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Embolization of the Geniculate Arteries Is an Effective Treatment of Recurrent Hemarthrosis Following Total Knee Arthroplasty That Can Be Safely Repeated

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ABSTRACT

Background: Recurrent hemarthrosis is a late complication in up to 1.6% of patients following total knee arthroplasty (TKA). In the absence of intrinsic coagulopathy, one etiology is bleeding of hypertrophic vascular synovium. The aim of this study is to evaluate the clinical outcome of patients referred to our center for angiographic embolization of geniculate arteries for recurrent hemarthrosis following TKA.
Methods: We retrospectively studied a cohort of patients who were referred for geniculate artery embolization following TKA between August 2011 and September 2016.
Results: A total of 24 embolization procedures were performed on 14 patients. Seven (50%) of these 14 patients underwent one embolization procedure. Due to symptom recurrence, 4 patients underwent a repeated procedure and 3 patients a third procedure. All embolization procedures were technically successful at the time of the procedure. Two patients reported an inguinal hematoma that healed without further treatment. At follow-up of mean 26.8 months, clinical success was achieved in 12 of the 14 patients (86%).
Conclusion: Embolization of the geniculate arteries in our study was a safe and effective treatment of recurrent spontaneous hemarthrosis following TKA. Although we have performed a substantial number of reinterventions, results of this study show that this procedure can be safely repeated without adverse events. Our results indicate that embolization could possibly be the treatment of choice when conservative measures fail and can be repeated in the event of recurrent or persistent symptoms.

Recurrent hemarthrosis following total knee arthroplasty (TKA) is a rare complication of a frequently performed procedure. The incidence of this late complication is reported to be 1.6% or less [1,2]. Symptoms can occur several months up to years after surgery. Most patients present with a painful and swollen knee joint that cannot be associated with traumatic events [1–3].

Diagnosis of hemarthrosis is based on clinical symptoms and joint aspiration. In the absence of intrinsic coagulopathy, the probable etiology is bleeding of hypertrophic vascular synovium that may be injured due to impingement between the articulating prosthetic components [4]. Other local causes can be arteriovenous fistula, pseudoaneurysm, pigmented villonodular synovitis, or prosthetic complications such as loosening or instability. Bleeding disorders, joint infection, and prosthetic complications should be evaluated in all patients. Angiography can be both diagnostic and therapeutic for treatment of hypertrophic synovium [3].

Conservative therapy based on rest, ice, elevation, or compression is only successful in one-third of patients. Open surgical synovectomy has been reported to be successful in most cases but is associated with the complications and morbidity of repeated surgery such as loss of function and infection [1,2,4]. Radiosynovectomy is a promising technique; however, this is only documented in case reports [5]. Embolization of geniculate arteries has been reported in small series of patients and is considered a minimally invasive treatment with good clinical success and a low complication rate [3,6].

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The aim of this study is to evaluate the clinical outcome of patients referred to our center who underwent angiographic embolization of geniculate arteries for the treatment of recurrent hemarthrosis following TKA.

Materials and Methods

Patients

We retrospectively studied a cohort of patients who underwent geniculate artery embolization following TKA in our tertiary care university medical center between August 2011 and September 2016. Data on age, gender, coagulopathy, angiographic procedures, and complications were retrieved from medical records and the Picture Archiving and Communication System. Patients were contacted by telephone in October 2016 to retrieve information on persistent clinical success or late complications.

Description of Angiographic Embolization

Selective angiography of the femoral and popliteal arteries was performed using femoral access to identify synovial hypertrophy indicated by a pathologic vascular blush (Fig. 1). A 2.7Fr microcatheter (PROGREAT; Terumo Medical Corporation, Somerset, NJ) was coaxially introduced into the feeding geniculate artery branch of the popliteal artery that exhibited a hyperemic blush. This was followed by embolization with tris-acryl gelatin microspheres, polyvinyl alcohol (PVA) particles, and/or coils. Embolization endpoint was (near) stasis of flow in locations of previously abnormal synovial vascularity, which was defined as technical success. All patients remained in hospital for one night.

