

Geniculate Artery Embolization in the Management of Spontaneous Recurrent Hemarthrosis of the Knee: Case Series

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ABSTRACT

Spontaneous recurrent hemarthrosis after knee arthroplasty is reported to occur in 0.3%–1% of patients, likely secondary to hypertrophic vascular synovium. Five patients who underwent previous arthroplasty presented with spontaneous hemarthrosis. Selective arterial embolization was performed with spherical embolic particles (diameter range, 100–700 μm). Angiography demonstrated synovial hypervascularity with geniculate artery “tumor blush” appearance in all patients. Average time to resolution of effusion was 2.6 weeks, with no recurrences reported during follow-up (mean, 25.4 mo; range, 16–48 mo). Two patients experienced transient cutaneous ischemia. Selective geniculate artery embolization with spherical embolic particles is an effective treatment for spontaneous recurrent hemarthrosis of the knee.

Spontaneous recurrent hemarthrosis after total knee arthroplasty is rare, with reported incidences of 0.3%–1% (1,2). The interval between surgery and onset of hemarthrosis has been reported to range from 2 weeks to 12 years, with a mean of 2 years (1). In the absence of coagulopathy, the most well accepted mechanism for hemarthrosis is trauma to hypertrophic vascular synovium (2,3). Less common causes of hemarthrosis include pigmented villonodular synovitis, arteriovenous fistula, and bleeding from a geniculate artery injury and/or pseudoaneurysm.

Episodes of hemarthrosis may resolve with conservative therapies, including aspiration, rest, and the use of ice-packs. The recommended surgical treatment for recurrent hemarthrosis is open synovectomy. Percutaneous endovascular embolization has been described in a small number of cases without long-term follow-up (3–6). Here we present five consecutive cases of transcatheter embolization for recurrent hemarthrosis, including magnetic resonance (MR) imaging findings and complications. Written informed consent was obtained. Institutional review board approval was obtained for the conduct of this research.

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MATERIALS AND METHODS

Five patients (three male; age range, 57–77 y), presented with spontaneous hemarthrosis after knee arthroplasty with a mean duration of symptoms of 2.8 months. Durations of time since knee replacement ranged from 8 to 18 years. All patients underwent repeated arthrocentesis that documented hemorrhagic effusion. Findings of joint fluid cultures were negative in all patients. One patient was receiving warfarin, but hemarthrosis persisted despite discontinuation.

MR imaging of the knee with intravenous gadolinium was performed in three patients before intervention. Angiography was performed with contralateral femoral arterial access in three patients and with ipsilateral access in two. Nonselective angiography of the femoral and popliteal arteries in multiple projections was performed initially to identify areas of hypervascular synovium. Steep angulation to avoid prosthesis interference was required, and attention was paid to the profunda femoris branches. Microcatheter selection of geniculate arterial branches that exhibited “tumor blush”-type vascularity was performed, with the catheter tip placed at least 2 cm beyond the ostium. Embolization (mean number arteries treated per patient, 2.8; range, 2–5) was performed to the extent of near-stasis to decrease visualization of the hypertrophic synovium—and with care to avoid reflux—with spherical embolic particles ranging in size from 100 μm to 700 μm (CeloNova Biosciences, San Antonio, Texas; or Merit Medical, South Jordan, Utah). Patients were followed clinically and with ultrasound to determine resolution of hemarthrosis.

