Endovenous stent-assisted coil embolization for a symptomatic femoral vein aneurysm

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An 83-year old man presented with recurrent pulmonary embolism originating from a distal left superficial femoral vein aneurysm despite therapeutic anticoagulation. We treated the patient transluminally using the technique of stent-assisted coil embolization via percutaneous transpopliteal venous access. Follow-up by serial duplex ultrasonography and computer tomographic venography (CTV) demonstrated resolution of the aneurysm. Our case demonstrates that stent-assisted coil embolization may effectively exclude a saccular venous aneurysm and prevent recurrent pulmonary embolization. (J Vasc Surg 2008;48:1032-6.)

Femoropopliteal venous aneurysms are rare entities which, in 45% of reported cases, present with pulmonary embolism.[1] Therapeutic anticoagulation, however, may not ameliorate the risk of pulmonary embolism.[1,2] Resection and venous reconstruction, usually with tangential excision and venorrhaphy, represent the traditional management of femoropopliteal venous aneurysms.[1] We report the first case of a distal superficial femoral vein aneurysm successfully managed by stent-assisted coil embolization.

CASE REPORT

An 83-year-old male was hospitalized in late 2001 with bilateral pulmonary emboli of unknown origin. He was managed with 12 months of oral anticoagulation. Within one month of completing anticoagulation, he developed recurrent bilateral pulmonary emboli. Medical evaluation excluded thrombophilia as well as occult malignancy, and he was prescribed a course of lifelong anticoagulation using warfarin. During a subsequent hospitalization for respiratory distress and suspected pneumonia in early 2006, a venous duplex scan revealed a 5.7 cm × 3.2 cm aneurysm of the distal left superficial femoral vein. No alteration in management occurred.

In September 2006, the patient again presented with recurrent pulmonary emboli. His international normalized ratio was 2.7. A repeat venous duplex scan demonstrated a distal left superficial femoral vein aneurysm with slow flow and rouleaux formation (Fig 1, *a*).

Vascular surgical consultation was requested and the patient subsequently underwent placement of a retrievable inferior vena cave (IVC) filter (Günther Tulip vena cava filter, Cook Medical, Bloomington, Ind). At the time of IVC filter placement, ascending phlebography was performed and this demonstrated a saccular aneurysm of the left superficial femoral vein (Fig 1, *b*). On further questioning by the vascular service, the patient recalled a remote football injury to the left thigh to which he attributed rare episodes of pain and swelling.

Because of the patient's history of recurrent pulmonary emboli and the potential for further thromboembolic events, intervention was recommended. The patient's age and cardiovascular risk profile suggested that he was at high risk for conventional surgery and, thus, we sought an endovascular solution to this problem. In the prone position and under local anesthesia with sedation, the left popliteal vein was cannulated using ultrasound-guidance. A total of eight coils (stainless steel embolization coils, 5 mm × 5mm (6) and 5mm × 3 mm (2), Cook Medical Inc., Bloomington, Ind) were deployed within the venous aneurysm sac followed by implantation of a 14 × 60 mm self-expanding nitinol stent (SMART, Cordis, a Johnson & Johnson company, Miami Lakes, Fla) across the neck (Fig 2). Postdilitation of the stent was not performed. The procedure was technically successful. Post-procedural venous duplex scan demonstrated patency of the stented venous segment with minimal extra-luminal flow into the aneurysm. Subsequent ascending phlebography at the time of IVC filter retrieval revealed rapid flow through the stented segment of the left superficial femoral vein with minor extravasation of contrast into the residual aneurysm sac. Serial venous duplex scans demonstrated contraction of the aneurysm and in-stent intimal thickening. (Fig 3, *a*) A computed tomography (CT) venogram, at 15 month follow-up, confirmed resolution of the venous aneurysm (Fig 3, *b*). The patient's overall physical condition has improved and he now leads an active lifestyle. He has experienced neither recurrent pulmonary embolism nor limb pain or swelling. Long-term anticoagulation was continued with warfarin based on the preference of the patient's hematologist. Because the long-term patency of this repair is unknown, he has agreed to participate in lifelong vascular follow-up.

