CLINICAL STUDY

Technically Successful Geniculate Artery Embolization Does Not Equate to Clinical Success for Treatment of Recurrent Knee Hemarthrosis after Knee Surgery

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ABSTRACT

Purpose: To evaluate technical details, clinical outcomes, and complications in patients undergoing geniculate artery embolization for treatment of spontaneous hemarthrosis after knee surgery.

Materials and Methods: During 2009–2014, 10 consecutive patients (seven women; mean age, 57.4 y) underwent geniculate artery embolization at a single tertiary care center. All patients except one had hemarthrosis after total knee replacement (TKR). One patient presented with hemarthrosis after cartilage surgery. Two patients in the TKR group had a history of TKR revisions before the embolization. Embolization was performed with polyvinyl alcohol particles (range, 300–700 μm). In one patient requiring repeat embolization, *N*-butyl cyanoacrylate/ethiodized oil was used. The endpoint for embolization was stasis in the target artery and elimination of the hyperemic blush.

Results: In 10 patients, 14 embolizations were performed with 100% technical success. Hemarthrosis resolved in six patients. Four patients required repeat embolization for recurrent hemarthrosis, which subsequently resolved in two of four patients. Three of the four patients who required repeat embolization had serious comorbidities, either blood dyscrasias or therapeutic anticoagulation. There were two minor skin complications that resolved with conservative management. The average length of follow-up after embolization was 545 days (range, 50–1,655 d). One patient was lost to follow-up.

Conclusions: Geniculate artery embolization is a safe, minimally invasive treatment option for spontaneous and refractory knee hemarthrosis after knee surgery with 100% technical success. However, limited clinical success and higher repeat embolization rates were noted in patients with serious comorbidities.

ABBREVIATIONS

NBCA = *N*-butyl cyanoacrylate, PVA = polyvinyl alcohol, TKR = total knee replacement

Total knee replacement (TKR) is a common orthopedic procedure, with > 600,000 TKRs performed each year in the United States (1). Hemarthrosis after TKR is uncommon, with a reported incidence of 0.3%–1.6% (2–5). The etiology of hemarthrosis includes direct vascular injury resulting from pseudoaneurysm, arteriovenous fistula, synovial impingement, and mechanical factors, and patient-specific disease states, such as hemophilia, pigmented villonodular synovitis, blood dyscrasias, and anticoagulation (2).

As part of the initial management, risk factors predisposing patients to increased risk of hemorrhage, such as therapeutic anticoagulation and bleeding dyscrasias, are identified and treated. In patients without bleeding dyscrasias, the exact mechanism for hemarthrosis after TKR is unknown. It is hypothesized that synovial hypertrophy is the main culprit in this patient population (2). Synovial hypertrophy leads to synovial impingement by the prosthetic components, which is followed by a cascade of hemorrhage and inflammation that promotes further synovial hypertrophy (2). A newer theory suggests that hemarthrosis might be secondary to neovascularity that occurs during the healing phase (3).

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Initially, patients are managed conservatively, with joint aspiration and ice for pain relief and cast immobilization in some circumstances. Anticoagulation should also be discontinued if possible. However, conservative management is successful in only one third of cases (4,5). Open synovectomy is reserved for patients who failed conservative management. However, this procedure is associated with increased risk of infection and delayed rehabilitation (3). Arthroscopic synovectomy is advocated as an effective method in controlling bleeding; however, some patients treated arthroscopically were reported to have subsequent recurrences, which required open synovectomy for further management (3). More recently, angiography and embolization has been incorporated in the algorithm for the treatment of hemarthrosis (2). Several case reports and two case series, with a total of 10 patients, have detailed the experience of geniculate artery embolization for the treatment of hemarthrosis after TKR (6–9). The patients were treated with various embolic agents, including particles of varying sizes (100–700 μm) as well as coils. In short-term and medium-term follow-up, all patients had complete resolution of symptoms. Only one of 10 patients required repeat embolization. Two patients experienced a superficial skin complication that resolved with conservative management.

This study discusses the technical details, outcomes, and complications in 10 patients who underwent geniculate artery embolization for spontaneous hemarthrosis after knee surgery at a single institution. The data are also compared with the results reported in the previously published case series.

MATERIALS AND METHODS

This retrospective review is compliant with the Health Insurance Portability and Accountability Act and was approved by the Institutional Review Board. Between February 2009 and August 2014 at a single tertiary care center, 10 consecutive patients (seven women; mean age, 57.4 y; range, 21–71 y) underwent geniculate artery embolization for spontaneous hemarthrosis after knee surgery (**Table 1**). Patients were excluded if they did not have prior knee surgery or if they had hemarthrosis secondary to a vascular malformation, trauma, or an iatrogenic cause. Two patients had bleeding diathesis: One patient had hemophilia A, and one patient had von Willebrand disease. One patient was receiving therapeutic anticoagulation for atrial fibrillation. Nine patients presented with persistent hemarthrosis after TKR, and one patient presented after cartilage surgery and subsequent synovectomy. Two patients with TKR had remote histories of previous arthroplasty revisions before embolization. One patient had a tibial component revision 1 month after embolization that was unrelated to the embolization.

All patients were initially evaluated and referred by the same orthopedic surgeon who performed the knee surgery.

Table 1. Demographic, Clinical, and Embolization Information

Characteristic	Value
No. patients	10
Female	7
Average age (y)	57.4*
Caucasian	10
Patients requiring repeat embolization	4
No. embolizations	14
Patients on anticoagulation	1†
Patients with bleeding diathesis	2‡
Average no. vessels with embolization	3.2 (range, 2–4)

*1 patient, knee surgery, not TKR, 17 years old.
†Warfarin (Coumadin).
‡1 hemophilia A, 1 von Willebrand disease.

Hemorrhagic effusions were documented by knee aspiration at the time of the orthopedic surgeon visit. Patients had hemarthrosis events persisting for at least 1.5 years up to 6 years after TKR. Subsequently, all patients were evaluated in the clinic before and after the procedure by the physician performing the embolization procedure. The procedures were performed by a single operator (M.D.D.) with 30 years of experience in endovascular procedures. Follow-up evaluations were done via telephone at 7 days and 14 days after embolization and in the clinic 1 month after embolization. For patients who were lost to initial follow-up at the 1-month time point, attempts for follow-up were made via telephone.

Technical success was defined as successful embolization of the geniculate arteries contributing to the synovial hyperemia with elimination of the hyperemic blush on angiography performed after embolization. Clinical success was defined as resolution of hemarthrosis based on physical examination. In addition to the known complications of arterial embolization, such as pain, access site complications, and nontargeted embolizations, cutaneous complications were specifically investigated because the geniculate network supplies the overlying cutaneous tissues.

Technique

All procedures were performed under moderate sedation using intravenous midazolam (Akorn Pharmaceuticals, Lake Forest, Illinois) and fentanyl (Janssen Pharmaceutica, Beerse, Belgium). Anterograde ipsilateral arterial access was obtained in eight patients, and retrograde contralateral access was obtained in two patients. The decision to perform anterograde versus retrograde access was made by the operator based on body habitus, with retrograde access preferred in obese patients. During diagnostic angiography of the affected leg, iodixanol contrast agent (Visipaque 270; GE Healthcare, Little Chalfont, United Kingdom) was injected in the anteroposterior projection at a 5 mL for 15 mL injection rate. Multiple oblique view arteriograms were used to help identify the origin of the geniculate arteries