Case 2
Bone Metastases from Lung Cancer

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History

A 78-year-old female with lung cancer presents with bone pain (Fig. 2.1).

Diagnosis

Bone metastases from lung cancer (adenocar cinoma)

Findings

- STIR hyperintense signal at T11 vertebral body with increased signal on T1-weighted Dixon out-of-phase indicating lack of fat content.
- PET/MR image shows intense FDG uptake at T11 vertebral body (wide arrow).
- Similar hyperintense STIR signal at C7 vertebral body with increased FDG activity (curved arrow).

Discussion

Skeletal metastases arise from a variety of primary cancers, with the most prevalent being lung cancer, breast cancer, renal cell carcinoma, and prostate cancer. Metastases account for the majority of malignant bone tumors. They may be asymptomatic or cause localized bone pain. Complications include pathologic fractures, cord compression, and hyper- or hypocalcemia.

The goal of imaging in skeletal metastases is to detect metastases early, assess treatment response, and identify vertebrae with risk of fracture. It can also be useful in determining if fractures are causing spinal cord compression, which may need surgical intervention. MR imaging can detect metastatic bone marrow involvement very early on due to its high soft-tissue contrast and high spatial resolution. The T1-weighted and STIR sequences are excellent for marrow evaluation and eliminate the need for intravenous contrast in patients with poor renal function. T1-weighted images have the highest sensitivity at detecting vertebral metastases but low specificity. The addition of STIR somewhat increases the specificity. Generally, involved marrow will show low T1-weighted signal due to fatty marrow replacement by malignant cells with increased signal on STIR and T2 images. If contrast is given, these malignant lesions will demonstrate enhancement. Purely osteoblastic lesions demonstrate low signal on both T1 and T2-weighted images, as well as STIR sequences. Whole-body techniques to evaluate the skeleton in one session are gaining popularity.

The Dixon technique provides uniform fat and water separation that is resistant to inhomogeneity compared to chemical-shift fat-suppression techniques. It also has the advantage of faster scan times and maintaining image signal-to-noise ratio. Dixon MRI sequences provide an

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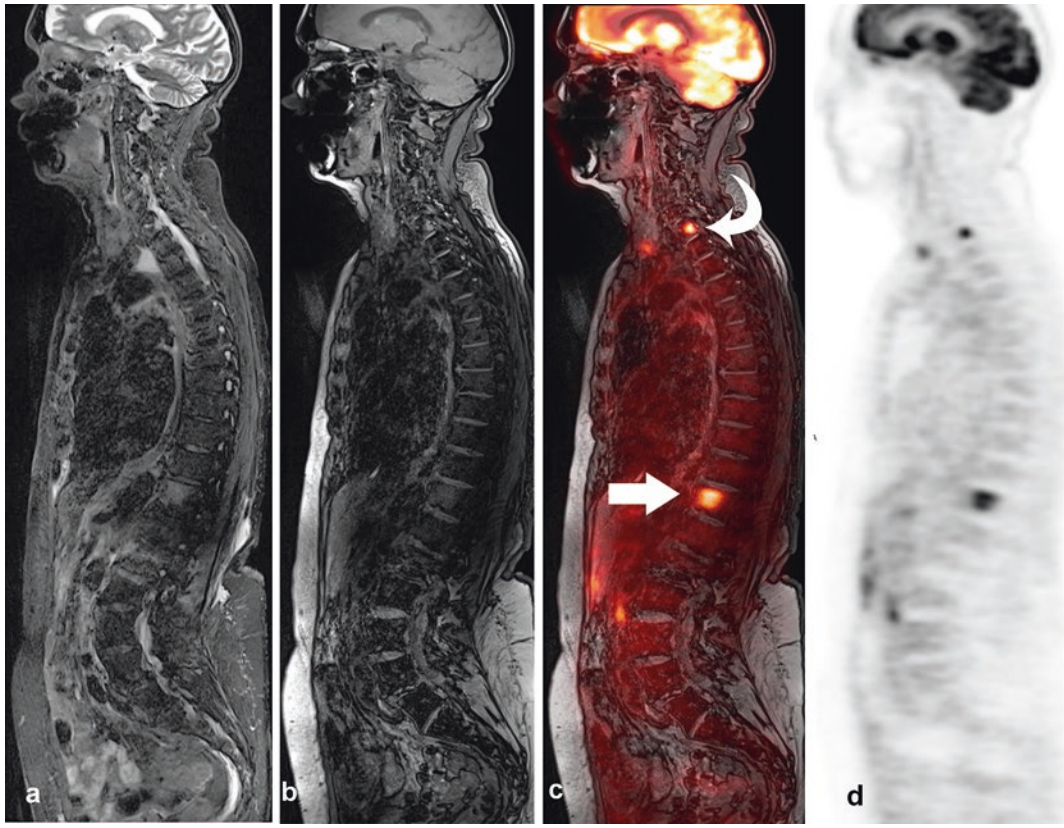

Fig. 2.1 STIR sagittal (**a**), Dixon T1-weighted out-of-phase sagittal (**b**), PET/MR Dixon T1-weighted out-of-phase sagittal fusion (**c**), and PET sagittal (**d**)

out-of-phase, in-phase image, fat-only, and water-only images. Metastatic bone lesions replace the bone marrow and do not drop on opposed-phase imaging. Dixon-based whole-body MRI has been shown to be specific and more sensitive than bone scan in detecting bone metastases, especially in breast cancer.

Overall MRI and PET imaging are roughly equal in sensitivity in detecting metastases. However, MRI has better resolution and can detect smaller lesions, while PET has the capability to effectively detect lesions on whole-body images. It can provide metabolic information related to the aggressiveness of the lesion and can determine whether the lesion is active following treatment. The use of FDG in PET/MR imaging allows for superior anatomic localization and functional assessment of malignant skeletal lesions and their response to therapy.

Suggested Reading

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