DISCUSSION

Venous aneurysms have been described in both the deep and superficial venous systems and in various anatomic locations.[3] They are associated with venous malformation syndromes such as the Klippel–Trenaunay

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Competition of interest: none.
Presented at the Thirty-second Annual Meeting of the Southern Association for Vascular Surgery, Naples, Fla, Jan 16-19, 2008.
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0741-5214/$34.00

doi:10.1016/j.jvs.2008.04.058

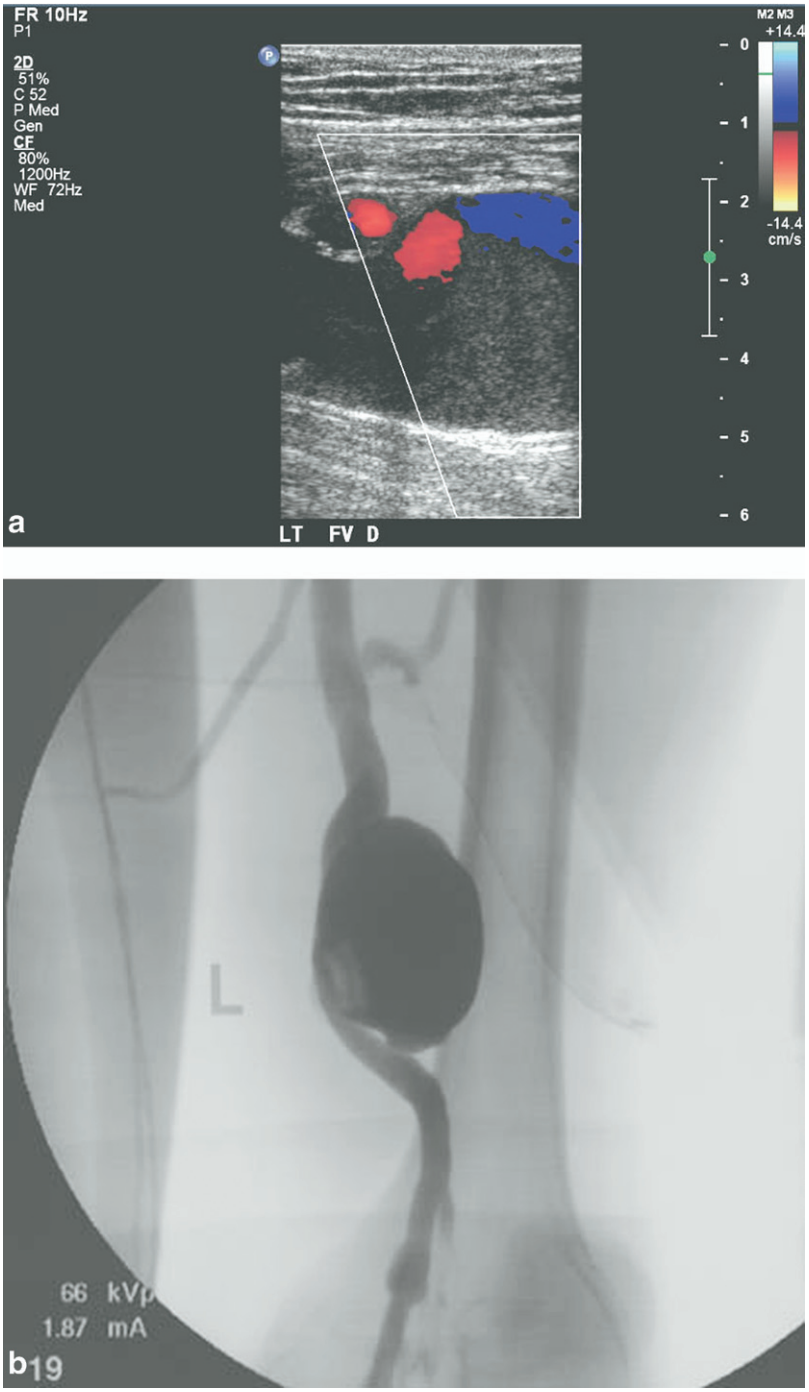

Fig 1. a, Venous duplex scan demonstrating rouleaux formation in left distal superficial femoral vein aneurysm. **b**, Ascending phlebography of the left thigh demonstrating left distal superficial femoral vein aneurysm.

