Bortezomib, a Newly Approved Proteasome Inhibitor for the Treatment of Multiple Myeloma: Nursing Implications

Kathleen Colson, RN, BSN, BS, Deborah S. Doss, RN, OCN®, Regina Swift, RN, BSN, Joseph Tariman, RN, APN, MN, BC, OCN®, and Teri E. Thomas, RN

Multiple myeloma (MM) is the second most common hematologic malignancy, with more than 15,270 newly diagnosed cases and more than 11,070 deaths in the United States estimated for the year 2004 (American Cancer Society, 2004). The disease is a cancer of the antibody-forming B cells, causing uncontrolled growth of plasma cells. The malignant plasma cells invade the bone marrow as well as many other organs in the body. Myeloma cells release into the blood massive amounts of monoclonal immunoglobulin (M protein), a dysfunctional type of antibody. The spread of myeloma cells causes a variety of complications involving the bones, blood, kidneys, and nervous and immune systems (Kyle et al., 2003). The disease frequently causes a chronic condition characterized by bone pain, low levels of blood calcium, decreasing or failing kidney function, multiple recurrent infections, bone fractures, spinal cord compression, anemia, defects in the blood clotting systems, and symptoms such as peripheral neuropathy, gastrointestinal disturbances, and abnormally decreased numbers of all types of blood cells (Rice & Sheridan, 2001).

Standard treatment has included combination chemotherapy such as melphalan and prednisone; vincristine, doxorubicin, and dexamethasone; or single-agent dexamethasone (Munshi, Tricot, & Barlogie, 2001). Multiple myeloma (MM), a malignancy of the plasma cells, accounts for an estimated 14% of all newly diagnosed hematologic malignancies. Advances in chemotherapy and stem cell transplantation have improved survival rates, but MM remains incurable. Bortezomib (Velcade™, Millennium Pharmaceuticals, Inc., Cambridge, MA), a first-in-class proteasome inhibitor, has been approved for patients with MM who have received at least two prior treatments and have demonstrated disease progression on the most recent one. During clinical trials, most side effects were manageable with standard interventions. The most common toxicities were asthenic conditions (fatigue, malaise, and weakness), gastrointestinal disturbances (nausea, vomiting, diarrhea, and constipation), thrombocytopenia, peripheral neuropathy, pyrexia, and anemia. Supportive therapies and strategies for side-effect management can prevent worsening of these symptoms, thereby avoiding dose reductions and treatment delays. Oncology nurses play a key role in ensuring the proper and safe administration of bortezomib and often are the first to identify the signs of side effects. Patient education about anticipated side effects and close monitoring of patients can lead to symptom management interventions that are essential to patient comfort and safety.

Key Words: multiple myeloma, peripheral neuropathies, proteasome

High-dose chemotherapy supported by autologous stem cell transplantation has extended survival in selected patients but is not an option for older patients or those with serious comorbidity or poor performance status. Conventional allogeneic transplantation and miniallogeneic transplantation are associated with high mortality (Catley & Anderson, 2004). More recently, based on its ability to reduce the formation of new blood vessels believed to promote tumor growth, thalidomide has been used. Novel therapies currently being studied include immunomodulatory drugs, arsenic compounds, and proteasome inhibitors (Tariman, 2003).
Bortezomib is a potent, selective, reversible proteasome inhibitor. Proteasomes are enzyme complexes that are present in all cells. The interaction of bortezomib with one specific proteasome prevents the breakdown of intracellular proteins affecting multiple proteasome-regulated pathways, as shown in Figure 1, including cell growth, apoptosis (programmed cell death), and survival (Millennium Pharmaceuticals, Inc., 2003). The full extent of the activity of bortezomib still is under study. In MM, bortezomib affects the interaction of myeloma cells in bone marrow. It also has been shown to overcome drug resistance in myeloma cells in vitro (Hideshima et al., 2001; LeBlanc et al., 2002; Ma et al., 2003; Read et al., 1995).

Bortezomib is the first approved drug in the proteasome inhibitor class of anticancer drugs. Bortezomib is approved for patients with MM who have received at least two prior treatments and have demonstrated disease progression on the last therapy (Millennium Pharmaceuticals, Inc., 2003).

