Three-phase ^{99m}Tc-MDP bone scan in a case of pigment villonodular synovitis

Case Report

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ABSTRACT

Pigment villondular synovitis (PVNS) is a rare synovial condition. The nature of this disorder is usually characterized as benign; however, malignant transformation has also been reported. MRI is the diagnostic modality of choice in evaluating this entity, revealing low T1 and T2 weighted signals and blooming artifact on gradient echo sequences. Three-phase ^{99m}Tc-MDP bone scan has been infrequently used to assess these lesions; and a varied pattern on three phase bone scans has been reported. In the present case, we report a case of diffuse type PVNS lesion of the knee, evaluated with three-phase ^{99m}Tc-MDP bone scan. This lesion had a progressive nature. Flow and blood pool images revealed minimal activity in the lesion, with increased radiotracer uptake on delayed images. After surgical resection, the patient's diagnosis of a PVNS was confirmed. Although, the pattern of PVNS has been characterized as more prominent on vascular and blood pool images, other patterns such as limited arterial and venous perfusion, as observed in our case, is also possible. In addition, SPECT-CT, as in this case, provided valuable information regarding the extent of joint involvement.

Key words: Synovitis; Bone scan; SPECT-CT; ^{99m}Tc-MDP

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INTRODUCTION

Pigmented villonodular synovitis (PVNS) is a rare benign entity. It is characterized by the progressive hyperplasia of synovium accompanied by joint effusions and adjacent bone erosions [1]. It consists of two types, localized and diffuse forms [2]. Its most common location is the knee [3]. Although, the nature of PVNS is more commonly characterized as benign, malignant transformation of these lesions and even metastatic lesions of PVNS have been previously reported [2, 4]. MRI is the diagnostic modality of choice for the evaluation of this entity, by revealing low signal intensity (SI) on T1 and T2 weighted images [2]; however, the ultimate diagnosis is made by histopathology [5]. Three-phase ^{99m}Tc-MDP bone scan is infrequently utilized for evaluation of PVNS lesions. Herein, we report a 28-year-old female who presented to our center for further evaluation of a left knee mass with three-phase ^{99m}Tc-MDP bone scan.

CASE PRESENTATION

The patient was a 28-year-old female who had developed progressive pain and swelling of the left knee for the past 1.5 years. The pain was exacerbated in the morning and during exposure to cold air. She had no history of fever or weight loss. On physical examination the skin was normal in texture and appearance. A soft swelling was noted in the suprapatellar region. On physical examination, the range of motion of the knee was complete and the neuromuscular examination was normal. The patient's erythrocyte sedimentation rate and white blood cell counts were within normal limits.

MRI of the left knee demonstrated multifocal mass like synovial proliferation and hypertrophy with nodular protrusions and low signal appearance in all sequences (iron deposition) with joint capsule distension and effusion in favor of diffuse type PVNS (Figure 1A, red arrows). There was a large Baker's cyst (* in Figure 1C) containing internal low signal synovial nodularity (red arrow). In addition, significant loss of cartilage along with subchondral marrow edema were noted in both patellar facets suggestive of grade IV patellar chondromalacia.

For further characterization of the lesion, a three-phase bone scan was requested. Angiographic and blood pool images, showed increased perfusion in the region of the left knee joint while faint activity was noted in the anterolateral aspect of the left thigh corresponding to the knee mass. On delayed views, increased radiotracer uptake was noted in the same region. Monoarticular inflammatory process was noted in the left knee (Figure 2). On delayed SPECT-CT images, a mass like the one lesion was noted in the anterolateral distal part of the left femur accompanied by synovial thickening and intense radiotracer uptake in the intraarticular space along with lower degree of activity in the mass like lesion. The whole-body scan was otherwise unremarkable (Figure 3).

