Bail-out technique to detach a locked Viabahn endoprosthesis in branched thoracic endovascular aortic repair

Wolf Eilenberg, MD, PhD, Giuseppe Panuccio, MD, PhD, Fiona Rohlffs, MD, PhD, Ahmed S. Eleshra, MD, PhD, Franziska Heidemann, MD, PhD, *and* Tilo Kölbel, MD, PhD, *Hamburg, Germany*

ABSTRACT

A 69-year-old female patient presented with a 5.8 cm thoracoabdominal aortic aneurysm Crawford type II after partial arch replacement. She was treated by a branched thoracic endovascular aortic repair procedure using a branched arch endograft with one retrograde branch to the left subclavian artery. After deployment of a Viabahn as a bridging covered stent to the left subclavian artery, the deployment line did not detach and the delivery catheter could not be removed. With the use of a physician-modified sidehole catheter and balloon fixation, the pulling line could be released without displacement of the Viabahn endoprosthesis. (J Vasc Surg Cases Innov Tech 2021;7:593-6.)

Keywords: Abdominal aortic aneurysm; TEVAR; Aortic aneurysm; Aortic dissection; Endovascular therapy; Outback catheter

Patients with thoracoabdominal aortic aneurysm frequently require coverage of the left subclavian artery (LSA). Techniques to preserve LSA perfusion during branched thoracic endovascular aortic repair (B-TEVAR) include the use of fenestrated and branched endografts.[1,2] Because of an acute take-off angle especially in type III arches acc. to Madhwal, bridging covered stent placement from a retrograde branch to the LSA may be challenging. Although the performance of bridging covered stents in fenestrated and B-TEVAR is well documented, there is little evidence on their use in the aortic arch.[3] The use of a brachiofemoral through-and-through wire or specific anchoring devices in the LSA offers an improved control during bridging covered stent deployment.[4]

In this technical note, we describe a challenging complication during B-TEVAR with a retrograde LSA branch. After deployment of a Viabahn endoprosthesis (W. L. Gore & Associates, Flagstaff, Ariz) as a bridging covered stent to the LSA, the deployment line of the device did not detach and the delivery catheter could not be removed. With the use of a physician-modified sidehole catheter 5F Lind (100 cm 5F Lind catheter; Cordis Corporation, a Cardinal Health company, Milpitas, Calif) and balloon fixation, the pulling line could be detached without displacement of the Viabahn covered stent with an excellent angiographic and clinical result.

TECHNIQUE

A 69-year-old female patient presented with a 5.8 cm thoracoabdominal aortic aneurysm Crawford type II after partial arch replacement. The patient was planned for a two-stage repair to reduce the risk of spinal cord ischemia: B-TEVAR landing proximally in the open surgical graft with a retrograde branch for the LSA first and a B-TEVAR with four outer branches in a second procedure. The first procedure was conducted in a hybrid operating room with a fixed imaging system (Allura Clarity; Philips Healthcare, Amsterdam, The Netherlands) and computed tomography fusion (Vesselnavigator; Philips Healthcare) under general anesthesia and full heparinization with an activated clotting time of 250 to 350 seconds. The branched main endograft was introduced over an extra-stiff guidewire (Lunderquist; Cook Medical, Bjaeverskov, Denmark) into the aortic arch and deployed under repeat angiography with the opening of the inner branch at the level of the LSA (Fig 1, *A-C*). After exchange of the deployment system for a 20F 25-cm Check-Flo sheath and a 12F 80-cm Flexor sheath (both Cook Medical), the LSA was catheterized and a 400-cm-long hydrophilic wire snared from a 7F 55-cm Ansel sheath in the

From the German Aortic Center, Department of Vascular Medicine, University Heart and Vascular Center, University Hospital Hamburg-Eppendorf.

Author conflict of interest: The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: T.K. receives royalties, speaking fees, and research, travel, and educational grants from Cook Medical; he is a consultant and proctor for and has intellectual property with Cook Medical. G.P. is a proctor for Cook Medical and has received travel and educational grants and speaking fees from Cook Medical.

Correspondence: Wolf Eilenberg, MD, PhD, FEBVs, German Aortic Center, Department of Vascular Medicine, University Heart and Vascular Center, University Hospital Hamburg, Eppendorf, Martinistraße 52, 20246 Hamburg, Germany; Department of General Surgery, Division of Vascular Surgery, Medical University of Vienna, Währinger Gürtel 18-20, A-1090 Vienna, Austria (e-mail: wolf.eilenberg@meduniwien.ac.at).

