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Managing Bone Metastasis in the Patient With Advanced Cancer

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Bone is the third most common site of cancer metastasis resulting in pain and other serious morbidities that can affect one's quality of life. The orthopaedic patient with bone metastasis faces many challenges and has complex nursing care needs. Managing care involves astute assessment skills, knowledge of treatments including medication, surgery, and radiation therapy, and recognition of serious complications such as fracture, spinal cord compression, and hypercalcemia. Nurses play a vital role in the patient treatment plan by implementing interventions that promote positive outcomes and prevent injuries.

More than 1.6 million people in the United States are expected to be diagnosed with cancer this year (American Cancer Society, 2012a). The leading cause of death among patients with cancer is metastatic disease. The bone is the third most common site for cancer to spread to after the liver and lungs (Narazaki, Alverga Neto, Baptista, Caiero, & DeCamargo, 2006). Breast, prostate, lung, thyroid, and kidney cancers are the types of solid tumor cancers that are most likely to spread to the bone (Narazaki et al., 2006). Multiple myeloma, which is a cancer of the plasma cells in the bone marrow, can invade the skeleton and form bone lesions. The spine, pelvis, femur, humerus, ribs, and skull are the most common sites of bone metastasis, although it can occur anywhere in the skeleton (American Cancer Society, 2012b).

This article examines the nursing management of a patient with bone metastasis, including pain assessment, recognition of serious complications, and treatment interventions. Insight into these areas will facilitate a better understanding of how bone metastasis can be managed to improve patient outcomes and increase quality of life. The case study described later illustrates how a patient with cancer may present on an orthopaedic unit after being diagnosed with bone metastasis.

Case Study

Mrs. A is a 60-year-old woman who has suffered a pathologic fracture of her right humerus as a result of breast cancer that has metastasized to her bone. She is recovering postoperatively following an open reduction and internal fixation with a plate to her right humerus (see Figures 1 and 2). Mrs. A's medical history includes a diagnosis of Stage IIIA invasive ductal carcinoma of the right breast in 2006, at which time she underwent a right mastectomy with lymph node dissection (with four positive lymph nodes) and completed eight cycles of chemotherapy. Mrs. A also had radiation therapy to the breast and axillary area following chemotherapy and she was started on hormone therapy to further decrease the risk of cancer recurrence.

For the next 5 years, Mrs. A did well as she continued on hormone therapy and with routine follow-up visits and scans. However, in 2011, Mrs. A was diagnosed with bone metastasis to the right pelvis following a bone scan. She began treatment with intravenous bisphosphonate therapy every 4 weeks and another course of chemotherapy. Bisphosphonate therapy continued for the next several months.

A few weeks ago, during one of Mrs. A's follow-up visits, she reported new-onset sharp pain to her right upper arm. She rated it as a 5/10 and noted that it increased in intensity with mobility. The medical oncologist ordered radiographs, which confirmed the presence of metastatic bone lesions and a fracture to the right humerus. At that time she was referred to an orthopaedic surgeon for evaluation and surgery followed.

Pathophysiology

Bone remodeling is a physiologic process by which the existing bone is resorbed and replaced with a new bone. This process occurs when bone is exposed to stimuli such as mechanical stress, hormones, drugs, or vitamins that activate bone cell apoptosis (Crowther-Radulewicz, 2010). In the normal remodeling cycle, a structured balance exists between osteoclast cells degrading and resorbing bone and osteoblasts building new bone. Growth factors and hormones released during bone remodeling play a role in regulating osteoclast and osteoblast activity (Reich, 2003).