syndrome, and this is thought to be related to weakness of the vein wall in the setting of venous hypertension and proximal obstruction.[4] Other suggested etiologies of venous aneurysms include trauma, entrapment, mechanical stress, and congenital weakness.[1,5] However, most reported popliteal venous aneurysms are sporadic and occur in adults. The venous aneurysm described in the present case was unique in that it was located at the adductor canal (ie, the distal superficial femoral vein). Most lower extremity venous aneurysms, however, occur in the popliteal vein and 75% of such cases involve its above-knee segment.[1] On phlebography, the venous

Fig 2. Radiography of left thigh (prone position) following stent-assisted coil embolization of left superficial femoral vein aneurysm. Note delayed emptying of contrast from the aneurysm sac.

aneurysm in the present case was characteristically wide-necked and saccular, the feature upon which endovascular management was based.

Endovascular management of wide-necked arterial aneurysms utilizing bare metal stents with adjunctive coil embolization has been most commonly reported for skull base aneurysms of the internal carotid artery and intracerebral aneurysms.[6-9] As demonstrated in experimental models, stent coverage of an aneurysm neck reduces turbulence and decreases flow within the aneurysm sac.[10] Consequently, gradual remodeling and ultimately resolution of the aneurysm may be observed through mechanisms including intimal hyperplasia and endothelialization of stent struts.[11] Coil embolization promotes thrombosis of an aneurysm. The combination of stent placement and coil embolization theoretically reduces intrasac flow and promotes sac thrombosis while stenting also prevents coil protrusion into the lumen of the parent vessel. Although mechanisms of stent endothelization and intimal hyperplasia are incompletely defined in the venous system,[12,13] we felt that this model was adaptable to the peripheral venous system and that aneurysm neck coverage would preclude recurrent pulmonary embolization. To our knowledge, this is the first report of treatment of a femoropopliteal vein aneurysm with stent-assisted coil embolization.

Technical strategies for stent-assisted coil embolization include coil embolization both preceding and following stent placement.[9] We chose to place coils deeply into the aneurysm sac before stenting to avoid potential trapping in and protrusion of coil remnants through the interstices of the stent. Such a technique would theoretically reduce the risk of thrombus formation in the parent vessel and particularly in the venous system. Similarly, we were judicious in the number of coils deployed, attempting to place the minimum number needed to initiate a thrombotic process within the aneurysm sac.

The diameter of the femoral vein bordering the aneurysm in this case was 10 to 12 mm. We opted to implant a slightly oversized stent to prevent potential stent migration. In retrospect, a smaller self-expanding stent of 12 mm diameter would have been acceptable. Likewise, were we to do this procedure today, we would employ larger coils, such as 10 mm $\times$ 10 mm.

An alternative endovascular technique for management of the venous aneurysm in this case could have been to exclude the aneurysm by placement of a self-expanding covered stent. Covered stents have been used successfully to exclude traumatic vena caval injuries with good success.[14-16] However, the thrombogenicity and, thus, durability of covered stents in the superficial femoral vein is uncertain. Based on poor results with ring-supported polytetrafluoroethylene (PTFE) grafts as replacement femoropopliteal venous conduits,[17,18] we concluded that a covered stent in this location would also perform suboptimally. Because the venous aneurysm in our case was locally asymptomatic and represented no threat of rupture, we were not compelled to achieve its immediate complete exclusion. Thus, we theorized that an endothelialized bare metal stent offered advantages which could not be completely duplicated with a covered stent.

Conventional therapy using tangential excision and venorrhaphy represents the definitive treatment for venous aneurysm in this location. Operative therapy, however, involves potential local and systemic morbidity and is complicated by thrombosis in up to 25% of reported cases. Additionally, it does not preclude the potential need for postoperative anticoagulation.[1,19] Edema and neuralgia related to surgical exposure is also a recognized complication. The advantage of endovascular therapy may be mitigated by potential late stenosis or occlusion from intimal hyperplasia with or without associated stent fracture or by development of mural thrombus. The long-term behavior of bare metal stents in the superficial femoral vein is unknown. If in-stent stenosis develops, remedial treatment would be based, in this case, purely on symptoms. Hence, lifelong clinical follow-up is necessary.

CONCLUSION

Venous aneurysms may present with pulmonary embolism and are effectively treated by tangential excision and venorrhaphy. Our case demonstrates that the novel approach of stent-assisted coil embolization may effectively exclude a venous aneurysm and prevent recurrent pulmonary embolism.

