See Article page 568.

Commentary: Embracing the future by bracing the arch

Eric E. Roselli, MD

“Change before you have to.”

—Jack Welch

Ascending aortic dissection is an increasingly prevalent cause of death requiring emergency surgery. Systems approaches to improvement in care have reduced early mortality, and it has become evident that a greater extent of dissection is associated with greater risk. This is particularly true during the early phase for those with malperfusion. Furthermore, persistent false lumen perfusion after emergency repair increases risk in the late hazard phase.^{1,2} Extended repair at the time of the acute operation may counteract these shortcomings of conventional, limited ascending replacement. Although this target for improvement has been recognized for years, adoption of extended repair operations has been tempered by the potential for increased early risk. Now is the time for a change.

Now is the time to combine modern surgical techniques with endograft technology to develop novel strategies for safely performing extended repair for patients with multi-segment thoracic aortic disease.³ Jakob and colleagues^{4,5} have worked for nearly a decade on creating a 3-zone, disease-specific device, and in the recent edition of the *Journal*, they present their initial experience with the latest generation device and delivery system.

The authors describe their experience with 6 patients who underwent emergency repair for acute DeBakey type I dissection using the latest 3-zone hybrid device (E-novia; JOTEC/CryoLife GmbH, Hechingen, Germany). This was a particularly high-risk subset of patients who had evidence

Now is the time to combine surgical and endograft technology to develop novel treatments.

CENTRAL MESSAGE

Arch and descending stenting combined with ascending replacement using a novel hybrid device may become an important alternative repair technique in select patients with acute aortic dissection.

of malperfusion including 5 with neurologic symptoms, 1 who was hemodynamically unstable, and all were intubated. In addition, all 6 patients had an intimal entry tear in the proximal descending aorta, a well-recognized risk factor for late complications. The device was safely delivered and deployed in all patients. Despite the high-risk population, outcomes were reasonable, with 1 operative death due to right heart failure from right coronary dissection. Another patient died 4 months postoperatively due to advanced lung disease.

Previous experiences with the frozen elephant trunk operation for acute dissection have demonstrated an association between the time of circulatory arrest and neurologic complications including stroke and spinal cord injury. None of the high-risk patients in this experience had neurologic complications. This is in part a credit to the excellent team performing the operations (eg, they reconstructed an occluded right common carotid artery for one). However, the simplification of the procedure facilitated by the novel device also deserves some credit for the successful outcomes and lends promise for its widespread utility. Jakob and colleagues were able to perform the operation with circulatory arrest times consistently less than 40 minutes and described a quick learning curve during this limited experience.

From the Aorta Center and Department of Thoracic and Cardiovascular Surgery, Heart, Vascular, and Thoracic Institute, Cleveland Clinic, Cleveland, Ohio.

Disclosures: Dr Roselli is a consultant and investigator for CryoLife, Gore, Medtronic, and Terumo Aortic.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication May 6, 2020; revisions received May 6, 2020; accepted for publication May 11, 2020; available ahead of print May 25, 2020.

Address for reprints: Eric E. Roselli, MD, Heart Vascular and Thoracic Institute, Cleveland Clinic, 9500 Euclid Ave, Desk J4-1, Cleveland, OH 44195 (E-mail: roselle@ccf.org).

J Thorac Cardiovasc Surg 2022;163:576-7
0022-5223/\$36.00

Copyright © 2020 by The American Association for Thoracic Surgery
<https://doi.org/10.1016/j.jtcvs.2020.05.037>

Another device is in a trial in Canada and Germany that includes a self-expanding bare stent that extends through the arch attached to fabric proximally (AMDS; Ascyrus Medical, Boca Raton, Fla).⁶ In that experience, the operators were also able to perform extended repair with relatively short circulatory arrest times and good outcomes in patients with malperfusion. Both of these devices deliver on the objectives of providing an expeditious way to perform extended repair that improves true lumen perfusion—an important early objective, but the 3-zone device described by Jakob and colleagues also includes a distal fabric-covered component. The device includes a clever design and delivery system so that the covered section can be accurately positioned in the arch. For the patients selected in their experience, this allowed for coverage of distal entry tears in the upper descending aorta.

Although follow-up was short, postoperative computed tomography was completed in survivors. One patient demonstrated aortic growth and was easily treated by thoracic endovascular aortic repair extension 2.5 years later. Complete false lumen thrombosis was demonstrated through the stent-grafted descending segment in 3 of 5 (60%) patients. Through the bare-stented arch segment this only occurred in 2 of 5 (40%). Understanding the fate of the aorta in these patients with incomplete reverse remodeling will be critical to understanding the role for this kind of repair.