**Bortezomib Clinical Trials**

The efficacy and safety of bortezomib in patients with advanced MM have been demonstrated in two multicenter phase II clinical trials, the SUMMIT trial and CREST trial.

The SUMMIT trial enrolled 202 heavily pretreated patients with relapsed MM who were refractory to the most recent therapy. The patients had received at least two prior therapies and have demonstrated disease progression on the last therapy (Richardson et al., 2003a). The patients received 1.3 mg/m² of bortezomib via IV push (3–5 seconds) in 21-day cycles twice weekly on days 1, 4, 8, and 11 followed by a 10-day rest period (days 12–21). Doses must be separated by at least 72 hours to allow for normal proteasome activity to recover (Orlowski et al., 2002).

The CREST trial involved 54 patients with relapsed or refractory MM who were randomized to one of two arms comparing different bortezomib doses: 1.0 mg/m² and 1.3 mg/m². All patients were treated twice a week for two weeks followed by a 10-day rest period (Jagannath et al., 2002).

Efficacy was assessed in both trials by an independent review committee according to the criteria of the European Group for Blood and Marrow Transplantation (Blade et al., 1998). A complete response (CR) required 100% disappearance of the original myeloma protein from the blood and urine by immunofixation, less than 5% plasma cells in the bone marrow, stable bone disease, and normal calcium on at least two occasions six weeks apart. A near-CR also required stable bone disease and a normal serum calcium level but allowed for M protein seen by immunofixation but not detectable by electrophoresis. Partial response (PR) required a 50% reduction in serum protein and a 90% reduction of urine protein on at least two occasions six weeks apart, stable bone disease, and normal calcium (Richardson et al., 2003a).

The major response rate (CR and PR) was 27.7% among the patients in the SUMMIT trial who were evaluable for response. The major response rate remained consistent regardless of the type of previous therapies, including thalidomide or stem cell transplantation, or baseline patient characteristics, including performance status (PS), myeloma type, β2-microglobulin, or chromosome 13 deletion status. Baseline predictors of decreased response were 50% plasma cells in the bone marrow and age (Richardson et al., 2003b). Median time to response was 38 days (two cycles). Median duration of response among patients with CR, PR, or minimal response to bortezomib alone was 12 months (n = 67) (Richardson et al., 2003a). The duration of response as of March 21, 2003, was reported as 14.3 months (n = 53) (Berenson et al., 2003).

In the CREST trial, overall response rates were 33% at 1.0 mg/m² and 50% at 1.3 mg/m². CR rates were 4% in each 108 study arm (Jagannath et al., 2003). Both the SUMMIT and CREST protocols permitted patients experiencing progression of their disease after at least two cycles or stable disease after the first four cycles of bortezomib to have dexamethasone added to their treatment regimen. Dexamethasone 20 mg was given on the days of and after bortezomib administration (i.e., on days 1, 2, 4, 5, 8, 9, 11, and 12 of the three-week cycle).

Eighteen percent of the patients in the SUMMIT trial and 21% of the patients in the CREST trial had a minimal or partial response and went on to receive dexamethasone with their bortezomib treatment (Jagannath et al., 2003; Richardson et al., 2003a). Experience with long-term use of bortezomib suggests that it can be administered for as many as 24 cycles (8 cycles in clinical trials followed by as many as 16 cycles in an extension trial) with a safety profile similar to that seen during the first six months of treatment (Berenson et al., 2003).

**Bortezomib and Multiple Myeloma: Nursing Considerations**

Oncology nurses play a key role in ensuring the proper and safe administration of bortezomib and often are the first to identify signs of side effects. Patient education about anticipated side effects and careful patient assessment can lead to effective symptom management. Administration of all doses often is dependent on effective symptom control.

**Dosing and Administration**

Bortezomib should be given according to the dosage and administration schedules outlined in the prescribing information. Bortezomib is injected by IV push directly into a peripheral vein or through an infusion port over three to five seconds. The line should be flushed with normal saline. In clinical trials,
extravasation was not associated with tissue damage. A small percentage of patients may experience a local skin reaction. Infusion reactions were reported rarely during clinical trials, and no cases of overdose were reported (Millennium Pharmaceuticals, Inc., 2003).

