



Case report

Recurrent Hemarthrosis After Total Knee Arthroplasty

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ABSTRACT

Recurrent hemarthrosis is a rare complication after total knee arthroplasty (TKA). Its incidence is reported as less than 1%. Most patients present with acute knee pain and swelling in the absence of trauma, resulting in significant loss of function. The authors report a case of recurrent hemarthrosis in a 64-year-old female. She presented with repeated episodes of sudden-onset right knee pain, swelling, and bruising at 18 months after a right TKA. During revision knee surgery, the recurrent hemarthrosis was identified to have been caused by entrapment of hypertrophied knee synovium under the TKA tibial base plate. After excision of the synovial tissue and cementing of the tibial defect, the patient recovered well after surgery with no future recurrences of knee pain and swelling.

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Introduction

Recurrent hemarthrosis is a rare complication after total knee arthroplasty (TKA) with a prevalence of less than 0.65%. If untreated, recurrent hemarthrosis can result in poor patient outcomes, such as persistent pain, stiffness, and even prosthetic joint infection. The possible causes of recurrent hemarthrosis in the literature include hypertrophied synovial tissue between components of the knee prosthesis, anticoagulant therapy, bleeding disorders, pigmented villonodular synovitis (PVNS), arteriovenous fistulae, pseudoaneurysms, and bleeding from arterial branches [1–4].

The evaluation of the cause of bleeding during each episode of hemarthrosis is challenging. This makes the management of such cases a diagnostic dilemma for both surgeon and patient. The authors present such a case of a health-care worker who had to endure 3 episodes of severe knee pain and swelling for 1 month while investigations and evaluations were performed to formulate a surgical plan. The improved understanding of post-TKA lucencies as well as its possible causation of recurrent synovitis and hemarthrosis helped the surgeons to manage her condition successfully.

Case history

A 64-year-old female health-care assistant presented to the clinic 18 months after a cruciate-retaining right TKA with sudden-onset knee pain and swelling. She had difficulty in weight-bearing on her right knee. She has a medical history of diabetes mellitus and chronic hypertension and was not on any antiplatelet or anticoagulation medications at the time. There was no preceding history of knee trauma or fever.

On examination, there was a gross right knee swelling and bruising noted over the proximal tibia. Movement of her right knee was painful, and the range of motion was markedly reduced. The blood investigations showed normal white cell counts, inflammatory markers, and coagulation panel. Radiographs of the right knee showed medial tibial bone resorption beneath the tibial base plate (Fig. 1a and b). After an overnight stay in the hospital, her pain, swelling, and bruising improved. The patient was comfortable enough to walk unsupported, and she was discharged home thereafter.

Two weeks later, the patient presented to the outpatient clinic with a similar episode of sudden-onset right knee pain and swelling. The knee joint aspiration revealed 30 mL of frank blood (Fig. 2). The fluid microscopy examination was normal, and the Synovasure Alpha Defensin Lateral Flow Test (by Zimmer, Warsaw, IN) performed on the aspirate was negative. All bacterial and fungal cultures were negative. The coagulation tests performed were normal. A non-contrast computed tomography (CT) scan of the

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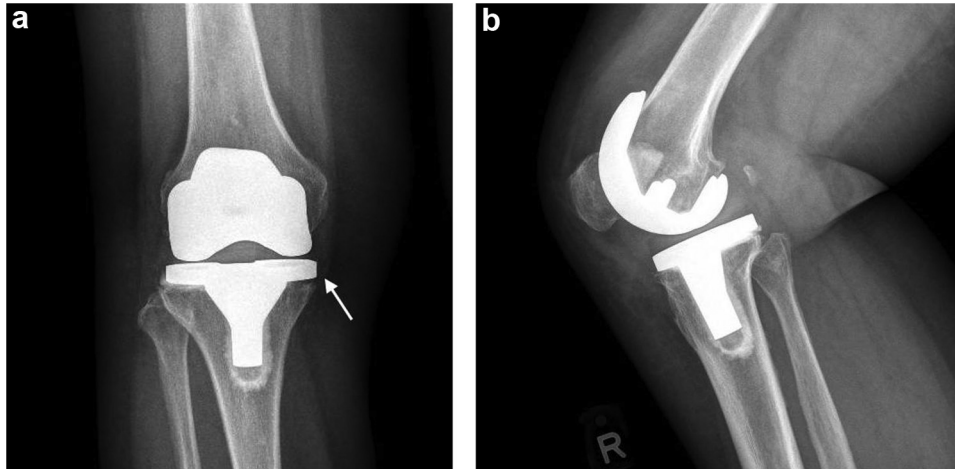


