Cancer that begins in an organ, such as the lungs, breast, or prostate, and then spreads to bone is called metastatic bone disease (MBD). More than 1.2 million new cancer cases are diagnosed each year. Approximately 50% of these tumors can spread (metastasize) to the skeleton.

With improved medical treatment of many cancers — especially breast, lung, and prostate — patients are living longer. However, the primary cancers in more of these patients are spreading to bone. The tumors that result are called bone metastases.

Every cancer patient should discuss his or her risk for developing MBD with an oncologist. Some cancers do not readily spread to bone, while others do.

The most common cancers that arise from organs and spread to bone include:

- Breast
- Lung
- Thyroid
- Kidney
- Prostate

MBD causes pain in the area of spread, damages and weakens bone, and puts the patient at a greater risk for broken bones. It can make it hard to participate in daily activities. The biggest concern for patients with MBD is the general loss in quality of life.

How much of an effect MBD has on a patient will vary and is associated with how much the cancer has spread, which bones are affected, and how severe the bone damage is. There are a range of treatment options, however, that can help patients manage pain and maintain their independence and activity levels.

**Description**

After the lung and the liver, the skeleton is the most common site of spread of cancers that begin in organs. Metastases to the lung and liver are often not detected until late in the course of disease because patients experience no symptoms. In contrast, bone metastases are generally painful when they occur.
Cancer most commonly spreads to these sites in the skeleton:

- Spine
- Pelvis
- Ribs
- Skull
- Upper arm
- Long bones of the leg

**Bone Damage**

Sometimes, the tumor can completely destroy the bone in a particular area. This type of process is termed osteolytic bone destruction. This type of damage is most common in cancers that have spread to bone from the lung, thyroid, kidney, and colon.

Alternatively, new bone can form in response to the cancer spread. This new bone, called osteoblastic, grows abnormally and causes the bone to be weak and deformed. It is more frequently seen in spread of prostate, bladder, and stomach cancer.

Breast cancer often behaves in a mixed osteolytic and osteoblastic manner. Osteolytic and osteoblastic metastatic bone disease occurs because the different cancer cells secrete factors that interact with the naturally occurring cells in the bone and cause bone destruction, new bone formation, or both.

**Effects**

Because MBD weakens the affected bones, people with the disease are prone to fractures. Broken bones caused by MBD are termed “pathological fractures.”

Sometimes the bone has not yet broken but is so weak that a break is imminent. Such scenarios are termed “impending pathologic fractures.” Patients with impending or actual fractures may be forced to remain on bedrest for long periods of time, which can lead to possible chemical imbalances in the blood such as increased calcium levels (hypercalcemia).

Patients with cancer that has spread to the spinal bones may develop nerve damage that can lead to paralysis or loss of the use of the legs and/or arms.
Metastatic Bone Disease cont.

Symptoms

- **Pain.** The most common symptom of MBD is pain. Patients may have pain in the spine, pelvis, or extremities because the bone has been weakened by the tumor.
- **Fractures.** Weakened bones break more easily. A fracture from a minor injury is another possible sign of MBD.
- **Anemia.** The most common sites of spread — spine, pelvis, ribs, skull, upper arm, and long bones of the leg — correspond to areas of bone marrow that produce high levels of red blood cells, the cells responsible for carrying oxygen to tissues in the body. Anemia (decreased red blood cell production) is a common blood abnormality in patients with MBD.

A cancer patient who experiences any pain, especially in the back, legs, and arms, should notify his or her doctor immediately. Pain that occurs without activity (i.e., walking or lifting an object) is particularly concerning.

Diagnosis

**Medical History and Physical Examination**

It is important for your doctor to understand your medical condition and your symptoms. Your doctor will ask questions about the nature of any pain you are having, your current health, and past medical conditions. The information your doctor learns is called your medical history.

After the medical history, your doctor will perform a physical examination, concentrating on the painful areas.

**Imaging Tests**

X-rays. After the interview and physical examination, your doctor will order x-rays if he or she suspects that you have metastatic bone disease. Because some pain is referred from other areas (for example, knee pain may be arising in the hip), your doctor may order x-rays of bone beyond the areas where you are experiencing discomfort.

The x-ray examination can tell an oncologist a great deal of information about whether and how much of the bone is involved.

