Tenosynovial Giant Cell Tumor of Diffuse Type Mimicking Bony Metastasis Detected on F-18 FDG PET/CT

Kyoung Jin Chang · Byung Hyun Byun · Han Sol Moon ·
Jihyun Park · Jae Soo Koh · Byung Il Kim ·
Sang Moo Lim

Received: 13 December 2013 / Revised: 24 March 2014 / Accepted: 26 March 2014 / Published online: 23 April 2014
© Korean Society of Nuclear Medicine 2014

Abstract Tenosynovial giant cell tumor of diffuse type (TGCT-D) is a locally aggressive neoplasm that arises in the tendon sheath, bursa, or synovium. It typically involves the appendicular skeleton and rarely involves the axial skeleton. Because there are no specific findings of TGCT-D based on imaging studies or clinical symptoms, TGCT-D can be confused with other primary or metastatic bone tumors. We report findings of TGCT-D involving the T9 vertebra incidentally detected on F-18 FDG PET/CT in a patient with papillary thyroid cancer.

Keywords Giant cell tumors · FDG · PET/CT

Introduction

Tenosynovial giant cell tumor of diffuse type (TGCT-D) is a locally aggressive neoplasm involving the synovial membrane of a joint [1]. Because there are no specific findings of TGCT-D based on imaging studies or clinical symptoms, it can be difficult to differentiate between TGCT-D and other benign inflammatory or neoplastic processes of the synovial lining [2]. TGCT-D mimics bony metastasis in patients with malignancy [3, 4] and typically involves the appendicular skeleton, while rarely involving the axial skeleton [5, 6]. We present findings of TGCT-D involving the T9 vertebra using fluorine-

18 fluorodeoxyglucose (F-18 FDG) positron emission tomography/computed tomography (PET/CT) in a patient with papillary thyroid cancer.

Case Description

A 33-year-old female patient was diagnosed with papillary thyroid carcinoma and underwent total thyroidectomy followed by high-dose radioactive iodine therapy (6.7 GBq). After 4 years of treatment, the patient was referred for PET/CT as a routine follow-up. PET/CT revealed a focal hypermetabolic lesion (the maximum SUV=7.1), and the CT images of PET/CT revealed a small osteolytic lesion with a sclerotic rim in the left facet of the T9 vertebra. MRI was performed 2 weeks after PET/CT and showed a mild gadolinium-enhancing lesion of 1.4×1.5×1.2 cm at the corresponding location (Fig. 1). Although the serum thyroglobulin level was negative and the patient had no symptoms, we could not exclude the possibility of bony metastasis to the T9 vertebra based on the findings of PET/CT and MRI. Therefore, she underwent surgical removal of the T9 lesion.

The gross specimen of the T9 lesion showed a yellowish osteolytic mass, and the histology revealed small histiocytoid cells, large epithelioid cells, osteoclast-like giant cells, and xanthoma cells. However, there was no evidence of malignant transformation (Fig. 2). Therefore, the tumor was diagnosed as TGCT-D. At a 9-month follow-up, there was no recurrence or metastasis.

Discussion

TGCT-D was originally defined as a pigmented villonodular synovitis by Jaffe et al. in 1941 and was described as an inflammatory lesion involving the tendon sheath rather than

K. J. Chang · B. H. Byun · H. S. Moon · J. Park · B. I. Kim ·
S. M. Lim (✉)
Department of Nuclear Medicine, Korea Cancer Center hospital,
Nowon-Gil 75, Gongneung-Dong, Nowon-Gu, Seoul 139-706,
Republic of Korea
e-mail: smlim328@kcch.re.kr

J. S. Koh
Department of Pathology, Korea Cancer Center hospital, Nowon-Gil
75, Gongneung-Dong, Nowon-Gu, Seoul 139-706, Republic of
Korea

Fig. 1 F-18 FDG PET/CT and MRI findings. Maximum intensity projection (MIP) (a) and transaxial fused image (b) of F-18 FDG PET/CT scan showed a hypermetabolic lesion with the maximum SUV of 7.1 in the left facet of the T9 vertebra (long arrows). The transaxial CT image (c)

of the PET/CT scan showed a small osteolytic lesion (short arrow) and MRI (d) performed 2 weeks after the PET/CT scan revealed an enhancing lesion of 1.4×1.5×1.2 cm at the corresponding location of the T9 vertebra (arrowhead)

as a malignant lesion [1]. According to the 2013 WHO classification of soft tissue tumors, TGCT can be subdivided into localized and diffuse forms [7]. TGCT-D is defined as a locally aggressive neoplasm and typically involves the appendicular skeleton, particularly the knee (80 %) and hip joint (15 %), and rarely involves the axial skeleton [5, 8]. The common symptoms of patients with diffuse-type TGCT include pain, limitation of motion, and minimal to mild joint swelling, heat, and tenderness [9]. Although wide excision is the treatment of choice for TGCT-D [1, 10], it has a higher recurrence rate (33 to 50 %) than that of the localized TGCT, and malignant behavior of TGCT-D has also been reported [2, 11].