Figure 1. Preoperative anteroposterior (a) and lateral (b) radiographs of the right knee. The arrow in (a) indicates an area of lucency under the medial tibial base plate.

right knee confirmed bone resorption under the medial tibial base plate with no fluid collection noted (Fig. 3). There was no vascular blush suggestive of an active bleeding source. The patient's right knee pain and swelling gradually resolved with 3 days of bed rest in the hospital, and she was subsequently discharged.

One week later, the patient again presented to the clinic with right knee pain and swelling. This was following her return to work after discharge where she had walked more than usual. A repeat right knee aspiration yielded 20 mL of frank blood. All cultures performed on this joint aspirate were once again negative.

After the second aspiration of blood from the knee joint, other imaging modalities to evaluate possible causes of intraarticular bleeding were discussed with the radiologist. This was however not pursued further as it was felt that the patient did not have an active,

ongoing source of intra-articular bleeding. As such, further imaging such as the use of an angiogram would have provided little yield.

After this third episode of right knee pain and swelling, it became apparent that the patient was experiencing recurrent episodes of hemarthrosis after her TKA. She was then counseled for an open synovectomy of the right knee.

The intraoperative findings correspond with the preoperative imaging, showing the overhang of the tray from medial bony resorption. The defect under the tibial base plate was visualized to be filled with hypertrophic synovium (Fig. 4). Synovectomy was performed after the arthrotomy. The synovial tissue entrapped within the bone defect was excised. The underlying bone was prepared with drill holes and dried thoroughly before cement was introduced to the defect (Fig. 5).



Figure 2. Culture bottles containing frank blood aspirated from the patient's right knee.

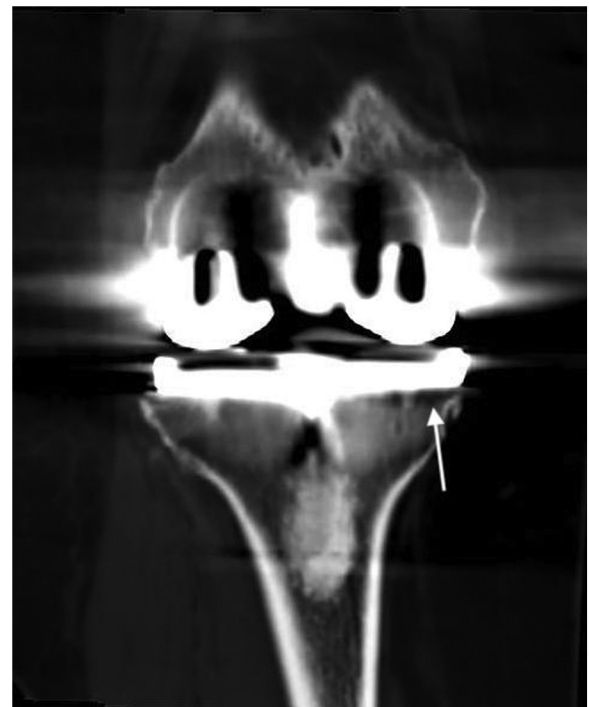


Figure 3. Coronal cut of a preoperative CT scan of the right knee. The arrow shows the area of bone defect under the tibial plate.

Postoperatively, the patient recovered uneventfully and was able to walk unsupported 1 week after surgery. All intraoperative blood cultures performed were negative. The patient was able to return to work 1 month after the surgery. She had no further episodes of right knee pain and swelling and remained well at 2 years after the surgery. Figure 6 shows a radiograph of her affected knee at 2 years after surgery. Her consent was obtained for the publication of this case report.

Discussion

The first learning point is that patients with recurrent hemarthrosis after a TKA can present with episodes of short-term acute-onset knee pain, swelling, and bruising without a history of trauma [1,2,4]. As was performed in our patient, the presence of a deep periprosthetic infection in the joint must be investigated with joint aspiration, laboratory testing, and synovial fluid culture.

The etiologies of recurrent hemarthrosis can be divided into either local or systemic (Table 1). The most common etiology reported is the entrapment of hypertrophied synovial tissue or fat pad between components of the knee prosthesis. Kindsfater and Scott reported that 43% of their patients had synovial entrapment as the source of recurrent hemarthrosis [2].

