Diagn Interv Radiol 2013; 19:233–236

Isolated vertebral metastasis with a fluid-fluid level from a poorly differentiated adenocarcinoma

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ABSTRACT
Fluid-fluid level in bone metastases is an extremely rare finding, with only five case reports published in the literature. Here we report a case of an atypical isolated bone metastasis presenting with a fluid-fluid level revealing lung cancer in a 47-year-old patient without history of cancer. The differential diagnosis and imaging features are discussed with reference to the relevant literature.

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Received 18 July 2012; revision requested 2 August 2012; revision received 7 August 2012; accepted 12 August 2012.

Published online 6 December 2012
DOI 10.4261/1305-3825.DIR.6320-12.1

The fluid-fluid levels (FFLs) are found in 2.7% to 11.2% of focal bone lesions (1–3). Most often, FFLs indicate hemorrhagic changes. These changes have usually been associated with aneurysmal bone cysts and telangiectatic osteosarcoma, but they also have been described in a wide range of benign and primary malignant lesions of bone (1, 2). Nonetheless, FFL in bone metastases is an extremely rare finding.

In the present paper, we report a case of an atypical bone metastasis revealing lung cancer in a 47-year-old patient. The isolated lesion in a patient without known history of malignancy was diagnostically challenging. We discuss the differential diagnosis and imaging features with reference to relevant literature.

Case report

A 47-year-old man presented with persistent back pain of two months duration. The patient had a 20-pack-year smoking history. Neither prior trauma nor other relevant medical history was reported. Physical examination revealed pain localized in the right upper lumbar region. Anteroposterior radiograph of the lumbar spine showed subtle lysis of the right pedicle of L1 (Fig. 1).

Magnetic resonance imaging (MRI) was performed with a 1.5 Tesla Philips MRI system (Achieva Release 11, Philips Medical Systems, Eindhoven, The Netherlands). The protocol included sagittal short tau inversion recovery (STIR), T1-weighted images and axial T2-weighted images. The postcontrast study included sagittal and axial fat-suppressed T1-weighted images. The MRI examination showed a bone lesion of the right posterior arch and the posterior aspect of the body of L1 extending into the intervertebral foramina with both solid and cystic components. Postcontrast MRI showed extensive enhancement of the osseous and soft tissue mass. The cystic component showed a single FFL representing less than half of the total lesion. The floating and dependent levels showed hyperintense and hypointense signals on T2-weighted images and STIR, respectively, indicating hemorrhagic changes (Fig. 1). High-resolution, multislice computed tomography (CT) (16-slice configuration, Brilliance CT, Philips Medical Systems) with multiplanar reformation was warranted to assess bone abnormalities. CT imaging showed an osteolytic lesion with cortical lysis of the right pedicle and transverse process of L1 (Fig. 1). Based on these findings, we considered the diagnosis of an aneurysmal bone cyst with an underlying primary osseous tumor, specifically a chondrosarcoma, because of the vertebral location.

The patient underwent a fluoroscopy-guided core biopsy of the right posterior arch of L1. Because of the risk of hemorrhagic complication, the biopsy only targeted the solid mass and avoided the cystic

