

Durability of the Viabahn stent graft after axillary artery pseudoaneurysm exclusion

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Pseudoaneurysm formation caused by iatrogenic arterial injury during a regional anesthetic block is a rare complication. We report a case of a 56-year-old male patient who developed an axillary artery pseudoaneurysm caused by brachial plexus block performed for an upper extremity dialysis access operation. Successful repair of this pseudoaneurysm was achieved with endovascular stent graft exclusion. The repaired axillary artery with the stent graft remained patent after 10 years of follow-up. The successful long-term patency of this treatment and a strategy to potentially avoid this complication are discussed. (*J Vasc Surg Cases and Innovative Techniques* 2017;3:99-101.)

Regional anesthesia techniques for upper extremity surgery are often used in the setting of outpatient surgery or for patients at increased risk of complications undergoing general anesthesia. Although proven to be safe and effective to provide adequate anesthesia for upper extremity procedures,¹⁻³ brachial plexus nerve block has been associated with various complications, which include bleeding, hematoma, traumatic arteriovenous fistula, local and systemic toxicities, and transient nerve injury.⁴ We present a case of axillary artery pseudoaneurysm as a complication of axillary brachial plexus block, which was treated with endovascular stent graft exclusion with a remarkable 10-year patency rate. The patient consented to publication of this report.

CASE REPORT

A 56-year-old man with end-stage renal disease underwent creation of a left upper extremity arteriovenous (AV) fistula for hemodialysis. The anesthesia was performed through a left axillary brachial plexus block using an electric nerve stimulator. The regional anesthetic block was successful, and the AV fistula operation was performed uneventfully as the patient was discharged to home as an outpatient. On the following day, when the regional anesthetic effect had dissipated, he reported dull discomfort in his axilla, particularly with arm elevation. The dull axillary pain progressively worsened over the course of 2 weeks, culminating in a hospital admission because of a painful pulsatile axillary mass. The physical examination noted a 2.5-cm × 3.0-cm pulsatile mass in the left axillary fossa

(Fig 1). A duplex ultrasound examination of the mass confirmed a left axillary artery pseudoaneurysm.

The patient underwent endovascular repair in the endovascular suite with a stent graft used for pseudoaneurysm exclusion. During the procedure, the Seldinger technique was used to obtain a right femoral artery access, followed by the placement of a 7F introducer sheath. A thoracic aortogram was performed to delineate the left subclavian artery as it arises from the descending thoracic aorta. A selective left subclavian artery angiogram identified the left axillary pseudoaneurysm. After a guidewire placement across the axillary artery, a 6-mm × 5-cm Viabahn Endoprosthesis (W. L. Gore and Associates, Flagstaff, Ariz) was deployed across the axillary artery pseudoaneurysm. A completion angiogram demonstrated successful pseudoaneurysm exclusion without endoleak (Fig 1).

The patient was discharged to home the following day. His left axillary discomfort symptoms eventually resolved 1 week later, and he was able to return to work 10 days later without any symptoms. He returned for regular annual follow-up with duplex ultrasound surveillance, which showed a patent stent graft without endoleak. His left arm AV fistula was ligated 2 years later because of an infection-related complication. In his most recent follow-up, which was 10 years after the stent graft implantation, he continued to be free of symptoms, and duplex ultrasound imaging showed a widely patent axillary Viabahn stent graft with a fully excluded axillary pseudoaneurysm (Fig 2).

