Straight deep hypothermic circulatory arrest for aortic arch surgery: Going the way of the dinosaurs?

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Central Message

Straight deep hypothermic circulatory arrest for brain protection during aortic arch surgery is not the best option after 40 minutes of ischemia.

See Article page 1831.

In this issue of the *Journal*, Damberg and colleagues¹ report their experience with straight deep hypothermic circulatory arrest (DHCA) as the sole means of brain protection during operations on the aortic arch in 613 consecutive patients, focusing on late outcomes.¹ The independent variables associated with increased 1-year mortality were acute type A aortic dissection, reoperative status, and the presence of descending thoracic aortic pathology. The independent variables associated with increased mortality beyond 1 year were increased age, postoperative complications (stroke, dialysis, pulmonary complications), and postoperative atrial fibrillation. The duration of DHCA did not emerge as a significant predictor of either 1-year or late mortality. Damberg and colleagues¹ conclude that aortic arch surgery with DHCA can be performed with favorable early and late survivals and that the length of DHCA has only limited impact on these outcomes.

Eleftheriades and his colleagues at Yale are perhaps the most impassioned (and persistent) advocates of straight DHCA for operations involving the aortic arch, and they have used no other alternative or adjunctive strategy for brain protection since at least 2003. Their early outcomes, in terms of mortality and overt neurologic injury, are impressive (2.9% operative mortality, 2% stroke rate). The low prevalences of reoperations for bleeding, pulmonary complications, prolonged ventilation, and renal replacement therapy should provide reassurance to the users of this technique that when it is applied in a systematic fashion, the rates of mortality and morbidity are comparable to those achieved with other commonly used techniques, including moderate hypothermia with antegrade brain perfusion.

Although Damberg and colleagues¹ did not identify use of DHCA as an independent predictor of either 1-year or late mortality, there are concerns related to this finding regarding stroke and other indicators of neurologic injury. The stroke rate was 10.5% for patients with a DHCA time of 50 minutes or longer, versus 1.7% for those with a DHCA time shorter than 50 minutes, a 6-fold difference

with a *P* value of .05. Temporary neurologic dysfunction and seizures, less sensitive but likely indicators of neurologic injury,^{2,3} occurred in 5.1% and 1% of the patients, respectively, but they were not analyzed further. It should also be noted that among the patients in whom the duration of DHCA was 40 minutes or longer, the operative mortality was 4.5%, 4 times higher than the mortality for the patients with a DHCA time of less than 40 minutes (1.1%), although the difference did not reach statistical significance.

Although there is no consensus, there is agreement among most aortic surgeons, including the same Yale group,⁴ that 40 minutes is the upper limit of safety when using DHCA. It is therefore concerning that, with the availability of other strategies for neuroprotection during extensive operations on the aortic arch (namely antegrade brain perfusion) and with knowledge of the adverse effects on neurologic function with the longer arrest times that were observed in this study, Damberg and colleagues¹ did not initiate brain perfusion either initially, when a prolonged and complicated procedure was anticipated, or when the DHCA time approached 40 minutes.

That said, Damberg and colleagues¹ have provided solid evidence that DHCA is a safe and effective method of brain protection for procedures involving the aortic arch if the duration of circulatory arrest does not exceed 40 minutes. It continues to be the method of choice for many surgeons who perform partial arch procedures, myself included, and it is likely to remain so.⁵ Will straight deep hypothermic

circulatory arrest for aortic arch operations eventually go the way of the dinosaurs in favor of other techniques with antegrade brain perfusion? Not any time soon.

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