY POINTS

Novel therapies used to treat multiple myeloma include thalidomide, lenalidomide, and bortezomib. The drugs can cause myelosuppression, which is a decrease in bone marrow activity, resulting in fewer red blood cells (anemia), white blood cells (neutropenia), and platelets (thrombocytopenia). The risk of side effects varies with each medication. Managing the side effects can reduce your discomfort, prevent serious complications, and allow you to receive the best treatment for your myeloma. Your healthcare provider may change your dose or schedule of medication to help manage your symptoms. Do not stop or adjust medications without discussing it with your healthcare provider.

ANEMIA

Anemia is a decrease in red blood cells, or hemoglobin, which carry oxygen in the blood. It may result from myeloma treatment, decreased kidney function, myeloma disease, or other medications.

Symptoms of anemia can include fatigue, low energy level, difficulty with normal daily activities, shortness of breath with activity, and chest pain with activity.

If you experience symptoms of anemia, contact your healthcare provider.

Try not to use too much energy in daily activities.

Your healthcare provider may prescribe a red blood cell supplement such as iron, erythropoietin, or a red blood cell transfusion. If necessary, changes may be made in medications you are taking.

NEUTROPENIA

Neutropenia is a decrease in white blood cells, which protect against infection. It may result from myeloma treatment, myeloma disease, or other medications.

The greatest concern with neutropenia is infection. Symptoms can include fever of 100.5°F (38°C) or higher, shaking chills, dizziness, fainting, redness at a wound site, difficulty breathing, cough, or sinus congestion.

If you experience fever or symptoms of infection, contact your healthcare provider immediately.

To reduce your risk of infection, wash your hands carefully and often, avoid crowds, and take antibiotics as prescribed by your healthcare provider.

Your healthcare provider will check your blood counts regularly based on your plan of care and may prescribe antibiotics to prevent infection and growth factors to stimulate white blood cell growth. If necessary, changes may be made to medications you are taking.

THROMBOCYTOPENIA

Thrombocytopenia is a decrease in platelets that protect against bleeding. It may result from myeloma treatment, myeloma disease, or other medications. It may be associated more frequently with lenalidomide and bortezomib.

Symptoms of thrombocytopenia may include bruising, pink urine, nosebleeds, small red or purple spots on the body (petechiae), and bleeding that does not stop with pressure.

If you experience signs or symptoms of a low platelet count, contact your healthcare provider immediately.

To reduce your risk of bruising or bleeding, avoid taking aspirin, ibuprofen, or naproxen. Avoid activities that can cause bruising or bleeding, such as contact sports, anal sex, and heavy lifting. Participate in gentle exercise only.

Your healthcare provider will monitor blood counts regularly based on your plan of care and may prescribe a platelet transfusion. If necessary, changes may be made in medications you are taking.

Note. For more information, please contact the International Myeloma Foundation (1-800-452-CURE; www.myeloma.org). The foundation offers the Myeloma Manager™ Personal Care Assistant™ computer program to help patients and healthcare providers keep track of information and treatments. Visit http://manager.myeloma.org to download the free software.

Note. Patient education sheets were developed in June 2008 based on the International Myeloma Foundation Nurse Leadership Board’s consensus guidelines. They may be reproduced for noncommercial use.