Am J Transl Res 2022;14(2):1123-1130
www.ajtr.org /ISSN:1943-8141/AJTR0140659

Case Report

Comprehensive imaging and pathology of solitary patellar metastasis from breast cancer with literature review on its diagnosis and prognosis

Jiazheng Zhao[1], Yi Zhao[1], Xiaowei Ma[1], Helin Feng[1], Xiaoyan Gao[2]

Departments of [1]Orthopedics, [2]Neurosurgery, The Fourth Hospital of Hebei Medical University, Shijiazhuang 050011, Hebei, China

Received November 19, 2021; Accepted December 31, 2021; Epub February 15, 2022; Published February 28, 2022

Abstract: Background: Breast cancer is the most frequent non-skin cancer in women and bone is its most common site of metastasis. The patella, as the largest sesamoid bone in the human body, is a rare site for cancer metastasis to occur. We reported the comprehensive auxiliary examination data and complete process of diagnosis, management and follow-up for a case of solitary patellar metastasis from breast cancer. Case presentation: A 47-year-old woman presented with patellar pain 6 years after breast cancer surgery. Thorough imaging and pathology examinations were carried out leading to a diagnosis of breast-derived patellar metastasis. Subsequent treatment and follow-up were performed. The patient recovered function slightly at 3 months postoperatively, but tibia and femur metastases developed at 6 months postoperatively and the patient started radiotherapy. Discussion: Cases of patellar metastases from malignant tumors are extremely rare but do exist. Due to the insidious onset and non-specific symptoms, it is worthwhile to alert clinicians. The diagnostic value of positron emission tomography/computed tomography for patellar metastases is significant and still provides certain advantages compared to pathologic examination, so it can be given priority. Prompt postoperative radiotherapy is necessary, while imaging should be actively performed with a short review interval.

Keywords: Surgery, patella, orthopedics, imaging

Introduction

Breast cancer (BC) is the most frequent non-skin cancer in women, and bone is the most common site of metastasis in BC, with more than half of advanced BC patients developing bone metastases [1]. The vast majority of bone metastases are concentrated in the axial skeleton, mainly the spine, ribs and skull, and are less prone to occur in the appendicular skeleton [2]. As the largest sesamoid bone in the human body, the patella is a rare site of occurrence for both primary and metastatic cancers [3]. Once the cancer has metastasized to the patella, diagnosis is difficult and the accuracy of the diagnosis can largely influence options for subsequent treatment and the prognosis. Nuclear medicine, as represented by positron emission tomography/computed tomography (PET/CT), plays a prominent role in identification of bone metastases from tumors and has significantly improved diagnostic efficiency [4].

We report the comprehensive imaging and pathologic data in the process of diagnosis, management, and follow-up for a case of solitary patellar metastasis from BC. As cases of cancer patellar metastases are rare, the diagnosis and prognosis of this type of disease are reviewed in the context of the clinical experience and published literature.

Case presentation

A 47-year-old woman was admitted to our hospital with pressure pain in the left patella for 3 months. The patient reported no history of trauma and had experienced significant pain in the left patella 3 months previously. Physical examination revealed pressure pain at her left patella, no significant abnormalities in left knee

movement, no significant swelling in left lower limb, favorable sensation and blood flow in left lower limb and muscle strength grade 5. Medical history indicated that the patient was diagnosed with right BC 6 years ago and underwent a modified radical right breast resection. No intravascular cancer emboli were evident at surgery, and there were no metastases to the nipple, intermuscular tissue or lymph nodes. Postoperative pathology displayed a 1.5 cm diameter right breast mass with a greyish white, brittle surface and immunohistochemistry showed ER (50% strongly positive), PR (20% strongly positive), Ki-67 (positive cells 70%), and HER2 (3+). The EC-T regimen (cyclophosphamide 0.8 g d1; epirubicin hydrochloride 50 mg d1 and 60 mg d2) continued after surgery to the present. In addition, the patient stated that she had suffered from hyperosteogeny for several years.