**Other imaging tests.** Your doctor may also order a bone scan. This test is helpful in determining if other bones, in addition to the one in question, are involved with metastatic bone disease. In select cases, a computerized tomography (CT) scan and/or magnetic resonance image (MRI) may be ordered, especially in cases where the spine or pelvis may be involved.
MBD vs. Primary Bone Cancer
The diagnosis of metastatic bone disease should not be assumed unless a patient has a known primary cancer that has previously spread to bone.

In adults older than 45 years of age who have no personal history of cancer and who have a bone growth detected in an x-ray, a specialist consultation should be obtained with an orthopaedic surgeon who has formal advanced training in cancer surgery (orthopaedic oncologist).

The orthopaedic oncologist will determine whether this bone tumor is a metastasis from an unknown primary carcinoma or a primary bone cancer (sarcoma).

For example, if an area of bone has been destroyed, the possible diagnoses include metastatic bone disease or a primary bone cancer, such as myeloma or lymphoma. Cancers that begin in bone are much less common in adults older than 45 years. Other diseases, such as Paget's sarcoma, post-radiation sarcoma, hyperparathyroidism, and fractures due to osteoporosis, are also possibilities. Additional tests will likely be needed to determine the exact diagnosis.

A biopsy may be necessary. This involves taking a piece of tissue from the tumor and looking at it under a microscope. This may be done in a clinic via a needle biopsy, or as a small surgical procedure.

Ongoing Tests
Early identification of metastatic bone disease is very important in order for treatment options to be most effective in maintaining quality of life.

Cancer patients should routinely be evaluated with certain blood tests, including a complete blood count, because loss of red blood cells (anemia) is a frequent finding in metastatic bone disease or multiple myeloma. Blood chemistries (i.e., electrolytes, calcium, and alkaline phosphatase) may be abnormal in patients with widespread disease. An analysis of the urine (urinalysis) can detect blood, which may be present in patients with renal cell carcinoma. Thyroid function tests, CEA, CA125, and prostate specific antigen (PSA) may be abnormal in patients with specific tumors. Serum and urine protein electrophoresis are important to exclude multiple myeloma.

Final Diagnosis
After the history, physical examination, x-ray and laboratory tests are completed, your doctor will determine whether you have metastatic bone disease.

It is important to point out that many cancer patients have bone pain from certain types of chemotherapy, and that just because you have bone or joint pain, it does
not mean that you have MBD. Nevertheless, careful follow up is very important if you are having pain.

**Treatment Options**

In many cases of metastatic bone disease, the cancer has progressed to the point where multiple bony sites are involved. As a result, treatment is often focused on managing the symptoms of pain and bone weakness, and is not intended to be curative.

The most common treatment options for MBD include radiation and medications to control pain and prevent further spread of the disease, and surgery to stabilize bone that is weak or broken.

Patients with metastatic bone disease require a team approach to care. A medical oncologist works closely with an orthopaedic surgeon very familiar with metastatic bone disease, as well as a radiation oncologist. Pain management specialists and social workers are strongly recommended also. Scheduled follow-up appointments should be set up with each of these individuals as determined by the medical oncologist and/or surgeon.

**Nonsurgical Treatment**

**Radiation**

Radiation can be highly effective and is one of the most common therapies used to treat symptoms in patients with incurable MBD. By killing the cancer cells, radiation relieves pain, stops the tumor from growing and can prevent the bone from breaking. Radiation can also be used to control the cancer after surgery to fix a broken bone. Research shows that radiation following surgery improves patient function and decreases the need for additional surgeries.

MBD is a systemic (body-wide) problem and radiation therapy is unlikely to be curative. Before treatment, the doctor and patient should have a clear understanding of the goals of radiation therapy: whether it is to lessen symptoms and pain, or whether it is intended to completely destroy disease in the affected bone.

Therefore, the doctor must balance the potential benefits and risks of radiation for each patient.

Different cancers respond differently to radiation. Several types of radiation therapy are available.
Local field radiation. Local field radiation is the most common type of radiation used to treat MBD. In this procedure, radiation is directed at the metastatic tumor and the immediate adjacent tissue. Entire bone segments or multiple bones can be targeted by local field radiation, depending upon how many areas are affected by the disease.