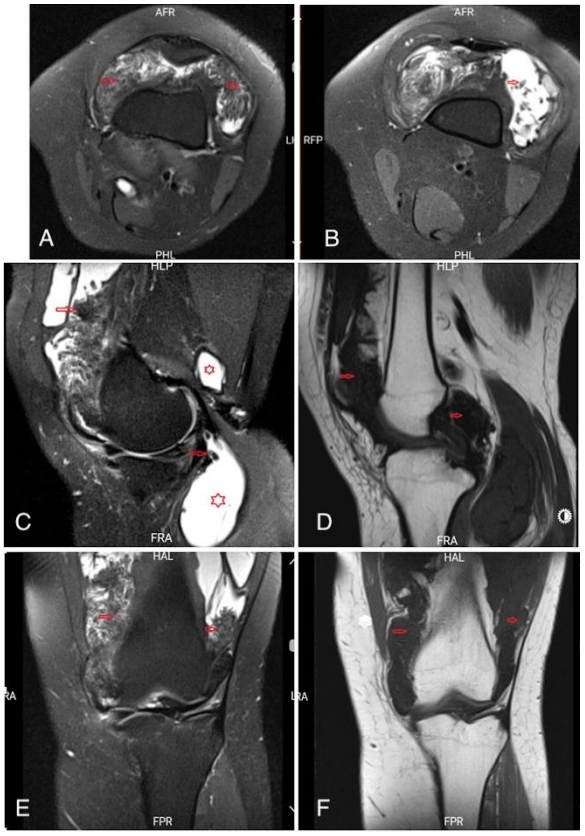

Fig 1. A-B Axial MRI PD (proton density) w fat saturation (sat) images: Severe joint capsule distension and effusion containing multiple low signal foci and low signal mass like synovial hypertrophy and proliferation (Red arrows). C-D Sagittal PD w fat sat and Sagittal T1w images: severe low signal synovial hypertrophy in supra and retro patellar region and deep popliteal fossa (Red arrow). Also note to the Baker cyst (*) contains internal signal void foci. E-F: PD w fat sat coronal and T1w coronal images: Note to the low signal multifocal synovial hypertrophy and mass like proliferation (Red arrow).

The patient underwent open arthrotomy and synovectomy and the mass was removed. Severely damaged joint cartilage due to long-standing disease process was noted. On histopathologic evaluation hyperplastic synovium and papillary projections composed of foamy cells, small histiocytes and hemosiderin containing macrophages were seen. Large clefts and pseudoglandular spaces lined by synovial cells as well as multinucleated giant cells were present (Figure 4). The post-operative course was uneventful and she was discharged on anti-inflammatory and analgesic medications. At two weeks follow-up, she reported significant improvement in pain followed by full pain relief at two months. Subsequently, full active and passive range of motion was restored in the affected knee joint.

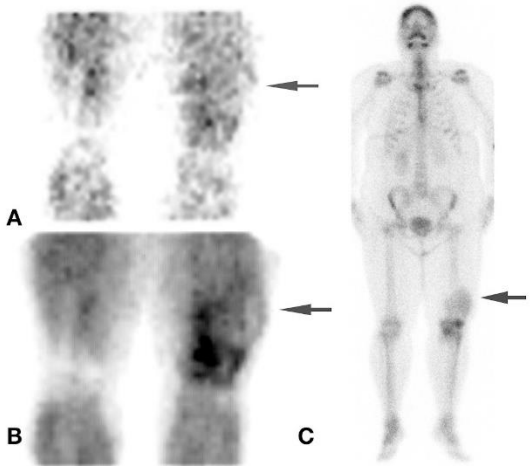

Fig 2. Angiographic and blood pool images, show increased perfusion in the region of the left knee joint while faint activity was noted in the anterolateral aspect of the left thigh corresponding to the knee mass (arrow). On delayed views, increased radiotracer uptake was noted in the same region (arrow). Monoarticular inflammatory process was noted in the left knee.

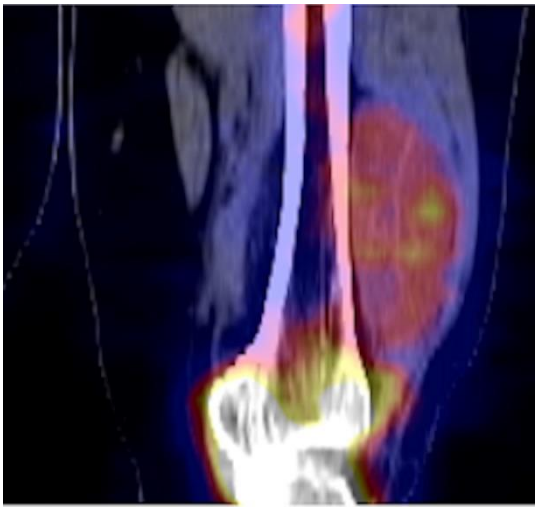

Fig 3. On delayed SPECT-CT images, a mass like lesion was noted in the anterolateral distal part of the left femur accompanied by intense radiotracer uptake in the intraarticular space along with lower degree of activity in the mass like lesion.