It has been suggested that partial false lumen thrombosis without growth can be equated with positive remodeling, but this definition is suspect. There is no evidence demonstrating an association with partial thrombosis and improved survival, and it has even been associated with poor outcome.⁷ In a previous analysis by Mani and colleagues,⁸ it was only the achievement of complete false lumen thrombosis in combination with aortic shrinkage that most consistently correlated with prolonged survival. Clarity of understanding the importance of imaging findings of chronic dissections is currently an important knowledge gap in the field.

The promising findings of this early study support the need for further development of techniques and devices to facilitate expeditious extended repair during acute dissection by optimizing true lumen flow acutely and promoting positive aortic remodeling later. In our center, we have developed a technique to achieve these goals with full fabric coverage in the arch combined with branch stentgrafting, but this is done with off-label use of off-the-shelf devices.⁹ The patients in Jakob and colleagues' series were carefully selected based on their anatomic features, including a

normal caliber arch, but entry tears beyond the origins of the arch branch vessels continued to perfuse the false lumen in the bare stented arch. Perhaps in the future when more options are available, operators will be able to more precisely tailor choices to the individual patient based on anatomy, morphology, non-aortic comorbidities, and the operator's own experience. For example, a patient with acute DeBakey type I dissection, an entry tear in the proximal descending aorta, and a normal caliber arch with no extension into the arch branch vessels might receive a 3-zone hybrid device, whereas one with more complex anatomy like an entry tear in the branch vessels or a tear within the arch may be treated with a device that looks more like the operation we perform in Cleveland. Additional questions abound regarding optimal treatment for these complex patients. For example, should the more distal aorta be treated more aggressively with bare stenting throughout, as has been described as the STABILISE concept?¹⁰

Now is the time for innovative teams of clinician scientists working alongside biomedical engineers and industry and regulatory partners to embrace change and provide the best precision medicine treatment for each individual patient who presents with aortic dissection.

References

- Peterss S, Mansour AM, Ross JA, Vaitkeviciute I, Charilaou P, Dumfarth J, et al. Changing pathology of the thoracic aorta from acute to chronic dissection: literature review and insights. *J Am Coll Cardiol*. 2016;68:1054-65.
- Roselli EE, Loor G, He J, Rafael AE, Rajeswaran J, Houghtaling PL, et al. Distal aortic interventions after repair of ascending dissection: the argument for a more aggressive approach. *J Thorac Cardiovasc Surg*. 2015;149(2 suppl):117-24.e3.
- Roselli EE. Trade in the hammer for a power driver—perspectives on the frozen elephant trunk repair for aortic arch disease. *Ann Cardiothorac Surg*. 2013;2:633-9.
- Jakob H, Dohle D, Tsagakis K. A new hybrid graft for fast ascending, arch and descending aortic replacement and endovascular stabilization. In: Greenhalgh RM, ed. *Vascular and Endovascular Challenges Update*. 1st ed. London: BIBA Medical; 2013:121-6.
- Jakob H, Shehada S, Dohle D, Wendt D, El Gabry M, Schlosser T, et al. New 3-zone hybrid graft: First-in-man experience in acute type I dissection. *J Thor Cardiovasc Surg*. 2022;163:568-74.e1.
- Bozso SJ, Nagendran J, Chu MWA, Kiaii B, El-Hamamsy I, Ouzounian M, et al. Single-stage management of dynamic malperfusion utilizing a novel arch remodeling hybrid graft. *Ann Thorac Surg*. 2019;108:1768-75.
- Tsai M, Wu H, Roan J, Tsai YS, Hsieh PCH, Yang YJ, et al. Effect of false lumen partial thrombosis on repaired acute type A aortic dissection. *J Thorac Cardiovasc Surg*. 2014;148:2140-6.e3.
- Mani K, Clough RE, Lyons OT, Bell RE, Carrell TW, Zayed HA, et al. Predictors of outcome after endovascular repair for chronic type B dissection. *Eur J Vasc Endovasc Surg*. 2012;43:386-91.
- Roselli EE, Idrees JJ, Bakaeen FG, Tong MZ, Soltesz EG, Mick S, et al. Evolution of simplified frozen elephant trunk repair for acute DeBakey type I dissection: midterm outcomes. *Ann Thorac Surg*. 2018;105:749-55.
- Hofferberth SC, Nixon IK, Boston RC, McLachlan CS, Mossop PJ. Stent-assisted balloon-induced intimal disruption and relamination in aortic dissection repair: the STABILISE concept. *J Thorac Cardiovasc Surg*. 2014;147:1240-5.