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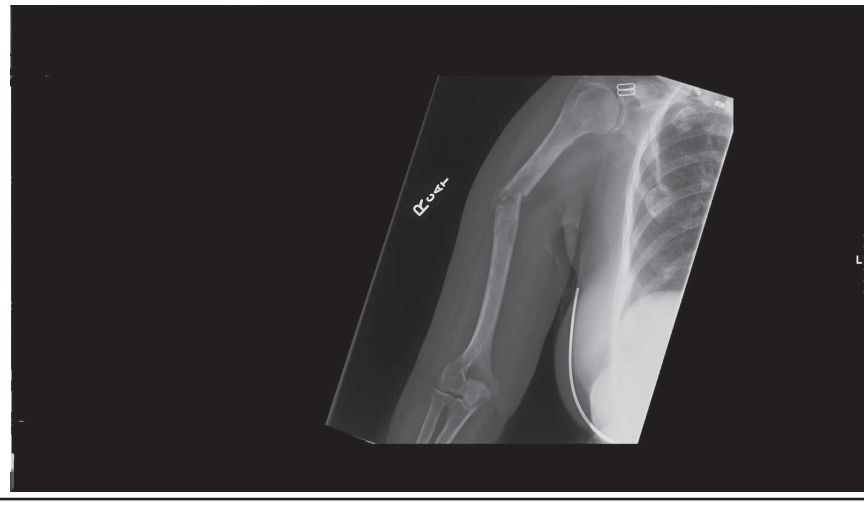

FIGURE 1. Permeative lytic lesion within the mid humeral diaphysis with a demonstrated transverse pathologic fracture.

A disruption in the normal bone remodeling cycle occurs when cancer cells invade the bone matrix. Tumor cells reach the bone by detaching from the site of the primary tumor, entering the vasculature, and adhering to the capillaries of the bone (Albert, 2007). This migration of cells into the bone further stimulates bone disintegration and the release of more growth factors near the cancer cells (Fitch et al., 2009). Tumor cells release their own growth factors in the bone and more bone degradation takes place (Albert, 2007). A vicious cycle begins as more growth factor stimulates local tumor cell growth and more bone destruction. Metastatic lesions can be characterized as osteolytic, osteoblastic, or mixed (see Table 1).

Assessment

Pain is the hallmark symptom of bone metastasis and usually develops gradually (Albert, 2007). This type of pain is thought to result from tumor growing into the bone and stimulating nerve endings in and around the bone. The pain may also be caused by the tumor stretching the periosteum of the affected bone (Johnson & Knobf, 2008).

The nurse should begin the review of systems with a focus on the patient's pain. When caring for a patient with a known history of cancer, any report of new onset bone pain must be evaluated. The National Comprehensive Cancer Network (NCCN) guidelines for adult cancer pain include several components (NCCN, 2012a). A quantified pain intensity score should be obtained using numerical rating scale when possible. The nurse should perform a formal comprehensive pain assessment asking the patient specific questions including location, duration, intensity, and the character of the pain. The use of body sketch diagrams as part of the pain assessment documentation is helpful if pain occurs in more than one location. The nurse should ask the patient to describe what aggravates the pain and what relieves it, including an analgesic history. Often, pain related to bone metastasis is described as constant and dull and is greater in intensity at night and with weight bearing (Reich, 2003). The physical examination should include noting areas of edema, tenderness, decreased range of motion, or abnormal positioning.

If bone metastasis is suspected, the nurse should notify the patient's oncology physician or practitioner and