DISCUSSION

Brachial plexus regional block has been used increasingly in past decades for patients undergoing upper extremity operations in outpatient surgical settings or in patients at risk for general anesthesia. As with any invasive procedure, brachial plexus block can result in certain but infrequent procedurally related complications. Arterial pseudoaneurysm secondary to a regional nerve block is an extremely rare adverse event. Only four cases have been reported in the literature previously, all of which underwent conventional open repair.⁵⁻⁷ Although the use of an endovascular stent graft for arterial pseudoaneurysm exclusion has been commonly described for peripheral arterial complications, our case report is notable because it highlights successful long-term

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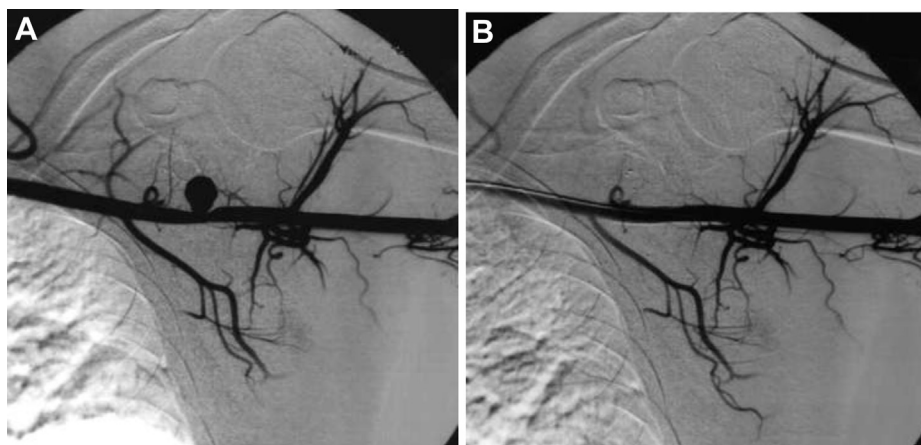


Fig 1. A, Initial left axillary angiogram revealed a saccular axillary artery pseudoaneurysm. **B,** Completion angiogram demonstrated successful endograft exclusion of the axillary pseudoaneurysm.

outcomes with a 10-year follow-up of a covered stent placed across a shoulder joint region.

Endovascular repairs of pseudoaneurysms in various vascular beds using a stent graft have been extensively reported.^{8,9} This treatment strategy offers multiple advantages over open surgical repair because it can be performed via a femoral artery site, which is remote from the pseudoaneurysm location. This endovascular treatment obviates surgical incision and wide dissection in the region of the injured vessel. In addition, this treatment can be performed percutaneously, which does not require general anesthesia in contrast to an open surgical repair.

Since it was first approved by the United States Food and Drug Administration for clinical application in 2005, the Viabahn stent graft has been widely studied in various arterial occlusive disease and aneurysm conditions.^{8,9} The use of this endovascular device in the treatment of axillary artery pseudoaneurysms has also been documented.^{10,11} Although studies have shown successful outcomes in lower extremity arterial occlusive disease,^{12,13} researchers have raised concerns regarding its long-term durability when a metallic stent is placed across mobile joints such as the hip or knee region.^{14,15} Device-related complications, including stent thrombosis, stent fracture, or fragment migration, have been reported, which undoubtedly have dampened the enthusiasm of using this endovascular technology in the arterial circulation across an orthopedic joint region.^{14,15} Schoenefeld et al¹⁴ reported that the durability of a covered stent graft device for popliteal artery aneurysm exclusion may be adversely affected by the flexion and extension movement of a knee joint. In contrast, the patency of Viabahn stent graft has been validated with favorable durability when placed in femoropopliteal segments across a knee joint.^{12,13,16} In a randomized study in which the Viabahn stent graft was compared with a polytetrafluoroethylene graft for

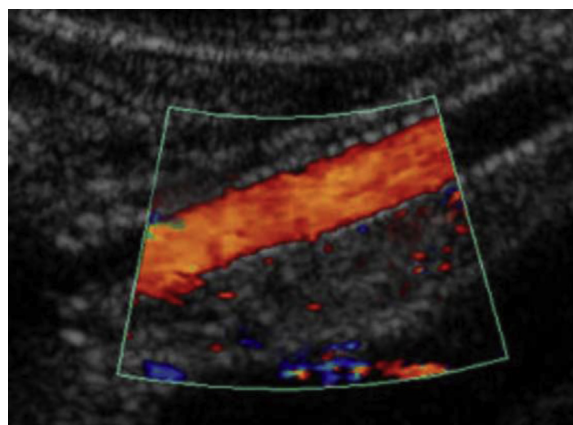


Fig 2. An arterial duplex ultrasound image showed a patent axillary artery Viabahn (W. L. Gore and Associates, Flagstaff, Ariz) stent graft 10 years after implantation.