DISCUSSION

PVNS is characterized by proliferation of synovium in the form of nodules, villi and villonodules, in association with hemosiderin deposits [2]. It most commonly occurs in the third and fourth decade of life and has an insidious onset. It usually presents with swelling and impaired mobility [1]. The most common location is the knee. Other sites of involvement include hip, ankles, shoulders and elbows [1, 2]. A few atypical locations of PVNS such as the temporomandibular and sacroiliac joints has been previously reported [6, 7]. PVNS consists of two subtypes, i.e. localized and diffuse, both of these subtypes comprise a small percentage of benign soft tissue masses [2, 3]. On pathology, the synovium may have a nodular appearance and is infiltrated by histiocytoid and multinucleated giant cells as well as hemosiderin [1, 2]. Diffuse type can present with a more aggressive feature on histopathology, which may be difficult to differentiate from soft-tissue sarcomas. Correlation with imaging modalities, specifically in this setting is helpful to differentiate from malignant sarcomas [2].

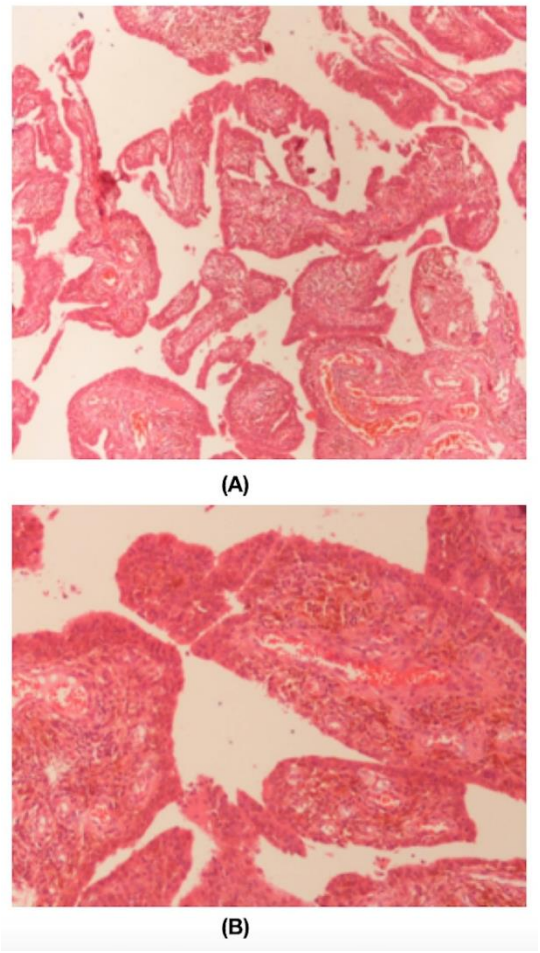

Fig 4. (A) Microscopically the lesion was composed of hyperplastic synovium with papillary and villous projections. (B) The papillary and villous structures showed proliferation of polygonal cells in a background of fibroconnective tissue, which was covered by synovial lining. Many hemosiderin-laden macrophages are also noted.

Different etiologies have been proposed including inflammation, hemangiomas or repetitive trauma; however, due to progressive growth, a neoplastic origin is strongly advocated [2]. Radiographically bony erosions, a dense effusion and preserved bone mineralization might be observed [8]. CT scan cannot adequately elucidate the extent of these lesions;

however, it can demonstrate bony erosions and subchondral cysts [2]. PVNS has characteristic findings on MRI constituting of intermediate to low signal intensity (SI) on T1weighted images as well as low SI on T2 images due to hemosiderin deposits. On gradient-echo images, there is blooming enlargement of low signal intensity [1, 2, 8]. Due to characteristic findings of MRI, other imaging modalities such as bone scan have been infrequently used.