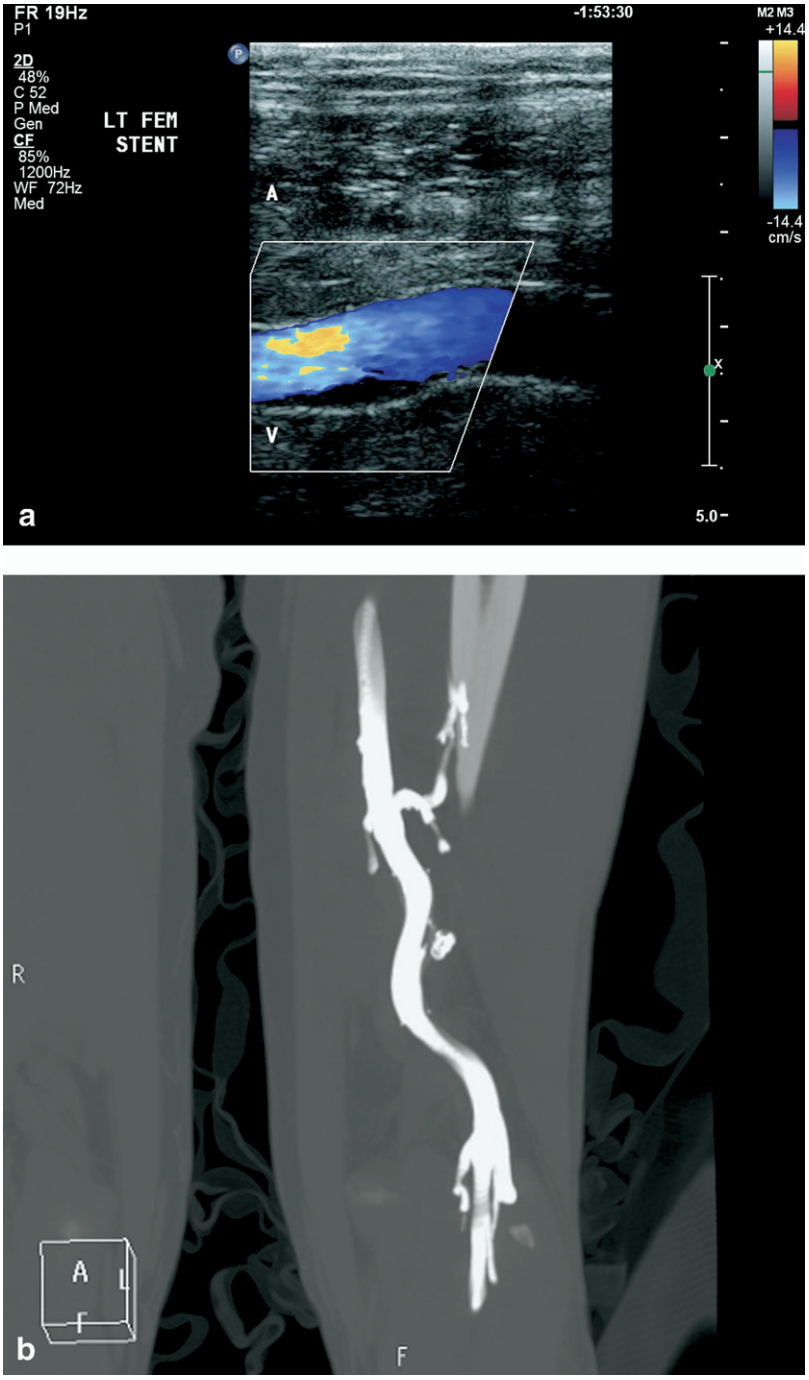

Fig 3. **a**, Post procedural venous duplex scan of left superficial femoral vein at level of treated aneurysm demonstrating in-stent intimal thickening and absence of extra-luminal flow. **b**, Computer tomographic venogram of left thigh demonstrating contraction of coiled aneurysm sac, extraluminal coils, and patency of left superficial femoral vein.

