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## Commentary: The frozen elephant trunk—the “hot” procedure. An important evolutionary step but probably not a final destination

Christopher R. Burke, MD, and Gabriel S. Aldea, MD

Numerous strategies and devices continue to emerge and aid contemporary aortic surgical teams in accomplishing complete, safe, and effective aortic arch and descending thoracic aortic (DTA) interventions. More recently, multiple strategies for hybrid and total arch replacements have been described, with the frozen elephant trunk (FET) technique perhaps the most clinically relevant (dominant) innovation in this area. Compared with the classic “elephant trunk” technique, the FET technique provides a significant advance, as it facilitates and simplifies future endovascular interventions for chronic aneurysmal disease while also proving useful in dissections by both potentially covering intimal tears as well as stabilizing the true lumen. The enthusiasm for this procedure has led to an evolving set of commercially available FET devices with a prefabricated thoracic endovascular aortic repair (TEVAR) and Dacron arch graft.

In this issue of the *Journal*, Ogino and colleagues<sup>1</sup> present a contemporary Japanese multi-institutional retrospective series examining FET with the novel FROZENIX device. A total of 684 patients undergoing arch repair were treated with either conventional (315) or FET (369) therapy. These procedures were performed for a variety of indications (aneurysm and/or dissection) and settings (acute, emergent, chronic, etc). The overall results are remarkable, with mortality rates for the entire cohort well less than 2%, and highlight the significant progress made in the field regarding surgical results in these challenging patients. Despite this, it is notable that the FET group did

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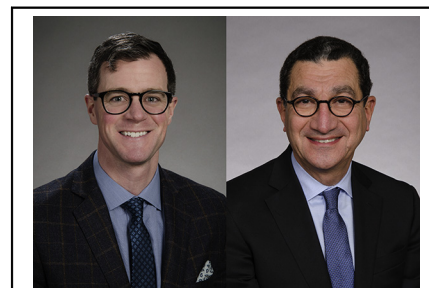
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### CENTRAL MESSAGE

The frozen elephant trunk (FET) represents a significant advance and addition to a broadening toolbox of procedures and equipment to treat complex arch and descending thoracic aortic pathologies.

have a greater neurologic event rate, especially as it pertained to spinal cord injury, which was close to 3%, similar to previous studies.

The “toolbox” available to aortic surgeons and teams treating complex aortic arch and DTA pathologies is broadening. The FET has proven to be a safe and effective technique. However, despite these exceptional results, it remains unclear what the future holds for the FET procedure. Specifically, with the numerous aortic arch-specific endovascular devices in clinical trials, multiple “simplified” arch operations have been described that allow interval TEVAR placement.<sup>2</sup> An excellent example of this is the “zone 2 arch” procedure followed by zone 2 single-side branch TEVAR into the left subclavian artery,<sup>3</sup> the advantages of which are a simplified upfront arch procedure that should have extremely low spinal cord risk. The left subclavian artery does not require intervention, which is sometimes difficult to access. This is especially useful during type A dissection repair, when patients may be unstable or have sustained a preoperative neurologic injury where limited circulatory arrest and cerebral ischemia time may be beneficial. This allows a staged interval placement of TEVAR to stabilize the DTA. Regardless of arch procedure, the fundamental concept for the aortic surgical team is to achieve is a suitable proximal landing zone of at least 3 to 4 cm of Dacron for future arch endovascular interventions.

It is without question that FET techniques will continue to be refined and outcomes optimized. The current report from the *Journal* highlights the remarkable results achieved at a national level with this complex procedure. That said, the future relevancy of this procedure is unclear. Understanding and acknowledging contemporary outcomes for complex arch replacement and FET will be critical as we examine outcomes from future aortic arch TEVAR trials. Within the next decade, we will be faced with the challenge of creating guidelines for open (hybrid) arch replacement versus entirely endovascular therapies with these novel branched devices. It is likely that this will follow a similar pattern to transcatheter aortic valve replacement, first used in high- and prohibitive-risk patients, and as technologies and experience evolve, their efficacy and utility assessed in lower-risk populations. With such dynamic evolution,

collaborative interdisciplinary aortic surgical teams will need continue to expand and broaden their endovascular and open arch repair (including FET) expertise, to not overly narrow their focus on a “one-size-fits-all” approach but rather maintain discernment and flexibility to individualize and optimize outcomes and treatment of complex arch pathologies.

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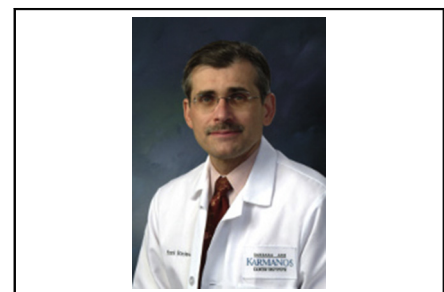
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## Commentary: Elephant trunk: Straight-up or frozen?

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A Japanese collaborative of 41 cardiac centers compared a group of patients undergoing arch replacement (AR) with standard or straight-up elephant trunk (SET) placed in the proximal descending thoracic aorta with a second group undergoing AR with a new J-graft Frozenix stent<sup>1</sup> positioned in the proximal descending aorta (frozen elephant trunk [FET]). The study reported by Ogino and colleagues<sup>2</sup> in this issue of the *Journal* included patients with both acute and chronic type A aortic dissection (AD), chronic type B



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**CENTRAL MESSAGE**

Both straight-up elephant trunk and frozen elephant trunk (FET) for arch replacement in acute and chronic type A aortic dissection and aortic arch aneurysm gave outstanding results. The increased incidence of paraplegia incidence with FET merits review.

AD with retrograde arch involvement, and aortic arch aneurysm (AA). The protocol allowed the participating institutions to select the recruited patients and use their method

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