



Selective arterial embolization with gelatin particles for refractory knee hemarthrosis

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PURPOSE

We aimed to evaluate the feasibility and safety of selective arterial embolization for refractory knee hemarthrosis

MATERIALS AND METHODS

Transcatheter arterial embolization for refractory knee hemarthrosis was performed on five female patients (median age, 77 years; range, 71–80 years) between May 2009 and September 2012. Selective arterial embolization of the feeding artery was performed using a 2.5 F microcatheter coaxially advanced from a 5 F catheter with its tip positioned in the superficial femoral artery. One- or two-millimeter gelatin particles were used as embolic agents.

RESULTS

In all patients, transarterial embolization performed successfully after arteriography showed nontumorous staining around the knee joint. The feeding arteries were the lateral superior genicular artery in all five patients, the lateral inferior genicular artery in four patients, the medial superior genicular artery in one patient, the medial inferior genicular artery in one patient, the middle genicular artery in one patient, and the descending genicular artery in one patient. In all five patients, staining was remarkably diminished around the knee joint after the embolization procedure. No complication was observed. The hemarthrosis improved after the embolization, and the postoperative course has been uneventful with no recurrence in any patient.

CONCLUSION

These results suggest that selective arterial embolization for refractory hemarthrosis of the knee is safe and useful.

Nonhemophilic knee hemarthrosis is an unusual entity (1, 2). Treatment methods include conservative therapy by immobilizing the joint in a cast or brace and discontinuing anticoagulants. In cases of repeated knee hemarthrosis, however, surgery is indicated. Surgical procedures comprise open or arthroscopic synovectomy. Open synovectomy ensures reliable hemostasis but is highly invasive. Arthroscopic synovectomy is less invasive but may result in the recurrence of hemarthrosis (3). In addition to surgical treatment, in recent years, arterial embolization has been reported to be a less invasive method of treatment (4). After recognizing its effectiveness in our daily clinical work, our institution has employed arterial embolization for refractory knee hemarthrosis despite the use of conservative therapies.

The aim of the present study was to evaluate the feasibility and safety of selective arterial embolization with gelatin particles for refractory knee hemarthrosis.

Materials and methods

Five female patients (median age, 77 years; range, 71–80 years) with refractory knee hemarthrosis for whom transcatheter arterial embolization was performed between May 2009 and September 2012 were the subjects of the present study. Written informed consent was obtained from each patient before the embolization procedure. Pain and swelling of the knee were observed in all five patients. Two patients had osteoarthritis, and these patients had no coagulation abnormalities. In three patients, hemarthrosis recurred after total knee arthroplasty, with a median period after total knee arthroplasty of 81 months (range, 23–116 months). The median duration of hemarthrosis was nine months (range, 2–17 months). In all five patients, a noninfectious hematoma was found within the joint, and arthrocentesis was performed repeatedly but failed to decrease the hematoma and pain. Thus, nonconservative therapy was required. Because all five patients were of advanced age, we decided to perform transarterial embolization, which was considered less invasive compared with surgical treatment.

Transarterial embolization was performed under local anesthesia (Fig.). A 5 F catheter was inserted from the contralateral or ipsilateral common femoral artery under local anesthesia, after which the catheter was advanced to the superficial femoral artery. Super-

