Editorial

The evolution of open total arch replacement: a case of different strokes for different folks

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Zheng *et al.* recently reported on a simplified approach to open total arch replacement (s-TAR) using a physician-modified stent graft (1). In the s-TAR procedure, the authors replace the ascending aorta with a Dacron graft, and then perform antegrade deployment of a stent graft under circulatory arrest with antegrade selective cerebral protection. After placement of a distal occlusion balloon and re-initiation of lower body circulation via femoral arterial cannulation, they proceed to modify the stent graft in-situ by cutting out three elliptical holes on the fabric portion of the stent graft corresponding to the 3 supra-aortic vessels, in preparation for subsequent anastomoses from within the stent graft. The graft is sewn to the proximal native arch, and the arch is then sewn to the ascending Dacron graft. They reported excellent results compared to their conventional open arch replacement (c-TAR), namely Sun's procedure (2), with no permanent strokes in either group, significantly shorter cardiopulmonary bypass (CPB), cross-clamp, and deep hypothermic circulatory arrest (DHCA) times in the s-TAR group, no 30-day mortality group in the s-TAR cohort compared to 4.9% in the c-TAR group, lower total hospital cost in the s-TAR cohort (14.5×10^5 versus 19.5×10^5 yuan), and no endoleaks, stent graft-induced new entry (SINE), or head vessel stenoses in the s-TAR cohort at 3 months follow-up. In addition, by limiting dissection into the arch, they reported no injuries to the recurrent laryngeal nerve or thoracic duct, compared to 7.7% and 2.6%, respectively, in the c-TAR group.

Of note, the cohort described herein is exclusively patients with aneurysmal disease. The authors use an arch diameter of >35 mm in conjunction with an ascending of >55 mm as an indication for repair, which is relatively consistent with contemporary guidelines for management of aortic disease adapted to Chinese patients as explained in the manuscript. Furthermore, while the authors state that their technique is simpler than c-TAR, it still seems to be somewhat complex. It is apparent that suturing an endograft to *in-situ* supra-aortic vessels from within the prosthesis whilst navigating the endograft struts may be slightly daunting for institutions with limited experience in this procedure. In the authors' hands, selective cerebral perfusion (SCP) time was on average 32.3 minutes with an associated lower-body circulatory arrest (LCA) time of 21.1 minutes. In patients with head vessels <1.5 cm apart, they revert to an island technique, which leaves a considerable amount of aneurysmal arch tissue included within the anastomosis to the stent graft with the obvious concern of further aneurysmal degeneration in younger

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patients. Unfortunately, no sub-group analysis is provided on the long-term results of this technique. Finally, for centers contemplating this approach the authors do provide further insight of their initial experience with s-TAR, in which they experienced endoleaks at the margin of the left subclavian artery (LSA), with these early patients having been excluded from their analysis.

Evolution of TAR over the past two decades has been supported by advancements in surgical technique, hypothermic circulatory support, cerebral monitoring and protection, and endovascular technology. Conventional options for TAR range from anatomical *en bloc* to separated graft technique (3,4), non-anatomical TAR with trifurcated grafts (5,6), to conventional and frozen elephant techniques (7). Furthermore, many groups have developed hybrid approaches to TAR with data regarding mid to long term outcomes being available (8,9). Of course, the latter require the institutional capability to perform TEVAR, along with either cervical transposition, cervical bypass, or branched arch endograft to manage supra-aortic vessels that were not debranched during the arch operation.

While the s-TAR procedure seems technically complex with somewhat of a learning curve, it appears to be a reasonable and effective approach to performing TAR in patients with aneurysmal disease. Inevitably cases will be encountered that will not lend themselves to this approach such as a caudally displaced LSA. Guided by underlying pathology including genetic cues, surgeons must aim beyond improving early outcomes to reducing rates of re-intervention and long-term mortality. TAR approach must be individualized depending on patient-specific parameters as well as institutional experience. The key determinant of any technique entering routine practice remains reproducibility and applicability to a broader patient population.

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