Giving patients a calendar outlining the treatment schedule indicating the days of treatment and the rest period is helpful. To comply with the schedule, patients can be treated on either a Monday and Thursday, Tuesday and Friday, or Wednesday and Saturday schedule.

Prior to each dose of bortezomib, patients should be assessed to establish baseline status of vital signs, blood counts, chemistries, and neurologic assessment and then monitored throughout therapy (see Figure 2).

Dose Modifications and Treatment Delays

When necessary, dosage should be modified promptly in response to toxicity, according to product labeling. At the onset of any grade 3 nonhematologic toxicities or any grade 4 hematologic toxicities, bortezomib should be withheld. Once the symptoms of toxicity have resolved, bortezomib may be reinstituted at a 25% lower dose (1.3 mg/m² dose reduced to 1.0 mg/m²; 1.0 mg/m² reduced to 0.7 mg/m²). Recommended dose modifications for bortezomib-related neuropathic pain and peripheral sensory neuropathy are presented in Table 1.

Quality of Life

In the SUMMIT trial, quality-of-life (QOL) questionnaires were administered at screening; on day 1 of cycles 3, 5, and 7; and at the end of the study (Lee et al., 2003). In addition, blood counts, number of transfusions, and Karnofsky performance status were assessed regularly. Hemoglobin, platelet counts, and Karnofsky performance status improved among patients who responded. No transfusions were required in responders after cycle 4 (Richardson et al., 2003a). Patients with CR or PR, an improvement from baseline QOL was observed. When patients able to be evaluated were included regardless of response, mean global QOL and disease symptoms improved. These data suggest that response to bortezomib in this patient population was associated with additional clinical benefit and improvement in patients’ well-being (Lee et al.). As bortezomib is used more in practice, nurses have opportunities to add to this body of knowledge by evaluating QOL and measuring the efficacy of symptom management interventions.

Peripheral Neuropathy

Another significant adverse event was cumulative, dose-related peripheral neuropathy. Peripheral neuropathy associated with bortezomib is predominantly sensory, although rare cases of mixed sensorimotor neuropathy have been reported. During the SUMMIT and CREST trials, only one case of grade 4 neuropathy occurred, and most patients had complete resolution or improvement of symptoms with dose modification or discontinuation (Richardson et al., 2003a).

Patients with preexisting symptoms of neuropathy may experience worsening during treatment. In fact, 80% of the patients treated in the SUMMIT trial had baseline peripheral neuropathy (Richardson, Briemberg, et al., 2003). Patients with preexisting neuropathy should be treated with bortezomib only after careful risk and benefit assessment. Patients who are at higher risk for neuropathy include those with a history of treatment with other drugs that cause neuropathy, including HIV medications such as nucleoside reverse transcriptase or protease inhibitors, post-transplant immunosuppressives such as tacrolimus, and chemotherapies including cisplatin, paclitaxel, methotrexate, cytarabine, ifosfamide, suramin, and most relevant for patients with MM, vincristine, other vinca alkaloids, and thalidomide (Dalakas, 2001; Nielsen & Brant, 2002; Peltier & Russell, 2002).

Because peripheral neuropathy can be dose limiting, patients should be monitored closely for early signs and symptoms. Dose modifications may prevent progression of neuropathy. New symptoms or changes in existing symptoms such as numbness or tingling sensations in the upper or lower extremities, burning sensations, or increased sensitivity to touch, and neuropathic pain, such as shooting pain in legs, severe leg cramps in calves or thighs, arthralgias, or myalgias, should be evaluated prior to each treatment. Patients should be instructed to contact their physicians if new symptoms develop or existing symptoms change.

Patients and their families should be educated to recognize the early signs and symptoms of neuropathy. Filling out the neurotoxicity assessment tool, which is presented in Figure 3, at each visit reinforces the importance of patient vigilance, increases awareness of symptoms, and establishes a method for tracking changes in symptoms. Referral to neurology, pain management, or psychology consultants may be appropriate.

