Authors have nothing to disclose with regard to commercial support.

hypothermia was no longer a must when ACP was used. Keeling and colleagues⁵ compared 2 temperature strategies for total aortic arch replacement with ACP (moderate hypothermia circulatory arrest [MHCA] vs DHCA). There was no difference in neurologic outcomes or in-hospital mortality for the 2 temperature groups.⁵ The perfusion strategy for aortic arch surgery has been evolving. In our institute, MHCA (nasal temperature 25°C) plus ACP is the current practice. The rationale is that MHCA could reduce cardiopulmonary bypass time, which has been clearly demonstrated as a risk factor for worse outcome.

Anecdotally, some surgeons are trying to replace the total aortic arch at a higher temperature (nasal temperature 28°C), requiring a brief lower-body circulatory arrest (<5 minutes), with an inflated balloon occluding the opened descending aorta after releasing the frozen elephant trunk. This method allows more time to create a secure end-to-end anastomosis between the graft and the descending aorta, because the brain and lower body are both perfused by cannulas in the femoral artery and right axillary artery.

We agree that there are some aspects of ACP requiring further clarification, such as bilateral/unilateral perfusion, appropriate flow rates, and pressure. We are approaching an era when aortic surgery could be performed with moderate hypothermia, brief circulatory arrest, and hopefully less disturbed physiology. Clinging to the old fashion seems unwise.

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<https://doi.org/10.1016/j.jtcvs.2018.01.001>

EVERYTHING OLD IS NEW AGAIN

Reply to the Editor:

We are pleased to respond to the letter of Yan and colleagues¹ commenting on our article² on long-term follow-up of patients undergoing aortic arch operations under straight deep hypothermic circulatory arrest (DHCA). We thank Yan and colleagues¹ for their kind comments regarding our operative results.

We wish to emphasize that the goal of our article² was not to argue against the use of adjunctive perfusion strategies. Rather, we demonstrated to the surgical community that use of DHCA alone does not hamper the *long-term* outlook for patients with aortic arch pathology.

In their letter, Yan and colleagues¹ provide an unbalanced view of available literature on this topic, citing studies supporting adjunctive perfusion but failing to cite studies that support the superiority of DHCA or those showing no benefit from adjunctive perfusion.³⁻⁵ Although Yan and colleagues¹ claim superiority of adjunctive antegrade cerebral perfusion, we are not aware of any randomized trials that compare the outcomes of different cerebral protection strategies. Furthermore, most studies, including those mentioned by Yan and colleagues,¹ typically evaluate heterogeneous groups of patients and may suffer from some degree of outcome bias on the part of the investigators.

We would like to pinpoint certain limitations in the studies that Yan and colleagues¹ cite as evidence in favor of perfusion:

1. Interestingly, in the study of Englum and associates,⁶ DHCA (without perfusion) was the most commonly used protection strategy, indicating the continued prominent role that DCHA plays in clinical practice today. It makes common sense that the most acutely ill patients (acute dissection, shock) would not undergo the more time-consuming axillary dissection nearly uniformly used with antegrade perfusion strategies. In the study

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of Englum and associates,⁶ the most severely ill patients (acute operation, dissected aorta) were found in the DHCA group, and there was no statistical adjustment for this acuity factor. In fact, 60% of patients who underwent surgery under DHCA were undergoing operation for aortic dissection, and 66% had either an urgent or an emergency procedure. As Englum and associates⁶ themselves state, “emergent/salvage cases were much more likely to be performed using a [DHCA] strategy.” This important study illustrates that surgeons in North America prefer to use the simpler straight DHCA technique for the emergency cases typically happening in the middle of the night. Given the acuity and severity of aortic disease in patients operated on under deep hypothermia in this study, it is understandable and expected that the surgical outcomes in this group will be inferior to those of groups receiving other cerebral protection strategies, which include mostly elective cases.

2. Kamenskaya and colleagues⁷ looked only at a small group with a very uncommon indication for aortic arch surgery: *chronic* type A aortic dissection, a rather unusual entity. In addition, they included only patients with *angiographically confirmed patent circle of Willis*—a piece of data not generally available in urgent aortic circumstances—thus specifically excluding those patients most vulnerable to the unbalanced brain perfusion that can complicate perfusion strategies. Not mentioned by Yan and colleagues¹ in their letter is the important finding that quality of life in late follow-up was *not* improved by an adjunctive perfusion strategy. In addition, the duration of DHCA was especially long (mean of 51 minutes and ranging up to 72 minutes), flirting with or exceeding the safe range. Furthermore, only patients without dissection of the innominate artery were included, a further favorable subgrouping of an overall rare group of patients.
3. In the study of Keeling and coworkers,⁸ both groups had antegrade cerebral perfusion. This was not a comparative study of straight DHCA.