The mechanism leading to synovial hypertrophy remains unknown. Minor trauma is postulated to lead to an initial episode of intra-articular bleeding with activation of proinflammatory mediators. This leads to synovitis and synovial hypervascularity. The proliferative synovium then gets impinged between components of the TKA during knee flexion. This leaves the synovium more susceptible to recurrent bleeds—a vicious cycle between synovial inflammation and recurrent episodes of hemarthrosis [5–8].

Another potentially serious cause of recurrent hemarthrosis is PVNS—a benign, proliferative tumor of the synovial tissue. The diagnosis of PVNS is made via histological examination of resected



Figure 5. Intraoperative picture showing the area where medial “spackling” was performed with cement used to cover the defect (as indicated by the arrow).

samples but can be suggested by findings seen on MRI scans [9]. On MRI, diffuse PVNS will show up as a diffuse, nodular, plaque-like thickening of the synovium with heterogeneous low to intermediate signal intensity on T1-weighted imaging and low signal

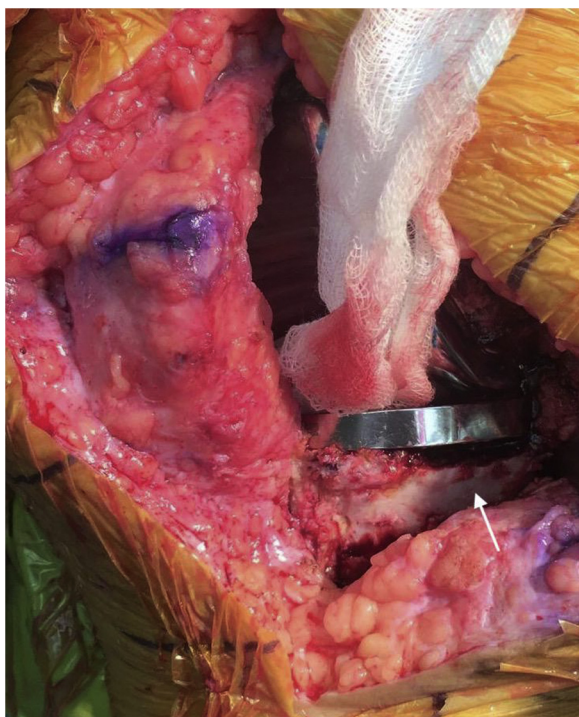


Figure 4. Intraoperative picture showing an area of lucency after excision of the synovium (as indicated by the arrow).



Figure 6. Two-year postoperative anteroposterior radiograph of the right knee. The arrow points to the cement under the medial tibial base plate.

Table 1
Etiologies of recurrent hemarthrosis.

Local
Impingement of hypertrophied synovium
Acute trauma/injury
Vascular malformations
Pigmented villonodular synovitis (PVNS)
Intra-articular/extra-articular tumors
Implant instability
Polyethylene wear
Systemic
Anticoagulant/antiplatelet use
Blood coagulopathies
Platelet defects

intensity on T2-weighted imaging (due to the presence of hemosiderin) while focal PVNS appears on all imaging sequences as a low signal mass [10].

Vascular injuries within the knee joint can also result in recurrent hemarthrosis. These include injuries to the superior and inferior lateral geniculate arteries, bleeding from arterial branches of the knee, arterio-arterial, or arterio-venous fistulae, pseudoaneurysms, or erosion of the femoral component through a hypertrophied atherosclerotic artery [11–14]. Risk factors for vascular malformations include previous complex surgeries, soft-tissue compromise, vascular diseases, and medical factors such as atherosclerosis, hypertension, and diabetes mellitus.

The second lesson is the proposed algorithm to investigate the cause of recurrent hemarthrosis. A coagulation panel is useful to assess the risk factors which predispose patients to episodes of recurrent bleeds. A coagulation panel assesses the total platelet count, prothrombin time, and activated partial thromboplastin time. Where indicated, specific factor assays (eg, for factors VIII and IX which are implicated in hemophilia) can be performed as well [15,16]. Walsh et al. also recommends that patients undergo further evaluation of their platelet function even if the coagulation panel and platelet counts return as normal [9]. This would elucidate platelet defects such as the platelet factor 3 availability defect and von Willebrand's disease which have been implicated in the pathogenesis of recurrent hemarthrosis [1].