During clinical trials at the Dana-Farber Cancer Institute (DFCI) in Boston, MA, the following recommendations, as described in Table 3, were drawn up as possible inter-ventions to help alleviate the discomfort of
peripheral neuropathies. These recommendations are based on experience and anecdotal information and are not necessarily applicable to all patients (Colson, 2003).

Any intervention must take into consideration the patient’s medical history and current medical status and should be discussed with the treating physician prior to initiation.

At the onset of neuropathy, clinicians at DFCI recommend that patients take a combination of supplements, including vitamins B6 and B12, folate, magnesium, amino acids, and others. All supplements should be used with caution in patients, taking into consideration each individual’s medical history. Magnesium may cause diarrhea, and additional caution is necessary in patients with renal failure, in whom magnesium supplementation may lead to hypermagnesemia (Rude, 1998). Dietary sources of potassium, which helps reduce cramping, include two teaspoons of apple cider vinegar, bananas, and oranges.

Amino acids are available at health food stores and, like vitamins, should be taken with food. Published reports suggest that L-carnitine ameliorates HIV-related neuropathies (Scarpini, Sacilotto, Baron, Cusini, & Scarlato, 1997). The staff at DFCI begins acetyl-L-carnitine at 500 mg twice a day and increases to as much as 2,000 mg a day, as tolerated.

Alpha-lipoic acid is an antioxidant that may improve symptoms of neuropathy in patients with diabetes (Ruhna et al., 1999). The dosage used at DFCI is 300–1,000 mg a day with food. Several prescription drugs have shown benefit in relieving the symptoms of peripheral neuropathy. At DFCI, clinicians start gabapentin at 100 mg three times a day, gradually increasing the dose to 600 mg three times a day, as tolerated (Marrs & Newton, 2003). Amitriptyline or sertraline hydrochloride at bedtime also may be beneficial. Lidocaine patches also have been used. Topical creams, such as capsaicin cream or cocoa butter (rich in vitamin E), applied to the affected area may ease discomfort. Patients complaining of nocturnal leg cramping may try drinking 8 oz. of tonic water (quinine water) in the evening before going to bed.

**Asthenia**

First onset of fatigue was reported most often during cycles 1 and 2, and most patients were able to continue therapy despite it. Individual patients should be evaluated for possible causes of fatigue, and nurses can recommend proper hydration and nutrition, vitamin supplements, and lifestyle changes; in some cases, antidepressants or counseling may be appropriate.

**Thrombocytopenia**

Platelet counts generally drop during the dosing period (days 1–11), with a return to baseline during the rest period (days 12–21). Onset of thrombocytopenia is most common in cycles 1 and 2, but it can continue throughout therapy. All patients developed about a 60% reduction in their platelet counts, although grade 4 thrombocytopenia was uncommon in patients with baseline platelet counts higher than 70,000 (Lonial et al., 2003). Some reports have been made of gastrointestinal and intracerebral hemorrhage in association with bortezomb-induced thrombocytopenia (Millennium Pharmaceuticals, Inc., 2003). Grade 4 thrombocytopenia may be managed by temporarily

---

**TABLE 1. RECOMMENDED BORTEZOMIB DOSE MODIFICATION FOR DRUG-RELATED NEUROPATHIC PAIN AND PERIPHERAL SENSORY NEUROPATHY**

<table>
<thead>
<tr>
<th>SEVERITY OF PERIPHERAL NEUROPATHY</th>
<th>MODIFICATION OF DOSE AND REGIMEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1 (paresthesia and/or loss of reflexes) without pain or loss of function</td>
<td>No action</td>
</tr>
<tr>
<td>Grade 1 with pain or grade 2 (interfering with function but not with activities of daily living)</td>
<td>Reduce bortezomib to 1 mg/m².</td>
</tr>
<tr>
<td>Grade 2 with pain or grade 3 (interfering with activities of daily living)</td>
<td>Withhold bortezomib therapy until toxicity resolves. Then reinstitute with a reduced dose of bortezomib at 0.7 mg/m² and change treatment schedule to once per week.</td>
</tr>
<tr>
<td>Grade 4 (permanent sensory loss that interferes with function)</td>
<td>Discontinue bortezomib.</td>
</tr>
</tbody>
</table>

**Note.** Based on information from Millennium Pharmaceuticals, Inc., 2003; National Cancer Institute Cancer Therapy Evaluation Program, 1999.

