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Case Reports

Use of a Covered CP Stent to Exclude an Aortic–Brachiocephalic Conduit Pseudoaneurysm

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A 63-year-old woman was incidentally found to have a thoracic aortic aneurysm. We performed hybrid repair involving aortic arch debranching and endovascular stent-graft placement. Four months later, an asymptomatic pseudoaneurysm had formed at the aortic conduit–brachiocephalic artery anastomosis. To exclude the pseudoaneurysm, we deployed a Covered CP Stent across the anastomosis through a surgically created right axillary artery conduit. We discuss the patient's case and our choice of treatment. ***(Tex Heart Inst J 2019;46(2):143-6)***

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Hybrid thoracic aortic repair can be appropriate when patients have complex aortic arch disease or when open repair poses a high risk. Aortic arch debranching, performed first, reroutes blood flow through an aortic conduit anastomosed to the supra-aortic great vessels. Endovascular techniques are then used to repair the pathologic aortic condition. Anastomotic leaks after aortic debranching can be difficult to repair in patients who are high-risk surgical candidates.

We report our use of a Covered CP Stent® (NuMED, Inc.) to exclude an aortic conduit–brachiocephalic artery anastomotic pseudoaneurysm in a 63-year-old woman who had undergone hybrid repair of a thoracic aortic aneurysm. The patient's aortic anatomy had changed consequent to the earlier repair, so we deployed this stent through a surgically created conduit to the right axillary artery. We discuss our choice of this treatment approach.

Case Report

In June 2016, a 63-year-old woman with diabetes mellitus and hypertension was incidentally found to have a descending thoracic aortic aneurysm (Fig. 1A). The 7-cm aneurysm extended from the distal aortic arch to the level of the T7 vertebral body. The patient underwent hybrid repair, consisting of aortic arch debranching followed by thoracic endovascular aortic repair (TEVAR).

After the debranching, the supra-aortic great vessels were supplied by an aortic conduit fashioned from an 18-mm Gelweave™ graft (Vascutek Terumo) with 2 additional 8-mm Gelweave side limbs. The proximal end of the 18-mm graft was attached to the aorta in end-to-side fashion, and the distal end, to the brachiocephalic artery in end-to-end fashion. The proximal 8-mm limb of the conduit was then attached in end-to-end fashion to the left subclavian artery; likewise, the distal side limb was attached to the left common carotid artery. Two days later, we performed TEVAR, deploying overlapping 3.7 × 20-cm and 3.1 × 15-cm Conformable Gore® Tag® Thoracic Endoprostheses (W.L. Gore & Associates, Inc.) from the ascending to the descending aorta, followed by proximal extension with a 4 × 10-cm Conformable Gore Tag aortic endograft to exclude a type IA endoleak. To exclude the aneurysm, the stents covered the mid ascending aorta just distal to the origin of the aortic conduit to the mid descending thoracic aorta at the level of the T8 vertebral body (Fig. 1B). The initial aortogram during TEVAR showed thrombosis of the left subclavian artery limb of the conduit.

Postoperatively, the patient had respiratory failure with right vocal cord paralysis that necessitated tracheostomy, dysphagia that necessitated gastric tube placement, a sternal wound infection, pneumonia, a urinary tract infection, and left internal jugular-to-brachial deep vein thrombosis. She was discharged in stable condition to a skilled nursing facility one month after aortic repair; a computed tomographic angiogram (CTA) showed no endoleak or vascular complication.