Different patterns of radiotracer uptake have been described on three-phase ^{99m}Tc-MDP bone scan. Most investigators reported increased blood flow and blood pool radiotracer uptake, more prominent than the delayed findings [2, 9]. The pattern of three-phase bone scan in PVNS is not always a typical one. Hua et al. reported a case of PVNS in the vicinity of temporomandibular joint, an atypical location for PVNS demonstrating normal perfusion and blood pool images with slightly increased radiotracer uptake on delayed images. By this appearance a benign process as opposed to a malignant lesion, which commonly demonstrate positive three-phase bone scan, was suggested [7]. We also demonstrated faint flow and blood pool tracer uptake in the region of the mass lesion above the knee, with increasing tracer accumulation on delayed images. Moreover, in this case SPECT-CT provided valuable information by clearly delineating the abnormality and also by revealing the extent of osteoblastic reaction and joint involvement as the result of long-standing PVNS lesion.

Other radiotracers such as thalium has been used to detect PVNS lesions [9]. Evaluation with FDG PET/CT has also revealed increased metabolic activity in PVNS [10, 11], which can be misleading when evaluating oncological patient.

In conclusion, variable three phase bone scan patterns are seen in PVNS. Blood pool and vascular phases are not always the dominant as compared with delayed images. In fact, as our case indicate, there could be limited arterial and venous perfusion with unimpressive early image findings in these lesions. SPECT-CT has the potential role for better characterization and evaluation of extent of the disease involvement.

REFERENCES

1. Sharma H, Jane M, Reid R. Pigmented villonodular synovitis: diagnostic pitfalls and management strategy. Curr Orthop. 2005;19(3):215-22.
2. Murphey MD, Rhee JH, Lewis RB, Fanburg-Smith JC, Flemming DJ, Walker EA. Pigmented villonodular synovitis: radiologic-pathologic correlation. Radiographics. 2008 Sep-Oct;28(5):1493-518.
3. Myers BW, Masi AT. Pigmented villonodular synovitis and tenosynovitis: a clinical epidemiologic study of 166 cases and literature review. Medicine (Baltimore). 1980 May;59(3):223-38.
4. Yoon HJ, Cho YA, Lee JI, Hong SP, Hong SD. Malignant pigmented villonodular synovitis of the temporomandibular joint with lung metastasis: a case report and review of the literature. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2011 May;111(5):e30-6.
5. Barile A, Sabatini M, Iannessi F, Di Cesare E, Splendiani A, Calvisi V, Masciocchi C. Pigmented villonodular synovitis (PVNS) of the knee joint: magnetic resonance imaging (MRI) using standard and dynamic paramagnetic contrast media. Report of 52 cases surgically and histologically controlled. Radiol Med. 2004 Apr;107(4):356-66.
6. Kang GH, Chi JG, Choi IH. Pigmented villonodular synovitis in the sacral joint with extensive bone destruction in a child. Pediatr Pathol. 1992 Sep-Oct;12(5):725-30.
7. Hua Q, Ni J. Tumorlike Pigmented Villonodular Synovitis With Atypical Location: Appearance on 3-Phase 99mTc-MDP Bone Scan. Clin Nucl Med. 2017 Mar;42(3):203-205.
8. Al-Nakshabandi NA1, Ryan AG, Choudur H, Torreggiani W, Nicoloau S, Munk PL, Al-Ismail K. Pigmented villonodular synovitis. Clin Radiol. 2004 May;59(5):414-20.
9. Kransdorf MJ, Murphey MD. Imaging of soft tissue tumors. 2nd ed. Lippincott williams & wilkins; 2006. p. 381-436.
10. Kitapci MT, Coleman RE. Incidental detection of pigmented villonodular synovitis on FDG PET. Clin Nucl Med. 2003 Aug;28(8):668-9.
11. Elumogo CO, Kochenderfer JN, Civelek AC, Bluemke DA. Pigmented villonodular synovitis mimics metastases on fluorine 18 fluorodeoxyglucose position emission tomography-computed tomography. Quant Imaging Med Surg. 2016 Apr;6(2):218-23.