In addition, many algorithms for recurrent hemarthrosis after TKA include vascular imaging modalities such as angio-CT, angio-MRI, Doppler studies, and angiography [1,2,4,16]. These can be used to visualize the vascular anatomy of the knee and thus detect vascular malformations or vascular injuries as well as identify active sources of bleeding. Hash et al. reported on the use of angio-MRI in the evaluation of recurrent hemarthrosis after TKA [7]. Angio-MRI is less invasive as it only requires intravenous access rather than arterial catheterization and can also evaluate adjacent osseous and soft-tissue structures, especially the synovial tissue. If a vascular lesion is found, selective embolization by angiography can be considered [7]. Weidner et al. reported that 12 of 13 patients obtained resolution of hemarthrosis after one session of embolization [11]. However, Yoo et al. reported recurrence of bleeding after arterial embolization in all 3 cases that underwent arterial embolization, with 2 out of the 3 cases requiring open arthrotomy subsequently [16].

For this patient, the coagulation panel was found to be normal. Further imaging modalities were not pursued in light of discussions with the radiologist. During each episode, the patient's pain and symptoms resolved with rest, suggesting no active sources of intra-articular bleeding present. As such, the radiologists and surgeons felt that further imaging would have provided minimal yield. The surgeons postulated that the tibial bone defect could account for her symptomatic synovitis and thus planned for a surgical solution after the 3 episodes of hemarthrosis which the patient experienced. The authors propose that in the workup algorithm of recurrent

hemarthrosis, vascular imaging may not be a compulsory component of investigations for patients with bone defects under the tibial base plate.

The third lesson is to formulate an appropriate treatment plan for the recurrent hemarthrosis. Of all, 82.3% of patients in one study were reported to have benefitted from conservative management alone, showing symptomatic improvement without further need for investigations or interventions [16]. However, other studies have only reported a one-third success rate with conservative treatment [1]. Conservative management involves symptom relief via joint aspirations as well as advice to the patient to immobilize, ice, and compress the affected knee. Patients on antiplatelets and anticoagulants were also asked to discontinue their medications [1,16].

If symptoms fail to resolve after conservative care, further investigations are then mandated, and possible surgery is recommended as the mainstay of treatment for recurrent hemarthrosis [10]. With surgery, better patient outcomes have been observed in open synovectomy than in arthroscopic synovectomy: Some patients who were treated arthroscopically had a recurrence of hemarthrosis that was only resolved after subsequent open synovectomy [2]. This is often because the synovial tissue remains easily entrapped between components of the prosthesis even after arthroscopic synovectomy is performed. Ohdera et al. reported that 2 out of 6 patients who had undergone arthroscopic synovectomy had a full resolution of symptoms [7]. It is also important to point out that cases which have an area of lysis under the tibial base plate cannot be addressed arthroscopically.

The final lesson is the surgical plan in the management of recurrent hemarthrosis as well as synovitis from medial tibial bone defects. The etiology of the medial tibial bone loss is uncertain. One possible reason is that bone resorption occurs as a result of stress shielding imparted by the more rigid tibial tray. A second reason is polyethylene wear—wear can present as an isolated radiological finding or it can also produce symptomatic wear debris synovitis and eventual osteolysis.

Scott reported that polyethylene wear complications account for 50% of repeat surgery after cruciate-retaining TKAs; two-third are associated with osteolysis, and one-third with synovitis only [17]. The incidence of requiring an operation for a wear-related problem is 0.2% per year of follow-up for the first 27 years [17].

Martin et al. have proposed a medial tibial “spackling” procedure for symptomatic medial tibial bone loss. [18] For this revision procedure, it is necessary to prepare the proximal medial tibia well. The area of resorption beneath the tray filled with fibrous tissue should be curetted down to bone. A small drill bit is used to drill holes of approximately 3–4 mm deep into the bone to enhance cement pressurisation and fixation. The bone bed for cementation is well irrigated and dried prior to cement application.

The bone cement pressurized manually into the medial tibial bone drill holes initially. An elevator is used to “spackle” additional cement into the bone void with care taken to apply the bone cement evenly and shaping it. Firm pressure is applied until the cement sets. This was what was performed for the medial bone defect in this patient.

