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The role in malignancy

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Staging of a newly diagnosed malignancy is crucial in treatment planning. Staging allows the differentiation of patients who are candidates for surgical resection from those with inoperable disease who may be treated with chemotherapy and/or radiotherapy. Determining if a tumor is localized or has metastases is the most important aspect of staging. Patients with disseminated metastases are not candidates for surgery. The skeletal system is the third most common site after the lungs and liver of distant metastasis of malignant tumors and bone metastasis are 25 times more common than primary bone tumors. Autopsy studies have revealed that the actual incidence of bone metastases of various tumors is higher than the detection rate of radiological or nuclear medicine techniques. Over the last several decades bone scan has been used extensively in detecting bone metastases. It can provide information about disease location, prognosis and response to treatment. The bone scan is based on the principle that metastatic sites generate reactive new bone formation which Tc-99m diphosphonates accumulates preferentially. Bone scan is still the diagnostically most valuable and most cost effective technique that enables whole body examination with high sensitivity especially in osteoblastic metastasis. Compared to X-ray examinations bone scan is definitely more sensitive technique which also gives an earlier positive finding. Bone scan is also successfully used in the posttherapy evaluation of malignant bone lesions. Treatment response can be evaluated by comparing bone scan with a baseline image. Lesions often show response to treatment by diminution in lesion intensity and regression of metastatic sites. The flare phenomenon, temporarily increased uptake after therapy, is an important limitation in evaluation of treatment response even though it may also indicate a response.

One limitation of bone scan is its lack of specificity. Tc-99m diphosphonates accumulates not only in malignant lesions but also in sites of infection and inflammation, fractures, as well as benign bone lesions. The specificity of bone scan can be increased by X-ray examinations. SPECT also increases the specificity of bone scan by clearly demonstrating anatomical localization of the lesions seen in bone scan especially in vertebral metastases. Because of rising medical cost the value of the bone scan as a routine investigation has been questioned in recent years due to its lack of specificity. An abnormal bone scan needs to be confirmed by other tests due to high false positive rate. To minimize the number of tests bone scan can be used with serum tumor markers such as PSA and CA15-3. When a doubtful bone scan is obtained a normal marker level makes it highly probable that lesions are not related to malignancy. Non specific tumor agents such as Tl-201 and Tc-99m MIBI may also increase the specificity and accuracy of bone scan in detecting malignant lesions. Specific radiotracers such as In-111-octreotide, I-123 or I-131 MIBG not only increase the specificity but also sensitivity of the bone scan in neuroendocrine tumors. Because these specific tracers can also depict cortical bone involvement and bone marrow as well. PET is a functional imaging modality based on the metabolic activity of malignant cells using FDG. Increased uptake of FDG allows the diagnosis, staging and assessment of the treatment response. However, its role in the detection of bone metastases still is not clear. PET seems to have a similar sensitivity in breast and lung cancer but has a higher sensitivity in myeloma. In prostate cancer bone scan has a higher sensitivity. Type of metastasis such as sclerotic or lytic type, seems to be relevant with the pattern and intensity of FDG uptake. Bone scan is the single most useful technique to assess patients for the presence and distribution of osteoblastic metastatic lesions that cause pain. A positive bone scan is a prerequisite for treating patients with a bone targeted radiometabolic therapy. The localization, the number and the distribution of metastatic sites is also important for clinical decision making. While the patients with focal disease are the candidates for focal therapies such as external beam radiotherapy, patients with multifocal disease are excellent candidates for systemic therapies. The number of bone scan positive sites and the extent of the disease on bone scan has been shown to be also an important prognostic factor that determines the success of therapy.

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