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Post-Traumatic Hemosiderotic Synovitis of the Knee Mimicking Pigmented Villonodular Synovitis on Magnetic Resonance Imaging (MRI) in a Child: A Case Report

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Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Conflict of interest: None declared

Patient: Male, 13-year-old
Final Diagnosis: Post traumatic hemosiderotic synovitis
Symptoms: Knee pain • swelling and limitation in movements
Medication: —
Clinical Procedure: —
Specialty: Radiology

Objective: Rare disease

Background: Hemosiderotic synovitis (HS) is a rare proliferative synovial disorder with incompletely understood pathophysiology. It mainly affects the knee joint. It can be confused with pigmented villonodular synovitis (PVNS), both clinically and radiologically. HS has not been previously reported in children, and this rare incidence may lead to difficulties in early clinical and radiological diagnosis, possibly affecting the patient's outcome.

Case Report: A 13-year-old boy presented with progressive right knee pain, swelling, and limitation of movement 2 months after a traumatic injury in a soccer game. His past medical and family history was unremarkable. His physical exam showed right knee effusion, fullness in the popliteal fossa, and painful restriction in active and passive knee motion. Laboratory tests showed a mildly elevated erythrocyte sedimentation rate. Knee X-rays showed joint effusion. Knee MRI showed large knee joint effusion with diffuse low signal intensity villous synovial hypertrophy in all sequences in addition to a large popliteal cyst with the same imaging characteristics, consistent with diffuse-form PVNS. Total arthroscopic synovectomy was performed without complications. Intraoperatively, there was a large effusion containing yellow clots. The histopathological diagnosis was post-traumatic HS with no evidence of PVNS or malignancy. The patient showed significant clinical and radiological improvement postoperatively with no evidence of recurrence.

Conclusions: Post-traumatic HS is a very rare entity that should always be considered in the differential diagnosis of synovitis in active, non-hemophilic children. Radiologists' familiarity with this rare condition is important to guide correct and early diagnosis, and to avoid unnecessary invasive intervention.

Keywords: Child • Hemosiderin • Synovitis, Pigmented Villonodular

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/931992

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Background

Hemosiderotic synovitis (HS) is a distinctive type of proliferative synovial disorder that develops as a result of recurrent hemarthrosis [1-3]. It is most commonly caused secondary to hemophilia [1,2,4,5]. The most commonly involved joint is the knee [1-3,5,6].

Post-traumatic synovitis is a subtype of hemosiderotic synovitis (HS). Although sports injuries involving the knee are common, only a few reported cases are found in the literature describing this rare entity [1-8]. The exact cause and mechanism for the development of the long-term sequelae of such synovitis remain unknown [2,9].

On MRI, joint effusion is seen in HS with hypertrophied hemosiderin-stained synovium. This imaging appearance can closely mimic pigmented villonodular synovitis (PVNS). It is hard to differentiate between HS and PVNS clinically as well, with about 40% of HS being misdiagnosed as PVNS, according to a previous report [10]. Radiologists' familiarity with this rare entity in children and active teenagers is important to guide toward correct and early diagnosis and to avoid unnecessary invasive intervention.

In this report, we present a case of post-traumatic HS in a child that closely mimicked PVNS on MRI. The potential radiological features distinguishing the 2 entities are discussed.

Case Report

A 13-year-old healthy male patient presented to the orthopedic outpatient clinic complaining of progressive right knee pain, with swelling and limitation of movement of 2 months duration. His history was remarkable for a traumatic injury to his right knee during a soccer game. There was no history of any previous joint problems, infection, or any other chronic medical illnesses. There was no family history of rheumatological diseases or bowel problems.

Physical examination showed diffuse right knee swelling and warmth, and also fullness in the popliteal fossa. There was a painful restriction of both active and passive knee flexion and extension. Examination revealed that the neurovascular bundle was intact.

Laboratory blood workup values, including bleeding and rheumatological profiles, were within normal ranges. However, the erythrocyte sedimentation rate was mildly elevated.

Plain anteroposterior and lateral X-rays of the right knee showed significant knee effusion with no bony abnormality.

