The Use of Magnetic Resonance Imaging in the Diagnosis of Pigmented Villonodular Synovitis

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ABSTRACT: Although the clinical and radiographic features of pigmented villonodular synovitis (PVS) have been well described, diagnosis is often delayed and high rates of recurrence after synovectomy are reported. Magnetic resonance imaging (MRI) has been shown to be useful in the diagnosis of soft tissue masses. Three patients with biopsy-proven PVS and radiographs showing only effusion underwent MRI in the axial, coronal, and sagittal planes. The margins of the diseased synovium were best demonstrated on long TR/TE (T2-weighted) images. The synovium contained areas of void signal intensity felt to be due to hemosiderin, interspersed with increased signal from both inflammation and fat. In all cases, the margins of the diseased synovium were clearly delineated, allowing classification as nodular or diffuse. No appreciable change in signal intensity was seen when comparing nodular and diffuse forms. MRI is useful but not specific for PVS, since rheumatoid synovitis may show a similar signal pattern. However, MRI in patients with suspected PVS may decrease the time until diagnosis, aid in preoperative planning and obtaining adequate margins of resection, and may be a non-invasive method of long-term follow up for possible recurrence.

Introduction

Pigmented villonodular synovitis (PVS), described by Jaffe et al in 1941,1 is a benign, usually monoarticular proliferation of synovium that most commonly occurs in the tendon sheaths of fingers, but also affects articular and bursal sheaths in the knee. Intraarticular lesions are subclassified into diffuse or nodular forms based on macroscopic appearance.2 Epidemiologically, PVS occurs equally in men and women during the second to fifth decades.3 Insidious onset of swelling and decreased range of motion are common presentations.4 Laboratory or plain roentgenographic evaluations are usually not helpful. Magnetic resonance imaging (MRI) has been found to be superior to CT scanning in defining soft tissue tumors.5 We describe three patients with biopsy proven PVS of the knee and who underwent MRI evaluation.

Materials and Methods

MRI was acquired using a General Electric SIGNA (Milwaukee, Wis) operating at 1.5 Tesla. Spin echo pulse sequences were obtained using various repetitions times (TR) and echo delays (TE). Short TR/TE (T1-weighted images) and long TR/TE (T2-weighted images) in axial, coronal, and sagittal planes were acquired in all patients. The images were correlated with plain radiographs and permanent pathologic specimens.

An 18-year-old man with a 9-month history of generalized swelling and stiffness in the left knee underwent MRI after radiographs demonstrated only an effusion and bone scan showed a suprapatellar hypervascularity (Fig 1A). MRI showed a large mass of increased signal intensity on T2-weighted images (Fig 1B,C) and a hypointense signal on T1-weighted sequences (Fig 1D) that was located beneath the vastus medialis and abutting the suprapatellar pouch. The mass was excised en-bloc via a medial parapatellar incision; pathologic sections confirmed PVS, nodular type. He was asymptomatic with a full range of motion at 9-month

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Fig 1A: Technetium bone scan (blood pool phase) showing hypervascular blush in the soft tissues in patient with nodular PVS of the knee. A moderate increased uptake on bone scan is usually seen in PVS during the blood flow and blood pool phases in soft tissues and in late images if bony erosion is present.

Fig 1B: T2-weighted (TR 2000/TE 80) sagittal image showing a well delineated large suprapatellar mass beneath the vastus medialis with areas of increased signal probably from edema and fat, and void signal consistent with hemosiderin. The combination of these findings are compatible with nodular PVS.

Fig 1C, D: Coronal section of nodular PVS with better demonstration of the mass on T2-weighted (TR 2200/TE 70) images (C), compared to the homogenous low signal on T1-weighted (TR 500/TE 20) images (D).
follow up. Postoperative MRI at that time showed no evidence of recurrence (Fig 1E).

The two other patients both had subtotal arthroscopic synovectomy with pathologic diagnosis of PVS. Both presented with stiffness and intermittent effusions. Xanthomatous fluid had been aspirated from both on multiple occasions. In one patient, a 40-year-old woman, MRI studies showed a mass in the left tibiofemoral joint space with superior, posterior, and anterior extension (Figs 2A-2B). This mass had areas of very bright signal intensity on T2-weighted images (Fig 2A) and was homogeneously hypointense on T1-weighted images (Fig 2B), consistent with diffuse type PVS. The other patient, a 28-year-old woman, showed a mass in the posterior aspect of the right knee of increased signal intensity on T2 imaging with adjacent erosion into the medial femoral condyle (Fig 3A). This mass had a signal intensity more inhomogenous on long and short TR and TE sequences (Fig 3B). After MRI, she underwent synovectomy via a medial arthroscopy, with pathologic diagnosis of PVS, diffuse type.