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

2468-4287

https://doi.org/10.1016/j.jvscit.2021.06.006

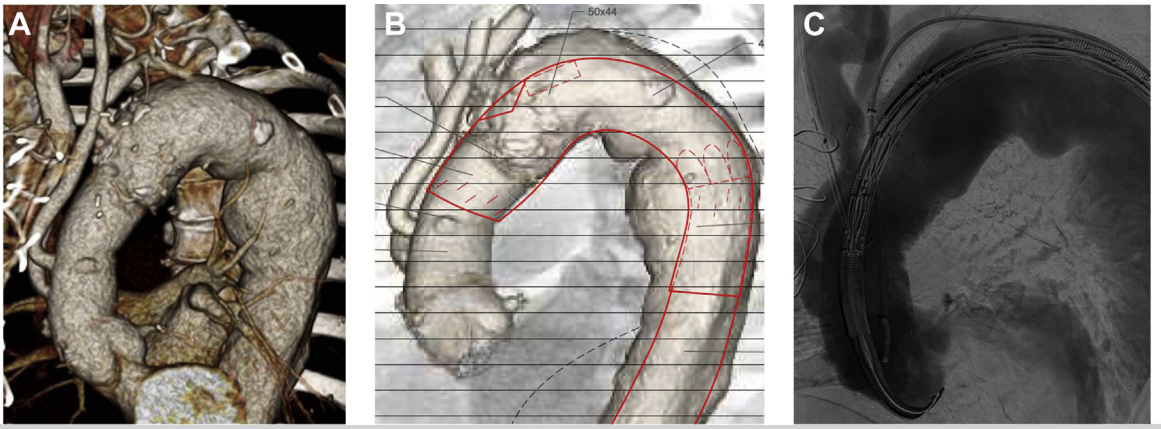

Fig 1. Planning a custom-made branched endograft for the left subclavian artery (LSA). **A,** Three-dimensional volume rendering of the preoperative computed tomography angiography. **B,** Sketch to illustrate the planned landing position of the retrograde LSA branch. **C,** Digital subtraction angiography before deployment of the branched main component.

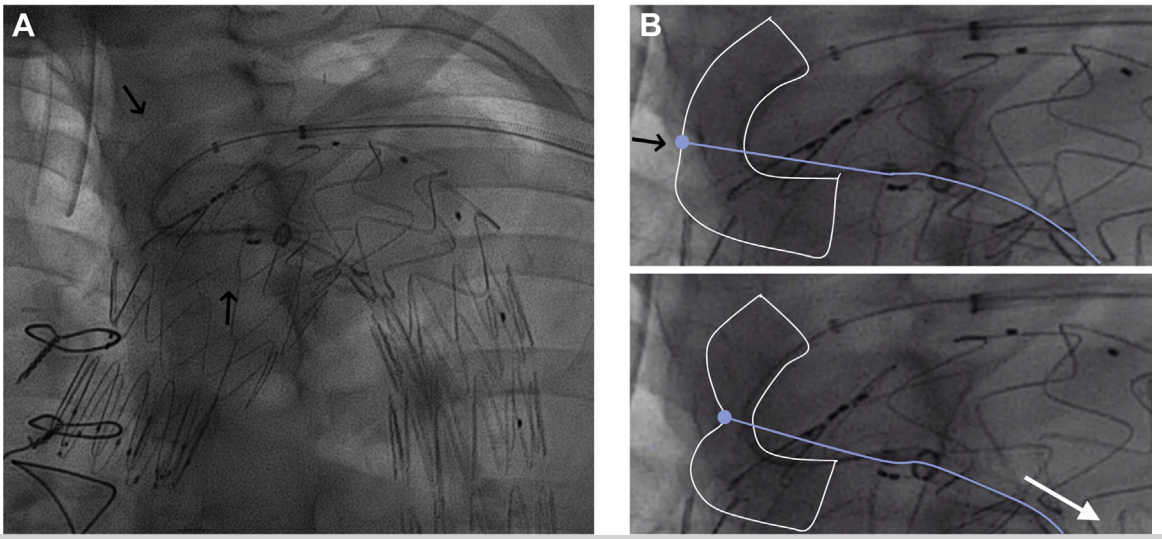

Fig 2. Intraoperative fluoroscopy after deployment of a Viabahn endoprosthesis (W. L. Gore & Associates, Flagstaff, Ariz) from the retrograde branch to the left subclavian artery (LSA). **A,** The *arrows* mark the extent of the Viabahn endoprosthesis. **B,** The pulling line (*blue*) is locked at the middle of the Viabahn endoprosthesis on the outer curvature (*black arrow*) and traction results in severe deformation (lower image).

left brachial artery to establish a through-and-through guidewire. A 50-mm-long 11 mm self-expandable Viabahn endoprosthesis (W. L. Gore & Associates) was introduced and deployed at the left vertebral artery ostium bridging the 10-mm inner branch to the LSA. Removal of the deployment knob with the attached pulling line was not possible, even when using significant force already deforming the Viabahn stent (Fig 2, *A* and *B*).