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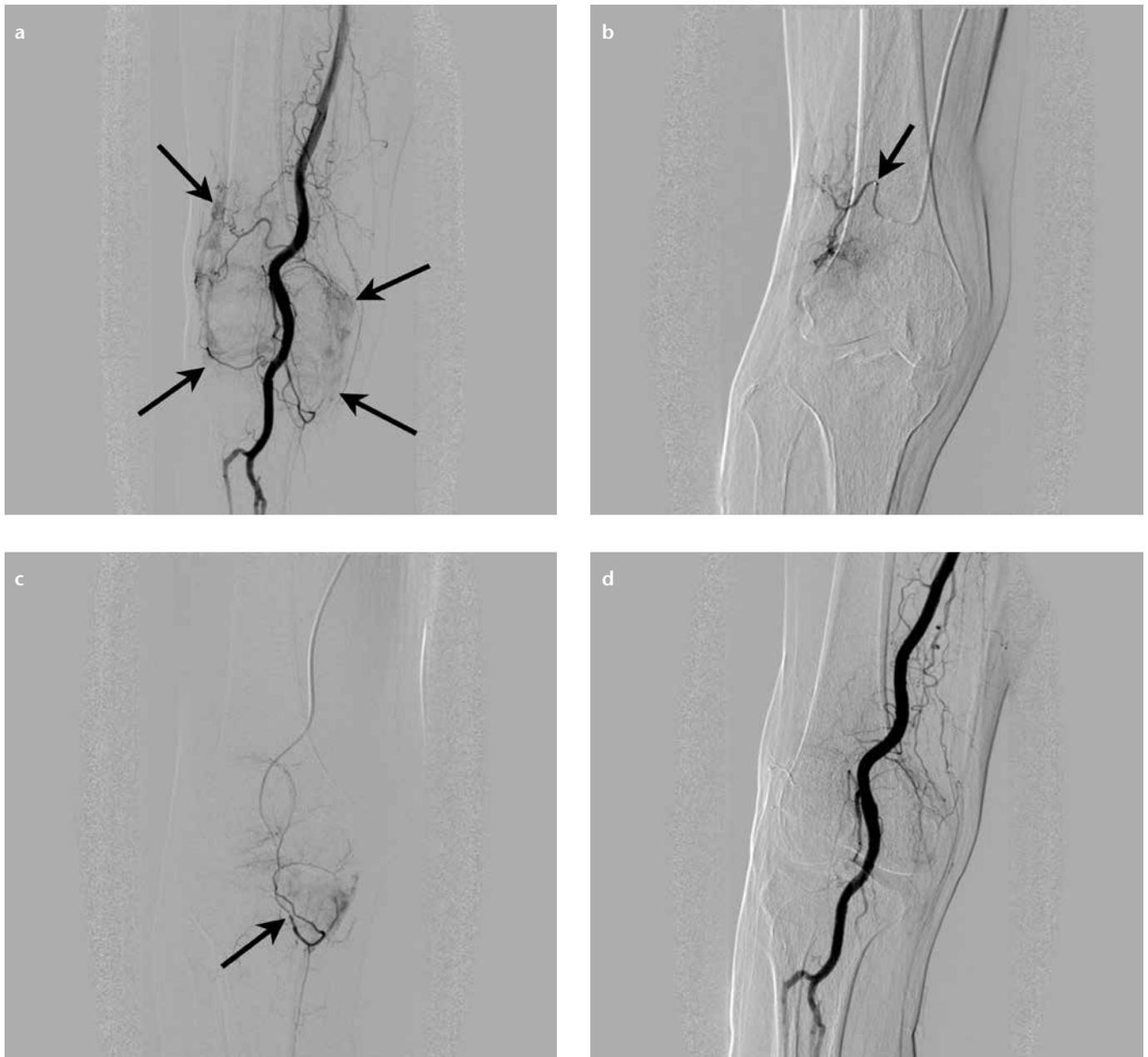


Figure. a–d. A 77-year-old female with knee osteoarthritis. Right superficial arteriography (**a**) shows nontumorous staining around the knee joint (*arrows*). Arteriography obtained via microcatheter selectively advanced in the lateral superior genicular artery (**b**, *arrow*), and the medial inferior genicular artery shows staining (**c**, *arrow*). Right superficial arteriography after embolization (**d**) shows almost complete disappearance of staining.

ficial femoral arteriography was performed to identify the feeding arteries. Selective arterial embolization of the feeding arteries was performed by advancing a 2.5 F microcatheter (Renegado, Boston Scientific, Watertown, Massachusetts, USA) coaxially from the 5 F catheter. One-millimeter gelatin particles (Spongel, Yamanochi, Tokyo, Japan), or 1 mm or 2 mm porous gelatin particles (Gel-part, Nippon Kayaku, Tokyo, Japan)

were used as embolic agents. Embolic agents were infused until staining from the bleeding vessels almost completely disappeared.

