Case report

Higher incidence of diffuse Pigmented Villonodular Synovitis in patients with ruptured cruciate ligament: A case report

Xi Chen a,b,1, Ping Li b,1, Wenhui Zhang b, Xiaopeng Yin a,b, Qunying Ma a,*, Kun Wang b,*

a Orthopedics department, Affiliated Hospital of Xizang Minzu University, Xianyang 712000, China
b Department of Joint and Trauma Surgery, The Third Affiliated Hospital of Sun Yat-sen University, Guangzhou 510630, China

1 Ping Li and Xi Chen work equally in this work.

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ABSTRACT

Introduction: Pigmented Villonodular Synovitis (PVNS) is a kind of extremely rare and not easily diagnosed disease, while the occurrence following the anterior cruciate ligament (ACL) rupture is comparably high. Case presentation: Here we reported 2 patients presenting knee swelling, pain, and giving away symptoms following a rupture of ACL history. Clinical and radiological findings were supportive of ACL rupture and PVNS, prompting the patient to undergo surgery. The synovium was completely removed with the help of an arthroscopic. Reconstruction of the ruptured ACL was carried out a few months later. At the last follow-up visit, both the patients were doing well with no recurrence of pain, swelling, or give way sensation. Discussion: The diagnosis of PVNS is often difficult because in the early stages, symptoms are often non-specific and pathological examination remains the gold standard for the diagnosis of PVNS. We have reviewed some of the previously reported literature on PVNS, suggesting that joint instability may be an important risk factor for PVNS and summarizing the treatment options for PVNS. Conclusion: More attention should be paid to the incidence of PVNS in patients with joint instability, particularly in patients with cruciate ligament injuries. Early and reliable stabilization of the joint may significantly prevent PVNS and ensure a better clinical outcome.

1. Introduction

Pigmented Villonodular Synovitis (PVNS) is a rare, locally aggressive disease that involves the joint synovia, bursae, and tendon sheath [1,2]. PVNS always occurs in the knee and seldomly involves the ankle and hand joints [3]. The WHO defined two different types: 1. Localized PVNS grows slowly over time and patients tend to present with pain and sometimes mechanical symptoms such as catching and locking; 2. Diffuse PVNS in the joint is typically characterized by knee effusion, pain, and limited range of motion (ROM) [4,5]. There have been several case reports citing intra-articular PVNS, but there have been no previous reports describing the development of PVNS after the rupture of the anterior cruciate ligament (ACL). In this case report, we present two rare cases of PVNS arising from the torn ACL and its treatment with arthroscopy. The work has been reported in line with the SCARE 2020 criteria [6].

2. Case report

Here we reported 2 patients presenting knee swelling, pain, and giving away symptoms following a history of ACL rupture. Both patients underwent MRI using a dedicated 1.2 T unit or a whole-body 3.0 T unit.

2.1. Case 1

A 28 years old young man suffered from a recurrence of left knee swelling for 11 months. The swelling occurred after an injury to the left knee during a basketball game. Since then, he has experienced swelling, pain, and a sense of giving away in his left knee during activities such as climbing stairs or squatting, which subsided after rest. Considering the recurrence of symptoms, the patient decided to visit our orthopedic department and had no other treatment prior to this. The patient had no other underlying diseases.

Physical examination revealed swelling, tenderness of the knee, and a limited ROM of the knee joint, with pain evoked by flexion over 45°.

* Corresponding authors.
E-mail addresses: b0b0b0b@163.com (Q. Ma), dr_wangkun333@163.com (K. Wang).

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Lachman test and anterior drawer tests were positive, while negative Pivot-Shift test, McMurray, and Apley test were detected. MRI of the knee showed significant joint effusion and cruciate ligament discontinuity [Fig. 1]. Laboratory tests showed elevated erythrocyte sedimentation rate and C-reactive protein, while all the other results were within normal limits.

Subsequently, arthroscopic and histological findings confirmed the diagnosis of diffuse PVNS and the ruptured ACL [Fig. 1]. The patient presented significantly decreasing pain compared to that during the preoperative period. The patient received monthly follow-up in the outpatient department with radiological and a complete clinical examination, and no signs of local recurrence were detected. After 9 months, the patient returned to our hospital and received ACL reconstruction. His sense of giving way was mitigated after reconstruction and no recurrence of the disease after 5 months of follow-up.

2.2. Case 2

A 46-year-old man is suffering from pain and swelling in his right knee after a long-distance hiking. A year prior to this injury, he had also experienced severe pain and swelling in his right knee after a basketball match, which subsided after rest. The patient had no chronic diseases and other underlying diseases. The patient complained of pain in his right knee, effusion, and locking symptoms, there also present a sense of giving way. In view of the significant pain, he came to our outpatient department and had not received other treatments prior to this.

On clinical examination, there was a 15° extensor lag in his injured knee, mild effusion, and tenderness along the lateral joint line. In addition, the anterior drawer test was positive, while the Pivot-Shift test, McMurray, and Apley test were negative. The MRI examination reveals severe effusion and discontinuity of the ACL [Fig. 2]. Routine laboratory examination indicated higher ESR and increased C-reactive protein level. In the arthroscopic examination, the joint capsule had been covered with yellowish-brown pigmentation [Fig. 2], while the menisci, posterior cruciate ligament, and articular cartilage were normal. There were no complaints of pain or swelling of any other joints.

Considering these symptoms, we also designed an arthroscopic total synovectomy for him, but no ACL reconstruction was performed. The patient received monthly follow-up in the outpatient clinic also with radiological and a complete clinical examination, and there was no recurrence of knee effusion. 6 months later, the patient returned to our hospital and underwent an ACL reconstruction. His sense of giving way was mitigated after reconstruction, and he has not experienced any recurrence of the disease after 12 months of follow-up.