**TABLE 2. MOST COMMON ADVERSE EVENTS BY GRADE REPORTED IN THE SUMMIT TRIAL**

<table>
<thead>
<tr>
<th>ADVERSE EVENT</th>
<th>GRADE 1–2 (%)</th>
<th>GRADE 3 (%)</th>
<th>GRADE 4 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nausea</td>
<td>58</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>41</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Fatigue</td>
<td>37</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Thrombocytopenia</td>
<td>13</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>Constipation</td>
<td>41</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Vomiting</td>
<td>27</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Anorexia</td>
<td>32</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Peripheral neuropathy</td>
<td>22</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Pyrexia</td>
<td>30</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Anemia</td>
<td>23</td>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>

N = 202

**Note.** Based on information from Millennium Pharmaceuticals, Inc., 2003.
Instructions for Patients
By circling one number per line, please indicate how true each statement has been for you during the past seven days.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at all</th>
<th>A little bit</th>
<th>Somewhat</th>
<th>Quite a bit</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have numbness or tingling in my hands.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I have numbness or tingling in my feet.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I feel discomfort in my hands.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I feel discomfort in my feet.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I have joint pain or muscle cramps.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I feel weak all over.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I have trouble hearing.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I get a ringing or buzzing in my ears.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I have trouble buttoning buttons.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I have trouble feeling the shape of</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>small objects when they are in my hand.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I have trouble walking.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Instructions for Healthcare Professionals
This assessment tool is provided to help you evaluate peripheral neuropathy in patients receiving chemotherapy. Healthcare professionals may find discussion of patients’ responses helpful in determining the grade of neuropathy as defined by the National Cancer Institute (NCI) Common Toxicity Criteria (CTC) listed below; there is no direct correlation between assessment scores and toxicity grades.

NCI CTC for Peripheral Neuropathy and Neuropathic Pain
Peripheral sensory neuropathy (NCI CTC grade)
1. Normal
2. Loss of deep tendon reflexes or paresthesia but not interfering with function
3. Objective sensory loss or paresthesia, interfering with function, but not with activities of daily living (ADLs)
4. Sensory loss or paresthesia interfering with ADLs
5. Permanent sensory loss that interferes with ADLs
Neuropathic pain (NCI CTC grade)
0. None
1. Mild pain not interfering with function
2. Moderate pain: pain or analgesics interfering with function but not ADLs
3. Severe pain: pain or analgesics severely interfering with ADLs
4. Disabling

Figure 3. Neurotoxicity Assessment Tool
Note. Based on information from Calhoun et al., 2000; Cella et al., 1993; National Cancer Institute Cancer Therapy Evaluation Program, 1999.

withholding bortezomib treatment or with platelet infusion. Treatment may be started at a 25% reduced dose when toxicity is resolved. Platelet counts should be checked prior to each dose of bortezomib for the first two cycles of therapy and as clinically indicated thereafter.

Neutropenia
The incidence of grade 4 neutropenia was rare in clinical trials, and febrile neutropenia was reported in fewer than 1% of patients (Millennium Pharmaceuticals, Inc., 2003).

Orthostatic Hypotension
Bortezomib may be associated with orthostatic hypotension throughout therapy. Caution should be used when treating patients at risk for hypotension, such as those with a history of syncope, those receiving medications associated with hypotension, and those who are dehydrated. Patients should be instructed to call their physicians if they experience these side effects or symptoms of lightheadedness, dizziness, or fainting. They should be cautious when driving cars or operating other machinery.

Electrolyte Imbalances
Hyponatremia may occur during treatment with bortezomib. Decreases in sodium levels have been reported after several cycles of treatment. Signs and symptoms include confusion, weakness, and seizures. Sodium levels should be kept above 130 mmol/L, and electrolytes should be checked prior to treatment. Patients can be encouraged to drink tomato juice prior to clinic visits or to increase the intake of sodium-rich foods. Frequent monitoring of serum electrolytes and early interventions can prevent worsening of these conditions and provide improved comfort for patients.