However, TGCT-D can also be found incidentally in imaging studies of patients without any of these symptoms.

TGCT-D manifests as a nonspecific well-defined soft-tissue mass with similar or slightly increased attenuation compared to that of adjacent muscle on CT images [5]. In MRI, TGCT-D shows low signal intensity with artifacts from hemosiderin deposits on T1- and T2-weighted images [2, 5]. The differential diagnosis based on imaging studies includes synovial sarcoma, rheumatoid arthritis, tuberculous arthritis, osteoarthritis, angiomas of the osseous origin, amyloidosis, fibrous dysplasia, multiple enchondromatosis, hemophilia, chronic indolent synovitis, and bony metastasis [3, 9]. Although there have been a few reports of TGCT-D located in the pelvic bones and knee joints detected on PET/CT [12, 13], there was no case of PET/CT involving the spine. The maximum SUV of TGCT-D has been reported to be variable, ranging from 4.4 to 25.0 [14, 15], so it would not be possible to

Fig. 2 Histologic findings. The tumor is composed of a small histiocytoid cells, large epithelioid cells, osteoclast-like giant cells, and xanthoma cells (original magnification×100, H&E stain) (a). High-power view (b) shows the large epithelioid cells with scant cytoplasm often

containing hemosiderin granules, multi-nucleated giant cells, and reniform mononuclear histiocytoid cells (original magnification ×400, H&E stain)

differentiate between TGCT-D and other benign or malignant bone lesions by using SUV alone. Hence, the findings of CT or MRI should be correlated for better diagnosis.

TGCT-D is usually a large mass (often >5 cm) with synovial hypertrophy consisting of papillary, villous, nodular, or villonodular patterns [5]. Microscopically, TGCT-D comprises polymorphic cells, resulting from histiocytoid cells with abundant eosinophilic cytoplasm, large epithelioid cells, osteoclast-like giant cells, xanthoma cells, and inflammatory cells [2, 5]. The large epithelioid cells of TGCT-D often contain hemosiderin granules [2]. Previous studies have demonstrated the upregulation of the glucose transporter protein GLUT-1 in human macrophages [16, 17]. Also, a positive relation between the overexpression of GLUT-1 and F-18 FDG avidity was reported [18, 19]. Hoshi et al. suggested a close association of F-18 FDG avidity with strong hexokinase-2 activity in giant cells and spindle cells [20]. Based on those studies, we postulate that the increased F-18 FDG uptake of TGCT-D might be attributable to the overexpression of GLUT-1 and hexokinase-2 in macrophages and giant cells, respectively.

To the best of our knowledge, this is the first report of TGCT-D involving the spine incidentally detected on PET/CT. This report indicates that TGCT-D should be included in the differential diagnosis of the spinal mass in PET/CT, and correlation with conventional imaging modalities would be helpful.

Acknowledgements This work was supported by the Establishment of a Center for PET Application Technology Development, Korea Institute of Radiological and Medical Sciences (KIRAMS), and by grants from the Ministry of Education, Science and Technology (50441-2013).

Conflict of Interest Kyoung Jin Chang, Byung Hyun Byun, Han Sol Moon, Jihyun Park, Jae Soo Koh, Byung Il Kim, and Sang Moo Lim declare that they have no conflict of interest.

Ethical Statements This study was approved by the ethics committee in our hospital and was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. All persons enrolled gave their informed consent prior to their inclusion in the study.

