DISCUSSION

Hybrid prostheses enable completion of aortic surgical repair in a single stage, thus avoiding the cumulative mortality and interval mortality associated with 2-stage approaches. A systematic review of 17 studies identified pooled mortality and stroke rate in 2-stage procedures of 8.3% and 4.9%, respectively.⁴ Cardiopulmonary bypass time, myocardial ischemia time, and circulatory arrest time were strongly correlated with mortality.

The multibranched Thoraflex stent-graft offers several new technical innovations relative to other designs.⁵ First, it is a short and handy device with an easy deployment system. Different sizes of the stented and unstented segments are provided for a better fit with aortic anatomy. Thanks to the malleable shaft, the stented part can be shaped to conform to the isthmus and descending aorta anatomy. This makes the device less traumatic on the descending aortic wall and easier to introduce into the aorta. The sewing collar between the Dacron polyester fabric tube and the stented segment ensures easier and safer anastomosis of the prosthesis to the aortic isthmus, reducing the hemodynamic traction on the anastomosis itself and allowing further hemostatic stitches, when necessary, even at the end of the procedure. The grafts' branches allow separate reimplantation of the supra-aortic vessels, enabling shorter ischemic visceral and myocardial durations, although en bloc reimplantation remains possible. Separate reimplantation also allows better individual hemostatic control of supra-aortic vessel anastomoses, including the isthmus anastomosis. This technique for arch vessels may be relevant when their origins are distant from each other or dissected and in patients for whom a radical aortic resection

may be needed, such as those with connective diseases or severe calcifications or clots at the proximal portions of the vessels. In some cases, the left subclavian anastomosis may be difficult to perform because of the closed position of the branch to the corresponding vessel and may need to be realized before the pump is restarted. This can minimally increase the visceral ischemic time. Finally, the radiopaque markers in the stented portion of the Thoraflex prosthesis further simplify endovascular completion when necessary.

After this initial experience, we consider the Thoraflex hybrid prosthesis to be a versatile device representing a suitable alternative for management of complex chronic aortic pathologies involving the arch and the proximal descending aorta.

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EDITORIAL COMMENTARY

Four-branched graft with stent hybrid prosthesis for single-stage treatment of chronic aortic arch pathology

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Treating chronic aortic arch pathologies such as dissection and aneurysm can be quite complex because typically it involves addressing the aortic arch and the proximal descending thoracic aorta (DTA). Single-stage operation for this pathology requires a thoracosternotomy incision to replace

FIGURE 1. Postimplantation anatomy of the Thoraflex (Vascutek, Inchinnan, UK) hybrid prosthesis. Image courtesy of www.vascutek.com/thoraflex-hybrid.

the aortic arch and the proximal DTA. Given the high comorbidity associated with such an extensive operation, several groups advocate for a 2-stage procedure, where the aortic arch is replaced first using an elephant trunk technique followed by open DTA replacement via a thoracotomy or retrograde thoracic endovascular aortic repair (TEVAR) by stent grafting of the DTA. Although less invasive and better tolerated, the 2-stage procedure is associated with interval mortality and prolongs overall patient recovery.¹ Therefore, any technologic advancement that enables a single-stage repair without requiring an extensive incision would not only simplify the treatment strategy, but also may improve patient morbidity and mortality. The Thoraflex hybrid prosthesis (Vascutek, Inchinnan, UK) enables single-stage repair for chronic arch pathologies through a median sternotomy (Figure 1). The device, which is a combination of a proximal multibranched graft (for total arch replacement) with a 150 mm stent graft (for DTA TEVAR), is available in various permutations of stent graft and arch graft diameter sizes.

In a retrospective case series by Ruggieri and colleagues,² early experience with the Thoraflex device in treating chronic arch dissection (2 cases) and aneurysm (4 cases) is reported. The authors must be commended for successful application of a new technology in treating a

complex disease process. Compared with an elephant trunk operation, use of the Thoraflex device enables simultaneous treatment of DTA pathology, and it is far less invasive than a thoracosternotomy incision. So is it the best of 2 worlds? Is the Thoraflex device the answer for treating chronic aortic arch pathologies?

There is little to no doubt that the Thoraflex device is an important technological advance in aortic arch surgery. Typically, patients with chronic arch pathologies have significant comorbid burden and the option for a single-stage procedure through a median sternotomy approach is highly attractive. But its application may be limited by patient aortic anatomy. In looking at the case series by Ruggieri and colleagues,² an important parameter to evaluate is the distal landing zone diameter in the DTA. At 150 mm from the left subclavian artery origin, the maximum distal landing zone diameter was 34 mm, which facilitated the placement of a 40 mm tapered stent graft. How many DTAs in the chronic setting have proper distal landing zone? It will be important to obtain this denominator in patients with chronic aortic pathologies before conjecturing the wide applicability of the Thoraflex device. Second, in the situation of chronic dissection, we need to understand fenestration location and size before broadly applying the Thoraflex device. In this setting, the true lumen landing zone diameter and the fenestration anatomy distal to the stent graft will be important to understand, because endoleak or retrograde filling of the false lumen in the DTA will negate the application of the Thoraflex system.

Therefore, as we embrace the technology of hybrid prostheses that will facilitate the frozen elephant trunk operation, stringent and careful selection criteria must be established for its use. In many cases, anatomic considerations of chronic aortic pathologies may not allow the use of this technology, and in these situations traditional approaches will still play an important role. Clearly, before we can draw conclusions about the role of hybrid prostheses, we need more trials.

Lastly, as we anticipate increasing use of hybrid prosthesis technology for arch pathologies, its efficacy and safety profile will be evaluated not only against traditional approaches, but also against emerging technologies in total endovascular branched grafts for aortic arch pathology. As TEVAR technology advances, branched stent grafts for zone 0 (proximal to innominate artery) landing will be coming. What kind of advantages and disadvantages will the hybrid prostheses provide in comparison to total endovascular branched stent grafts? Will traditional all-open surgical approaches still play a role? For sure, as technology advances the relative domains of all-open surgery versus hybrid procedure versus all-endovascular procedure in aortic arch surgery will be redefined.

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