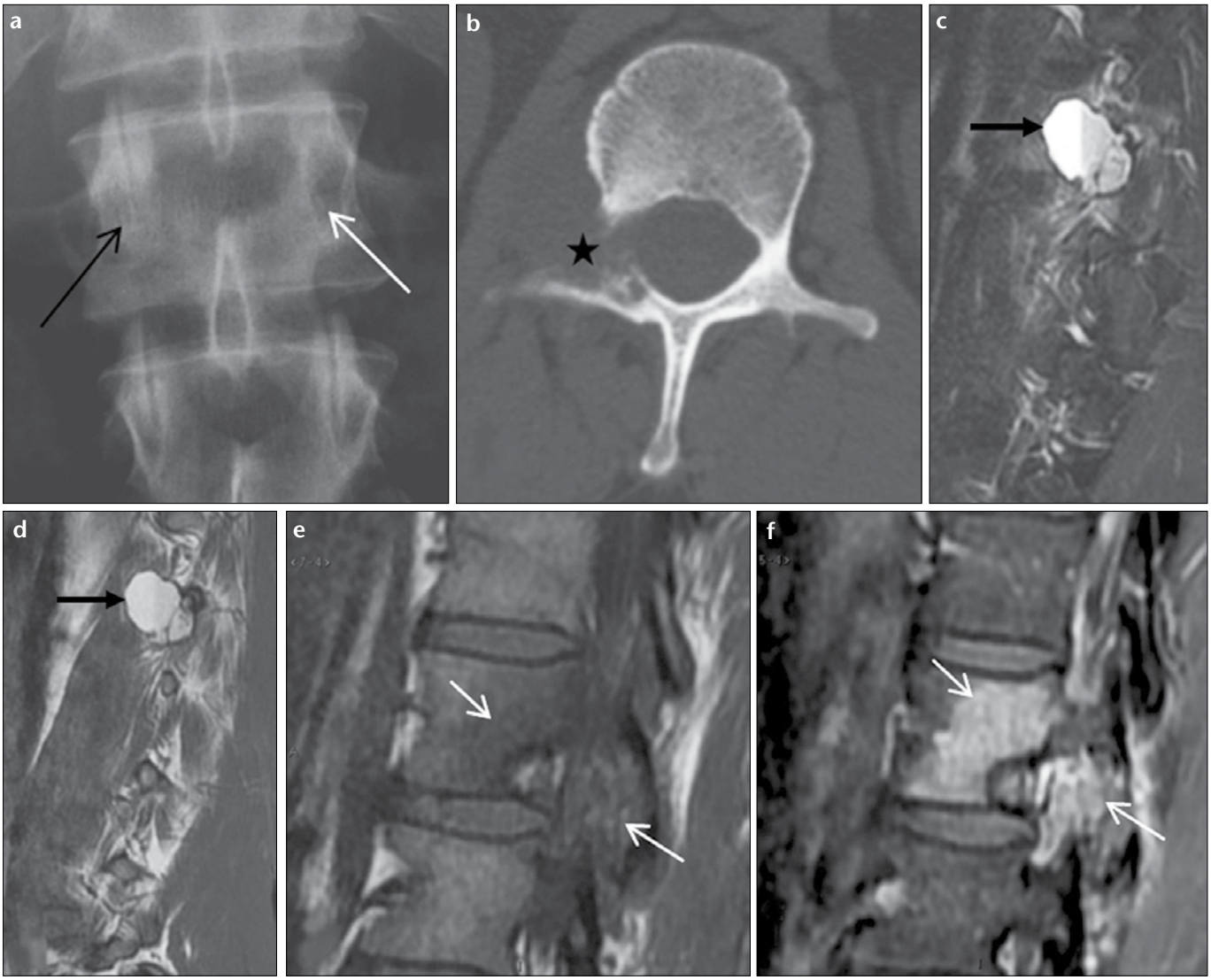

Figure 1. a–f. Lumbar spine radiograph, CT, and MRI images. Anteroposterior radiograph of the lumbar spine **(a)** shows subtle pedicular osteolysis (*black arrow*) compared to the contralateral pedicle (*white arrow*). Axial high resolution CT image **(b)** displays an aggressive osteolytic lesion of the right pedicle and transverse apophysis of L1 (*star*). Sagittal STIR **(c)** and T1-weighted image **(d)** show the paravertebral fluid-fluid level at the level of L1. The superior layer demonstrates hyperintensity on both pulse sequences (*arrows*). Sagittal T1-weighted image before **(e)** and after **(f)** contrast administration shows extensive enhancement of the vertebral body and the right pedicle of L1 corresponding to the solid part of the mass (*arrows*).