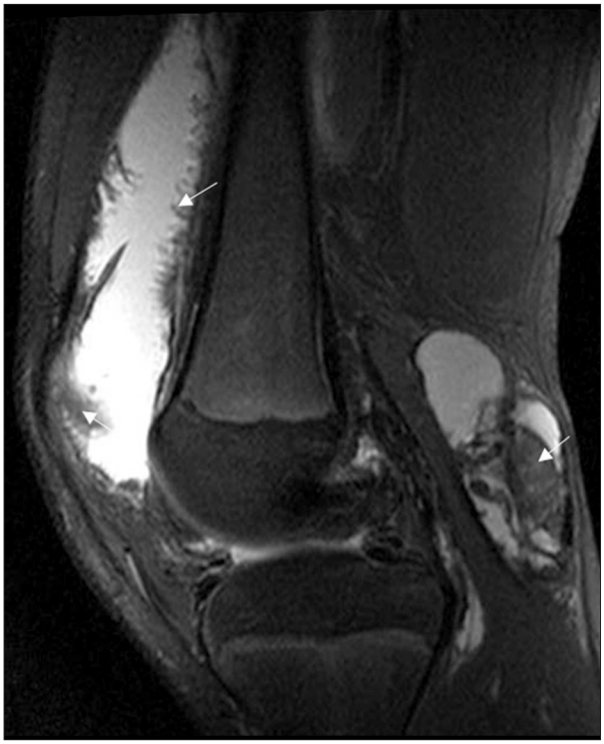

Figure 1. Sagittal proton density MRI of the knee showing large joint effusion with frond-like low signal intensity projections and lobulated masses seen in the suprapatellar recess and popliteal fossa (arrows).

An MRI scan was performed for better assessment, which showed large knee joint effusion with significant diffuse frond-like projections arising from the synovium, conferring low signal intensity on T1 and T2, consistent with hemosiderin deposition (**Figure 1**). Also, there was a septated popliteal cyst showing the same features. No post-contrast images were obtained at this time. The bone, menisci, and ligaments were all unremarkable.

A presumed radiological diagnosis of diffuse-form PVNS was given. Accordingly, the orthopedic surgeon planned to proceed with total arthroscopic synovectomy. However, the patient missed his follow-up appointment and came back after about 2 months reporting progression in his symptoms, including knee swelling and limitation of movement. A preoperative knee MRI was performed, which showed a significant increase in the joint effusion and popliteal cyst with unchanged hemosiderin-stained synovial villous hypertrophy (**Figure 2A**). A new lobulated, predominantly hypointense mass-like lesion was seen in the suprapatellar region (**Figure 2B**). The radiological assessment was consistent with the initial radiological diagnosis of progressing diffuse-form PVNS.

The intraoperative findings showed synovial thickening with a large effusion containing yellow clots. The mass of thickened

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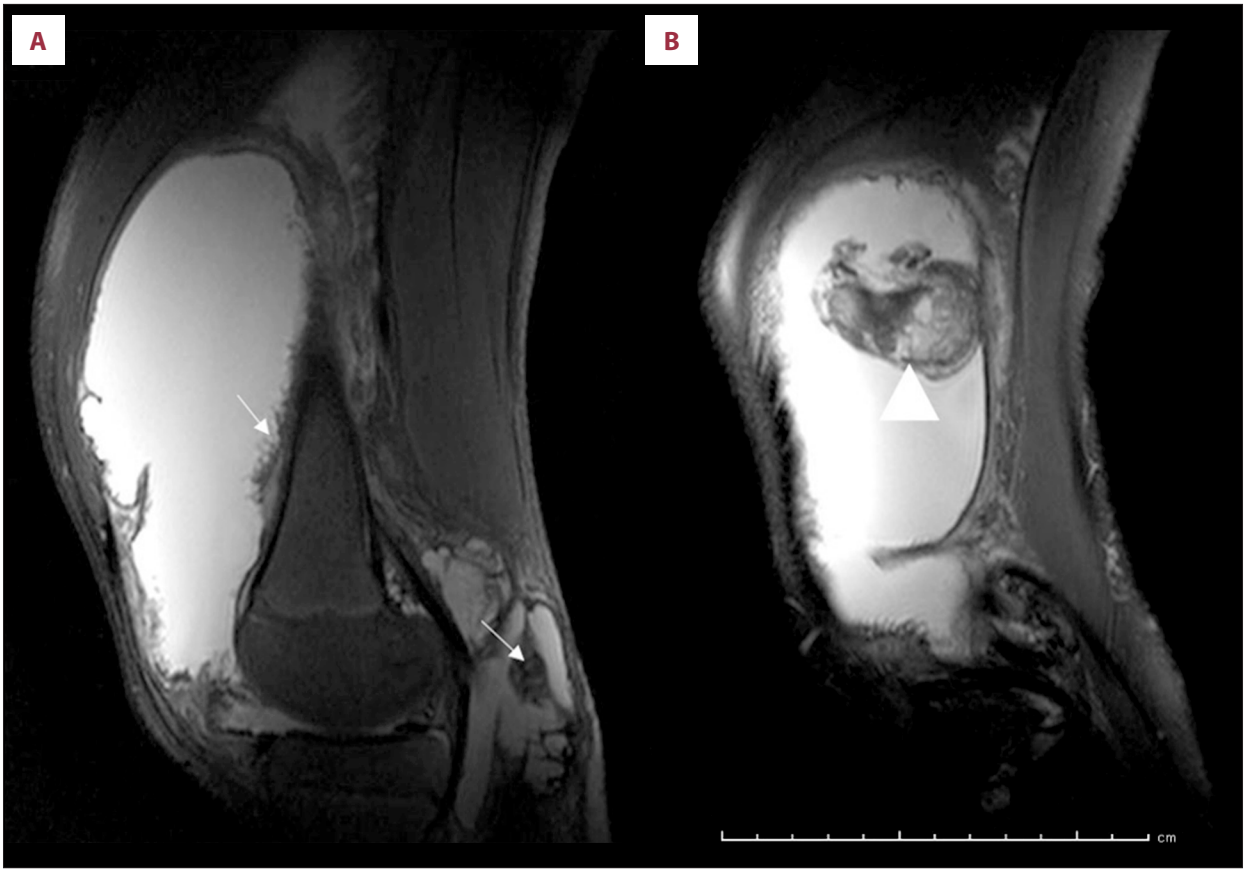