We gathered data on the arteries from which embolic agents were infused, the duration of the procedure, the technical success rate in achieving disappearance of staining, the clinical success rate in achieving the disappearance of symptoms, complications, and the rate of recurrence.

Results

Nontumorous staining was evident in all patients (Table 1). No anomalies such as arteriovenous malformation, extravasations, and aneurysms were observed in any of the patients. In all patients, all feeding arteries were finally successfully embolized. The catheter was inserted from the contralateral femoral artery in one case, from the ipsilateral femoral artery in three cases, and from both the contralateral femoral artery

Table 1. Characteristics of five patients with refractory knee hemarthrosis and details of transarterial embolization procedures performed

Patient no./age (years)/gender	Post-TKA	Duration of hemarthrosis (months)	Affected side	Puncture side	DSA findings	Feeding artery	Embolized artery	Embolic agents	Time (min)	Technical success	Clinical success
1/80/Female	Yes	17	Right	Left (contralateral)	Staining	LSGA LIGA MGA	LSGA LIGA MGA	Gelpart (1 mm)	120	Yes	Yes
2/77/Female	No	4	Right	Left (contralateral) Right (ipsilateral)	Staining	LSGA LIGA	LSGA LIGA	Gelpart (1 mm)	140 40	No Yes	NA Yes
3/71/Female	Yes	9	Left	Left (ipsilateral)	Staining	LSGA DGA	LSGA DGA	Gelpart (2 mm)	85	Yes	Yes
4/77/Female	No	4	Right	Right (ipsilateral)	Staining	LSGA LIGA MSGGA MIGA	LSGA LIGA MSGGA ^a MIGA	Spongel (1 mm)	125	Yes	Yes
5/78/Female	Yes	2	Left	Left (ipsilateral)	Staining	LSGA LIGA	LSGA LIGA	Spongel (1 mm)	110	Yes	Yes

^aembolized from MIGA through the communicated vessel with MIGA.

DGA, descending genicular artery; DSA, digital subtraction angiography; LIGA, lateral inferior genicular artery; LSGA, lateral superior genicular artery; MGA, middle genicular artery; MIGA, medial inferior genicular artery; MSGGA, medial superior genicular artery; TKA, total knee arthroplasty.

and ipsilateral femoral artery in one case. In the last case, all feeding arteries could not be selected by the contralateral femoral artery because the iliac and femoral arteries were too tortuous to advance the microcatheter sufficiently to all of the feeding arterial branches; therefore, an additional transarterial embolization was performed from the ipsilateral femoral artery on another day. Embolized arteries were the lateral superior genicular artery (n=5), lateral inferior genicular artery (n=4), medial superior genicular artery (n=1), medial inferior genicular artery (n=1), middle genicular artery (n=1), and descending genicular artery (n=1). In all cases, staining had almost completely disappeared after embolization. The median total time required for performing selective angiographies and arterial embolizations was 115 min (range, 40–140 min). No sign or symptom such as pain, skin pallor, motor paralysis, hypesthesia, or evidence of infection was apparent from the knee to the lower leg, and no complication related to embolization was identified.

Currently, the median observation period after embolization is 26 months (range, 3–36 months). Regarding symptoms of knee hemar-

throsis, both pain and swelling have disappeared completely or almost completely in all five patients during these observation periods. Also, there has been no recurrence of hemarthrosis.