femoropopliteal artery bypass, McQuade et al¹⁷ reported a comparable patency rate at 4 years of follow-up. Biomechanical investigations have identified a variety of different hemodynamic forces in the popliteal artery secondary to the flexion and extension motion in a knee joint.¹⁸

Although our patient's functioning left arm AV fistula may have increased the upper extremity circulation, we do not believe it contributed to in the long-term patency because it was ligated 2 years later. The 10-year patency rate of the Viabahn stent graft in our patient, who had a successful axillary pseudoaneurysm exclusion, is remarkable because this underscores the durability of this device, given that it has been subjected to a long-term multidimensional rotational movement routinely exerted in a shoulder joint, including flexion, extension, abduction, adduction, and external and internal rotation.

Although an iatrogenic arterial injury caused by regional anesthetic block is a highly uncommon complication with an incidence of <1% in clinical studies,¹⁻³ we

postulate that this is a potentially avoidable complication, particularly given currently available technology. In our patient, an experienced anesthesiologist administered the brachial plexus block using an electric nerve stimulator based on anatomical landmarks. Although such a practice is considered routine and safe in the hands of experienced practitioners, numerous randomized studies have demonstrated ultrasound-guided visualization clearly enhances the safety profile of needle placement and provides accurate anesthetic administration compared with anesthetic procedures performed without ultrasound guidance.^{19,20} A similar safety benefit of ultrasound-guided femoral artery access has been demonstrated in endovascular interventions, with significantly reduced procedural related complications.²¹ Given the increased adaptation of endovascular procedures in the past decade, portable ultrasound equipment is now commonly found in many operating rooms. We believe ultrasound visualization should be used whenever possible when a needle is placed for regional anesthetic administration because it may potentially reduce the complication as seen in our patient.

CONCLUSIONS

The remarkable long-term patency of an axillary stent graft for pseudoaneurysm exclusion in our patient validates the beneficial utility of this minimally invasive endovascular modality. Further follow-up surveillance and clinical investigation are warranted to validate the therapeutic benefit of this endovascular treatment modality.