component. There were no postprocedure complications. Histologic analysis showed a trabecular bone lysis caused by a tumoral proliferation of large cohesive cells with hyperchromatic nuclei, a high nucleocytoplasmic ratio and eosinophilic cytoplasm. The tumoral cells were organized into solid sheets and islets. Alcian blue staining highlighted a few intracytoplasmic droplets of mucin. Immunohistochemistry showed tumoral cells strongly positive for anti-CK7 and anti-TTF1 nuclear staining (Fig. 2). Antithyroglobulin staining was negative. These histological findings were highly suggestive of bone metastasis from a poorly differentiated lung adenocarcinoma.

The patient then underwent a fluorine-18-fluorodeoxyglucose positron emission tomography-CT (FDG PET-CT) for primary tumor localization and, eventually, to assess extension and stage the disease. In addition to the vertebral metastasis that showed FDG uptake, the FDG PET-CT displayed a region of high metabolic activity in the apex of the left lung, which matched a nodule on the CT scan (Fig. 3), confirming the diagnosis of a primary pulmonary tumor. There was no other vertebral lesion in the FDG PET-CT.

Discussion

FFL is a non-specific finding that occurs in a wide variety of tumoral and non-tumoral benign and malignant lesions, such as aneurysmal bone cyst (ABC), simple bone cyst, giant cell tumor, chondroblastoma, osteoblastoma, Langerhans cell histiocytosis, osteomyelitis, hemangioma, osteosarcoma, and malignant fibrous histiocytoma (1, 2). In bone metastases, however, FFL is an extremely rare finding, with only five case reports published in the literature thus far (4–8). Four of the reported cases had either a known history of cancer (4, 7) or multiple lesions at diagnosis (6–8). The fifth case had a rib lesion