The patient underwent radiography, which showed reduced bone density of the left patella with an area of hypodense bone destruction at the lower edge. The bony trabeculae were obscured and the surrounding soft tissue was swollen (**Figure 1A**). CT scan showed hyperosteogeny in both knees, osseous destruction of the left patella, and effusion in the left knee (**Figure 1B**). Magnetic resonance imaging (MRI) examination indicated hyperosteogeny in her left knee, abnormal signals in the left patella, and effusion in the left knee (**Figure 1C**). At this point, a possible patellar metastasis from BC was considered. However, since similar cases were extremely rare and difficult to assess with the available imaging data, nuclear medicine related emission computed tomography (ECT) bone scan and PET/CT tumor examination were performed. ECT scan displayed unusual concentration of signals in the left patella (**Figure 1D**). PET/CT examination revealed visible aberrant glucose hypermetabolism on the basis of CT images, with the left patellar hypermetabolism exhibiting the greatest SUV value of 10.7 (**Figure 2**), thus clarifying the diagnosis of patellar metastasis. Subsequently, a biopsy of the occupied left patella was conducted to investigate the feasibility of surgery. Haematoxylin-eosin (H&E) staining of biopsy section presented a few anomalous cells, which tended to be cancerous (**Figure 3A**). An enlarged left patellar resection + ligament reconstruction was ultimately performed. The operation was uneventful, and the postoperative specimen showed significant destruction of the inferior pole in the left patella (**Figure 3B**) with pathologic examination suggesting adenocarcinoma (**Figure 3C**). Immunohistochemistry (**Figure 4A-H**) displayed CDX2 (-), TTF-1 (-), CK20 (-), AE1/AE3 (+), CK7 (+), GATA3 (+), Mammaglobin (+), ER (3% positive), PR (3% positive), Ki-67 (positive cells 60%), and HER2 (3+), which also confirmed the breast origin of the patellar cancer. Postoperatively, annual intravenous zoledronic acid infusion was ordered to inhibit bone metastases and relevant knee rehabilitation was recommended. In addition, we explained to the patient about possible poor prognosis of the disease and therefore highly recommended local radiation therapy and regular outpatient review, but these were not accepted by the patient.

A telephone follow-up was carried out 3 months after the operation and the patient expressed relative satisfaction with the outcome. She stated there was normal extension function and slightly abnormal flexion function of the left knee, with a maximum flexion angle of 100°. During resting, there was no pain in her left knee and the visual analogue scale (VAS) score was 0. When walking upstairs, there was minor discomfort in the left knee joint, with a VAS score of 2. We advised the patient to undergo imaging evaluation, which the patient refused on the grounds of positive functional recovery. After that, an outpatient follow-up was performed at 6 months postoperatively, and the patient reported a substantial loss of motor function in her left knee with intense pain accompanied by a VAS score of 6. The re-examination of CT scan indicated that the left patella was not visualized, which was considered to be a postoperative change. Uneven density of the left upper tibia and left medial femoral condyle was considered to be cancer metastasis (**Figure 5**). After being informed of the condition, the patient agreed to receive radiation therapy to postpone the progression of disease.

Discussion and conclusions

Patellar metastases from BC are extremely rare, with only two cases incompletely reported and a paucity of relevant imaging information [5, 6]. Here we report a case involving patellar

