From the Eastern Vascular Society

Utility and safety of axillary conduits during endovascular repair of thoracoabdominal aneurysms

Jordan R. Stern, MD, Sharif H. Ellozy, MD, Peter H. Connolly, MD, Andrew J. Meltzer, MD, *and* Darren B. Schneider, MD, *New York, NY*

ABSTRACT

Objective: Endovascular treatment of thoracoabdominal aortic aneurysms (TAAAs) with branched and fenestrated stent grafts often requires upper extremity arterial access for antegrade delivery of bridging covered stents into the visceral arteries. Axillary, brachial, and radial artery approaches have been described, but data on the safety and utility of the different approaches remain limited. We have preferentially used axillary artery conduits for upper extremity arterial access during endovascular repair of TAAA and describe our technique and report our experience herein.

Methods: Thirty-two patients were treated within an investigator-sponsored investigational device exemption clinical trial of endovascular repair of TAAAs using custom-manufactured stent grafts. In 29 of these cases, the axillary artery was exposed through an infraclavicular incision, and an axillary conduit was used for antegrade delivery of bridging visceral artery stent components. In all cases, a 12F sheath was placed through the conduit for delivery of stent graft components. The left axillary artery was used in 27 of these 29 cases, and the right axillary artery was used in 2 patients. Proximal brachial artery access was used in two patients, and one patient did not require upper extremity access. Aneurysms treated included pararenal (n = 3) and Crawford TAAA extent I (n = 1), extent II (n = 3), extent III (n = 10), and extent IV (n = 15). Patients have been followed up to 2 years after the procedure, with a mean follow-up of 226 days.

Results: Axillary conduits were used to deliver a total of 170 stent components placed into 81 branches and 27 fenestrations with 99.1% technical success (one accessory renal branch could not be cannulated). There were no intraoperative complications related to the construction or use of the conduit. There were two postoperative complications (6.9%) potentially attributable to the conduit; one patient experienced ipsilateral hand weakness and one patient had postoperative minor stroke, which resolved by the first postoperative visit. There were no cases of arm ischemia, wound hematoma, or reoperation related to the conduit.

Conclusions: The use of an axillary conduit during endovascular repair of complex aortic aneurysms provides safe and effective upper extremity access for delivery of visceral branches. Moreover, axillary conduits facilitate delivery of 12F sheaths without interrupting upper extremity perfusion and provide a shorter working distance compared with brachial artery approaches. (J Vasc Surg 2017;■:1-6.)

Contemporary morbidity and mortality rates for open surgical repair of thoracoabdominal aortic aneurysms (TAAAs) remain high, even at the highest volume centers.[1] National data suggest a perioperative mortality of at least 10%, with morbidity occurring in >50% overall.[2,3] Consequently, there is growing interest in endovascular treatment of TAAA with fenestrated and branched graft technology. Since the first report of implantation into a patient with a contained supraceliac rupture,[4] several centers have reported outcomes for endovascular repair of TAAA with encouraging early results that are comparable to those of open surgical repair at high-volume centers, even in patients who are at high risk for open surgery.[5-8]

Upper extremity access is often required during complex endovascular aortic surgery, as is the case with endovascular TAAA repair to deliver bridging stent components through antegrade-directed branches and to deliver parallel visceral stents during chimney and sandwich procedures. The left side may be preferable to limit passage of devices through the aortic arch. A variety of approaches and techniques have been described for upper extremity arterial access, including radial, brachial (both percutaneous and open), and axillary; however, there is no consensus on the best approach.[9-11]

We have preferentially used an axillary artery approach with a temporary conduit to facilitate delivery of bridging components during endovascular repair of TAAA with branched and fenestrated stent grafts. We have found that axillary conduits are well tolerated and have several advantages over alternative approaches, including being

From the New York-Presbyterian Hospital/Weill Cornell Medical Center.

Author conflict of interest: none.

Presented at the Thirtieth Annual Meeting of the Eastern Vascular Society, Philadelphia, Pa, September 15-17, 2016.

Correspondence: Darren B. Schneider, MD, Associate Professor of Surgery, Chief of Vascular & Endovascular Surgery, New York-Presbyterian Hospital/Weill Cornell Medical Center, 525 E 68th St, P-707, New York, NY 10065 (e-mail: dbs9003@med.cornell.edu).

The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

0741-5214

http://dx.doi.org/10.1016/j.jvs.2016.12.107

able to deliver large sheaths without interruption of upper extremity perfusion, shortening the working distance to the visceral arteries, and permitting full angulation of the C arm because the arms remain tucked at the patient's side. Herein we describe our experience and outcomes with use of axillary conduits for delivery of bridging stent graft components during endovascular treatment of TAAA.