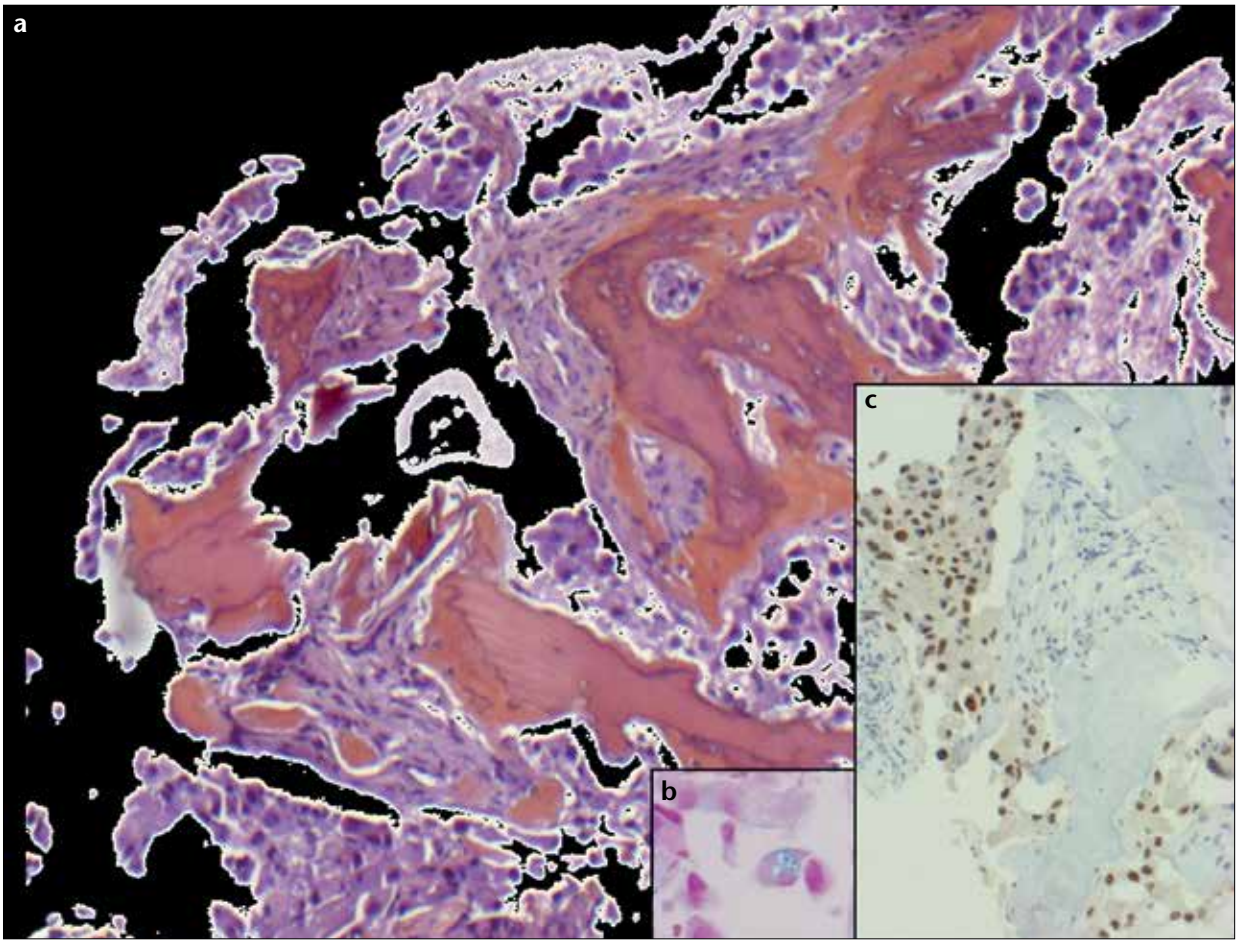

Figure 2. a–c. Histopathology images. Core biopsy from the bone lesion **(a)** shows metastatic adenocarcinoma with intracytoplasmic droplet with an Alcian blue staining **(b)** and cells that are strongly positive for TTF-1 nuclear staining **(c)**.

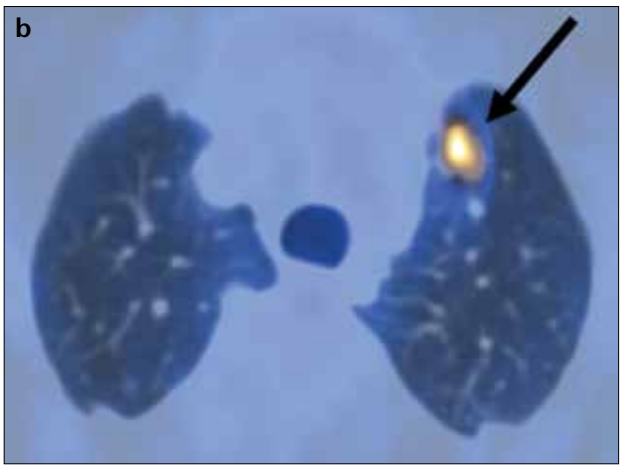

Figure 3. a, b. Coronal **(a)** and axial **(b)** views of FDG PET-CT scan show focal uptake of the right side of L1 (*white arrow*) as well as a nodular uptake of the left lung apex matching a suspicious mass in CT (*black arrows*). Note also an uptake of the right cervical region matching a known enlarged right thyroid lobe (*star*).

with a suspect pulmonary nodule at the same CT examination (5).

FFL is observed when a lesion contains two different physicochemical compositions with different relaxation times, and thus exhibits contrasting signal intensities. FFLs are best seen when the images are acquired in the plane orthogonal to the horizontal interface of the FFL. The usual presentation on T2-weighted images is relative hyperintensity of the superior layer compared to the lower layer, which usually represents hemorrhagic components. On T1-weighted images, however, different aspects have been described, depending on the relative signal intensity of the superior layer compared to the inferior layer (thus distinguishing high/low and low/high patterns). The high/low pattern is likely a result of subacute hemorrhage and implicates the presence of extracellular methemoglobin in the superior layer. Previous reports suggest that malignancy may occur slightly more frequently with this pattern (2, 3). In our patient, the hyperintensity of the superior layer could therefore be considered as an additional finding supporting malignancy.