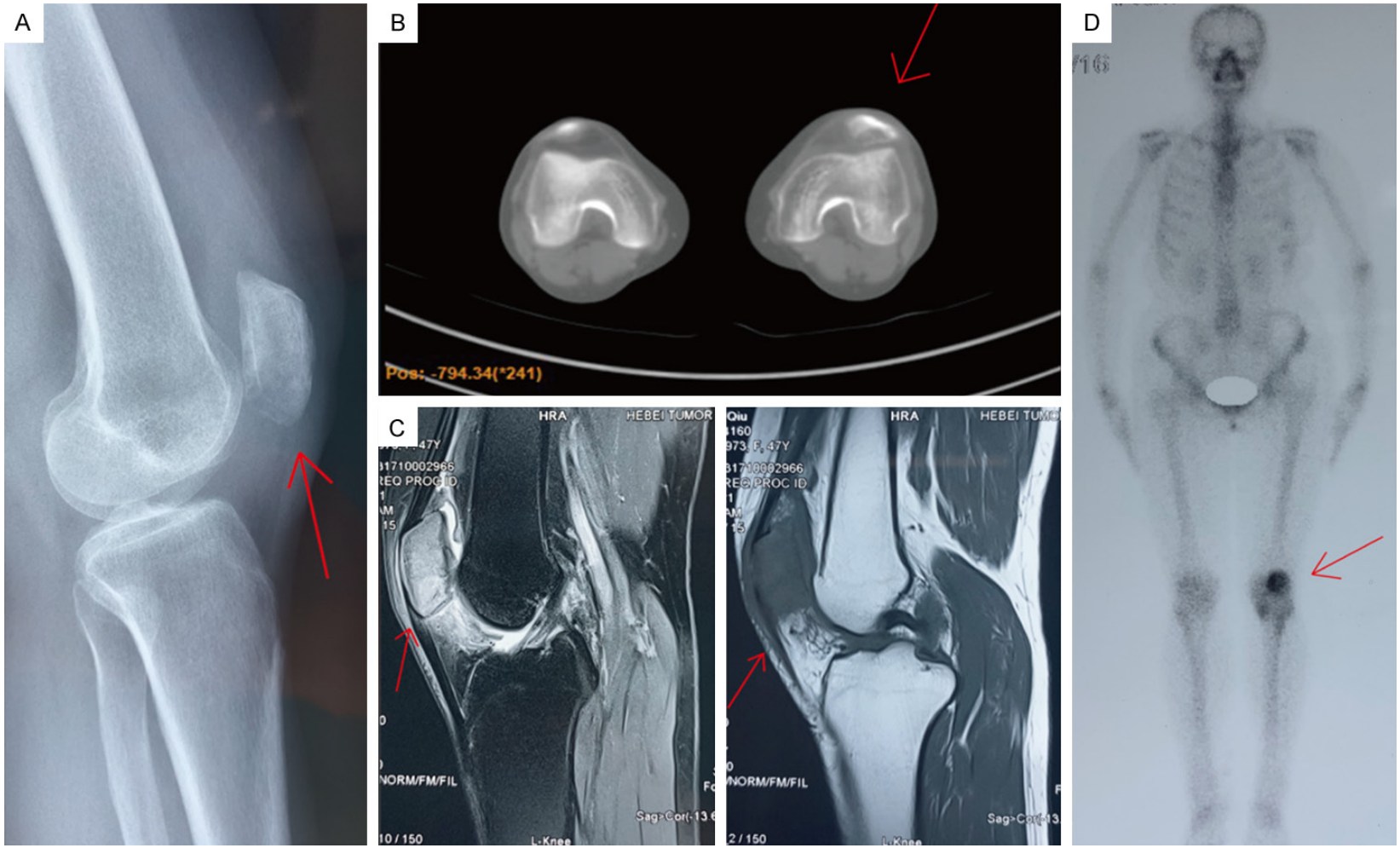

Figure 1. The patient's preoperative series of auxiliary examination data. A. Radiography indicated a reduced bone density of the left patella; B. CT scan indicated osseous destruction of the left patella; C. MRI examination indicated abnormal signal in the left patella; D. ECT scan indicated an unusual concentration of signal in the left patella.