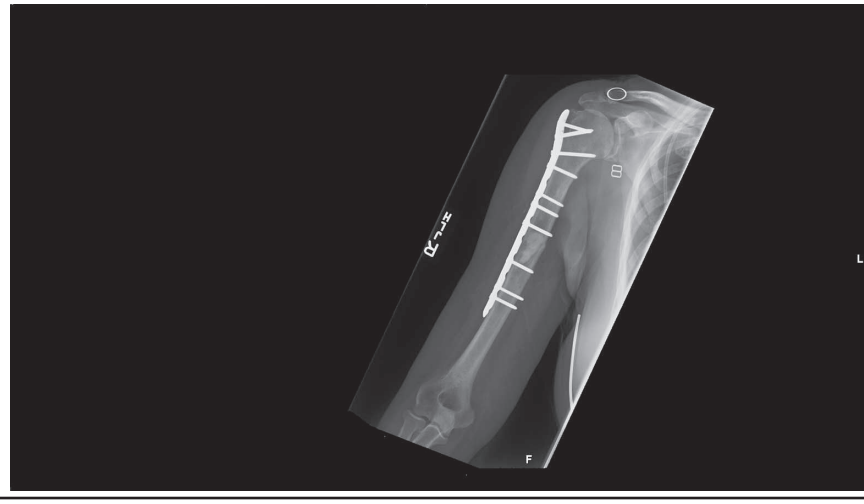

FIGURE 2. Placement of a lateral plate and screws at the pathologic fracture site of the mid humeral diaphysis.

Table 1. Features of Metastatic Bone Lesions

Type of Metastatic Bone Lesions	Characteristics	Associated Cancers
Osteolytic	• Increased bone breakdown causing bone erosion • Appear as punched out areas on x-ray • More likely than osteoblastic lesions to cause pathologic fracture	• Lung • Multiple myeloma • Kidney • Breast • Thyroid
Osteoblastic	• Increased sclerotic bone formations	• Prostate • Breast
Mixed	• Include features of both osteolytic and osteoblastic	• Breast

Note: Based on the information from "Evaluating Bone Metastases," by K. Albert, 2007, *Clinical Journal of Oncology Nursing*, *11*(2), pp. 193–197; and "Advances in the Treatment of Bone Metastases," by J. Reich, 2003, *Clinical Journal of Oncology Nursing*, *7*(6), pp. 641–646.

prepare the patient for diagnostic testing. This may include plain radiographs, computed tomographic scan, magnetic resonance imaging scan, and nuclear medicine testing such as a bone or positron emission tomographic scan. Laboratory tests that may be ordered consist of a complete blood count with differential, liver function tests, serum calcium or ionized calcium levels, phosphorus, erythrocyte sedimentation rate, and alkaline phosphatase (Johnson & Knobf, 2008).

Complications

Pathologic fracture, spinal cord compression (SCC), and hypercalcemia are serious complications that can all quickly develop as a result of bone metastases.

Pathologic Fracture

If the patient with bone metastasis is experiencing a sudden onset of sharp bone pain, a pathologic fracture should be suspected (Strohl & Hawkins, 2006). The pain is characterized as sharp, having a focal point at the site of the fracture, and can radiate if there is nerve involvement (Johnson & Knobf, 2008). Fractures occur in 9%–29% of patients with bone metastases and develop most frequently in the long bones (Narazaki et al., 2006). Surgery may be an appropriate intervention to repair the fracture. However, some patients are not surgical candidates due to comorbidities such as poor cardiovascular or respiratory function. In those cases, immobilization with a splint or brace may be indicated.

Spinal Cord Compression

Spinal cord compression occurs in about 5% of all patients with cancer (Cole & Patchel, 2008). In more than 85% of patients who develop SCC, the cause is bone metastasis to the vertebral bodies of the spine, which then spreads into the epidural space and compresses the spinal cord (Cole & Patchel, 2008). Breast, prostate, and lung cancers each account for 15%–20% of the cases, although any tumor can cause SCC (Lewis, Hendrickson, & Moynihan, 2011). Spinal cord compression is an oncologic emergency with early recognition and intervention crucial to patient outcomes. About 75%–100% of patients who are able to ambulate prior to SCC will remain ambulatory after treatment (Colen, 2008). However, of the patients who are experiencing partial or full paralysis prior to therapy, only 15%–30% will regain function (Colen, 2008). Early signs of SCC include back pain, constipation, urinary retention, and incontinence. Later signs are weakness, sensory impairment, and sensory loss. Intravenous corticosteroids administered immediately are needed to decrease swelling, halt progression of neurologic symptoms, and reduce pain. Treatment may include surgery, external beam radiation therapy, or both, depending on degree of compression, spinal column stability, and radiosensitivity of the tumor (Lewis et al., 2011).