Summary

Recurrent hemarthrosis after TKA is rare. It presents with sudden acute knee pain, without a history of trauma. The diagnosis is achieved via aspiration of the affected knee joint. The workup includes the need to exclude a prosthetic joint infection, a coagulation panel, and additional vascular imaging modalities such as angiography. In recurrent hemarthrosis, open synovectomy and the need to address tibial bone defects are critical for a good revision outcome.

Conflicts of interest

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 article.

Acknowledgments

Informed Patient Consent: The author(s) confirm that informed consent has been obtained from the involved patient(s) or if appropriate from the parent, guardian, power of attorney of the involved patient(s); and, they have given approval for this information to be published in this case report (series).

References

- [1] Walsh JM, Campbell KJ, Jacobs JJ, Rosenberg AG. Recurrent haemarthrosis following total knee arthroplasty: etiology, diagnosis, and treatment. *Semin Arthroplasty* 2018;29(3):223.
- [2] Kindsfater K, Scott R. Recurrent hemarthrosis after total knee arthroplasty. *J Arthroplasty* 1995;10(S1):S52.
- [3] Sward P, Frobell R, Englund M, Roos H, Struglics A. Cartilage and bone markers and inflammatory cytokines are increased in synovial fluid in the acute phase of knee injury (hemarthrosis) - a cross-sectional analysis. *Osteoarthritis Cartilage* 2012;20(11):1302.
- [4] Worland RL, Jessup DE. Recurrent hemarthrosis after total knee arthroplasty. *J Arthroplasty* 1996.
- [5] Saksena J, Platts AD, Dowd GSE. Recurrent haemarthrosis following total knee replacement. *Knee* 2010;17(1):7.
- [6] Hash TW, Maderazo AB, Haas SB, Saboeiro GR, Trost DW, Potter HG. Magnetic resonance angiography in the management of recurrent haemarthrosis after total knee arthroplasty. *J Arthroplasty* 2011;26(8):1357.
- [7] Ohdera T, Tokunaga M, Hiroshima S, Yoshimoto E, Matsuda S. Recurrent hemarthrosis after knee joint arthroplasty: etiology and treatment. *J Arthroplasty* 2004;19(2):157.
- [8] Bunting D, Kampa R, Pattison R. An unusual case of pigmented villonodular synovitis after total knee arthroplasty. *J Arthroplasty* 2007;22(8):1229.
- [9] Friedman T, Chen T, Chang A. MRI diagnosis of recurrent pigmented villonodular synovitis following total joint arthroplasty. *HSS J* 2013;9(1):100.
- [10] Luyckx EGR, Mondelaers AMP, Zijden TVD, Voormolen MHJ, Bergh FRA, d'Archembeau OC. Geniculate artery embolisation in patients with recurrent haemarthrosis after knee arthroplasty: a retrospective study. *J Arthroplasty* 2020;35(2):550.
- [11] Weidner ZD, Hamilton WG, Smirntopoulos J, Bagla S. Recurrent hemarthrosis following knee arthroplasty treated with arterial embolisation. *J Arthroplasty* 2015;30(11):2004.
- [12] Kalsi PS, Carrington RJ, Skinner JS. Therapeutic embolization for the treatment of recurrent hemarthrosis after total knee arthroplasty due to an arteriovenous fistula. *J Arthroplasty* 2007;22(8):1223.
- [13] Barrientos C, Barahona M, Cermenati T, Wulf R, Hinzpeter J. Successful selective embolisation for recurrent haemarthrosis after knee arthroplasty. *Case Rep Orthop* 2019:1.
- [14] Pathak BS, Munger AM, Charifa A, et al. Total knee arthroplasty in hemophilia A. *Arthroplasty Today* 2020;6(1):52.
- [15] Malhotra R, Bhan S, Kiran EK. Haemarthroses after total knee arthroplasty caused by an isolated platelet factor 3 availability defect. *J Bone Joint Surg* 2005;87(11):1549.
- [16] Yoo JH, Oh HC, Park SH, Lee S, Lee Y, Kim SH. Treatment of recurrent haemarthrosis after total knee arthroplasty. *Knee Surg Relat Res* 2018;30(2):147.
- [17] Scott RD. The evolving incidence and reason for re-operation after fixed bearing PCL retaining total knee arthroplasty. *J Bone Joint Surg Br* 2012;94-B:134.
- [18] Martin JR, Walters TS, Levy DL, Jennings JM, Boyle JP, Dennis DA. Medial Tibia' spackling' to lessen chronic medial tibia soft tissue irritation. *Arthroplasty Today* 2016;2(3):111.