Outcome Measures

Standard follow-up evaluations 6 weeks after discharge were performed by means of telephone calls; more evaluation points were included if these were judged clinically desirable. In case clinical symptoms of hemarthrosis recurred, the patient underwent repeat angiography. Clinical success was defined as the absence of clinical symptoms of hemarthrosis at last follow-up (October 2016) as reported by the patient.

Statistics

Continuous data means and standard deviations were calculated using IBM SPSS Statistics for windows version 23 (IBM Corporation, Armonk, NY).

Ethics

Follow-up was performed in the context of clinical treatment and to improve quality of care. As this is a retrospective study, our institution ethical approval was not required.

Results

Between August 2011 and September 2016, 14 patients were referred to our tertiary center for geniculate artery embolization for the treatment of recurrent hemarthrosis following TKA (Supplementary Table 1). Mean age at angiography was 66.7 years (standard deviation [SD] 8.2) and 8 patients were female.

Indication for geniculate artery embolization was a recurrent knee hemarthrosis, with symptoms of a painful and swollen knee joint. Symptoms began at a mean 10.3 months (SD 7.8) after TKA. Hemarthrosis was confirmed by joint aspiration in all patients. Other causes of symptoms such as knee instability, prosthesis loosening, or infection were ruled out by the treating orthopedic surgeon. Initial conservative treatment measures were unsuccessful in all patients.

All pre-embolization angiograms performed in the 14 patients demonstrated a pathologic vascular blush or blushes adjacent to the knee joint. No vascular malformations, tumors, or pseudoaneurysms were identified during angiography. The interval between first complaints and first angiography procedure was mean 6.9 months (SD 4.0). All 14 patients underwent subsequent embolization of the geniculate arteries feeding the pathologic synovium. All embolization procedures were technically successful. Seven patients experienced persistent or recurrent symptoms at follow-up, 4 of these patients underwent a second embolization and 3 patients a third embolization procedure. We performed a total of 24 embolization procedures in the group of 14 patients. The interval between the previous procedure and the successive procedure was mean 6.7 months (SD 7.1).

The mean duration of follow-up after the last performed embolization was 26.8 months (SD 20.0). At the end of follow-up, 12 of the 14 treated patients were asymptomatic. Of the 2 remaining patients, 1 patient was still suffering recurrent hemarthrosis after 3 embolization procedures and was still under analysis. The other patient underwent open surgical synovectomy 3.1 months after one embolization procedure, unfortunately repeat embolization was not considered. No patient had a known intrinsic coagulopathy. One patient was on Acenocoumarol and one patient was on Apixaban. In both cases these were temporarily stopped before a procedure.

PVA particles were used in 18 of 24 procedures, and tris-acryl gelatin microspheres in 6. In 1 patient a 2-3 mm microcoil was additionally placed after 355-500 μm PVA particle embolization. Clinical success following the embolization procedures was not dependent on microparticle/microsphere size or type. There were no patients with ischemic (cutaneous) complications. Two patients reported an inguinal hematoma 1 day after the procedure. One of these patients was seen at the emergency department and was successfully treated conservatively. The second patient did not seek medical care at that time, but mentioned this self-limiting complication at follow-up.

Discussion

This study shows that geniculate artery embolization for the treatment of recurrent hemarthrosis following TKA has excellent clinical results without major complications in 14 patients. We report technical success of all procedures and clinical success in 12 of 14 patients (86%). Our results are consistent with prior studies reporting technical success of 99%-100% and clinical success of 60%-92% [6–9]. This study is among the largest published case series [7,8].

Synovectomy has been recommended when recurrent hemarthrosis does not resolve after conservative treatment, with open surgery being more effective than arthroscopic [1,2,4]. Kindsfater and Scott [4] report clinical success in 14 of 15 patients after open synovectomy (93%), similar to the clinical success rate of embolization therapy in this study. However, synovectomy exposes the patient to the complications and morbidity of repeated surgery such as loss of function and infection. Although we have performed numerous reinterventions, there were no serious adverse events. Our results indicate that embolization could likely be the treatment of choice when conservative measures fail and can be repeated in the event of recurrent or persistent symptoms.

The interesting finding of this study is the high rate of repeat embolization. We have repeated embolization in 7 of 14