

Evaluating Bone Metastases

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Case Presentation: Mr. P is a 67-year-old African American man with a known history of stage IIIC prostate carcinoma, originally diagnosed in 2002. He underwent a radical prostatectomy and initially was given leuprolide injections every three months. In 2004, he was diagnosed with bone metastases in the T8 and T12 vertebrae and was started on bicalutamide.

Mr. P's prostate-specific antigen has been stable since the initiation of bicalutamide. His past medical history includes hypertension and osteoarthritis.

Mr. P presented for a follow-up office visit and routine laboratory work, complaining of a one-month history of progressively worsening right hip pain. He reported significant right hip pain when bearing weight, occurring in the past few days. Mr. P has no thoracic pain from the areas of known metastases.

An initial diagnostic workup, including a radiograph of Mr. P's right hip, revealed no fracture; however, the radiologist observed what appeared to be an osteoblastic bone metastasis at the right femoral neck. A bone scan was positive for uptake in T8, an area at the right femoral neck, and at T12, an area in the right fifth rib. Mr. P was started on a daily calcium supplementation, IV bisphosphonate every four weeks, and analgesics for pain.

Incidence and Prevalence of Bone Metastases

Approximately 60%–84% of patients diagnosed with solid tumors develop bone metastases (Berger & Koprowski, 1999). The third most common site of metastatic disease is the skeleton, and metastasis is the most frequently occurring bone malignancy (Jacofsky, Frassica, & Frassica, 2004). Prostate, breast, lung, kidney, and thyroid cancers account for 80% of skeletal metastases,

which occur most often in the spine, pelvis, ribs, skull, and proximal femur (Jacofsky et al.).

The prevalence of metastatic bone disease is highest in breast and prostate cancers, with approximately 65%–75% of patients with advanced disease developing bone metastases. In addition, about 30%–40% of patients with advanced lung cancer and virtually all patients with multiple myeloma develop bone metastases (Lipton, 2004; Smith et al., 2005). Improved survival rates of patients with cancer have led to an increased incidence of metastatic bone disease and subsequent sequelae.

Pathophysiology

Bone normally undergoes continual remodeling in response to mechanical stress. Osteoclasts and osteoblasts alternately cause bone resorption and repair, respectively. The mineralized bone matrix contains numerous growth factors that are released during the process (Lipton, 2004). The favorable microenvironment of the bone matrix and its ample blood supply are the most likely causes for the high rate of bone metastases in patients with cancer.

Metastasis of tumor cells involves a cascade of events, including detachment from the primary tumor site, invasion of the vasculature, migration and adherence to distant capillaries of the bone, extravasation, and proliferation. Once tumor cells have invaded the bone matrix, they produce growth factors that can directly or indirectly stimulate osteoclasts to degrade the bone. In response, the bone releases growth factors that stimulate tumor cell growth, which establishes a cycle of bone destruction and local tumor growth (Lipton, 2004).

Types of Bone Metastases

As a metastatic lesion grows in the medullary cavity, the surrounding bone is remodeled by osteoclastic or osteoblastic processes. The relationship between the osteoclastic and osteoblastic remodeling processes determines whether a predominant lytic, blastic, or mixed pattern is seen on radiographs (Peh & Muttarak, 2005).

Osteolytic lesions are characteristic of multiple myeloma and cancers of the lung, thyroid, kidney, and breast. Tumor cells responsible for the lesions cause

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