AUTHOR CONTRIBUTIONS

Conception and design: CR, PS
Analysis and interpretation: Not applicable
Data collection: CR, PS
Writing the article: CR, PS
Critical revision of the article: JD, RG, TN
Final approval of the article: CR
Statistical analysis: Not applicable
Obtained funding: Not applicable
Overall responsibility: CR

REFERENCES

1. Sessa C, Nicolini P, Perrin M, Farah I, Magne JL, Guidicelli H. Management of symptomatic and asymptomatic popliteal venous aneurysms: a retrospective analysis of 25 patients and review of the literature. J Vasc Surg 2000;32:902-12.
2. Winchester D, Pearce WH, McCarthy WJ, McGee GS, Yao JS. Popliteal venous aneurysms. Surgery 1993;114:600-7.
3. Gillespie DL, Villavicencio JL, Gallagher C, Chang A, Hamelink JK, Fiala LA, et al. Presentation and management of venous aneurysms. J Vasc Surg 1997;26:845-52.
4. Paes EH, Vollmar JF. Aneurysma transformation in congenital venous angiodysplasias in lower extremities. Int Angiol 1990;9:90-6.
5. Gorenstein A, Katz S, Schiller M. Congenital aneurysms of the deep veins of the lower extremities. J Vasc Surg 1987;5:765-8.
6. Benndorf G, Campi A, Schneider GH, Wellnhofer E, Unterberg A. Overlapping stents for treatment of a dissecting carotid artery aneurysm. J Endovasc Ther 2001;8:566-70.
7. Fiorella D, Albuquerque FC, Deshmukh VR, Woo HH, Rasmussen PA, Masaryk TJ, McDougall CG. Endovascular reconstruction with the Neuroform stent as monotherapy for the treatment of uncoilable intradural pseudoaneurysms. Neurosurgery 2006;59:291-300.
8. Lylyk P, Cohen JE, Cerratto R, Ferrario A, Miranda C. Endovascular reconstruction of intracranial arteries by stent placement and combined techniques. J Neurosurg 2002;97:1306-13.
9. Biondi A, Janardhan V, Katz JM, Salvaggio K, Riina HA, Gobin YP. Neuroform stent-assisted coil embolization of wide-neck intracranial aneurysms: strategies in stent deployment and midterm follow-up. Neurosurgery 2007;61:460-8; discussion 468-9.
10. Cantóun G, Levy DI, Lasheras JC, Nelson PK. Flow changes caused by the sequential placement of stents across the neck of sidewall cerebral aneurysms. J Neurosurg 2005;103:891-902.
11. Lopes D, Sani S. Histological postmortem study of an internal carotid artery aneurysm treated with the Neuroform stent. Neurosurgery 2005; 56:E416.
12. Neglen P, Raju S. In-stent recurrent stenosis in stents placed in the lower extremity venous outflow tract. J Vasc Surg 2004;39:181-8.
13. Neglen P, Hollis KC, Olivier J, Raju S. Stenting of the venous outflow in chronic venous disease: long-term stent-related outcome, clinical, and hemodynamic result. J Vasc Surg 2007;46:979-90.
14. Burket MW. Challenging cases: superior vena cava rupture. Endovasc Today 2003;2:11-3.
15. Azizzadeh A, Pham MT, Estrera AL, Coogan SM, Safi HJ. Endovascular repair of an iatrogenic superior vena caval injury: a case report. J Vasc Surg 2007;46:569-71.
16. Erzurum VZ, Shoup M, Borge M, Kalman PG, Rodriguez H, Silver GM. Inferior vena cava endograft to control surgically inaccessible hemorrhage. J Vasc Surg 2003 Dec;38:1437-9.
17. Schwarzbach MH, Hormann Y, Hinz U, Bernd L, Willeke F, Mechtersheimer G, et al. Results of limb-sparing surgery with vascular replacement for soft tissue sarcoma in the lower extremity. J Vasc Surg 2005 July;42:88-97.
18. Ghert MA, Davis AM, Griffin AM, Alyami AH, White L, Kandel RA, et al. The surgical and functional outcome of limb-salvage surgery with vascular reconstruction for soft tissue sarcoma of the extremity. Ann Surg Oncol 2005;12:1102-10.
19. Aldridge SC, Camerota AJ, Katz MJ, Wolk JH, Goldman BI, White JV. Popliteal venous aneurysm: report of two cases and review of the world literature. J Vasc Surg 1993;118:708-15.

Submitted Feb 5, 2008; accepted Apr 24, 2008.