Figure 2. Sagittal proton density MRI of the knee after 2 months. (**A**) Notice the interval increase in the knee effusion compared with Figure 1. The frond-like low signal intensity projections and popliteal mass looked the same (white arrows). (**B**) There has been interval development of a large lobulated low signal intensity mass in the suprapatellar recess (arrow head).

synovium was excised and sent for histopathological analysis. The final histopathological diagnosis, surprisingly, revealed post-traumatic HS with no evidence of PVNS or malignancy.

The patient had an uneventful postoperative course. Significant clinical improvement in pain and range of knee motion was observed during his follow-up. MRI repeated 5 months after surgery revealed a significant interval decrease in the knee effusion and popliteal cyst with persistent diffuse hemosiderin-stained synovial thickening (**Figure 3A**). Post-contrast images obtained at this time showed mild synovial enhancement (**Figure 3B**).

Discussion

Post-traumatic synovitis is a rare subtype of HS that occurs secondary to intra-articular bleeding. As presented in this case, it can closely mimic PVNS both clinically and radiologically. The gross appearance of the synovium is also similar in both conditions, giving a brown or rusty color to the synovial membrane [5,11]. The ultimate goal of early recognition of this condition is to prevent permanent joint damage.

Few cases of non-hemophilic HS have been reported in the literature, and most of these, in contrast to this case, were not related to trauma (**Table 1**). HS has mostly been reported in the knee joint (**Table 1**) as is the case in our report, but HS has also been reported in the shoulder and hip joints [12-14]. Interestingly, one of these cases was secondary to a post-traumatic pseudoaneurysm of the posterior circumflex humeral artery, which mimicked shoulder PVNS on MRI.

The age of presentation for knee HS reported in the literature is variable, ranging from 19 to 76 years [1-8] (**Table 1**). This case report, to the best of our knowledge, represents the youngest reported patient with post-traumatic knee HS, and this added to the challenges in diagnosis. Similar to this case, most reported cases of HS were seen in males [1,6-8].

The duration of symptoms of HS varied among previous reports, ranging from 10 days after sustaining trauma [7] to 5 years in another report, in which no clear history of trauma was documented [4]. This might reflect the variable and unpredictable synovial response to mechanical trauma and intra-articular bleeding at the microscopic level. This is further