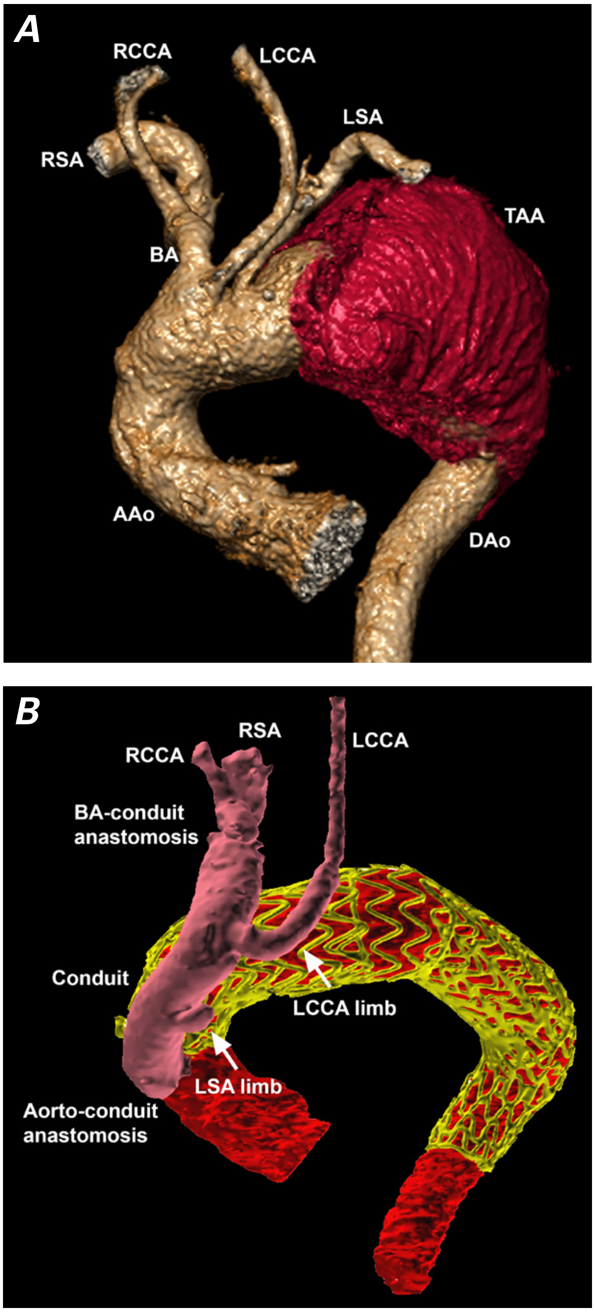

Fig. 1 *Surface-rendered computed tomographic angiograms show the* ***A****) thoracic aortic aneurysm before hybrid repair and* ***B****) one month later, including thrombosis in the left subclavian limb of the aortic conduit.*

AAo = ascending aorta; BA = brachiocephalic artery; DAo = descending aorta; LCCA = left common carotid artery; LSA = left subclavian artery; RCCA = right common carotid artery; RSA = right subclavian artery; TAA = thoracic aortic aneurysm

Four months after the repair, a routine CTA showed a large pseudoaneurysm arising medially from the aortic conduit–brachiocephalic artery anastomosis (Fig. 2). There were no other aberrations; the anastomosis itself was widely patent, and the native brachiocephalic artery was normal. The pseudoaneurysmal sac was approximately 4.1 cm (anteroposterior) × 5.5 cm (transverse)