References

- Jaffe H, Lichtenstein L, Sutro C. Pigmented villonodular synovitis, bursitis and tenosynovitis. *Arch Pathol.* 1941;31:731–65.
- Somerhausen NS, Fletcher CD. Diffuse-type giant cell tumor: clinicopathologic and immunohistochemical analysis of 50 cases with extraarticular disease. *Am J Surg Pathol.* 2000;24:479–92.
- Perka C, Labs K, Zippel H, Buttgerit F. Localized pigmented villonodular synovitis of the knee joint: neoplasm or reactive granuloma? A review of 18 cases. *Rheumatology.* 2000;39:172–8.
- Mahmood S, de Llano SR. Localized nodular synovitis mimicking metastatic melanoma in a patient with metastatic melanoma on whole-body F-18 FDG PET/CT with MRI and pathological correlation. *Clin Nucl Med.* 2007;32:532–4.
- Murphey MD, Rhee JH, Lewis RB, Fanburg-Smith JC, Flemming DJ, Walker EA. Pigmented villonodular synovitis: radiologic-pathologic correlation. *Radiographics.* 2008;28:1493–518.
- Frassica FJ, Bhimani MA, McCarthy EF, Wenz J. Pigmented villonodular synovitis of the hip and knee. *Am Fam Physician.* 1999;60:1404–10.
- Somerhausen N, Rijn M. Tenosynovial giant cell tumour, diffuse type. In: Fletcher CD, Bridge JA, Hogendoorn PC, Mertens F, editors. *WHO classification of tumours of soft tissue and bone.* 4th ed. Lyon, France: IARC; 2013. p. 102–3.
- Giannini C, Scheithauer BW, Wenger DE, Unni KK. Pigmented villonodular synovitis of the spine: a clinical, radiological, and morphological study of 12 cases. *J Neurosurg.* 1996;84:592–7.
- Dorwart RH, Genant HK, Johnston WH, Morris JM. Pigmented villonodular synovitis of synovial joints: clinical, pathologic, and radiologic features. *Am J Roentgenol.* 1984;143:877–85.
- Ravi V, Wang WL, Lewis VO. Treatment of tenosynovial giant cell tumor and pigmented villonodular synovitis. *Curr Opin Oncol.* 2011;23:361–6.
- Bertoni F, Unni KK, Beabout JW, Sim FH. Malignant giant cell tumor of the tendon sheaths and joints (malignant pigmented villonodular synovitis). *Am J Surg Pathol.* 1997;21:153–63.
- Kitapci MT, Coleman RE. Incidental detection of pigmented villonodular synovitis on FDG PET. *Clin Nucl Med.* 2003;28:668–9.
- Wissmeyer M, Kohl S, Juengling FD, Stauffer E, Siebenrock KA, Krause TM. FDG uptake in giant cell tumor of the tendon sheath in a patient restaged for gastrointestinal stroma tumor (GIST). *Clin Nucl Med.* 2009;34:193–6.
- Watanabe H, Shinozaki T, Yanagawa T, Aoki J, Tokunaga M, Inoue T, et al. Glucose metabolic analysis of musculoskeletal tumours using 18fluorine-FDG PET as an aid to preoperative planning. *J Bone Joint Surg Br.* 2000;82:760–7.
- Pallas A, Hagge R, Borys D, Hunter J. Intense FDG uptake in an intra-articular localized giant-cell tumor of the tendon sheath (pigmented villonodular synovitis) mimics metastatic melanoma. *RCR.* 2009;4:343.
- Fu Y, Maianu L, Melbert BR, Garvey WT. Facilitative glucose transporter gene expression in human lymphocytes, monocytes, and macrophages: a role for GLUT isoforms 1, 3, and 5 in the immune response and foam cell formation. *Blood Cells Mol Dis.* 2004;32:182–90.
- Malide D, Davies-Hill TM, Levine M, Simpson IA. Distinct localization of GLUT-1, -3, and -5 in human monocyte-derived macrophages: effects of cell activation. *Am J Physiol.* 1998;274:e516–26.
- Chung JH, Cho KJ, Lee SS, Baek HJ, Park JH, Cheon GJ, et al. Overexpression of Glut1 in lymphoid follicles correlates with false-positive (18)F-FDG PET results in lung cancer staging. *J Nucl Med.* 2004;45:999–1003.
- Horiuchi C, Tsukuda M, Taguchi T, Ishiguro Y, Okudera K, Inoue T. Correlation between FDG-PET findings and GLUT1 expression in salivary gland pleomorphic adenomas. *Ann Nucl Med.* 2008;22:693–8.
- Hoshi M, Takada J, Oebisu N, Hata K, Ieguchi M, Nakamura H. Overexpression of hexokinase-2 in giant cell tumor of bone is associated with false positive in bone tumor on FDG-PET/CT. *Arch Orthop Trauma Surg.* 2012;132:1561–8.