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CASE REPORT - DIAGNOSIS

A rare case of a solitary osseous metastasis from breast carcinoma presenting with fluid–fluid levels on MRI

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Abstract

Osseous metastatic disease is commonly encountered in breast carcinoma, which typically presents as either osteolytic, osteoblastic, or mixed lesions on imaging. Osseous metastasis presenting as a multiloculated cystic lesion with fluid–fluid levels resembling that of an aneurysmal bone cyst (ABC) is sparsely described in the literature, and even less so in the case of breast carcinoma. We report an unusual case of fluid–fluid levels in a bone metastasis to the spine in a 66-year-old female with a prior history of breast carcinoma. Magnetic resonance imaging (MRI) demonstrated a cystic lesion with fluid levels resembling that of an ABC. Computed tomography (CT)-guided biopsy revealed the lesion to be a metastasis from breast carcinoma. The management of ABCs and osseous metastases differ drastically. Accurate diagnosis and distinction between these lesions is paramount as the management of metastatic disease can have a significant impact on the quality and length of life. The presentation, differential diagnoses and imaging features of this atypical case are discussed.

Keywords Metastasis · Osseous · Breast carcinoma · Fluid–fluid level · Aneurysmal bone cyst · Magnetic resonance imaging · Computed tomography

Introduction

Fluid–fluid levels is a radiological sign that indicates haemorrhagic changes in focal bone lesions and are most commonly reported in aneurysmal bone cysts (ABCs) [1]. ABCs can be primary or secondary to various osseous lesions. Primary bone tumours associated with secondary ABC change include benign bone lesions such as fibrous dysplasia, intraosseous ganglions, chondroblastoma and giant cell tumours, but also malignant bone lesions, namely osteosarcoma, telangiectatic osteosarcoma, plasmacytoma and fibrosarcoma [2, 3]. Although benign, primary ABCs can be locally aggressive, and management options include curettage, sclerotherapy and embolization [4]. The management of secondary ABCs is directed by the nature of the preceding bone tumour [2].

The presence of fluid–fluid levels in bone metastases is a rare finding and sparsely described in the literature [1, 5–13] (Table 1), particularly with breast carcinoma. Of the cases described, the majority are seen with renal and lung carcinoma. A literature search revealed only 3 of osseous metastatic lesions with fluid–fluid levels from metastatic breast carcinoma [6–8]. Bony metastases characteristically present as osteolytic and less commonly as osteoblastic (sclerotic) or mixed lesions, with the most common sites occupying the axial skeleton [14]. Accurate diagnosis of bone metastases has a major impact on the management plan in breast carcinoma, with significant implications for quality of life and survival.

We report an atypical case of a spinal osseous metastasis with fluid–fluid level identified on magnetic resonance imaging (MRI) in a 66-year-old female with breast carcinoma. The imaging features closely resembled that of an ABC. The differential diagnoses and radiological features are discussed below.

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Table 1 A list of case reports published in the literature reporting fluid–fluid levels in bone metastases

Journal	Year	Case description
Skeletal Radiology [13]	2018	Multiple bone metastases with fluid–fluid level from gastric cancer
Images in Clinical Rheumatology [5]	2014	Multiple vertebral metastases with fluid–fluid levels from a poorly differentiated signet ring cell adenocarcinoma
Neurocirugia [11]	2014	Cystic spinal bone metastasis with the presence of haemorrhagic fluid–fluid level from primary lung carcinoma
Acta Orthopaedica et Traumatological Turcia [7]	2013	Three cases of fluid–fluid level metastases in the axial skeleton. Two cases were from primary gastric carcinoma and one from primary breast carcinoma
Interventional Radiology [1]	2013	Isolated vertebral metastasis with fluid–fluid level from a poorly differentiated adenocarcinoma
Joint Bone Spine [8]	2010	Multiple fluid-filled bone metastases from metastatic breast carcinoma
Skeletal Radiology [10]	2004	Multiple vertebral metastases with fluid–fluid levels from a moderately to poorly differentiated carcinoma of unknown origin
Magnetic Resonance Imaging [9]	2002	Bone marrow metastasis with fluid–fluid levels from small cell neuroendocrine carcinoma of the bladder
Skeletal Radiology [6]	1996	Bone metastasis from breast carcinoma with fluid–fluid level
Cancer Associated Radiology [12]	1990	Fluid–fluid level in a solitary rib metastases from primary carcinoma of the bronchus

This paper aims to make the reader aware of this unusual form of osseous metastasis from breast carcinoma, which may be rarely encountered, in addition to the more commonly seen osteolytic, osteoblastic and mixed metastatic lesions. It is important that radiologists and clinicians are able to recognise the entity when encountered in clinical practice, so that appropriate management can be commenced.