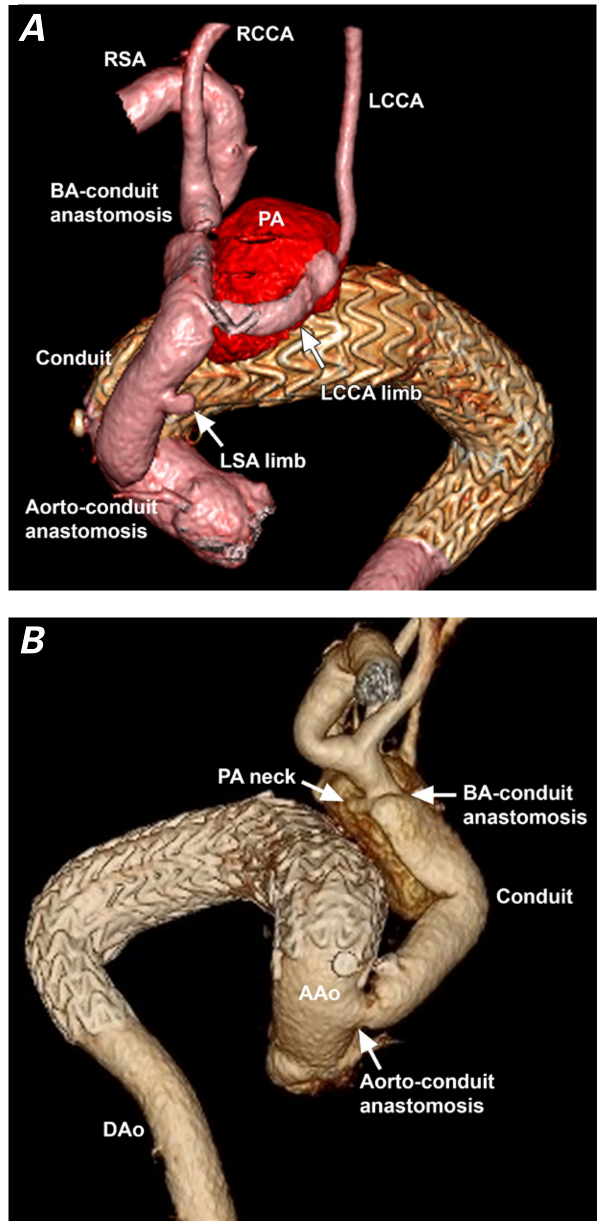

Fig. 2 *Surface-rendered computed tomographic angiograms 4 months after hybrid aortic repair show* ***A****) a pseudoaneurysm extending medially from the brachiocephalic artery-aortic anastomosis (right anterior view) and* ***B****) the anastomosis and pseudoaneurysmal neck (right posterior view).*

AAo = ascending aorta; BA = brachiocephalic artery; DAo = descending aorta; LCCA = left common carotid artery; LSA = left subclavian artery; PA = pseudoaneurysm; RCCA = right common carotid artery; RSA = right subclavian artery

× 5.4 cm (craniocaudal) in diameter; the neck was 1.1 cm. The sac had a mass effect within the superior mediastinum, causing nonocclusive compression of the left common carotid artery; however, the patient was asymptomatic. Treatment options included high-risk open repair or endovascular exclusion of the pseudoaneurysm. The patient provided written informed consent for the latter approach.

We thought that the multiple angles of the postsurgical aorta would preclude stable, large-bore access into the aortic conduit from the groin. Therefore, we surgically created a right axillary arterial conduit for endovascular access. Using a cutdown on the right axillary artery, we anastomosed a Hemashield® graft (Maquet Getinge Group) to the axillary artery proximally in end-to-side fashion. We tunneled the graft through the skin and secured its distal end to a 20F sheath (Cook Medical) with multiple ties (Fig. 3).

The patient was transferred to the angiography suite. Systemic heparinization had a targeted activated clotting time of 250 s. We positioned a 5F angiographic catheter in the proximal aortic conduit through a common femoral approach. Angiograms showed the pseudoaneurysm and the supra-aortic great vessel anatomy (Fig. 4). We manually crimped an 8 Zig 4.5-cm Covered CP Stent over a 16-mm BIB® Catheter Balloon (NuMED), then delivered it through the axillary conduit and across the aortic conduit–brachiocephalic artery anastomosis to the level of the pseudoaneurysm. The inner balloon was inflated first, to stabilize and secure the stent. The outer balloon was then inflated to deploy the stent within the targeted landing zone between the origins of the left common carotid graft limb inferiorly and the right common carotid artery superiorly. Angiograms showed residual flow into the pseudoaneurysm through an expected type IA endoleak. We further dilated the caudal portion of the stent