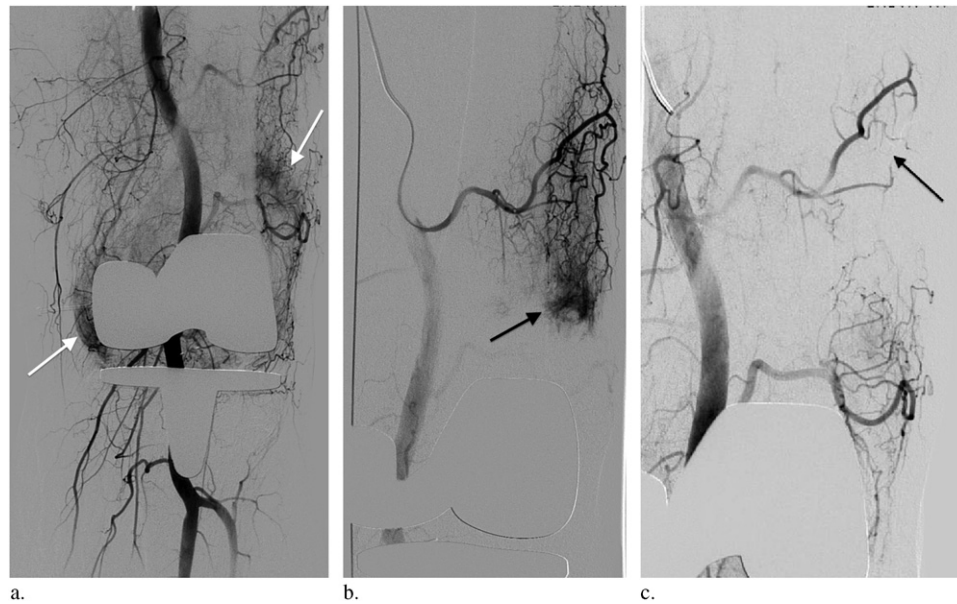


Figure 1. (a) Popliteal angiography demonstrates superior medial and lateral geniculate artery hypertrophy with synovial hypervascularity (arrows). (b) Selective superior lateral geniculate artery angiography shows tumor blush-type appearance of synovium. (c) After embolization, there is diminished synovial vascularity noted within the superior lateral distribution.

RESULTS

MR imaging findings included joint effusion, synovial thickening, and prominent synovial enhancement on enhanced subtracted images. Angiography (**Fig 1**) demonstrated geniculate artery hypertrophy and synovial hypervascularity with a tumor blush-type appearance in all

patients. No vascular malformations or pseudoaneurysms were identified. The location and appearance of synovial enhancement and thickening on MR imaging was similar during catheter angiography (**Fig 2**).

Average time to resolution of effusion was 2.6 weeks (range, 1–5 wk). Two patients experienced transient cutaneous ischemia, which sloughed small patches of