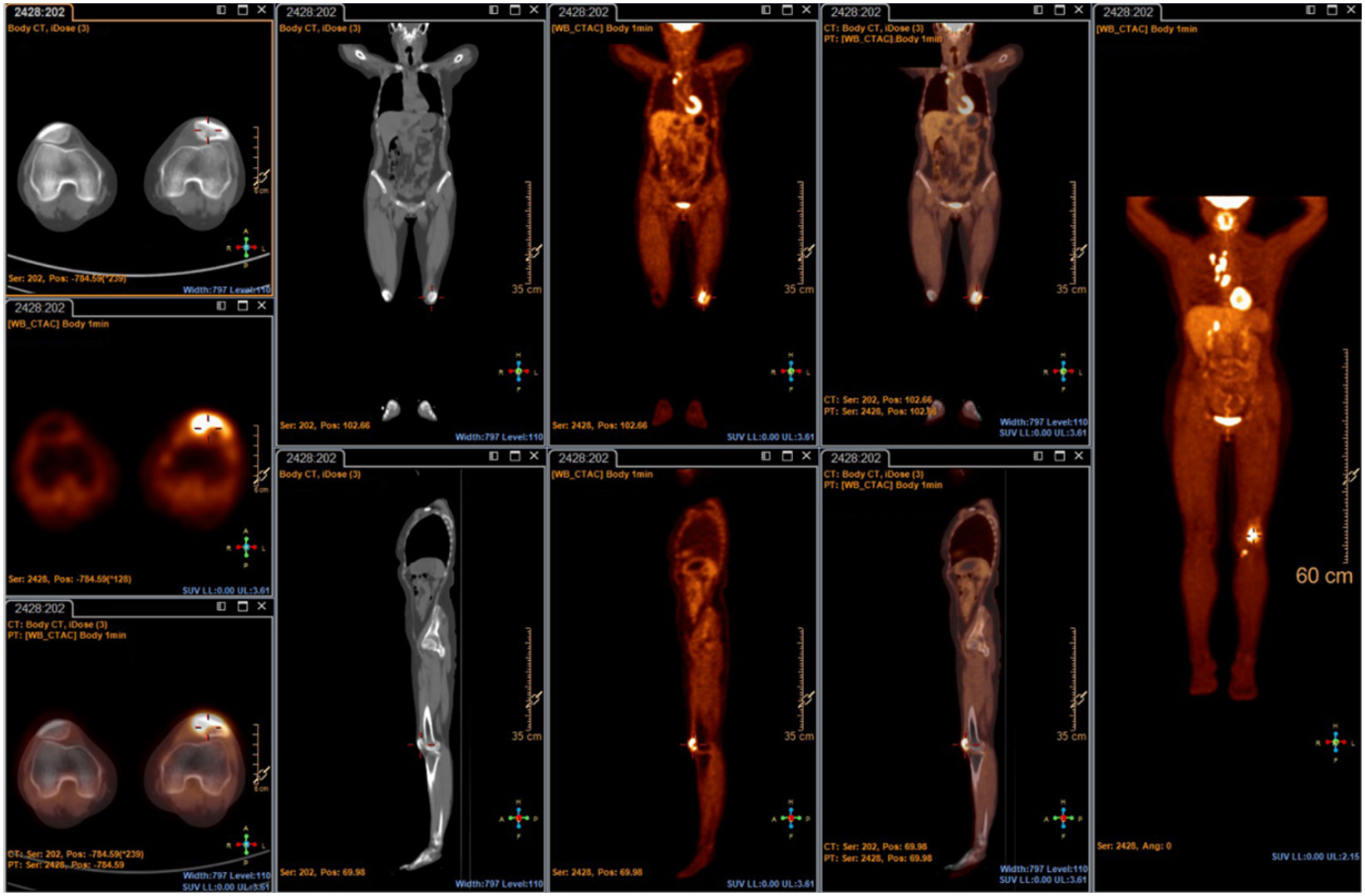

Figure 2. PET/CT examination indicated aberrant glucose hypermetabolism in the left patella.

