Case 21
Osteoblastic Metastasis from Breast Cancer

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History

A 47-year-old female with metastatic breast cancer presents for restaging (Fig. 21.1).

Diagnosis

Osteoblastic metastasis from breast cancer

Findings

- Left femoral head lesion demonstrates hypointense signal on T1 and T2-weighted sequences (thin arrow).
- PET fusion image shows mild FDG uptake consistent with an osteoblastic metastasis.

Discussion

Osteoblastic, also known as sclerotic, bone metastases can arise from a variety of different primary malignancies, with prostate and breast cancer being the most common causes. Prostate cancer tends to exhibit purely sclerotic metastases, whereas bone lesions in breast cancer are often mixed, lytic, or sclerotic. Less common primary tumors presenting with osteoblastic bone metastases include carcinoid, medulloblastoma, neuroblastoma, lymphoma, colon carcinoma, and transitional cell carcinoma. Various molecular mechanisms responsible for the deposition of new bone with upregulation of osteoblasts, growth factors, and adhesion molecules have been postulated.

While osteolytic metastases are usually aggressive, osteoblastic lesions tend to show a somewhat slower progression. Both lytic and sclerotic bone metastases favor areas with high red marrow content, such as the pelvis, vertebrae, ribs, and ends of long bones. MRI is excellent at assessing spread of metastatic disease in the marrow cavity as well as extension out of the marrow cavity to involve surrounding structures. Normal bone marrow contains a high fat percentage with high signal on T1-weighted images. Osseous metastatic involvement replaces the fat and leads to foci of low T1-weighted signal. On T2-weighted sequences, osteoblastic disease tends ~~to~~ show low to intermediate signal. This is in contrast to osteolytic metastases, which have a higher water content and therefore demonstrate high T2-weighted signal. Both types of medullary metastases show a higher signal rim on T2 images representing the reactive interface.

FDG PET provides images reflecting metabolic activity of osseous metastases. It is particularly helpful in detecting osteolytic disease, which is usually highly metabolically active when compared to osteoblastic disease. Because of the relatively low metabolic activity

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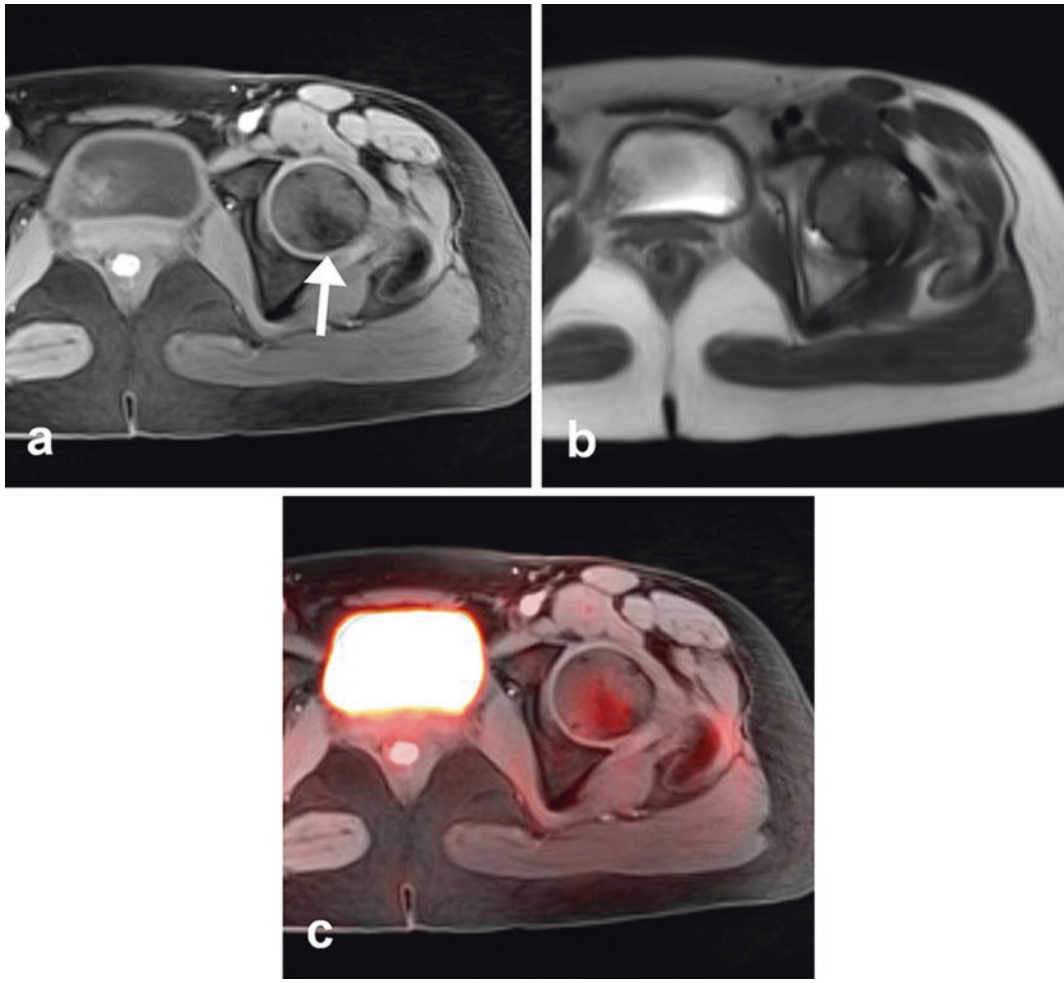

Fig. 21.1 T1 radial VIBE with fat suppression axial (**a**), T2 HASTE axial (**b**), and FDG PET/MR T1 radial VIBE with fat suppression axial fusion (**c**)

in osteoblastic metastases, lesions may show minimal to mild FDG uptake, while smaller sclerotic lesions may go undetected. Combining PET and MRI can help to improve detection of osteoblastic bone metastasis as the MR component provides excellent marrow evaluation and can demonstrate malignant marrow infiltration even when metabolic activity may be low. Future applications of PET/MR imaging include not only accurate detection of bone metastases but also evaluation of treatment response, particularly in breast cancer patients, who typically have mixed sclerotic and lytic bone metastases. In these cases MR should include in- and out-of-phase images to exclude the presence of small foci of fat.

Suggested Reading

Cook GJ, Houston S, Rubens R, Maisey MN, Fogelman I. Detection of bone metastases in breast cancer by 18FDG PET: differing metabolic activity in osteoblastic and osteolytic lesions. J Clin Oncol. 1998;16(10):3375–9.

O'Sullivan GJ, Carty FL, Cronin CG. Imaging of bone metastasis: an update. World J Radiol. 2015;7(8):202–11.