Formal informed and signed consent was obtained from the patients before reporting the cases.

3. Literature search strategy

To further analyze the effects of the ruptured cruciate ligaments in the etiology of PVNS, we reviewed all the published reports about PVNS, we searched MEDLINE/PubMed database up to May 2022 using the keywords: pigmented villonodular synovitis/PVNS, TGCT, and cruciate ligament. We reviewed abstracts and retrieved the appropriate articles reporting PVNS patients with damaged knee joints published in English.

4. Discussion

Pigmented villonodular synovitis demonstrates a locally destructive process which could lead to difficulty with daily activities. PVNS is frequently delayed in diagnosis due to nonspecific symptoms [2,7–9]. Compared to X-ray and CT scans, MRI has a good resolution of soft tissue and could accurately and completely show the location, extent, and depth of invasion of the lesions. PVNS on MRI is usually presented as a lump with lobulated contours margins and shows low signal intensity on both the T1 and T2 weighted images [10,11]. However, histopathological result remains the gold standard for PVNS diagnosis. Pathological specimens of PVNS often be characterized that the hypertrophic synovium is typically villous, nodular, or villonodular and encloses floating amounts of hemosiderin [12–14]. However, non-specific symptoms, the high cost of imaging examinations, and invasive specimen collection methods prevent many patients from being diagnosed on time.

Rupture of the cruciate ligament leads to twisting of the weight-bearing limb, timely cruciate tendon reconstruction could reduce the risk of medial meniscus ruptures and future cartilage erosion. However, the locally destructive and inflammatory environment induced by this disease leads to a high failure risk of cruciate tendons reconstruction. According to the clinical and radiographic results, PVNS is defined as the localized PVNS with well circumscribed nodules and diffuse-PVNS with ill circumscribed and locally aggressive [15]. In our review, we found that among all the patients with damaged cruciate tendon, the incidence of diffuse PVNS is much higher than localized type in patients with damaged cruciate ligaments: 12 out of 16 patients, and are mostly male patients, while localized PVNS mainly occurs in patients with partial damaged cruciate tendons, meniscus injury or loose joints, indicating that unstable joints could be an important risk factor of PVNS. Besides, the age also counts: 21 patients with an age ≤45 years old and only 10

Fig. 1. (A) MRI of the knee joint, showing effusion, discontinuity of the ACL, and low signal intensity of hyperplastic synovium on T2. (B) Arthroscopic examination, revealing the yellowish-brown pigmentation in the joint capsule. (C) H&E staining exhibited proliferating mononuclear synovial cells, round histiocytes, and deposition of brown hemosiderin pigment (H&E staining, original magnification ×10). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
patients out of a total of 32 patients. Surprisingly, the genders did not show big differences [Table I]. The occurrence rate of localized PVNS and diffuse PVNS is nearly the same: 17 and 14 respectively. While due to the high recurrence of diffuse PVNS, finding more effective therapies for PVNS remains a theme of dispute. In a retrospective review of the patients who accepted surgical treatment between 1990 and 2022 [16–23], the results exhibit that higher recurrence rate of arthroscopic synovectomy compared with open synovectomy. However, the arthroscopic therapy is a minimally aggressive surgical operation that could narrow the scope of operation, lessen tissue trauma, and promote early functional exercise, allowing the earlier return to the daily life [24]. The combined anterior arthroscopic and posterior open synovectomy in the knee could be a good option because some researches have shown that the recurrence rate of it is lower than arthroscopic synovectomy and open synovectomy. In addition, if there is a destructive change in the joint surface that cannot be treated by synovectomy alone, total knee arthroplasty can provide a reliable improvement in function, but the risk of knee stiffness is significantly increased after total knee arthroplasty which should be noted [25,26].

It is helpful for adjuvant therapies to improve treatment outcomes and reduce the recurrence rate of diffuse PVNS. Recently, researchers found that the recurrence rate of patients who embraced adjuvant external beam radiotherapy, normally with a dosed of 30 Gy to 50 Gy, was prominently lower than that of patients who accepted only synovectomy [27–29]. Meanwhile, some systemic treatments targeting the CSF1-CSF1 receptor axis for patients with PVNS have been proven to be effective [30–32]. However, targeted therapies have side effects of different degrees so they are used for patients with locally advanced PVNS and multiple recurrences. In recent decades, CSF-1 pathway was reported to be involved in the pathological process. Emactuzumab and PLX3397 could be promising alternations, which work either through binding to the CSF-1 receptor on the surface of macrophages, or blocking molecular endpoints of CSF-1, demonstrating a well-tolerated and high clinical response, reaching almost 52 %, of patients [33,34]. More recently, the usage of pexidartinib, a CSF-1 receptor antagonist, was approved by the FDA in August 2019 and achieved a good response in patients with the extensive disease [35,36].

5. Conclusion

PVNS is a very rare condition. This report aims to arise concerns about the incidence of PVNS in patients with joint instability, especially in patients with cruciate ligament injuries. Timely and reliable stabilization treatments of the joint may significantly prevent PVNS and guarantee a better clinical outcome.

Consent

Signed consents were obtained from both patients for publishing this
case report and the usage of the accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

**Ethical approval**

This study was approved by the local ethics committee (The Third Affiliated Hospital of Sun Yat-sen University [2022-02-107-01]).

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**CRediT authorship contribution statement**

Kun Wang: Conceptualization, Methodology, Investigation, Resources, Data Curation.

Ping Li: Methodology, Formal analysis, Writing - Review & Editing, Supervision, Project administration, Diagnosis and clinical management of the case and final approval of the version to be published.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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