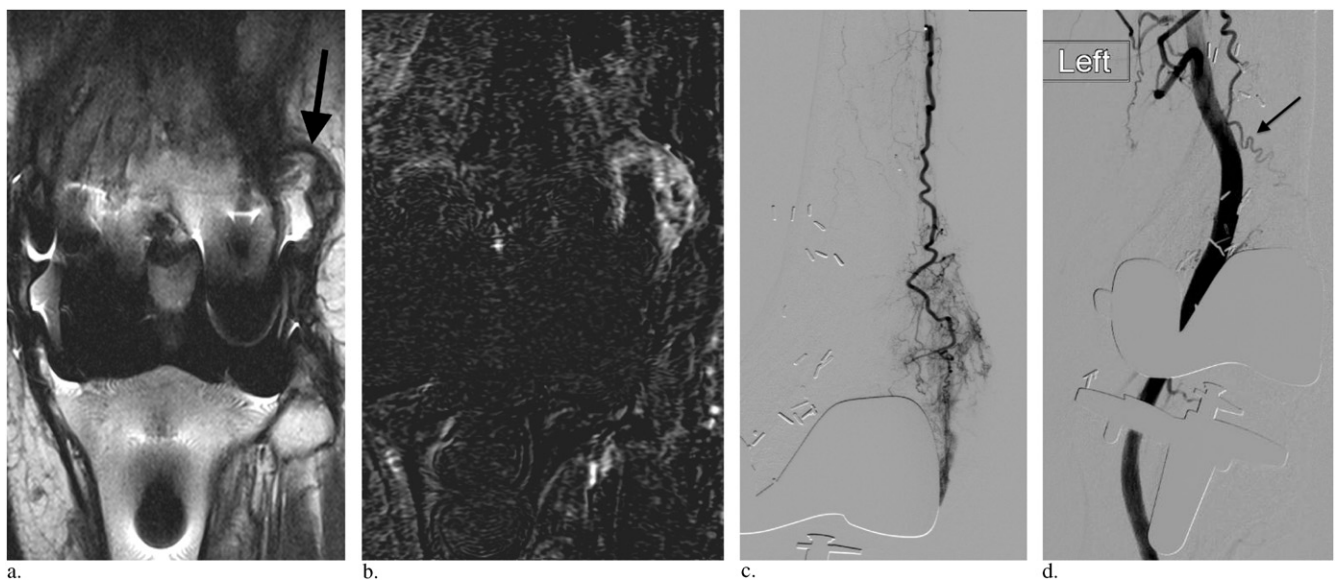


Figure 2. (a) Coronal T2 MR image demonstrates lateral superior synovial thickening (arrow). (b) Subtracted MR image after intravenous gadolinium injection shows increased synovial enhancement in the area of thickening. (c) Selective angiography of superior lateral geniculate artery shows hypertrophy and hypervascularity in the corresponding area of abnormal synovium. In this patient, the superior lateral geniculate artery originated from the profunda femoris artery, which highlights the importance of angiography of the superficial and profunda femoris arteries. (d) Angiography after embolization shows near-stasis in the superior lateral geniculate artery (arrow) with absence of hypervascular synovium.



Figure 3. (a) Photograph shows cutaneous ischemia at 24 hours after embolization. (b) Photograph 1 week after the angiogram shows skin sloughing, which entirely resolved after 3 weeks. (Available in color online at www.jvir.org.)



Figure 4. Geniculate artery anatomy: *A*, highest geniculate artery; *B*, superior medial geniculate artery; *C*, superior lateral geniculate artery; and *D*, inferior lateral geniculate artery from anterior recurrent tibial artery. The inferior medial geniculate artery origin is not shown as a result of the prosthesis.

ischemia in one case. This resolved completely in 3 weeks (**Fig 3**). Both patients who had cutaneous ischemic complications had undergone embolization with spherical particles smaller than 300 μm . One patient experienced postprocedural pain that required 2 days of nonsteroidal antiinflammatory medication. No recurrent hemarthrosis has been reported at a mean follow-up of 26 months.

DISCUSSION

Spontaneous recurrent hemarthrosis of the knee is an unusual entity, with traditional surgical therapy associated with significant morbidity. Given et al (7) reported three cases of geniculate artery embolization, with spherical embolic particles used in two patients and microcoils used in the other one. One patient had a recurrence at 6 months, and no complications were encountered. Although the present experience was with spherical embolic material only, and demonstrated longer-term results of geniculate artery embolization, transient cutaneous complications did occur in 40% of patients.

Cutaneous branches arising directly from the superficial femoral and popliteal arteries can be identified as coursing lateral to the synovium, and avoided during angiography. However, cutaneous supply from geniculate arteries distal to synovial distribution cannot be avoided during embolization, and larger particles may be necessary to avoid distal embolization. The rich collateral vascular supply to the knee (**Fig 4**) also allows small embolic particles to pass from one geniculate artery to a more distal vessel without reflux being identified. This is well demonstrated in the

lateral territory of the knee, with collateral flow from the superior to inferior geniculate artery. From our limited experience, the use of spherical particles larger than 300 μm may be less likely to cause cutaneous ischemia.

MR imaging was useful in identifying the presence and location of synovial hypertrophy. Contrast-enhanced imaging with subtraction techniques allows for delineation of hypervascular synovium while limiting artifact from the knee prosthesis. This information may be critical, as it was not necessary to treat all geniculate arteries to yield a durable result.

Although previous studies have demonstrated the feasibility of embolization in the management of acute and late hemarthrosis after knee arthroplasty, the present experience demonstrates longer-term results of this procedure. In conclusion, selective geniculate artery embolization with spherical embolic particles is an effective treatment for late recurrent hemarthrosis of the knee.

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