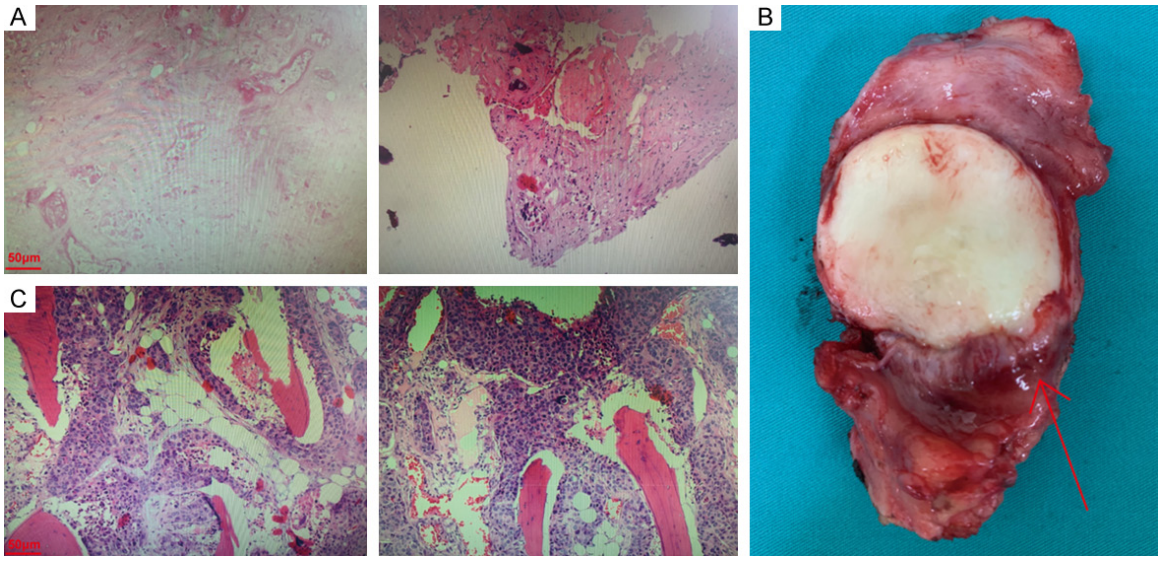

Figure 3. Patient's series of pathologic data. A. H&E staining of the biopsy indicated a few anomalous cells (×200); B. Postoperative specimen indicated significant destruction of the inferior pole in the left patella; C. H&E staining of postoperative specimen indicated adenocarcinoma (×200).