Hypercalcemia

Approximately one-third of patients with cancer will experience hypercalcemia at some point in the course of their disease (Lewis et al., 2011). Eighty percent of malignant hypercalcemia occurs as a result of the release of parathyroid hormone-related peptide by the tumor cells that causes bone resorption and renal retention of calcium (Lewis et al., 2011). Calcium levels increase when bone metastases stimulate osteolytic activity and bone breakdown, resulting in an increase of calcium released into the bloodstream. Hypercalcemia is an oncologic emergency requiring prompt attention. Untreated hypercalcemia can lead to renal, neurologic, and cardiovascular changes that can result in death (Rosiak, 2009). Assessment for signs and symptoms includes lethargy, confusion, weakness, hypertension, and constipation. Because these are somewhat nonspecific symptoms, it is important to monitor calcium levels closely. An ionized calcium level of above 1.35 mmol/L or a serum calcium above 11 mg/dl is considered elevated (Rosiak, 2009). Serum calcium may need to be corrected if hypoalbuminemia is present, which can give an incorrect lower value (Lewis et al., 2011). The formula to obtain a corrected value of calcium in mg/dl = total serum calcium (mg/dl) + (4.0 − serum albumin [g/dl]) × 0.8 (Rosiak, 2009). Aggressive hydration is the first step of treatment to restore intravascular volume, followed by the use of loop diuretics, such as furosemide, to promote calciuresis once the patient is adequately hydrated (Lewis et al., 2011). Administration of bisphosphonates and glucocorticoids may be ordered to further inhibit bone resorption (Rosiak, 2009).

Treatment

Treatment goals for a patient with bone metastasis include pain control, maintenance or restoration of mobility, and prevention of complications including pathologic fracture, SCC, and hypercalcemia. The interventions used to meet these goals include medications (analgesics, bone-modifying agents, hormones, and chemotherapy), radiation therapy, and surgery.

Analgesics

The NCCN guidelines for pain management follow an algorithm based on a numerical pain intensity rating (NCCN, 2012). A pain rating of 1–3 is considered mild pain, 4–6 moderate pain, and 7–10 severe pain. The NCCN further distinguishes between opioid naive patients (not chronically taking opioids) and opioid-tolerant patients (chronically taking opioids for cancer pain). For opioid naive patients with mild pain, nonsteroidal anti-inflammatory medications or acetaminophen may be used first. If pain is unrelieved or worsens, a short-acting opioid analgesic can be added (NCCN, 2012). For opioid-tolerant patients experiencing breakthrough, pain doses of their current medication are titrated until an acceptable pain level is achieved.

Adjuvant analgesics, such as corticosteroids, can be added to the pain regimen to enhance analgesia or help minimize adverse effects of an opioid, such as nausea (NCCN, 2012). Because corticosteroids have an anti-inflammatory effect, they are useful in treating bone pain.

Bone-Modifying Agents

Bisphosphonates are a class of bone-modifying drugs that work by causing apoptosis of the osteoclasts that inhibits bone resorption. Bisphosphonates slow bone loss and are effective in reducing skeleton-related events including pathologic fracture, radiation therapy to bone, surgery to bone, or SCC in patients with bone metastasis from solid tumors (Iranikhah, Wilborn, Wensel, & Ferrell, 2012). Bisphosphonates have an analgesic effect, reduce morbidity associated with bone metastases, and improve quality of life in patients with advanced cancer (Fitch et al., 2009). Nurses administering intravenous bisphosphonates must be aware of some complications such as acute phase reactions, renal insufficiency, and osteonecrosis of the jaw that can occur with this therapy. Acute-phase reactions occur in the first 24 hours of the infusion and include flu-like symptoms and increased bone pain (Berenson, 2005). These side effects are self-limiting and can be managed with acetaminophen. Bisphosphonates can affect renal function, so patients' serum creatinine levels need to be monitored prior to each infusion. Osteonecrosis of the jaw is a rare side effect of intravenous bisphosphonate therapy but can be very damaging (Fitch et al., 2009). Patients should have an oral examination prior to initiation of therapy, obtain regular dental examinations, practice good oral hygiene, and avoid invasive dental procedures while on therapy.

