hemiarach operations. Outcomes, including mortality, neurologic complications, and long-term survival using DHCA alone were comparable to adjunct cerebral protection methods.

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EDITORIAL COMMENTARY

Belt and suspenders: Can we keep them in the drawer?

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See related article on pages 2911-7.

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In this issue of the *Journal*, Kaneko and colleagues¹ report their institutional experience with cerebral protection strategies in patients undergoing proximal aortic arch resection for aneurysms and dissection. This is a large contemporary series spanning a 10-year period, and at face value the results show that the adjunctive protection measures of antegrade cerebral perfusion (ACP) or retrograde cerebral perfusion (RCP) offer no added benefit to deep hypothermic circulatory arrest (DHCA) alone in the prevention of cerebral morbidity, such as stroke or transient ischemic attack. This complements a recently published large series of patients from another experienced group who also reported low cerebral morbidity with the use of DHCA alone for hemiaortic arch replacement.²

In the current study, the authors appear to adhere to the original and time-tested tenets of the conduct DHCA first outlined by Griep and colleagues,³ such as adequate cooling over an extended period of time to a systemic temperature of 18°C and an isoelectric electroencephalogram, an expeditious operation with acceptable circulatory arrest times, presumed meticulous de-airing, and controlled rewarming. At first look, these results can be construed as evidence that the additional time and effort of instituting adjunctive protection procedures is unnecessary if arrest times are kept to below 30 minutes. On closer inspection, however, care must be taken when interpreting these data and applying the findings to one's own practice for the following reasons:

1. The authors describe a select group of fairly healthy and younger patients with proximal thoracic aortic disease, the majority presenting in elective fashion with degenerative aneurysms associated with aortic valve disease. Excluded are the higher-risk patients with mid or distal arch disease of atherosclerotic origin and coexisting comorbidities, those who may be at risk for atheroma/calcific emboli during resection and who may benefit from retrograde "flushing" of the arch vessels with adjunctive cerebral perfusion techniques.
2. The authors use central cannulation in 70% of their patients. The avoidance of femoral cannulation (10% in this series) is to be commended because retrograde perfusion from the groin risks the generation of atheroemboli unless there is computed tomography scan documentation of a disease-free arch, descending, and aortoiliac system.
3. Cardiopulmonary bypass times are meaningfully shorter in the DHCA and RCP groups relative to the ACP group, which could introduce error in interpretation of cerebral morbidity between the groups because longer cardiopulmonary bypass times have been associated with a greater independent risk of stroke in some studies.
4. The limitations inherent to any retrospective non-randomized study are present and include institutional bias, surgeon bias based on a dichotomy of cerebral protection strategies between 2 groups of surgeons with differing practices, and temporal bias introduced by the length of the study period. In regard to the latter, the definition of stroke used in this study is the contemporary definition endorsed by the Society of Thoracic Surgeons National Database in 2011. The authors are to be commended for use of this definition, but it may be difficult to tease out documented cerebral morbidity from older records in a retrospective review if there is a time difference in definition (ie, the older definition of reversible ischemic neurologic deficit would be considered a stroke in the contemporary era). If less stringent definitions were used in coding before incorporating the current definition, some strokes could be

missed if charts were not expertly gleaned. Error would then be introduced if there were not a normal distribution of the 3 protection strategies over the course of the 10-year study period. It is also unknown whether aggressive imaging (ie, magnetic resonance imaging) was performed in all patients with temporary deficits. Finally, temporary neurologic dysfunction is not defined or reported, and is a weakness of the study.

Are there drawbacks to the use of a strategy of ACP or RCP with DHCA? Proponents of DHCA alone argue that the setup is time-consuming and can introduce extra cannulas in the field that are cumbersome.² Indeed, axillary cannulation for ACP adds 10 to 15 minutes to the operation, but bicaval cannulation for RCP adds little extra time. It is also argued that ACP is associated with unprotected and potentially damaging luxury perfusion to the brain, and the induction of cerebral edema. However, this is not borne out in animal and human studies if excessive cerebral perfusion pressure is avoided.^{4,5} The argument against the use of RCP is that it does not provide nutritive blood flow to the brain. Although this is well documented, RCP gives the advantage of maintaining base cooling of the brain and the ability to flush debris and air before reinstitution of systemic perfusion.⁶ A recently published large series of patients undergoing arch and hemiarch replacement with DHCA/RCP reported a very low rate of cerebral morbidity.⁷

In aggregate, these recent studies show that ACP and RCP with DHCA is safe and offers utility. Is DHCA alone safe? The answer again is yes, and the pants won't drop if the belt and suspenders are left in the drawer if an operation is well planned and is directed to the right pathology. DHCA without adjunctive cerebral protection measures demands that the surgeon be facile with the technique, adhere to the original tenets of the procedure, maintain the circulatory arrest time to less than 30 minutes, and select younger patients with degenerative nonatherosclerotic aneurysms and straightforward anatomy. Remaining dogmatic in this approach alone, however, is unwise, and having a backup plan in place is recommended. The ability to institute ACP or RCP with preemptive cannulation of the axillary artery or superior vena cava in most cases is recommended because unexpected events can occur that could prolong the duration of circulatory arrest. Ultimately, only prospective data collection with standardized techniques and outcomes reporting will best determine the appropriate approach to cerebral protection with aortic arch replacement.⁸

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