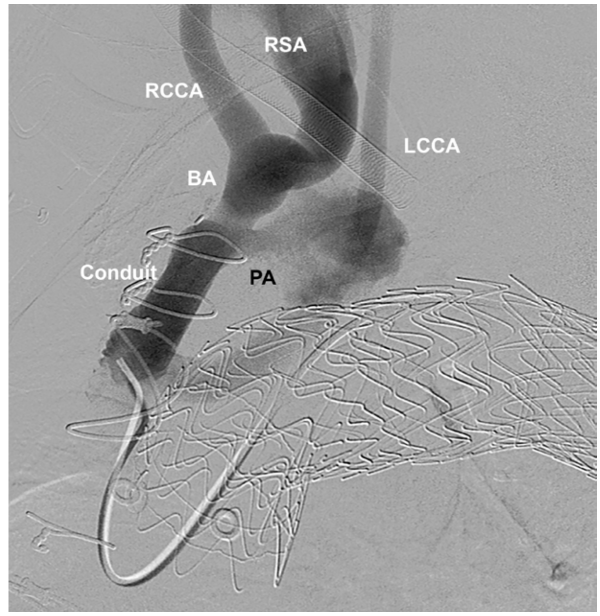

Fig. 4 *Digital subtraction angiogram from the aortic conduit shows the arterial anatomy and the pseudoaneurysm after hybrid repair of a thoracic aortic aneurysm.*

BA = brachiocephalic artery; LCCA = left common carotid artery; PA = pseudoaneurysm; RCCA = right common carotid artery; RSA = right subclavian artery

by using a 20-mm Vida® PTV Dilatation Catheter (Bard Peripheral Vascular, Inc.) to achieve apposition with the conduit walls. Angiographic results confirmed complete exclusion of the pseudoaneurysmal sac (Fig. 5). We closed the common femoral arteriotomy with use of a Perclose ProGlide® Suture-Mediated Closure System (Abbott), severed and closed the right axillary conduit, and closed the skin site surgically. There were no procedural complications.

The patient recovered well, without neurologic deficits. A CTA 4 days after the procedure showed complete exclusion of the pseudoaneurysm and preserved patency of the conduit, stent-graft, and branch vessels (Fig. 6).

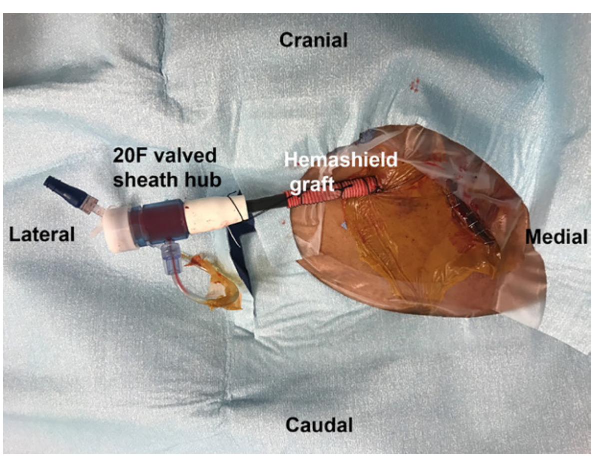

Fig. 3 *Photograph shows the surgically created right axillary conduit before endovascular repair of the anastomotic pseudoaneurysm.*

Discussion

After the patient underwent TEVAR, delivering the CP stent through a femoral approach would have involved several tight curves, including an almost 180° turn at the aorta–conduit anastomosis. Accordingly, we chose an upper-extremity retrograde approach. A 12F delivery sheath was needed, so we surgically created an axillary conduit that enabled a relatively straight approach across the right subclavian artery and around the curvature of the brachiocephalic artery.

Furthermore, endovascular exclusion of the pseudoaneurysm necessitated precise stent-graft positioning in a tight landing zone that tapered substantially from the aortic conduit into the native brachiocephalic artery. As