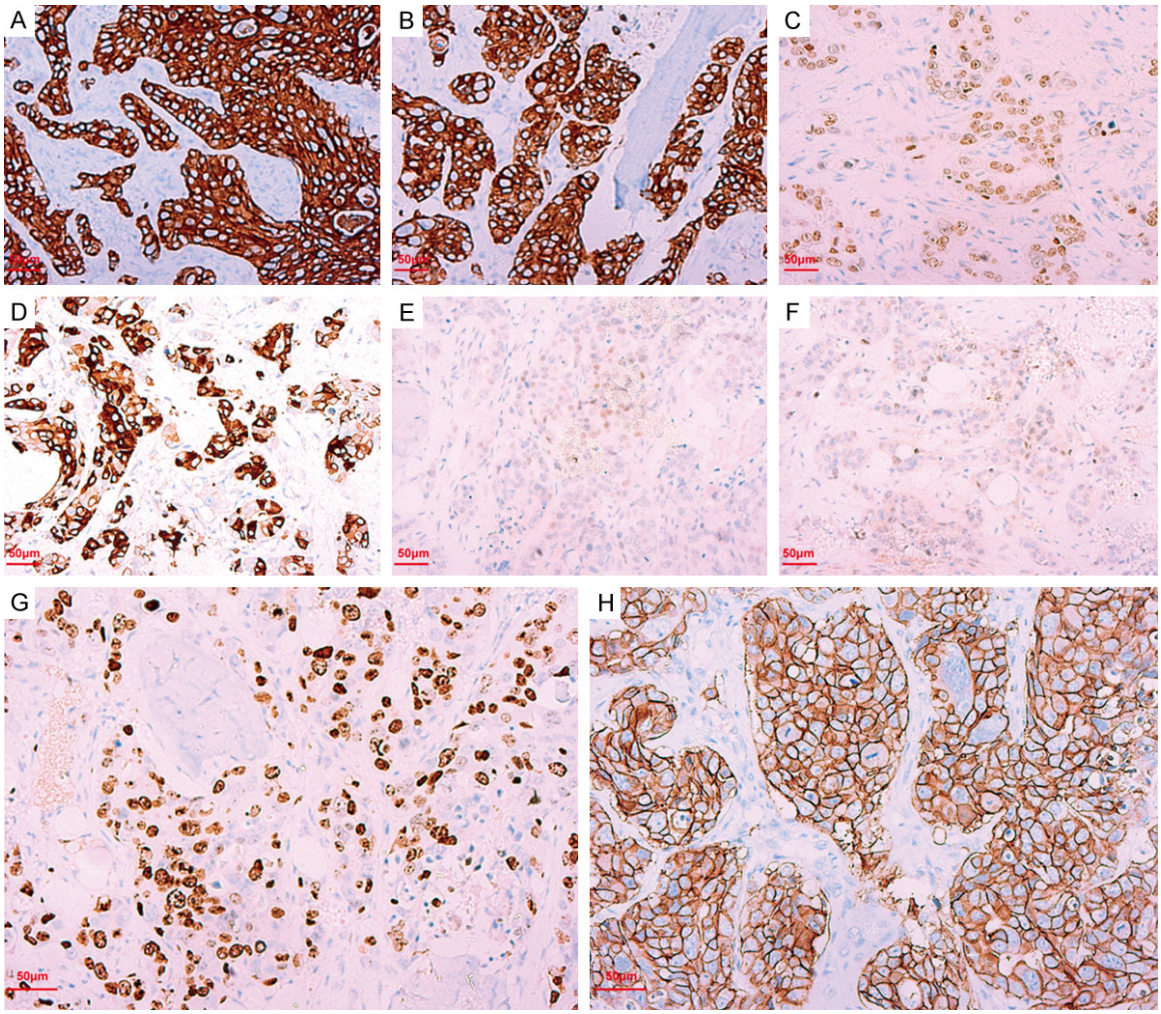

Figure 4. Immunohistochemical results of the patient's postoperative specimen (×200). A. AE1/AE3; B. CK7; C. GATA3; D. Mammaglobin; E. ER; F. PR; G. Ki-67; H. HER2.

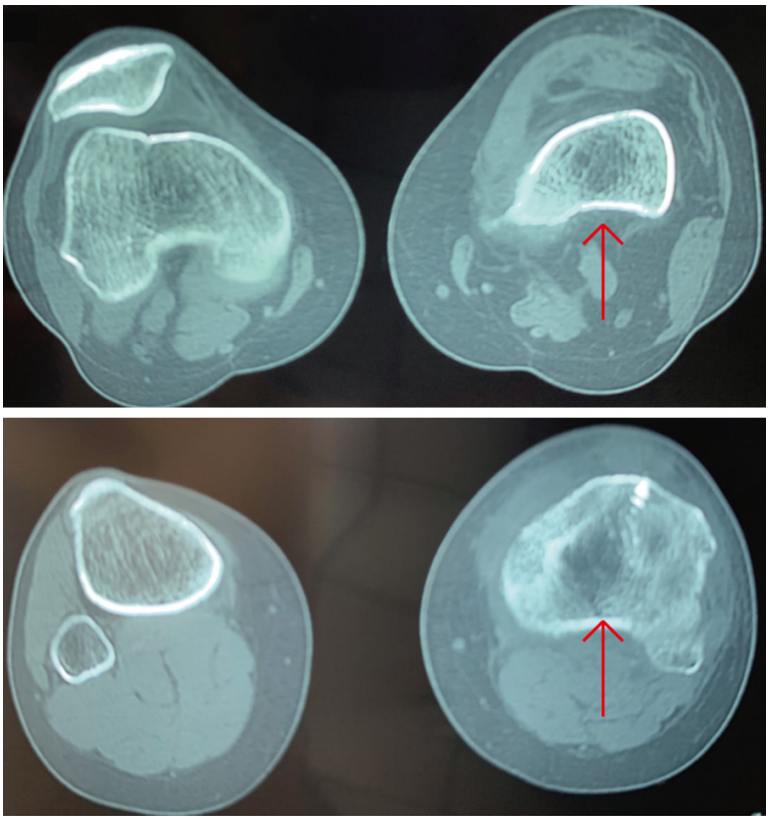

Figure 5. CT scan indicated no visualization of the left patella and uneven density of the left upper tibia and left medial femoral condyle.

metastasis from BC with comprehensive auxiliary examination data and the complete process of diagnosis, management and follow-up.