Case report

A 66-year-old female presented with a 3-month history of progressive lower thoracic, non-mechanical back pain. No history of trauma was reported. No features of radiculopathy or myelopathy were present on clinical examination. The patient had a past medical history of oestrogen receptor (ER)-positive left breast carcinoma, which was diagnosed and treated 10 years prior to this current presentation. Initial breast cancer staging computed tomography (CT) scan was negative for metastases or lymphadenopathy. She was treated with wide local excision and axillary node clearance, and has been in remission since then. There was no other history of relevance.

An MRI scan was performed to investigate her symptoms. T1, T2 and short tau inversion recovery (STIR) sequences were performed; these demonstrated an expansile, multiloculated cystic lesion in the T11 vertebral body extending posteriorly into both pedicles. The lesion was predominantly hyperintense to marrow on T2 and STIR, and hypointense on T1. Multiple fluid–fluid levels were present within the lesion, best appreciated on the fluid sensitive sequences, and high-grade perilesional marrow oedema was present (Figs. 1a–d). There was no extraosseous soft tissue mass. These imaging features closely resembled that of an ABC [1]. CT demonstrated a solitary, lytic, expansile lesion occupying the T11 vertebra, with complete destruction of the posterior vertebral cortex (Fig. 2).

Given the patient's history of breast carcinoma and the unusual demographic group for an ABC, a differential diagnosis of metastatic breast carcinoma was considered, and a CT-guided biopsy was performed for histological confirmation. Histopathology revealed trabecular bone infiltration by solid nests of malignant epithelioid cells (Fig. 3). Immunohistochemistry was positive for CKMNF116, EMA, CK7, AE1AE3, ER and GATA3, all of which are immunohistochemical markers associated with breast carcinoma. Subsequently, the specimen was also tested for the human epidermal growth factor receptor 2 (HER2) marker for treatment planning and prognostication, and it was negative. The specimen was negative for USP6 gene expression, which is typically expressed in primary ABC. There were also no histological features of ABC. The diagnosis was, therefore, confirmed as metastatic breast carcinoma.

The patient was referred to her local breast oncology team for management and ongoing follow-up, which consisted of radiotherapy to the T11 lesion as well as bone protection medication in the form of denosumab.

Discussion

ABCs are benign, intraosseous, vascular lesions which frequently occur in the spine and metaphysis of long bones [15]. ABCs can be locally aggressive, with focal osseous destruction being a common feature [16]. The aetiology of