Like all cardiac and vascular surgeons, we love organ perfusion, especially as regards the brain. For aortic arch surgery, however, we find DHCA to be simple, safe, and effective. We have studied neurocognitive outcomes in our patients quantitatively and extensively, including focused investigation of a special “high cognitive group”—all with extremely favorable findings.^{9,10}

FIGURE 1. Means and standard deviations of the differences between postoperative and preoperative neuropsychometric scores for the groups with (DHCA) and without (non-DHCA) deep hypothermic circulatory arrest. Note how similar the groups are in all tests. (Reprinted with permission from reference 11: Chau KH, Friedman T, Tranquilli M, Elefteriades JA. Deep hypothermic circulatory arrest effectively preserves neurocognitive function. *Ann Thorac Surg*. 2013;96:1553-9.)

Figure 1 shows how well neurocognitive performance was preserved by DHCA relative to simpler operations without DHCA.¹¹

We do not understand why Yan and colleagues¹ would suggest discontinuation of a technique that yields the excellent mortality and stroke rates in our series^{2,11,12} (which they themselves commend), as well as in other series.

Of course, surgical efforts for aortic arch resection performed under DHCA must be quick and definitive. We certainly agree that antegrade cerebral perfusion offers the surgeon the luxury of a longer safe operating time to complete the procedure. As endovascular efforts proliferate, young surgeons may soon lack the experience or confidence to complete an open arch repair in the safe DHCA period of 50 to 60 minutes. This may shift the balance in favor of perfusion strategies in the future.

We have shown in previous articles, however, that DHCA is effective in the short term from both survival and brain protection points of view.⁹⁻¹² One might be concerned that DHCA could have adverse long-term consequences. In the article under discussion in the letter of Yan and colleagues,¹ we have shown that long-term outcomes after DHCA are excellent (in fact, equivalent to those of an age- and sex-matched reference population).² One might say that we have provided strong new evidence in support of an old

technique—reinvigorating the scientific and clinical basis for DHCA. Everything old is new again.

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<https://doi.org/10.1016/j.jtcvs.2018.02.013>

MORE THAN ONE WAY TO WIRE A CHEST To the Editor:

We read with great interest the meta-analysis by Pinotti and colleagues that examined 7 randomized controlled trials comparing a standard sternal closure technique with a reinforced parasternal wiring technique in 2138 patients. Pinotti and

colleagues conclude that a parasternal wire closure is more expensive and time-consuming, and should not be used given that there are no differences in sternal complication rates between standard care and anchoring techniques.

We raise some concerns with regard to the authors' conclusions and include some suggestions to further evaluate the robustness of their analysis. First, their conclusion regarding the parasternal technique being more expensive and time-consuming is not supported because the authors did not examine the operative time or cost differences between the treatment groups in their analysis. In the absence of a formal economic evaluation, it would be inappropriate to draw conclusions regarding the cost consequences of adopting (or not adopting) the parasternal wiring technique. Allen and colleagues showed that index hospitalization cost was higher with rigid plate fixation compared with wire cerclage because of the high acquisition costs of sternal plates.¹ However, rigid plate fixation was cost-effective at 6 months, driven by higher rates of readmission in the wire cerclage group. Second, although there was no difference for the primary outcome of deep sternal wound infection, we wonder whether the inclusion of a composite outcome of "any sternal complication" or the reporting of additional clinically relevant outcomes such as sternal dehiscence (reported in 5 of the studies) may have demonstrated a difference between the 2 arms. Finally, the presence of moderate heterogeneity seen in the outcome of deep sternal wound infection requires additional post hoc sensitivity analyses to assess the robustness of the findings and look for potential causes of heterogeneity. We advocate that a leave-one-out analysis to assess the robustness of the results may be critically important because the removal of the study by Schimmer and colleagues² (responsible for 39.1% of the weighting) may have a significant impact on the outcome. A leave-one-out analysis is also prudent in this specific study because they elected to include 2 studies that shared a potentially overlapping population that in essence "double counts" the patients included.^{2,3} The use of post hoc subgroup analyses may also help determine the cause of significant heterogeneity. It would be interesting to examine whether differences existed for the primary outcome between those treated with a modified Robicsek versus the traditional Robicsek closure when compared with standard closure.

Again, we commend the authors for drawing their attention to this very important issue in cardiac surgery. However, the optimal sternal wire closure technique to reduce sternal complications remains uncertain. We believe that any technique that follows the principles of bone healing, namely, reapproximation, stabilization, and immobilization through some form of rigid fixation, will allow the sternum the optimal environment to heal.