Commentary: Surprisingly good results from a complex, lengthy aortic arch technique

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Aortic arch replacement with Carrel patch reimplantation of the bovine innominate artery.

Central Message

Aortic arch replacement with a 4-branch graft and antegrade cerebral perfusion presents another option for surgeons, but no evidence is presented demonstrating superiority over conventional techniques.

See Article page 1370.

▶ Video clip is available online.

Minatoya and colleagues¹ are to be congratulated for their excellent clinical results in applying antegrade cerebral perfusion (ACP) and a 4-branched graft in aortic arch replacement in more than 1000 patients. Hospital mortality was 5.1%, permanent stroke 3.6%, and paraplegia 0%. Midterm survival was good (81% and 63% at 5 and 10 years, respectively). Graft-related complications during follow-up were minimal. The cardiothoracic surgery community is fortunate for the authors' clear documentation of their technique's favorable clinical experience. The authors' technique is closely related to the Sun technique, but with a different anastomotic sequence.^{2,3}

Some unusual characteristics of the experience and some negatives deserve noting:

- The rate of concomitant aortic valve repair or replacement was very low (only 6.4%), lower than expected for such a patient group.
- The rate of concomitant aortic root replacement was low (3.8%), again lower than expected.
- There was not a single case of recurrent nerve injury and vocal cord paralysis in the entire series—a remarkable accomplishment.
- The operations were exceedingly long, with an operative time of 8 hours, a cardiopulmonary bypass time of 4.2 hours, an ACP time of 2.6 hours, and a lower body circulatory arrest time of 1 hour. It is surprising that these important lengthy intervals did not exact clinical consequences. We are not certain that the fortunate results in the present study would be seen in general application.

- Superficial temporal artery cannulation was used to monitor brain perfusion pressures. Clinical familiarity with this technique is not widespread.
- Perfusion was performed at rates much lower than conventionally used (10-20 cc/kg/min)¹. This may be a positive because cerebral edema tends to accompany ACP techniques.^{4,5}
- The performance of a possibly superfluous anastomosis of the branched graft to the elephant trunk graft is questionable. Operative and perfusion times are already long. It seems this anastomosis could be avoided quite simply by in-folding the branched graft into the descending aorta (a bit cumbersome, but possible) or using a Sienna (ie, skirt) graft with bespoke attachment of the branches before bypass.

It is important to put the clinical methods of the present study into perspective on 2 important points. The simpler Carrel patch technique for great vessel attachment has yielded excellent results over many years and should not be abandoned (see [Figure 1](#) and [Video 1](#)). In fact, it is our clinical experience that late dilatation of the Carrel patches of the head vessels leading to so-called patch aneurysms is quite uncommon. As is known from pathology, arterial branch points are reinforced by extra collagenous fibers (a sort of biological rebar),^{6,7} and this may be the reason that the patch of aortic arch vessels is relatively dilatation-resistant. We recommend using a 2-vessel Carrel patch, which provides for a smaller suture line requiring less

FIGURE 1. Aortic arch replacement with a 2-vessel Carrel patch reimplantation. A, Artist's rendition. B, Intraoperative image. Note that in the intraoperative image the innominate and left common carotid arteries have a common origin, which is known as the bovine aortic arch anomaly.

time for anastomosis completion and allows placement of the distal aortic anastomosis between the left carotid and left subclavian arteries.⁸ The left subclavian artery is very easily handled when the stage II elephant trunk procedure is performed several weeks later via left thoracotomy.

The authors' technique incurs periods of sequential interruption of perfusion of each of the 3 head vessels, at only moderate hypothermic levels and while they are actively re-warming. This may not be safe for the brain at the cellular level. The authors' clinical results would be best supplemented by quantitative neurologic studies to document that the brain is indeed well preserved with their techniques. By comparison, not only does straight deep hypothermic circulatory arrest yield excellent clinical and cerebral re-

sults,^{4,8} but also preservation of brain protection has been demonstrated quantitatively by extensive pre- and postoperative neuropsychometric testing.^{9,10}

We thank Minatoya and colleagues¹ for their important contribution to the aortic arch replacement literature.

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VIDEO 1. Two-vessel Carrel patch technique for aortic arch replacement. Video available at: [https://www.jtcvs.org/article/S0022-5223\(18\)32963-5/fulltext](https://www.jtcvs.org/article/S0022-5223(18)32963-5/fulltext).