

Bone Metastasis

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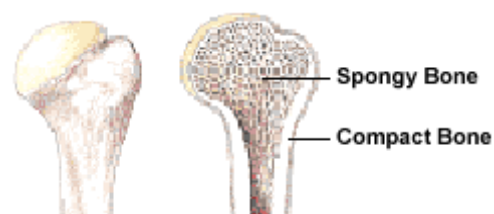
What Is Bone Metastasis?

Cancer that has developed in one area of the body can spread beyond that site and invade other parts of the body. This process is called metastasis. The bone is a common site of metastasis for a number of different cancers. They include: lung, breast, prostate, kidney, thyroid cancers and multiple myeloma.

Cancer cells that have metastasized to the bone can damage the bone, which gives rise to symptoms. Various treatments are available to control the symptoms and the spread of bone metastases.

Bone Basics

Bone is a type of connective tissue made up of minerals, such as calcium and phosphate, and the protein collagen. The outer layer of bone is called the cortex and the spongy center of bone is called cancellous bone. The bone marrow fills in the spaces within the spongy bone. Bone tissue is porous and alive, with blood vessels running through it.



Bone constantly repairs and renews itself through a process called remodeling. Two kinds of cells are involved:

- Osteoblasts, bone-forming cells
- Osteoclasts, cells that break down, or resorb, bone

Bones carry out a number of functions in the body.

- The skeleton provides structural support for the body.
- Bones store and release minerals that the body needs to function, such as calcium, magnesium, phosphorus, and sodium when the body needs them.
- Bone marrow produces and stores blood cells--red blood cells that transport oxygen from the lungs to the rest of the body; white blood cells that fight infections; and platelets that help the blood clot.

When cancer cells invade the bone, any of these functions may be affected.

How Cancer Spreads to the Bone

When cells break away from a cancerous tumor (a primary tumor) they can travel to other parts of the body through the bloodstream or the lymph vessels. Moving through the bloodstream or lymphatic system, cancer cells can lodge in an organ at a distant location and establish a new (secondary) tumor. Different types of tumors seem to prefer to spread to particular sites in the body, such as the liver or the skeleton. Many cancer types noted above commonly spread to the bone.

Secondary tumors that have spread to bone (bone metastases) are not the same as primary bone cancer that starts in the bone (sarcoma). A tumor that has metastasized to bone is made up of abnormal cancer cells from the original tumor site and not of bone cells. For example, lung

cancer that spreads to the bone consists of lung cancer cells. In this case, bone metastasis would be called metastatic lung cancer.

When cancer cells spread to the bone, they commonly lodge in the spine, rib cage, pelvis, limbs, and skull.

Cancer cells that spread to bone can cause damage in two ways:

- The tumor may wear away bits of bone, creating small holes called osteolytic lesions. This process can make bones fragile and weak so that they break or fracture easily.
- The tumor may stimulate bone to form and build up abnormally. These areas of new bone are called osteoblastic or osteosclerotic lesions. They are weak and unstable and may break or collapse. They also can be painful.

Symptoms

A number of symptoms arise as a result of bone metastasis.

- **Bone pain.** Pain is the most common symptom of bone metastasis and is usually the first symptom that patients notice. At first the pain may come and go. It tends to be worse at night or with bed rest. Eventually the pain may increase and become severe. Not all pain indicates metastasis. The doctor can help you distinguish between pain from metastasis and aches and pains from other sources.
- **Fractures.** Bone metastasis can weaken bones, putting them at risk for fractures. In some cases a fracture is the first sign of bone metastasis. The long bones of the arms and legs and the bones of the spine are the most common sites of fracture. A sudden pain in the middle of the back may indicate a cancerous bone breaking and collapsing.
- **Spinal cord compression.** When cancer metastasizes to the spine, it can squeeze the spinal cord. The pressure on the spinal cord may not only cause pain, it may cause numbness or weakness in the legs, problems with the bowels or bladder (for example, trouble urinating), or numbness in the abdominal area.
- **High blood calcium levels.** High levels of calcium in the blood (hypercalcemia) is caused when calcium is released from the bones. High calcium levels may reduce one's appetite, may cause nausea, thirst, constipation, tiredness, and confusion. If untreated, it may cause a coma.
- **Other symptoms.** If bone metastasis affects the bone marrow, other symptoms may be experienced, depending on the type of blood cell affected. Red blood levels may drop, causing anemia that leads to symptoms of tiredness, weakness, and shortness of breath. If white blood cells are affected, the patient may develop infections that cause fevers, chills, fatigue, or pain. If the number of platelets drops, abnormal bleeding may occur.

It is important for patients to discuss any of these symptoms with their doctor. Detecting and treating this condition early can help reduce complications.

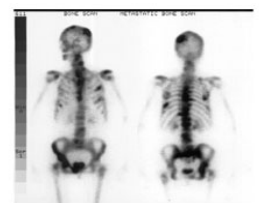
How Bone Metastasis is Diagnosed

When a patient experiences symptoms suggestive of bone metastasis, various tests can be done to confirm the cause. In some cases bone metastasis may be detected before symptoms arise.