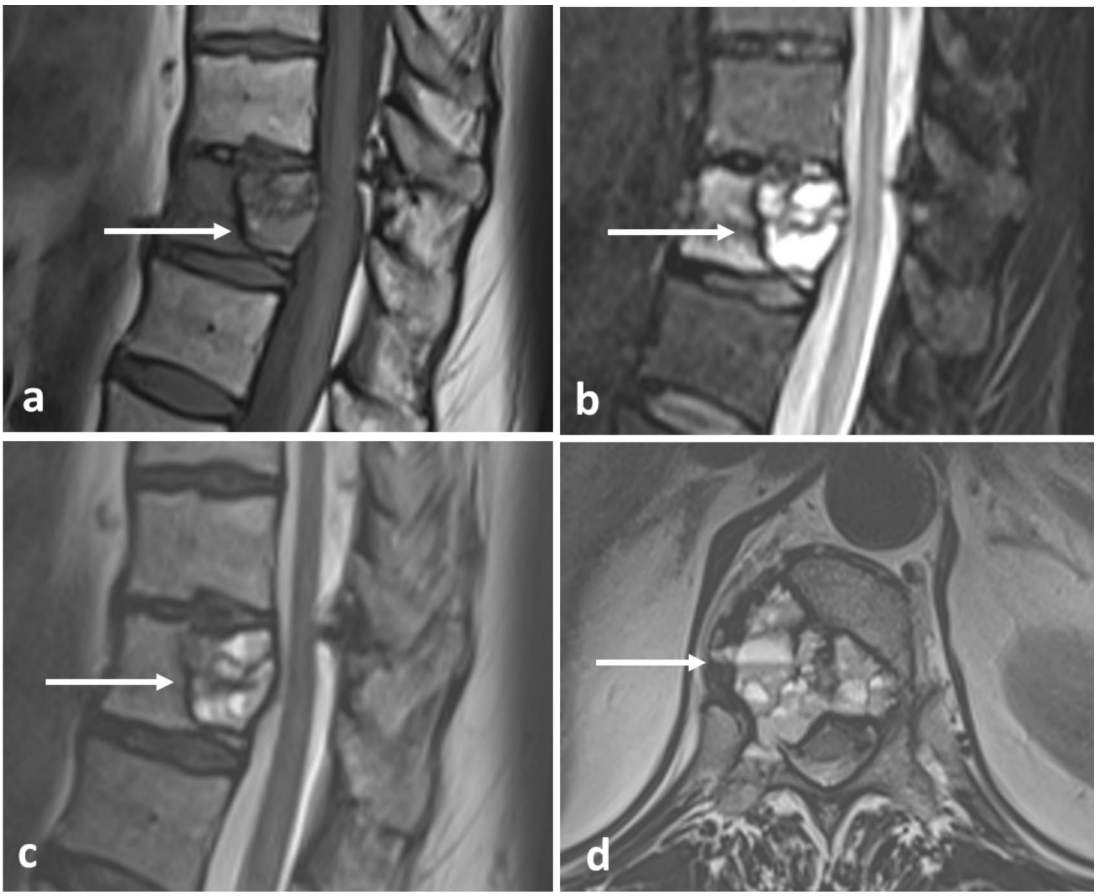

Fig. 1 **a**–**d** Sagittal T1 (**a**), STIR (**b**), T2 (**c**) and axial T2 (**d**) MRI images demonstrating an expansile, multiloculated cystic lesion in T11 vertebra extending to the pedicles (white arrows). Multiple fluid–fluid levels are present. There is also perilesional oedema within the T11 vertebral body

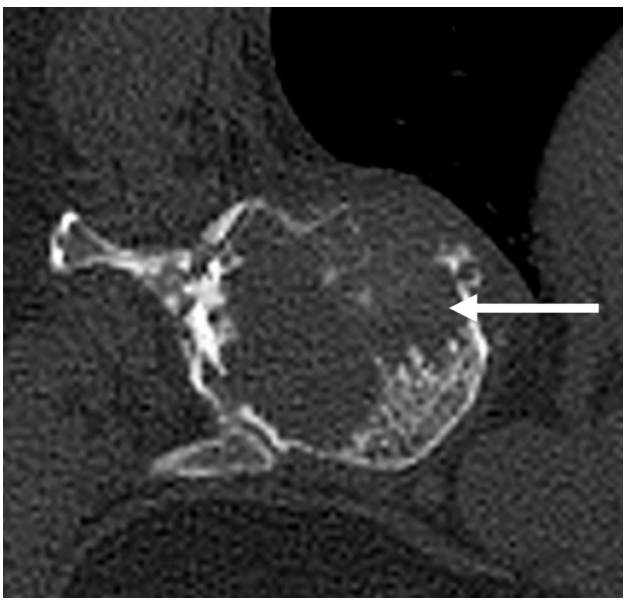

Fig. 2 Axial CT image demonstrating a lytic expansile lesion occupying the T11 vertebra and with complete destruction of the posterior vertebral cortex (white arrows)

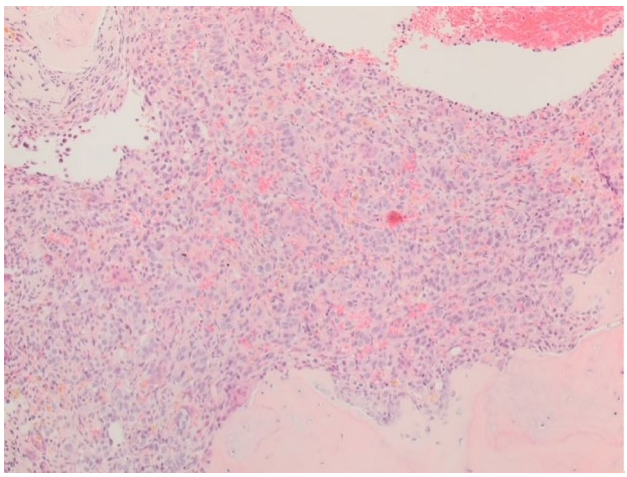

Fig. 3 Histological image of lesion showing infiltration by malignant epithelial cells confirming metastatic breast carcinoma (blue). There are no features of an aneurysmal bone cyst

ABCs remains unclear; however, vascular malformations have been indicated [17]. Secondary ABC-like changes occur alongside other primary bone tumours such as fibrous dysplasia, giant cell tumours, osteoblastomas and telangiectatic osteosarcomas [2, 3]. Primary ABCs most commonly arise during the first 2 decades of life, with the majority of cases diagnosed before the age of 20 [16, 17]. A very small proportion of ABCs can occur in the older population, with the oldest reported patient being 74 years according to one study [4].