To better transfer the pulling force to the attachment site of the pulling line at the Viabahn prosthesis, we modified a 5F 100-cm Lindh catheter (Cordis Corporation, a Cardinal Health company) by adding a sidehole close to its tip and used a 0.014 wire to thread the pulling line after cutting the deployment knob and removing the deployment catheter of the Viabahn endoprosthesis into the catheter. The catheter modification allowed a "rapid-exchange" use, which was needed as the catheter could not be used in an over-the-wire fashion due to the limited length of the pulling line. By stiffening the shaft of the Lind catheter with an exra-stiff Lunderquist wire fixating the Viabahn prosthesis in place using a 2-cm-long 12-mm percutaneous transluminal angioplasty balloon (Fig 3, *A-C*) the pulling line could be detached without displacement of the Viabahn covered stent (Fig 4, *A* and *B*). A 38-mm-long 10-mm Advanta covered stent (Getinge, Merrimack, NH) was additionally used

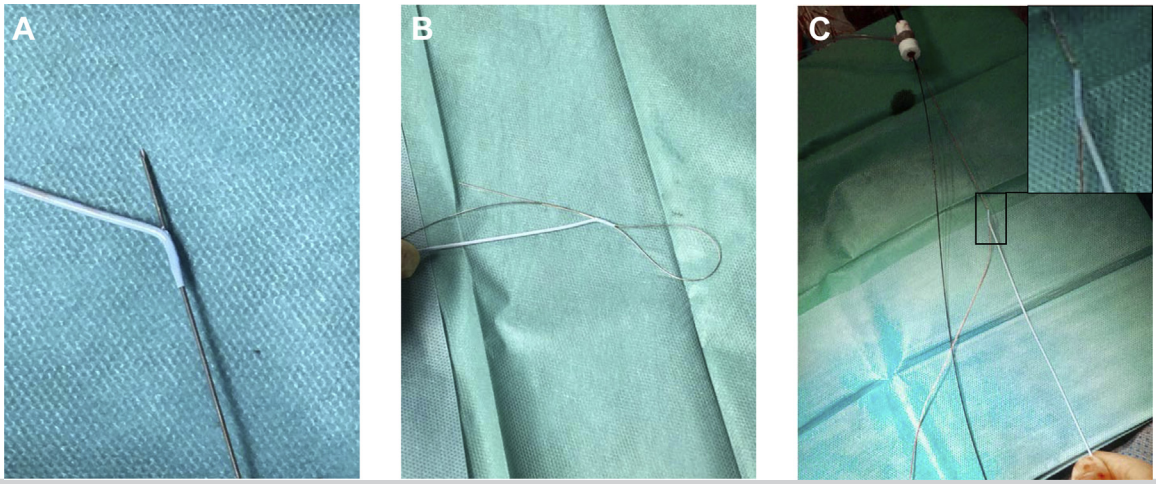

Fig 3. Modification of a 5F Lindh catheter. **A,** Puncture with a 21G needle. **B,** 0.018″ wire loop to support threading of the pulling line. **C,** Modified 5F Lindh catheter with the threaded pulling line in a rapid-exchange fashion.