X-rays. Radiographic examination, or X-rays, can provide information about what part of the skeleton the cancer has spread to as well as the general size and shape of the tumor or tumors. (It is common for more than one metastasis to be found.)

Bone scan. Bone scans can detect bone metastasis earlier than X-rays can. They also allow the doctor to monitor the health of all the bones in the body, including how they are responding to treatment.

In a bone scan, the patient is given an injection of a low amount of radioactive material (much lower than that used in radiation therapy). The radioactive substance is attracted to diseased bone cells throughout the body. Diseased bone appears on the bone scan image as darker, dense



areas. Conditions other than metastasis, such as arthritis, infections, or previous fractures that have healed, may also be picked up on a bone scan, although the patterns they produce are often different from those produced by cancer. Additional tests can help distinguish among these other conditions.

Computed tomography (CT) scan. The CT scan provides X-ray images to look at cross sections of organs and bones in the body. Rather than provide one image as a conventional X-ray does, the CT scanner takes many pictures as it rotates around the body. A computer combines the images into one picture to show if cancer has spread to the bones. It is particularly helpful in showing osteolytic metastases that may be missed with the bone scan.

Magnetic resonance imaging (MRI). MRI scans use radio waves and strong magnets instead of X-rays to provide pictures of bones and tissues. They are particularly useful in looking at the spine.

Laboratory tests. Bone metastasis can cause a number of substances, such as calcium and an enzyme called alkaline phosphatase, to be released into the blood in amounts that are higher than normal. Blood tests for these substances can help diagnose bone metastasis. Doctors also can measure the levels of these chemicals over time to monitor a patient's response to treatment. Elevated levels of these substances can indicate other medical conditions besides metastasis.

How Bone Metastasis is Treated

Effectively treating the primary cancer is the best way to manage bone metastases. In addition to treating the cancer, there are a variety of treatment options available for bone metastasis.

Bisphosphonates. Bisphosphonates are drugs that slow the bone damage caused by metastases. They are used to decrease the risk of bone complications like fractures and to lower abnormally high blood calcium levels. Data also suggest that bisphosphonates can also reduce the bone pain associated with metastasis.

Different types of bisphosphonates are available and include etidronate, clodronate, pamidronate, ibandronate, and zoledronic acid. Bisphosphonates exist in both oral and intravenous (IV) forms. IV Bisphosphonates are more commonly used for the treatment of bone metastasis. The side effects of bisphosphonates are usually mild and do not last long. They include tiredness, nausea, vomiting, lack of appetite, or transient bone pain.

Studies with bisphosphonates have demonstrated their efficacy in patients with bone metastasis from various solid tumors including breast, prostate, lung and other cancers, as well as in patients with multiple myeloma. Investigators are also looking at whether bisphosphonates can also prevent the development or recurrence of bone metastases.

Chemotherapy and hormone therapy. Chemotherapy drugs are used to kill cancer cells throughout the body. They may be taken orally or given intravenously. Hormone therapy uses drugs to prevent hormones from forming or acting on cells to promote cancer growth. (For example, hormones such as estrogen in women can promote the growth of some cancers, such as breast cancer.) The goals of chemotherapy and hormone therapy in patients with bone metastases are to control the tumor's growth, thus potentially reducing the risk of associated bony complications.

Radiation therapy. Radiation is useful in relieving pain and controlling the growth of tumor cells in the area of the bone metastasis. It may be used to prevent a fracture or as a treatment for spinal cord compression.

Radiation therapy uses high-energy ionizing radiation to injure or destroy cancer cells. Typically radiation is administered once a day in 10 treatments over a 2-week period. Full effects of this treatment may take 2 to 3 weeks to occur. Side effects of radiation therapy may include skin changes in the area being treated and a temporary increase in symptoms of bone metastasis.

Another type of radiation therapy is called radiopharmaceutical therapy. This approach involves injecting into a vein a radioactive substance such as strontium-89. This substance is attracted to areas of bone containing cancer. Providing radiation directly to the bone in this way destroys active cancer cells in the bone and can relieve symptoms. Two important side effects are decreased blood counts with increased risk of bleeding, and rarely, leukemia.¹

¹ Kossman SE, Weiss MA. Acute Myelogenous Leukemia After Exposure to Strontium-89 for the Treatment of Adenocarcinoma of the Prostate Cancer. 2000;88:620-624

Surgery. Surgery for bone cancer is done to prevent or to treat a bone fracture. It usually involves removing the tumor and stabilizing the bone to prevent a fracture. Metal rods, plates, screws, wires, nails, or pins may be surgically inserted to strengthen or provide structure to the bone damaged by metastasis.

Other therapies. Other treatments for bone metastases and their symptoms include physical therapy and drug and nondrug approaches to control pain. Many different drugs or combinations of drugs can be used to treat pain from bone metastases. The principal drug type used to treat bony metastases is the non-steroidal anti-inflammatory agents (NSAIDs) (including aspirin, ibuprofen, naproxen, and prescription drugs), which stop prostaglandins. Prostaglandins seem to be responsible for much of the bony pain. It is important to take these medicines with food or milk to protect the stomach. Nondrug approaches to managing pain include the use of heat and cold, relaxation techniques, and therapeutic beds or mattresses.

Clinical trials are exploring the ways to better manage bone metastases.

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