REFERENCES

1. Andersson A, Akeson J, Dahlin LB. Efficacy and safety of axillary brachial plexus block for operations on the hand. *Scand J Plast Reconstr Surg Hand Surg* 2006;40:225-9.
2. Davis WJ, Lennon RL, Wedel DJ. Brachial plexus anesthesia for outpatient surgical procedures on an upper extremity. *Mayo Clin Proc* 1991;66:470-3.
3. Urban MK, Urquhart B. Evaluation of brachial plexus anesthesia for upper extremity surgery. *Reg Anesth* 1994;19:175-82.
4. Stan TC, Krantz MA, Solomon DL, Poulos JG, Chaouki K. The incidence of neurovascular complications following axillary brachial plexus block using a transarterial approach. A prospective study of 1,000 consecutive patients. *Reg Anesth* 1995;20:486-92.
5. Flowers GA, Meyers JF. Pseudoaneurysm after interscalene block for a rotator cuff repair. *Arthroscopy* 2004;20(Suppl 2):67-9.
6. Zipkin M, Backus WW, Scott B, Poppers PJ. False aneurysm of the axillary artery following brachial plexus block. *J Clin Anesth* 1991;3:143-5.
7. Groh GI, Gainer BJ, Jeffries JT, Brown M, Eggers GW Jr. Pseudoaneurysm of the axillary artery with median-nerve deficit after axillary block anesthesia. A case report. *J Bone Joint Surg Am* 1990;72:1407-8.
8. Siani A, Flaishman I, Siani LM, Mounayergi F, Zaccaria A, Schioppa A, et al. Spontaneous rupture of the superficial femoral artery treated via an endovascular approach. *Tex Heart Inst J* 2008;35:66-8.
9. Hoppe H, Barnwell SL, Nesbit GM, Petersen BD. Stent-grafts in the treatment of emergent or urgent carotid artery disease: review of 25 cases. *J Vasc Interv Radiol* 2008;19:31-41.
10. Weger N, Klaassen Z, Sturt C, Hertz S. Endovascular treatment of a pseudoaneurysm after an iatrogenic axillary artery injury. *Ann Vasc Surg* 2010;24:826.e9-12.
11. Park SK, Hwang JK, Park SC, Kim SD. Endovascular treatment of a spontaneous aneurysm in the axillary artery. *Interact Cardiovasc Thorac Surg* 2015;20:140-2.
12. Saxon RR, Dake MD, Volgelzang RL, Katzen BT, Becker GJ. Randomized, multicenter study comparing expanded polytetrafluoroethylene-covered endoprosthesis placement with percutaneous transluminal angioplasty in the treatment of superficial femoral artery occlusive disease. *J Vasc Interv Radiol* 2008;19:823-32.
13. Lammer J, Zeller T, Hausegger KA, Schaefer PJ, Gschwendtner M, Mueller-Huelsbeck S, et al. Heparin-bonded covered stents versus bare-metal stents for complex femoropopliteal artery lesions: the randomized VIASTAR trial (Viabahn endoprosthesis with PROPATEN bioactive surface [VIA] versus bare nitinol stent in the treatment of long lesions in superficial femoral artery occlusive disease). *J Am Coll Cardiol* 2013;62:1320-7.
14. Schoenefeld E, Donas KP, Schonefeld T, Osada N, Austermann M, Torsello G. Mid-term outcome after endovascular therapy in the superficial femoral and popliteal artery using long stents. *Vasa* 2012;41:49-56.
15. Bosiers M, Torsello G, Gissler HM, Ruef J, Muller-Hulsbeck S, Jahnke T, et al. Nitinol stent implantation in long superficial femoral artery lesions: 12-month results of the DURABILITY I study. *J Endovasc Ther* 2009;16:261-9.
16. Sarac M, Marjanovic I, Jevtic M, Misovic S, Zoranovic U, Rusovic S. Endovascular repair of posttraumatic multiple femoral-femoral and popliteal-popliteal arteriovenous fistula with Viabahn and excluder stent graft. *Vojnosanit Pregl* 2011;68:616-20.
17. McQuade K, Gable D, Pearl G, Theune B, Black S. Four-year randomized prospective comparison of percutaneous ePTFE/nitinol self-expanding stent graft versus prosthetic femoral-popliteal bypass in the treatment of superficial femoral artery occlusive disease. *J Vasc Surg* 2010;52:584-90; discussion: 590-1, 591.e1-e7.
18. DeGoede KM, Ashton-Miller JA, Schultz AB, Alexander NB. Biomechanical factors affecting the peak hand reaction force during the bimanual arrest of a moving mass. *J Biomech Eng* 2002;124:107-12.
19. Mariano ER, Kim TE, Wagner MJ, Funck N, Harrison TK, Walters T, et al. A randomized comparison of proximal and distal ultrasound-guided adductor canal catheter insertion sites for knee arthroplasty. *J Ultrasound Med* 2014;33:1653-62.
20. Gedikoglu M, Andic C, Evren Eker H, Guzelmansur I, Oguzkurt L. Ultrasound-guided supraclavicular brachial plexus block for analgesia during endovascular treatment of dysfunctional hemodialysis fistulas. *J Vasc Interv Radiol* 2014;25:1427-32.
21. Kalish J, Eslami M, Gillespie D, Schermerhorn M, Rybin D, Doros G, et al. Routine use of ultrasound guidance in femoral arterial access for peripheral vascular intervention decreases groin hematoma rates. *J Vasc Surg* 2015;61:1231-8.