It has been suggested that the proportion of the lesion occupied by FFL is inversely correlated with the risk of malignancy (1, 2). O'Donnel and Saifuddin (1) categorized the lesions into four groups based on the proportion of FFL: less than one-third of the lesion, one-third of the lesion, two-thirds or more, and FFL occupying the entire lesion. He showed that the smaller the proportion of tumor occupied by FFL, the higher the prevalence of malignancy (1). In our patient, we estimated the FFL to be less than half of the total lesion. Other imaging features, including cortical lysis and soft tissue extension, were highly suggestive of malignancy. The absence of known cancer in the patient's clinical history, the identification of this lesion as an isolated lesion, and the presence of FFL were all suggestive indicators that the lesion may have been a primary malignant tumor. However, the biopsy and FDG PET-CT confirmed the correct diagnosis. In a setting of a single vertebral lesion in a middle-aged adult, radiologists should be aware of the possibility of osseous metastases. In our patient, the location of the lesion and its aggressiveness on CT and MRI were suggestive of malignancy, although the atypical FFL and absence of history of malignancy were evidence against this diagnosis. FFL may be suggestive of ABC, which usually presents as an osteolytic expansile lesion surrounded by an eggshell-like calcification. In our patient, the preponderance of the solid component and the aggressive radiologic appearance, i.e. the cortical rupture, made the diagnosis of ABC extremely unlikely.

In conclusion, this case report describes a rare and diagnostically challenging case of a solitary bone metastasis with FFL. Radiologists should be aware that an isolated bone lesion with FFL may represent a metastatic disease, although it is a rare occurrence.

Conflict of interest disclosure

Ali Guermazi is the President of Boston Imaging Core Lab (BICL) LLC, and a consultant to MerckSerono, Stryker, Genzyme, AstraZeneca, and Novartis. Other authors declared no conflicts of interest.

References

1. O'Donnell P, Saifuddin A. The prevalence and diagnostic significance of fluid-fluid levels in focal lesions of bone. Skeletal Radiol 2004; 33:330–336.
2. Van Dyck P, Vanhoenacker FM, Vogel J, et al. Prevalence, extension and characteristics of fluid-fluid levels in bone and soft tissue tumors. Eur Radiol 2006; 16:2644–2651.
3. Alyas F, Saifuddin A. Fluid-fluid levels in bone neoplasms: variation of T1-weighted signal intensity of the superior to inferior layers--diagnostic significance on magnetic resonance imaging. Eur Radiol 2008; 18:2642–2651.
4. Nguyen BD, Westra WH, Kuhlman JE. Bone metastasis from breast carcinoma with fluid-fluid level. Skeletal Radiol 1996; 25:189–192.
5. Lum PA, Davis MJ, Orizaga M. Computed tomography fluid-fluid level in bone metastasis. Can Assoc Radiol J 1990; 41:296–299.
6. Bladt O, Demaerel P, Catry F, Van Breuseghem I, Ballaux F, Samson I. Multiple vertebral fluid-fluid levels. Skeletal Radiol 2004; 33:660–662.
7. Kickuth R, Laufer U, Pannek J, Adamietz IA, Liermann D, Adams S. Magnetic resonance imaging of bone marrow metastasis with fluid-fluid levels from small cell neuroendocrine carcinoma of the urinary bladder. Magn Reson Imaging 2002; 20:691–694.
8. Frenzel L, Javier RM, Eichler F, Zollner G, Sibilia J. Multiple fluid-filled bone metastases. Joint Bone Spine 2010; 77:171–173.