Discussion

Spontaneous hemorrhage in the knee can occur in both congenital and acquired conditions. After exclusion of abnormalities of coagulation, other possible causes such as arthritides, collagen vascular disorders, hemochromatosis, vascular lesions (vascular malformation, aneurysm, or angioma), and myeloproliferative diseases need to be considered (4). Hemarthrosis after total knee arthroplasty is rare, with a reported frequency of 0.3%–1.6% (1, 3, 5, 6).

The proportion of patients in whom hemarthrosis recurs despite conservative treatment is minuscule. For hemarthrosis that recurs after total knee arthroplasty and that fails to improve with conservative treatment, open synovectomy has been recommended by some studies (1, 5, 6). Kindsfater and Scott (1) reported no recurrence in 14 of 15 knees, and Worland and Jessup (5) found no recurrence in any of seven knees. Open synovectomy thus has a good

postoperative outcome but entails problems such as the risk of infection and time required for rehabilitation. Arthroscopic synovectomy has the advantages of a small incision, little bleeding, and short postoperative rehabilitation. However, Ohdera et al. (3) reported that, although healing occurred in two of six knees for which arthroscopic synovectomy combined with electric coagulation was performed, the condition recurred in the other four knees, and healing did not occur until open synovectomy was performed. This suggests the need for caution concerning recurrence after arthroscopic treatment.

In addition to surgical methods, case reports in which knee hemarthrosis was successfully treated by transarterial embolization, which is less invasive, have been published as listed in Table 2 (4, 7–14). All but one of these reports describe treatment for recurrent hemarthrosis after total knee arthroplasty. Embolic agents used were coils, polyvinyl alcohol (PA), or tris-acryl gelatin microspheres (TAGM). Sizes of particles chosen were 150–250 or 250–350 μ m for PA and 500–700 μ m for TAGM. Genicular arterial branches and/or the supra-articular popliteal artery

Table 2. Previous case reports on arterial embolization for recurrent knee hemarthrosis

Study	Number of patients	Post-TKA	Puncture side	Findings on arteriography	Embolic agents	Technical success	Clinical success
Tat-Sing Law et al. (7)	3	Yes	Ipsilateral	AVF, extravasation, stain	Coils	3/3	3/3
Aldin et al. (4)	1	No	Ipsilateral	Stain	PVA and coils	1/1	1/1
Given et al. (8)	3	Yes	Ipsilateral	Stain, extravasation	PVA and coils	3/3	2/3
Kalsi et al. (9)	1	Yes	-	Stain, AVF	PVA and coils	1/1	1/1
Maheshwari et al. (10)	1	Yes	-	Stain	Coils	1/1	1/1
Pritsch et al. (11)	1	Yes	-	Stain	TAGM	1/1	1/1
Pham et al. (12)	1	Yes	Ipsilateral	Stain	TAGM	1/1	1/1
Katsimihias et al. (13)	1	Yes	Ipsilateral	Stain	Coils	1/1	1/1

AVF, arteriovenous fistula; PVA, polyvinyl alcohol; TAGM, tris-acryl gelatin microspheres; TKA, total knee arthroplasty.

were target arteries selectively embolized (4, 7–14). In all cases reported, embolization was technically successful, with no clinical recurrence except for one. In that case with recurrence, symptoms disappeared after embolization was again performed (8).

In the present study, gelatin particles, which are commonly used as an embolic agent in our country, were chosen (15, 16). Good results were achieved in that symptoms improved in all patients evaluated without any complications related to the procedure, and no recurrence occurred. However, this report obviously includes far too few patients to make any serious comments concerning the safety of this embolic agent.

In conclusion, selective arterial embolization using gelatin particles is an effective and safe treatment for refractory knee hemarthrosis, as well as embolization reported using other embolic agents such as coils, PA, and TAGM. Additionally, our study showed that selective arterial embolization is also effective for idiopathic hemarthrosis with osteoarthritis, not just for hemarthrosis after total knee arthroplasty.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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