Although patellar disease is relatively infrequent, the patella as the largest sesamoid does serve as the site of skeletal system pathology. Tumor is not a common type of patellar disease. The incidence of patellar tumor is minor and the majority are chondroblastoma and giant cell tumor [7]. Reports of malignant tumors metastasizing to the patella are even more rare, with only about 30 published case reports of definite malignant tumor metastases to the patella, which may be explained by the low blood flow to the patella [8]. The uniqueness of patellar anatomy and the rarity of patellar metastases contribute to the insidious onset and low detection of this disease. Despite the fact that this patient was 6 years postoperative for BC and that intraoperative evidence regarding intravascular cancer embolus and metastases to nipple, intermuscular tissue and lymph nodes were all negative at that time, bone metastasis can still occur after this long period of time, leading to knee pain as the first manifestation. Patients with published cases of patellar metastases are always initially diagnosed with osteoarthritis associated with a history of trauma or no apparent cause, presenting with pain, swelling, and movement restriction [9-12], which are the most recurrent symptoms of patellar tumors [13]. When the pain cannot be reasonably explained or the nature of pain is not consistent with the degree of trauma, suspicion of patellar metastasis and further diagnosis are necessary [14].

Since most patients with patellar metastases are middle-aged and elderly with hyperosteogeny and other osteoarticular diseases, it is difficult to diagnose them despite a clear history of primary cancer. Naturally, the possibility of patellar metastases also cannot be ignored in patients without a primary tumor history. In this case, PET/CT plays a definite role in the diagnosis. In principle, pathologic examination is considered to be the diagnostic criterion for patellar metastasis, but we would rather recommend the nuclear medicine scan represented by PET/CT as the first step. Compared to pathologic examination, PET/CT is efficient, safe, and non-invasive while ensuring diagnostic accuracy; also, its diagnostic advantage is unparalleled in suspected cases of multiple metastases, including the patellar site [15, 16]. In addition, in spite of the expensive cost of PET/CT, its value is particularly evident in cases of suspected patellar metastasis where the diagnosis is difficult to confirm and ordinary imaging is not conducive to a definite conclusion. Accurate and efficient

diagnosis can avoid a delay in treatment, thus widening surgical possibilities for the patient.

Surgery is the preferred treatment for patellar tumors [17, 18]. The surgical approach to patellar metastases is mostly common with patellar osteotomy [11], but surgical treatment alone usually does not guarantee the prognosis of these patients. Previous reports have shown that the outcomes of these patients are often not promising, and even if the primary cancer is effectively controlled, unsatisfactory management of metastatic lesions can directly affect the life quality and overall survival of patients [19, 20]. The current evidence supports a strong suppressive effect of local radiation therapy on patellar metastases [16, 21]. Combined with our previous clinical experience of two patellar metastasis patients [20, 22], we strongly recommended radiotherapy after the operation but the patient refused, and only 6 months after surgery the patient developed significant metastases in both the adjacent tibia and femur. The special anatomy of the knee joint leads to vulnerable involvement of the distal femur and proximal tibia in patellar lesions [23]. Due to the high malignancy and rapid progression of the disease, even if the surgery is successful, without reasonable follow-up treatment and timely review and monitoring, the impact will be irreversible. Consequently, we recommend that patients with patellar metastases after surgical treatment should be promptly treated with radiotherapy to inhibit local invasion and metastasis, and at the same time, imaging should be actively performed with a short review interval.

In conclusion, we report the comprehensive auxiliary examination data and the diagnosis, management, and follow-up for a case of solitary patellar metastasis from BC. Cases of patellar metastases from malignant tumors are extremely rare but do exist. Due to the insidious onset and non-specific symptoms, it is worthwhile to alert clinicians. The diagnostic value of PET/CT for patellar metastases is significant and still provides certain advantages over pathological examination. Prompt postoperative radiotherapy is necessary, and imaging should be actively performed with a short review interval.

Acknowledgements

The patient provided written consent to the use of clinical data for publication.

Disclosure of conflict of interest

None.

Abbreviations

BC, Breast cancer; PET/CT, Positron emission tomography/computed tomography; MRI, Magnetic resonance imaging; ECT, emission computed tomography; HE, Haematoxylin-eosin.