Discussion

Pigmented villonodular synovitis is an uncommon, slow growing, monoarticular lesion found in synovial joints and tendon sheaths. The etiology is unknown. Since Jaffe’s original description, intraarticular PVS has
Fig 3A, B, C: Sagittal T2-weighted image (A) showing an inhomogenous mass in the posterolateral and infrapatellar right knee consistent with diffuse type PVS. Note the erosion into the medial femoral condyle that is not appreciated on plain films (C). Again, T1 imaging (B) does not demonstrate the abnormality as well as the T2 images.

been subclassified based on its macroscopic appearance.2 Nodular PVS refers to the pedunculated synovial lesion; these patients often present with a clinical picture of internal derangement.6-8 Diffuse PVS refers to extensive synovial involvement, intermittent effusions, and moderate pain.6,7 The onset is insidious in both forms, and often months pass before patients seek medical attention.4,7 Local excision of nodular PVS usually results in complete relief of symptoms without recurrence.2,4,9-11 Curing patients with diffuse disease is more difficult, with recurrence rates of up to 46% after complete synovectomy, as reported by Byers et al.9 and 30% after synovectomy and postoperative radiation, as reported by Atmore et al.10 Total synovectomy in the knee is difficult, perhaps explaining these high recurrence rates. Treatment of recurrent intraarticular PVS is controversial. Wide synovectomy, radiation therapy, and radiation synovectomy have all been reported with variable results.4,7,9,10,12-14

Histologically, the hyperplastic hypervascular synovium contains hemosiderin-laden cells interspersed with lipid-filled foam cells and multinucleated giant cells
Fig 4A, B, C: Photomicrographs of hematoxylin/eosin sections at 100 x magnification (A) and 1000 x (B, C). Lower power shows proliferating mononuclear cells with scattered giant cells. Higher power view shows giant cells with adjacent foam cells, with inflammation, fibrosis, iron deposits, and occasional mitoses (C).

with variable amounts of inflammatory cells and fibrosis (Fig 4).2,4,7

Diagnosis cannot be confirmed by plain radiographs. Smith and Pugh described radiographic features of 28 patients with PVS of the knee.15 Cystic or erosive bony changes were seen in 8 of 24 patients with the diffuse form, and in 1 in 4 patients with the localized form. Most showed minimal soft tissue changes consistent with generalized synovitis. CT diagnosis of PVS was described by Rosenthal et al, who noted increased attenuation in the soft tissue iron content in the synovial tissues of patients with intraarticular PVS.16

No study exists comparing MRI findings of diffuse versus nodular PVS of the knee. Isolated cases of MRI of the nodular form have been reported.17-20 Both Kottali et al17 and Spritzer et al19 demonstrated increased signal intensity interspersed with low signal intensity on T2 images, which they felt was due to hemosiderin, synovial fluid, edema, and fat. No T2 image was described in Mandelbaum’s case report.18 Three cases of PVS of the knee were described by Jelinek et al, who noted signal characteristics similar to those seen in the current study.21

In our study, the signal intensities from the two patients with diffuse disease were similar to those from the patient with the nodular-type lesion. In all cases, the margins of the diseased synovium were clearly delineated, allowing classification as nodular or diffuse. This aids in surgical planning and prognosis. However, MRI is not specific in predicting the histologic nature of the lesion. Differential diagnoses include synovial sarcoma, synovial chondromatosis, hemophilia,
synovial hemangioma, and rheumatoid synovitis. Synovial sarcoma is usually pararticular, and soft tissue calcifications can be seen on plain radiographs in 30% of cases. Intraarticlar calcifications are usually found in synovial chondromatosis. Hemophilia is readily distinguished on clinical presentation and laboratory values. Hemangiomas often show phleboliths on plain radiographs.

The most difficult differential diagnosis is rheumatoid synovitis. Clinical history is important because PVS almost always appears as a chronic monoarticular arthropathy, while rheumatoid synovitis is often polyarticular. Jelinek et al stated that while T2 images of PVS and rheumatoid synovitis were indistinguishable, the T1 image in rheumatoid disease may have a more homogenous signal than in PVS. In addition, several cases of PVS in patients with rheumatoid arthritis have been described. MRI is thus useful, but not specific in the diagnosis of PVS.

References

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