The primary goal of radiation treatment is to relieve pain with minimal side effects. Local field radiation typically results in complete pain relief in 50% to 60% of cases and partial relief in more than 80% of cases. How well MBD responds to radiation depends on many things, including cancer type (for example, breast cancer typically responds very well to radiation, while kidney cancer does not), and where the tumor is located.

Pain usually begins to subside in the first 1 to 2 weeks, but maximum relief may take several months. Therefore, pain medication is prescribed throughout the radiation treatment course.

Hemibody irradiation. This treatment is a large field radiation therapy that is often used for patients with wide-spread metastatic disease. Rather than targeting specific bones, hemibody irradiation targets the larger fields of the upper body, mid-section, or lower body.

Most metastatic cancer patients have multiple tumors. Hemibody irradiation is used to supplement local field radiation and may reduce the progression of widespread disease.

Radioisotope therapy. An alternative to hemibody irradiation is radioisotope therapy. This involves injecting a radioactive medicine (radiopharmaceutical) into a vein. The areas of metastatic bone disease absorb the radiopharmaceutical, which then kills the tumor cells. Compared to hemibody irradiation, radioisotope therapy is easier to give patients, and is also easier for patients to tolerate.

Medication Treatment

Medication treatment options for patients with MBD include:

- **Chemotherapy.** This treatment uses combinations of various drugs to destroy cancer cells. Because these drugs affect the entire system, healthy cells can also be damaged, including white blood cells and platelets. Chemotherapy is done in cycles with rest periods in between to let the blood cell count recover.

- **Endocrine therapy.** Also called hormone therapy, this drug treatment is used for types of cancer that are affected by hormones. Hormones are chemicals that are produced by glands in the body. In certain types of cancer, hormones can
help cancer cells grow and spread, or they can destroy cancer cells and prevent them from growing. Treatment involves either increasing the levels of hormones or blocking hormone production.

Breast cancer and prostate cancer are examples of primary cancers that are often treated with endocrine therapy.

- **Bisphosphonates.** These drugs help prevent bone damage caused by tumors. They work by interfering with osteoclasts, the cells that are involved in the breakdown of bone. Bisphosphonates are also used to treat bone pain and elevated calcium levels in the blood (which can cause a variety of uncomfortable and dangerous health problems).

**Surgical Treatment**

The goals of surgical treatment for MBD are to relieve pain, reduce the need for pain medication, restore skeletal strength, and regain abilities to do daily activities.

Surgery for MBD is used to treat or prevent broken bones. A broken or weakened bone must be carefully fixed in position and supported until it is strong enough to bear weight. During surgery, the tumor may be removed and the bone is stabilized with fixation devices, such as wires, plates, rods, pins, nails, and screws. Often, bone cement is placed into the defect created by the tumor to give added strength.

Research shows that patients who have had surgery to prevent a break do much better than those who require surgery after a break has actually occurred. They have shorter hospitalizations, are more likely to be discharged to home, return more quickly to previous activities, and have improved survival and fewer surgical complications. Surgery to reinforce the bones at risk for fracture also allows the medical oncologist and surgeon to coordinate surgical treatment and systemic chemotherapy.

The decision to proceed with surgery is complex and individualized to each patient. Orthopaedic surgeons will consider several factors in determining whether a bone is at risk for breaking. These include whether the site is painful, the size of the tumor, and how the bone looks in an x-ray.

**Potential Complications**

Because patients with metastatic bone disease are generally less healthy than the average patient undergoing orthopaedic surgery and the surgery is more involved, there is an increase in the routine risks of surgery, such as infection, bleeding, blood clotting, and damage to nerves.
Accordingly, the patient, family, surgeon, and oncologist must make a very careful, informed, cooperative decision as to whether surgery should be undertaken.

Conclusion

Advances in surgical techniques as well as radiation and medical therapies have significantly improved the quality of life for the individual suffering from cancer that has spread to the skeleton from its site of origin.

Treatment options for MBD are based upon how much the cancer has spread, which bones are affected, and how severe the bone damage is. For more information on treatment options for MBD in specific areas of the skeleton (such as the upper arm or pelvis): Metastatic Bone Disease: Treatment Options for Specific Areas of Spread online at http://orthoinfo.org/topic.cfm?topic=A00654

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