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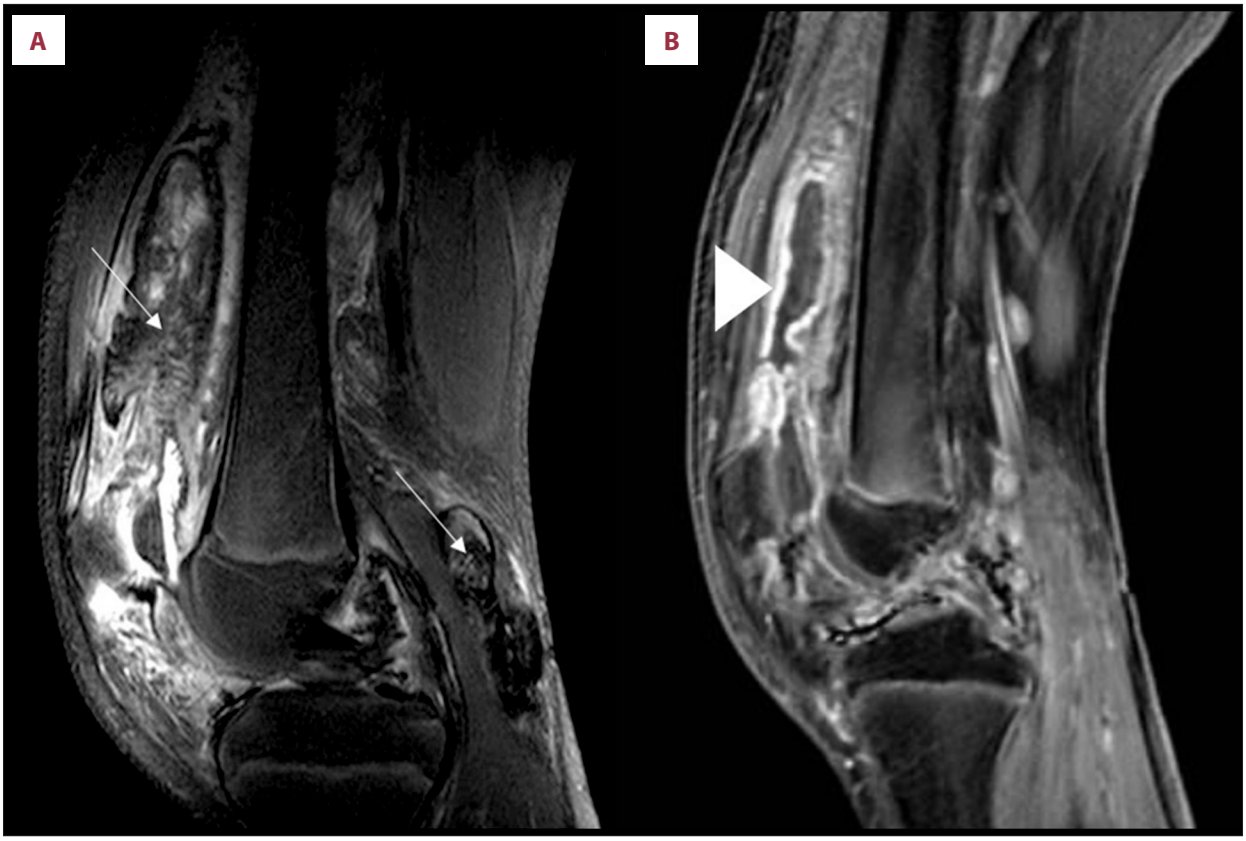

Figure 3. Sagittal MRI of the knee, 5 months after synovectomy. (**A**) Sagittal proton density with fat saturation. The joint effusion has resolved with persistent hemosiderin-stained synovium (arrows). (**B**) T1 post-contrast images with fat saturation demonstrating synovial enhancement (arrow head).

emphasized in our case by the progression of the clinical and radiological findings 2 months after the initial presentation.

All the reported cases in the literature posed a radiological diagnostic challenge at the time of presentation (**Table 1**), as was the case with our patient. In both our case and previous reports, X-ray findings were non-specific and inconclusive of certain diagnoses. Although MRI is an excellent non-invasive method for characterizing synovial diseases, the imaging appearances of HS and PVNS can overlap and cause confusion for the reading radiologists. This was evident in our case, in which the MRI was read on 2 separate occasions by an experienced musculoskeletal radiologist and a pediatric radiologist as PVNS. The combination of a popliteal cyst and low signal intensity mass-like lesions arising from the synovium, which were visible on all MRI scans, as well as the presence of hemosiderin-stained synovial hypertrophy, were highly suggestive of PVNS, although the age of our patient is not typical for this condition.