Rashes, Hives, and Pyrexia
Rashes were a reported side effect in about 21% of patients in the phase II trials and were primarily grade 1 or 2 (Millennium Pharmaceuticals, Inc., 2003). Diphenhydramine or hydrocortisone creams may be administered. Pyrexia also has occurred and may be treated with acetaminophen. A few patients have experienced hives, which, if they develop, usually are seen after three or four cycles of bortezomib. Administering small doses of prednisone for a few days usually relieves this symptom. If any rash continues to progress, bortezomib may have to be discontinued.

Additional Precautions for Comorbidity and Concurrent Medications
Patients with comorbidities and preexisting chronic conditions should be monitored closely. In addition to the adverse events reported in clinical trials, risks associated with bortezomib administration include congestive heart failure and tumor lysis syndrome (Millennium Pharmaceuticals, Inc., 2003). Patients with existing cardiac disease or risk factors for cardiac disease should be watched closely. Patients with high tumor burden should be followed, and appropriate precautions should be taken for tumor lysis syndrome. Diabetics and patients receiving oral hypoglycemics should have blood glucoses monitored, and adjustments to their medications may be necessary (Millennium Pharmaceuticals, Inc.). Pharmacokinetic studies in patients with renal or hepatic dysfunction are ongoing. Patients with hepatic or renal impairment should be monitored closely for toxicities when treated with bortezomib (Millennium Pharmaceuticals, Inc., 2003). For patients on dialysis, the timing of dosing has not been studied formally. Some have suggested that dosing should occur on days when dialysis is not performed to minimize the possibility of interfering with the concentrations of bortezomib.

Conclusions
Bortezomib is a new, first-in-class treatment for MM that offers new hope to patients with the disease. Administering this new therapy offers nurses many opportunities for educating patients and their families about the mechanism of action of the drug, how it differs from other chemotherapies, and what to expect during treatment.
### Table 3. Side Effects and Nursing Considerations for Patient Management

<table>
<thead>
<tr>
<th>Side Effect</th>
<th>Possible Interventions</th>
</tr>
</thead>
</table>
| **Peripheral neuropathy**| Patient education for signs and symptoms  
Establish baseline neurologic assessment and monitor throughout treatment.  
Vitamin supplements, including multi-B complex with B6, B12 (at least 400 mcg), folic acid, 1–2 mg folate, and vitamin E, 400 IU daily  
Magnesium supplement, 250 mg twice a day  
Dietary considerations (e.g., increased potassium intake, such as 2 teaspoons of apple cider vinegar, bananas, and oranges)  
Amino acid supplements (e.g., L-carnitine [start with 500 mg twice a day with food, up to 2,000 mg a day], L-glutamine [10 g a day for one week followed by 1 g twice a day], alpha-lipoic acid [400–600 mg a day with food])  
Tonic water (quinine or seltzer water) for cramping  
Topical creams such as capsaicin cream or cocoa butter  
Medications as indicated  
  • Gabapentin (start with 100 mg three times a day and gradually work up to 600 mg three times a day; can dose as high as 2,700 mg with physician permission)  
  • Amitriptyline (25–50 mg at bedtime)  
  • Sertraline (50–100 mg at bedtime)  
  • Lidoderm patch 5% (1.5 patches to each area of pain; remove after 12 hours each day)  
Referral to neurology or pain management |
| **Gastrointestinal**      | **Diarrhea**  
Dietary considerations such as BRAT diet (bananas, rice, apple sauce, and toast)  
Adequate fluid intake (at least 2 quarts every day)  
Fiber supplements or natural bacterial flora supplements, such as  
  • Benefiber™ (1 tablespoon every day in 6 oz of liquid, increased to 2 tablespoons twice a day if needed)  
  • Culturelle™ (1 tablet a day)  
  • Glutamine (15 g twice a day)  
Antidiarrheals (e.g., loperamide [1–2 tablets before each dose of bortezomib and 1 after every loose stool for 36 hours, not to exceed 8 tablets per day])  
Referral to nutritionist |
|                          | **Constipation**  
Dietary considerations such as high-fiber foods (e.g., flaxseed meal, prunes or prune juice every morning)  
Start with stool softeners (docusate sodium twice a day then three times a day). If needed, add senna-based laxatives, flaxseed oil (2 tablespoons a day), or milk of magnesia every other night at bedtime.  
If no stool in three days, try magnesium citrate, but not more than once a week.  
Referral to nutritionist |
|                          | **Nausea and vomiting**  
Consider antiemetics as premedications as needed.  
Anorexia  
Appetite stimulants |
|                          | **Anemia**  
Patient education on signs and symptoms of bleeding, such as easy bruising or nose bleeds |
|                          | **Neutropenia**  
Monitor blood counts  
Transfusions and growth factors at physician’s discretion |
|                          | **Hypotension**  
Determine whether patient has history of hypertension or syncope.  
Monitor all concomitant medications (hypertensive medications).  
Instruct patient to report symptoms such as lightheadedness and dizziness and to be cautious when driving.  
Monitor blood pressure. |
|                          | **Electrolyte imbalances**  
Monitor blood chemistries.  
Magnesium and potassium supplements as needed  
Dietary considerations, including high-sodium foods (e.g., canned soups, tomato juice) and potassium-rich foods (e.g., bananas)  
Adequate fluid intake |
|                          | **Rash and pyrexia**  
Medications such as diphenhydramine and cortisone creams or acetaminophen as indicated |