METHODS

As part of an investigator-sponsored investigational device exemption clinical trial (G130193) between 2014 and 2016, there were 32 patients with TAAAs deemed at high risk for open surgical repair treated with custom branched or fenestrated stent grafts (Cook, Inc, Bloomington, Ind). The protocol and informed consent were approved by the Institutional Review Board, and all patients gave informed consent. Bilateral femoral artery access for delivery of aortic stent graft components was obtained either percutaneously with Perclose ProGlide (Abbott Vascular, Santa Clara, Calif) closure or surgical cutdown based on the patient anatomy's and the attending physician's preference. Bridging visceral stent graft components were preferentially delivered through the left axillary artery, using a temporary conduit.

The axillary artery was exposed through a transverse infraclavicular incision. After anticoagulation with intravenous heparin, a 6-mm-diameter Dacron graft (Hemashield; Maquet, Wayne, NJ) was sewn end to side to the axillary artery by a running 5-0 polypropylene suture (Fig 1). The conduit was then tunneled subcutaneously and brought out through a small counterincision located a few centimeters inferolaterally for better ergonomics (Fig 2). The axillary conduit was accessed with a 5F sheath; a guidewire was advanced into the descending thoracic aorta and was snared from a femoral approach to establish axillary-femoral through-wire access. The axillary sheath was subsequently exchanged for a 12F High-Flex Ansel sheath (Cook, Inc), which was advanced over the through-wire into the descending thoracic aorta. The through-wire was maintained to stabilize the sheath, and additional sheaths and guidewires for delivery of bridging covered stent components into target visceral arteries were introduced through the 12F sheath alongside the through-wire. After the endovascular TAAA repair was completed, the sheaths were removed and the axillary conduit was transected, leaving a 3- to 4-mm cuff of graft material attached to the artery. The graft cuff was closed by oversewing it with running 5-0 polypropylene suture in two layers, creating a functional patch closure to prevent narrowing of the artery. The incision was then closed with absorbable sutures.

RESULTS

Baseline characteristics of the patients treated are outlined in Table I. The average age of the study patients was 75.6 ± 8.3 years, with an average maximal aneurysm diameter of 69.6 ± 10.6 mm; 81.2% of patients were male, 71.8% white, 18.7% African American, 6.2% Latino, and 3.1% Asian. All patients were American Society of Anesthesiologists class 3 (68.8%) or class 4 (31.2%). Anatomically, thoracoabdominal aneurysms by Crawford classification included 1 extent I (3.1%), 3 extent II (9.3%), 10 extent III (31.2%), and 15 extent IV (46.9%). Three patients (9.3%) had pararenal aneurysms; 15.6% of patients had a prior endovascular aortic aneurysm repair, and 40.6% had a prior open surgical aortic repair. Many patients had multiple medical comorbidities; comorbid conditions are summarized in Table II.

A total of 208 components were used in 81 branches and 41 fenestrations, corresponding to 122 target visceral arteries. Of the fenestrations, 27 of 41 (65.8%) were cannulated through an upper extremity approach and the remainder through a femoral approach. All branches were cannulated through an upper extremity approach. Axillary conduits were used for upper extremity access in 29 of the 31 patients (93.5%), and a total of 170 components were delivered into 108 target arteries through axillary conduits (average of 5.9 components per patient); the individual breakdown of bare-metal and covered stents deployed is summarized in Table III. Twenty-seven of 29 (93.1%) axillary conduits were left-sided, and two right-sided conduits were used in patients with permanent pacemakers overlying the left axillary artery.

Technical success was achieved in 107 of 108 cases (99.1%), defined as cannulation of the branch or fenestration and target vessel with successful deployment of bridging components and patency on completion angiography. In one patient, an accessory renal artery could not be cannulated through an antegrade branch, and the branch was sacrificed.

There were two postoperative complications possibly related to the axillary conduits. One patient experienced arm weakness, probably from a brachial plexopathy on the ipsilateral side. Another patient suffered a minor ipsilateral stroke, presumably in the anterior circulation with symptoms of arm weakness on the contralateral side. However, a computed tomography scan of the brain did not reveal an infarct or hemorrhage, and the diagnosis of a presumed stroke was based on clinical presentation. His symptoms had resolved by the first

ARTICLE HIGHLIGHTS

- **Type of Research:** Single-center retrospective study
- **Take Home Message:** Using an axillary conduit instead of brachial access, the authors performed 29 endovascular repairs of thoracoabdominal aneurysms, with two minor conduit-related complications.
- **Recommendation:** This study suggests that axillary conduit is suitable for endovascular repair of thoracoabdominal aneurysms.