Few previous reports have investigated imaging features potentially differentiating between HS and PVNS. Some authors have emphasized the role of gradient echo magnetic resonance images for demonstrating the paramagnetic effect of hemosiderin stain in cases of HS associated with hemarthrosis [1]. Another report emphasized the history of trauma per se, in addition to the absence of bony changes on MRI, as adjuvants to the diagnosis of HS [7]. On MRI, the different ages of blood, depicted as areas of high signal intensity on T1 (subacute hemorrhage/methemoglobin), can be seen in both entities [6,13]. Significant joint effusion was seen in all of the reported cases of HS (**Table 1**) and is commonly seen in PVNS, making it an unuseful distinctive feature. A recent report has described the distribution of the maximum thickness of the thickened synovium in the suprapatellar bursa in HS compared with posterior predominance in PVNS [6]. They also reported less synovial contrast enhancement in HS compared with PVNS [6]. In the authors' opinion, normal surrounding bones might help to differentiate between these 2 entities in cases presenting early on after sustaining trauma. With recurrent bleeding to the joint and long-standing history, osteoarthritic changes may take place in response to the articular cartilage damage influenced by the release of proinflammatory cytokines secondary to iron deposition [15]. This makes histopathological diagnosis the criterion standard for differentiating between HS and PVNS. Histopathologically, HS lacks the distinct foam cells and

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Table 1. Cases of hemosiderotic synovitis identified through literature review.

Author	Site involved	Sex	Trauma	Age (years)	X-ray findings	MRI findings				Diagnostic method	Treatment
						Knee effusion	Thickened synovium	Low T1 and T2	Blooming on GRE		
Jain et al [1]	Right knee	M	No	19	Knee effusion and periarticular swelling	Yes	Yes	Yes	Yes	Histo-pathology	N/A
Deshmukh et al [4]	Left knee	F	No	19	N/A	Yes	Yes	Yes	N/A	Histo-pathology	Synovectomy
Yalçin et al [5]	Right knee	F	No	20	Normal	N/A	Yes	N/A	N/A	Histo-pathology	Subtotal synovectomy
Jayalakshmi et al [2]	Left knee	F	No	73	N/A	N/A	N/A	N/A	N/A	Histo-pathology	Total knee replacement
Atik et al [7]	Right knee	M	Minor twist	23	Normal	Yes	Yes	Yes	N/A	Histo-pathology	Synovectomy
Ando et al [6]	4 right knees, 4 left knees	6M, 2F	No	48-76	N/A	Yes	Yes	Yes	Yes	Histo-pathology	N/A
Zeiss et al [8]	Left knee	M	Motor vehicle accident	40	Knee effusion	Yes	Yes	Yes	N/A	Histo-pathology	Partial synovectomy
Bartlett et al [3]	Left knee	F	No	77	Valgus deformity, subchondral sclerosis and infarction of the lateral femoral condyle	N/A	N/A	N/A	N/A	Histo-pathology	Total knee replacement

M – Male; F – Female; MRI – magnetic resonance imaging; GRE – gradient echo; N/A – not available.

the multinucleated giant cells that characterize PVNS [10,11]. Therefore, we advise arthroscopic synovial biopsy for any patient who presents with atypical clinical or confusing MRI findings of synovitis to avoid more invasive intervention, especially in children, like in our case.

Conservative and surgical options are both available for treating HS depending on the severity of symptoms and the underlying cause [1,9]. Synovectomy is an effective surgical option in preventing osteoarthritic changes and treating recurrent bleeding into the joint [1]. PVNS, on the other hand, requires aggressive surgical resection and possibly radiotherapy [4]. The difference in treatment strategies serves to emphasize the importance of making the distinction between the 2 pathologies. Most of the reported cases of HS in the literature were treated with subtotal/total synovectomy. This was either due to unclear preoperative clinical and radiological diagnosis – as was the case in this report – or to control the patients' symptoms.

Conclusions

Post-traumatic hemosiderotic synovitis is a very rare entity that should always be considered in the differential diagnosis of knee hemarthrosis in active, non-hemophilic children.

Radiologists should be aware of the different possible causes of knee synovitis, as prompt early recognition of the underlying cause will lead to appropriate therapy, thus preventing permanent joint damage.

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Arthroscopic synovial biopsy should always be considered in cases with atypical clinical and radiological presentations of synovitis. This would help in avoiding a more invasive intervention, especially in children.

Further studies at the microscopic level are needed to identify the exact triggering factor contributing to the changes seen in post-traumatic hemosiderotic synovitis. The risk factors associated with the variable body response to trauma/intra-articular bleeding should also be further investigated.

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Conflict of Interest

None.

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