Denosumab is a monoclonal antibody that has been recently indicated for the prevention of skeleton-related events in patients with solid tumors (Barton, 2011). Denosumab is a bone-modifying agent that works by binding to the receptor activator of nuclear factor kappa-B ligand (RANKL) protein that reduces bone resorption (National Cancer Institute, 2012b). Denosumab is a subcutaneous injection administered every 4 weeks and carries the same dental risks as bisphosphonates. Although frequent assessment of renal function is not necessary, patients' calcium levels need to be monitored because denosumab can cause severe hypocalcemia.

Both bisphosphonates and denosumab should be administered according to the appropriate dosing schedule, and education of patients on the adherence to their treatment schedule is important. Patients who are receiving bisphosphonates or denosumab are recommended to take both oral calcium and vitamin D supplements to reduce the risk of hypocalcemia (Iranikhah et al., 2012).

Hormone Therapy

Hormone therapy use is limited to certain types of hormone responsive tumors. Certain cancer cells contain proteins (hormone receptors) that are activated when hormones bind to them. Activation of these receptors can stimulate cell growth as a result of changing the expression of specific genes (National Cancer Institute, 2012a). Therefore, anti-estrogen therapy in women with estrogen and/or progesterone positive breast cancer and androgen deprivation therapy in men with prostate cancer can slow tumor growth. Patients should be instructed that hot flashes, emotional effects, and fatigue may be side effects of these treatments.

Chemotherapy

Chemotherapy is administered to treat the primary malignancy and the metastatic disease. The type of chemotherapeutic agent or regimen depends on the responsiveness of the tumor cells and the patient's condition. Patients need to be educated on the specific side effects associated with the chemotherapy drug. For example, a patient with non–small cell lung cancer that has metastasized to the bone may receive first-line therapy with a regimen containing the chemotherapy drug cisplatin (NCCN, 2012b). This drug causes fatigue, nausea, nephrotoxicity, and myelosuppression (Shields, 2011). However, if the disease progresses on this therapy, a second-line therapy with the chemotherapy drug docetaxel may be initiated (NCCN, 2012b). Side effects of this medication also include fatigue and myelosuppression but can also cause peripheral neuropathy, fluid retention, and nail changes (Shields, 2011).

External Beam Radiation Therapy

Recent guidelines from the American Society for Radiation Oncology state that external beam radiation therapy continues to be the recommended treatment of choice for painful, uncomplicated bone metastasis and for the prevention of morbidity caused by bone metastasis (Lutz et al., 2011). Radiation works by damaging the cancer cells' DNA, thus affecting the ability of the cells to grow and divide. Treatments can be administered in a single fraction dose or multiple fractions. The American Society for Radiation Oncology guidelines also include evidence that it is safe and effective to repeat external beam radiation therapy to a previously irradiated site if further symptom management is warranted (Lutz et al., 2011). Metastases to multiple sites in the bone can be treated with radiation to larger fields of the body. In some select patients, postoperative radiation therapy is recommended following surgical decompression for SCC (Lutz et al., 2011). Patients should be informed that side effects of radiation therapy should

be minimal but may include fatigue, nausea, anorexia, and skin irritation.