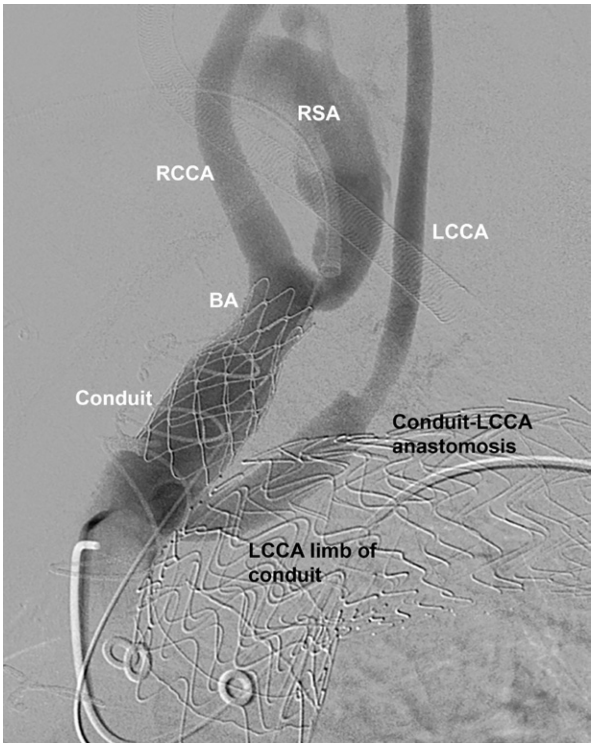

Fig. 5 *Digital subtraction angiogram of the aortic conduit shows exclusion of the pseudoaneurysm after deployment of a Covered CP Stent.*

BA = brachiocephalic artery; LCCA = left common carotid artery; RCCA = right common carotid artery; RSA = right subclavian artery

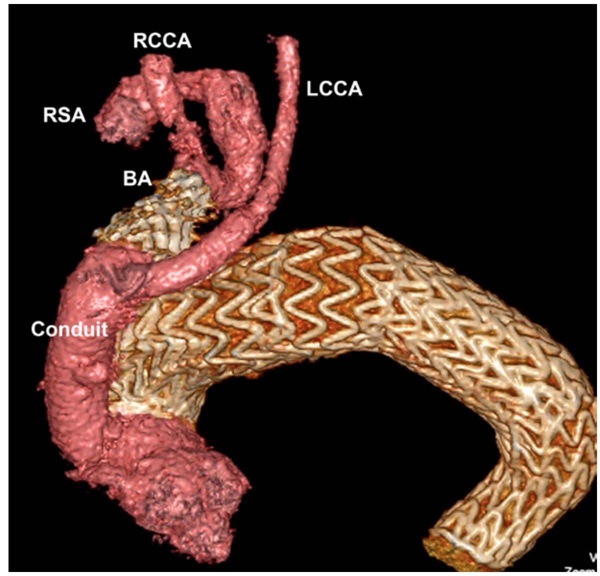

Fig. 6 *Surface-rendered computed tomographic angiogram shows stent-graft repair of the pseudoaneurysm and preserved patency of the conduit and branch vessels.*

BA = brachiocephalic artery; LCCA = left common carotid artery; RCCA = right common carotid artery; RSA = right subclavian artery

shown on preprocedural images, the approximately 4.5-cm landing zone extended from the inferior border of the origin of the right common carotid artery to the superior border of the left common carotid artery limb of the conduit. The conduit was 18 mm in diameter at the inferior landing zone, and the superior landing zone in the native brachiocephalic artery was approximately 12 × 10 mm—with distortion from the abutting pseudoaneurysm. Given this discrepancy in the calibers, we used a balloon-expandable stent-graft so that we could conform its diameter to the arterial diameter at each end. The short landing zone restricted our choice of usable stent-grafts.

The Covered CP Stent, approved by the U.S. Food and Drug Administration for treating congenital pediatric and adult aortic coarctation,[1,2] has many off-label vascular applications. It can expand in somewhat irregular anatomies and easily cover a tube that is narrow at one end and much larger at the other, as in our patient's case. All Covered CP stents are constructed from 0.013-in palladium-iridium alloy wire with an 8-zig formation welded in series to create stents of differing lengths.[3] The stents vary only in length; for this patient, we selected the 8 Zig 4.5-cm Covered CP Stent. These stents can be dilated to almost 30 mm in diameter without ripping their covering, and they have exponential foreshortening, especially after dilation beyond 22 to 24 mm. On BIB catheters, one can deliver these stents precisely through relatively low-profile sheaths. The tradeoff for ductility is their propensity to fracture, so in a dynamic environment, it is sometimes necessary to buttress them with stents that have a higher radial force.

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