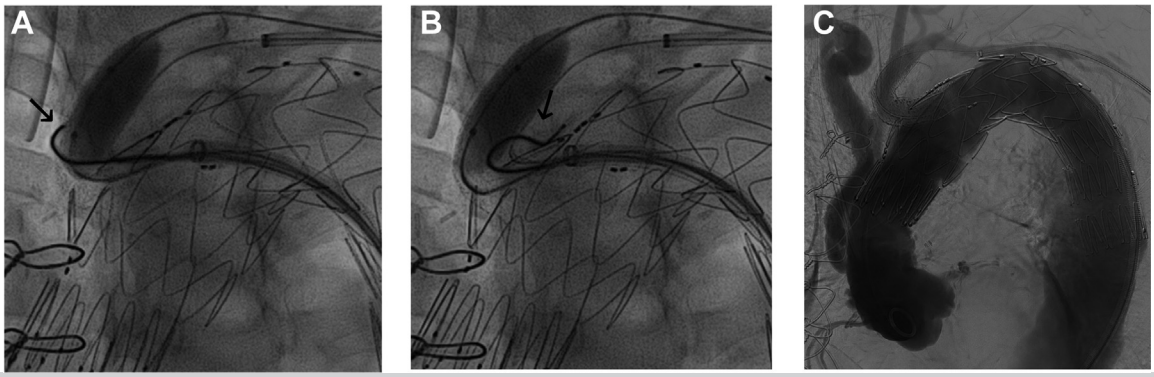

Fig 4. Intraoperative fluoroscopy of removal of the pulling line using a modified sidehole catheter with support and a 12 mm/2 cm balloon. **A,** The pulling line is still fixated at the Viabahn endoprosthesis (W. L. Gore & Associates, Flagstaff, Ariz) indicated by the tip of the modified Lindh catheter that is supported by a Lunderquist wire and thus made visible (*arrow*). **B,** Traction on the pulling line while maintaining the position of the Lindh catheter and the 12 mm/2 cm balloon detaches the pulling line indicated by the displaced Lindh catheter and Lunderquist guidewire (*arrow*). **C,** Final digital subtraction angiography with unimpeded flow to the left subclavian artery and left vertebral artery.

and dilated with the 12 mm percutaneous transluminal angioplasty balloon to connect the Viabahn prosthesis safely to the 10 mm retrograde branch with an excellent angiographic and clinical result. Final angiography showed unimpeded flow into the branch and the descending thoracic aorta (Fig 4, *C*). The procedure time was 205 minutes. Fluoroscopy time was 110 minutes. In total, 270 mL of contrast agent was used. The postoperative course was uneventful with the patient extubated right after the procedure. The patient could be discharged in good condition on day 8. The second-stage procedure was performed 6 weeks later with a good result. The patient agreed to allow the authors to publish their case details and images, and the institutional review board approved the publication.

DISCUSSION

Depending on the arch type, the take-off angle of the LSA may give rise to technical challenges, using a retrograde branch, which require the bridging covered stent to follow a curve of up to 180°. No covered stents were approved for this purpose yet, so mid- and long-term failures of this off-label use may be anticipated. Technical failures revascularizing the LSA in TEVAR are scarcely reported but are identified more frequently with the increasing case numbers of endovascular arch repair.[5,6] In this technical note, we described a technical solution for a detachment of a locked pulling line of a Viabahn endoprosthesis, consisting of a sidehole catheter, creating a Bowden housing together with a stiff guidewire and a balloon fixation in order not to dislodge the

Viabahn prosthesis, which was placed in a delicate position just short of the left vertebral artery. In case this solution failed, a branch occlusion and a carotid-subclavian bypass would have been an alternative solution to revascularize the LSA.[7] A recent meta-analysis has reported excellent outcomes for the left carotid-subclavian bypass.[8]

CONCLUSION

The presented bail-out technique for a locked pulling line of a Viabahn endoprosthesis was successful and allowed safe detachment without displacement of the device in a delicate treatment location.

We thank Mrs Haack with the support of gaining all clinical material and figures.

REFERENCES

1. Dake MD, Fischbein MP, Bavaria JE, Desai ND, Oderich G, Singh MJ, et al. Evaluation of the Gore TAG thoracic branch endoprosthesis in the treatment of proximal descending thoracic aortic aneurysms [e-pub ahead of print]. *J Vasc Surg*, https://doi.org/10.1016/j.jvs.2021.04.025.
2. Tsilimparis N, Law Y, Rohlffs F, Spanos K, Debus ES, Kölbel T. Fenestrated endovascular repair for diseases involving the aortic arch. J Vasc Surg 2020;71:1464-71.
3. Panuccio G, Bisdas T, Berekoven B, Torsello G, Austermann M. Performance of bridging stent grafts in fenestrated and branched aortic endografting. Eur J Vasc Endovasc Surg 2015;50:60-70.
4. Kölbel T, Bosaeus L, Tsilimparis N, Heidemann F, Rohlffs F, Liungman K. Fenestrated TEVAR using a guidewire fixator for anchoring in aortic arch target vessels. J Endovasc Ther 2018;25:40-6.
5. Katsargyris A, Spinelli D, Oikonomou K, Mufty H, Verhoeven EL. Incomplete expansion of chimney stent graft during chimney-thoracic endovascular aneurysm repair. Ann Vasc Surg 2017;39:293.e1-5.
6. Spanos K, Tsilimparis N, Rohlffs F, Wipper S, Detter C, Behrendt CA, et al. Total endovascular arch repair is the procedure of the future. J Cardiovasc Surg (Torino) 2018;59:559-71.
7. Konstantinou N, Debus ES, Vermeulen CFW, Wipper S, Diener H, Larena-Avellaneda A, et al. Cervical debranching in the endovascular era: a single centre experience. Eur J Vasc Endovasc Surg 2019;58:34-40.
8. Hajibandeh S, Antoniou SA, Torella F, Antoniou GA. Meta-analysis of left subclavian artery coverage with and without revascularization in thoracic endovascular aortic repair. J Endovasc Ther 2016;23:634-41.

Submitted Mar 9, 2021; accepted Jun 9, 2021.