Surgery

Surgery may be performed to prevent pathologic fractures, treat an actual fracture, or stabilize the spine. Prophylactic surgery for an impending fracture can reduce a patient's morbidity and increase quality of life and is technically easier and less traumatic for patients than a stabilization surgery on a fracture that has already occurred (Eastley, Newey, & Ashford, 2012). However, surgery for actual fractures should be performed when possible to restore mobility and decrease pain. The type of surgery depends on many factors, including the location of the metastases, treatment goals, and condition of the patient (Johnson & Knobf, 2008). For example, a total hip replacement may be indicated for a patient with metastases to the femoral head and neck, whereas kyphoplasty may be used to treat a collapsed vertebral body. Nursing care involves preparing patients preoperatively by immobilizing the affected bone(s) and providing education on the surgical intervention. Routine postoperative care includes deep vein thrombosis prophylaxis, respiratory hygiene, and skin care.

Many surgical oncology patients with metastatic bone disease have already received prior treatments with chemotherapy. Before any surgical procedure, a complete blood cell count should be done to identify myelosuppression, which can manifest as a decrease in white blood cell count, red blood cell count, and/or platelet count. It may be necessary to allow time for blood cell counts to recover from a previous cycle of chemotherapy before surgery can be performed. However, if a patient's blood cell counts are chronically low or it is not feasible to delay surgery, nurses must be knowledgeable about the proper measures to take to decrease the probability of complications.

A low white blood cell or neutrophil count can place a patient at an increased risk of infection. Nurses must adhere to diligent hand-washing practices. The surgical sites should be assessed every shift for erythema and purulent drainage. Vital signs, including temperature checks, need to be performed routinely. Educate patients on the importance of hand hygiene, surgical site care, and the signs and symptoms of infection.

A low red blood cell count can cause fatigue, tachycardia, and shortness of breath, all of which can impact a patient's recovery. Significant surgical blood loss can further contribute to anemia. Blood transfusions may be indicated if symptoms become severe. Nurses should instruct patients to pace themselves throughout the day, ask for help with activities as needed, and notify a practitioner if symptoms of dizziness or chest pain occur.

A low platelet count can increase a patient's risk of bleeding. Nurses should assess for any signs of bleeding from the surgical site or mucous membranes such as the nose or gums. If active bleeding exists, a platelet transfusion may be necessary. Educate patients on bleeding precautions including the use of soft-bristle toothbrushes, prevention of injuries such as cuts or bumps, and avoidance of constipation. Patients should report any bleeding to a practitioner.

Patient Safety

Nurses are instrumental in promoting the health of patients with bone metastasis through education in safety measures. This population is at high risk for injury due to the nature of their disease and the medications they may be taking. It is important to discuss any history of falls. Implement safety precautions in the hospital by maintaining the bed in a low position, ensuring that the call light is in reach, and encouraging the use of handrails while ambulating. Discuss plans for home safety including keeping a well-lit environment, wearing nonslip footwear, and removing throw rugs and light cords from the floor area. Make referrals to physical and occupational therapy as needed.

Nurses should educate patients and their families on the importance of reporting new or worsening signs and symptoms such as pain and neurologic changes. Encourage the patient to keep a diary of pain scores or other adverse events. The diary may help patients recognize subtle changes in their health and aid nurses in identifying when an intervention is needed (Fitch et al., 2009).

Case Study Follow-Up

Mrs. A was able to be discharged home following her postoperative recovery with her arm in a sling and a prescription for physical therapy to improve arm strength and use. Her pain has been well controlled with oxycodone. Mrs. A was provided with home instructions on surgical site care, the importance of monitoring for signs and symptoms of infection, and reporting any new or increased pain to the surgical site or other bone pain. She was instructed on safety precautions for her home environment. Mrs. A plans to restart chemotherapy in approximately 6 weeks, which will allow time for surgical site healing.

Conclusion

Managing bone metastasis in the patient with advanced cancer is complex and challenging. The nurse's assessment skills, prompt recognition of complications, and knowledge of the treatment plans will help patients with bone metastasis throughout their course of care. Implementing interventions that promote positive outcomes and prevent complications can greatly affect a patient's quality of life.

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