Address correspondence to: Xiaoyan Gao, Department of Neurosurgery, The Fourth Hospital of Hebei Medical University, 12 Health Road, Shijiazhuang 050011, Hebei, China. E-mail: xiaoyangao0311@163.com

References

[1] Brook N, Brook E, Dharmarajan A, Dass CR and Chan A. Breast cancer bone metastases: pathogenesis and therapeutic targets. Int J Biochem Cell Biol 2018; 96: 63-78.
[2] Coleman RE, Croucher PI, Padhani AR, Clézardin P, Chow E, Fallon M, Guise T, Colangeli S, Capanna R and Costa L. Bone metastases. Nat Rev Dis Primers 2020; 6: 83.
[3] Song M, Zhang Z, Wu Y, Ma K and Lu M. Primary tumors of the patella. World J Surg Oncol 2015; 13: 163.
[4] Kannivelu A, Loke KS, Kok TY, Osmany SY, Ali SZ, Suat-Jin L and Ng DC. The role of PET/CT in the evaluation of skeletal metastases. Semin Musculoskelet Radiol 2014; 18: 149-165.
[5] Keeley CD. Bilateral patellar metastases from carcinoma of the male breast. Can J Surg 1973; 16: 328-329.
[6] Humphreys L and Sridhar M. Patellar metastasis. Lancet 2002; 359: 1739.
[7] Samuel AM, Costa J and Lindskog DM. Genetic alterations in chondrosarcomas - keys to targeted therapies. Cell Oncol (Dordr) 2014; 37: 95-105.
[8] Meddeb N, Hamza S, Moalla M, Siala M and Sellami S. Patelar metastasis of primary lung cancer. Rev Pneumol Clin 2003; 59: 176-178.
[9] Choi YS, Yoon YK, Kwak HY and Song IS. Patellar metastasis from a squamous cell carcinoma of the larynx. AJR Am J Roentgenol 2000; 174: 1794-1795.
[10] Pauzner R, Istomin V, Segal-Lieberman G, Matetzky S and Farfel Z. Bilateral patellar metastases as the clinical presentation of bronchogenic adenocarcinoma. J Rheumatol 1996; 23: 939-941.
[11] Lim CT, Wong AS, Chuah BY, Putti TC, Stanley AJ and Nathan SS. The patella as an unusual site of renal cell carcinoma metastasis. Singapore Med J 2007; 48: e314-319.

[12] Broomfield J, Ralte P, Morapudi S, Vasireddy N and Kershaw S. Anterior knee pain: an unusual presentation of renal cell carcinoma. J Surg Case Rep 2014; 2014: rju018.
[13] Kransdorf MJ, Moser RP Jr, Vinh TN, Aoki J and Callaghan JJ. Primary tumors of the patella. A review of 42 cases. Skeletal Radiol 1989; 18: 365-371.
[14] Sun EC, Nelson SD, Seeger LL, Lane JM and Eckardt JJ. Patellar metastasis from a squamous carcinoma of the lung: a case report. Clin Orthop Relat Res 2001; 234-238.
[15] Wu B, Xiu Y, Jiang L and Shi H. SPECT/CT imaging of patella metastasis from a squamous carcinoma of the lung. Clin Nucl Med 2013; 38: 125-127.
[16] Codreanu I, Zhuang H, Alavi A and Torigian DA. Patellar metastasis from lung adenocarcinoma revealed by FDG PET/CT. Clin Nucl Med 2012; 37: 623-624.
[17] Schuett DJ, Hake ME, Mauffrey C, Hammerberg EM, Stahel PF and Hak DJ. Current treatment strategies for patella fractures. Orthopedics 2015; 38: 377-384.
[18] Kakazu R and Archdeacon MT. Surgical management of patellar fractures. Orthop Clin North Am 2016; 47: 77-83.
[19] Aktas S, Demiral H, Bilgi S, Caglar T and Calpur OU. Patellar metastasis from a lung epidermoid carcinoma. Yonsei Med J 1998; 39: 474-477.
[20] Zhao Y, Zhang Q, Feng H and Zhu X. Oesophageal carcinoma with solitary patellar metastasis: a rare case report. J Int Med Res 2021; 49: 3000605211009812.
[21] Sur RK, Singh DP, Dhillon MS, Gupta BD, Murali B and Sidhu R. Patellar metastasis: a rare presentation. Br J Radiol 1992; 65: 722-724.
[22] Feng H, Li H, Wang J, Zhang X and Feng J. Squamous carcinoma of the lung metastases to the patella. Clin Nucl Med 2015; 40: 504-505.
[23] StatPearls. Treasure Island (FL): StatPearls Publishing; 2021.