*Note.* These interventions have been used in bortezomib phase II trials, but experience with them is anecdotal. A formal evaluation has not been conducted.  
*Note.* Based on information from Colson, 2003.
Early intervention with symptom management strategies can prevent side effects from developing or worsening. Oncology nurses are in a key position to identify these signs and to initiate appropriate treatment measures. In addition to monitoring laboratory values and following other standard clinic practices for treating MM, nurses are able to assess changes in patients’ conditions, initiate interventions, evaluate the efficacy of supportive interventions, and further refine symptom management strategies. The management of some of the side effects associated with the administration of bortezomib, such as fatigue, hypotension, and gastrointestinal disturbances, may be affected by hydration regimes. Dietary supplements, including vitamins, minerals, and other supplements including amino acids, may ameliorate symptoms associated with peripheral neuropathies, but research is needed to support these interventions. Tools, such as the neurotoxicity assessment form, calendars, and information on symptom management can increase patients’ awareness of important aspects of their care, minimize discomforts, and prevent unnecessary interruptions in treatment.

The authors wish to acknowledge the special contributions of Anne Chiavacci, MS, RD, and Stephanie Vangness, RD, of the Dana-Farber Cancer Institute Nutrition Department to the discussion of and tables on side effects. The authors also would like to acknowledge Susan Anderson, BS, MFA, and Lynne Lederman, PhD, for their contribution in the preparation of this article.

Author Contact: Kathleen Colson, RN, BSN, BS, can be reached at 617-632-6303; please also contact the editor at CIONeditor@jsobel.com.

References


---

**Rapid Recap**

**Bortezomib, a Newly Approved Proteasome Inhibitor for the Treatment of Multiple Myeloma: Nursing Implications**

- Multiple myeloma (MM), the second most common hematologic malignancy, remains incurable, stimulating interest in novel therapies.
- Bortezomib is the first in a new class of anticancer drugs known as proteasome inhibitors. Its mechanism of action disrupts multiple signaling cascades involved in tumor cell proliferation, survival, and spread.
- Bortezomib has been approved to treat patients with MM who have received at least two prior therapies and have progressed on the most recent one.
- The most common side effects of asthenic conditions (including fatigue, malaise, and weakness), gastrointestinal events (including nausea, vomiting, diarrhea, anorexia, and constipation), thrombocytopenia, peripheral neuropathy, pyrexia, and anemia usually can be managed by standard interventions.
- Pretreatment assessments, patient education, and early identification of side effects by oncology nurses minimize treatment delays and interruptions and the worsening of symptoms.
- Nurses play a vital role in developing and implementing management strategies for side effects that can guide nursing interventions in the future in this new class of drugs.

---

For more information on this topic, visit the following Web site.

**Velcade® Consumer Information**

[www.fda.gov/cder/consumerinfo/druginfo/velcade.htm](http://www.fda.gov/cder/consumerinfo/druginfo/velcade.htm)

A link can be found at [www.ons.org](http://www.ons.org).