On MRI, ABCs are often seen as lytic, expansile osseous lesions, with fluid–fluid levels due to blood products of different densities within multi-cystic cavities separated by internal septa [18]. The contents are often predominantly hyperintense on fluid sensitive sequences, with layering low signal material within them. The layering blood products can appear hyperintense on T1. Perilesional oedema may also be present [19]. A small proportion of ABCs, approximately 5–7.5%, can be solid [20]. The internal septa and the solid components typically enhance with contrast administration. The presence of a solid component should also raise the possibility of secondary ABC change but can also be seen with associated pathological fracture. Pathological vertebral collapse may also be seen on imaging [21]. CT imaging of ABCs demonstrates a lytic, hypodense lesion, surrounded by a thin shell of bone, with a narrow zone of transition [22].

Gross histological features of ABCs are characterised by a thin shell of reactive bone covering a haemorrhagic, spongy mass. Microscopic features include cystic cavities bounded by septa composed of fibroblasts, calcification, multinucleated giant cells and osteoid spicules [22]. Immunohistochemical findings are commonly found to be positive for the USP6 oncogene which is indicated in the pathogenesis of primary ABCs [16]. The mainstay of ABC management is intralesional curettage [4]; however, elective embolization has also been shown to be effective in certain cases. CT-guided sclerotherapy has also been described as an effective and minimally invasive alternative to surgery [23, 24].

Bone metastasis in breast carcinoma occurs through migration of metastatic tumour cells from the breast primary site to bone through the bloodstream. Once at the target site, the tumour cells can disrupt bone homeostasis by activating signalling pathways to promote both osteoclast and osteoblast differentiation [25]. Osseous metastases secondary to breast carcinoma usually present as multiple osteolytic, osteoblastic or mixed lesions, most commonly in the axial skeleton [26]. Lytic metastases are typically hypodense on CT, with variable degree of osseous destruction, and osteoblastic (sclerotic) metastases appear hyperdense. On MRI, lytic metastases are typically of low to intermediate signal on T1 sequences, and isointense to hyperintense on fluid sensitive sequences. The lesions may enhance with gadolinium contrast. Conversely, osteoblastic metastases show reduced signal intensity on both T1 and fluid sensitive sequences, and may only be seen on fat suppressed sequences by a halo of surrounding marrow oedema [26]. Most metastases in the vertebral column are found in the lumbar region, followed by the thoracic region. Patients with spinal metastases characteristically present with non-mechanical back pain and occasionally a pathological fracture [27]. Imaging modalities used to diagnose metastatic lesions include CT, whole body MRI, bone scintigraphy and positron emission tomography (PET) scanning [28].

Management of metastatic breast carcinoma is guided by a multidisciplinary team discussion and selection of therapy is determined by many factors, including presence of hormonal biomarkers, menopausal status, comorbidities and prognosis [29]. Systemic drug therapies are the mainstay of metastatic disease management, which include chemotherapy, endocrine therapy for hormone receptor positive cancers and targeted therapy drugs for HER2-positive cancers. Radiotherapy and surgery may be considered for symptomatic relief for metastatic lesions in some cases [30]. Management of spinal metastases includes surgical decompression, stabilisation and/or reconstruction, radiotherapy to the sites of osseous disease and bone protection in the form of bisphosphonates or denosumab [31].

This case is an atypical presentation of bone metastasis, with the very rarely described finding of fluid–fluid levels. As discussed, primary ABCs usually occur in a younger demographic compared to bone metastases [17]; therefore, the age of this patient was unusual when considering the differential diagnosis of a primary ABC. Similarly, the majority of primary osseous lesions that can give rise to secondary ABC change, such as osteosarcoma, giant cell tumour and fibrous dysplasia, are also typically seen in the younger population. Given the patient's history of breast cancer and presenting complaint of back pain, the differential diagnosis of metastatic disease was considered with a high index of suspicion. Hence, it is crucial that the imaging findings are correlated with a detailed clinical history and histological analysis, even in patients with a long disease-free interval after treatment of a primary breast carcinoma, as was the case with our patient. Whilst CT is a preliminary and commonly used imaging modality for the investigation of back pain and spinal metastatic disease, the distinction between an osteolytic metastatic deposit and one with fluid–fluid levels can only be confidently made on MRI.

Breast cancer is reported to have a protracted relapse-free interval, particularly in ER-positive carcinomas, as described in this case [14]. The characteristic late recurrence, over a decade in some cases, raises the notion of labelling breast

cancer as a chronic disease, highlighting the need for long-term surveillance and follow-up in patients [32].

Conclusion

We highlight a rare case of metastatic breast carcinoma presenting as a solitary multi-cystic bone lesion with fluid–fluid levels, closely resembling that of an aneurysmal bone cyst. Nonetheless, the possibility of metastatic disease should be considered an important differential diagnosis when similar lesions are encountered, particularly in an unusual demographic, or when there is a history of malignancy.

Data availability Data availability statement is not applicable.

Declarations

Conflict of interest The authors have no conflicts of interest or funding to declare.

Consent for publication Consent has been obtained from patient for publication of anonymised images.

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