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Commentary: Retrograde is retrograde

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Selective antegrade cerebral perfusion (ACP) in aortic arch surgery as we know it today began with innovators in the mid-1980s,^{1,2} but it did not find more widespread use until the decades that followed. It can be argued that if the advent of selective ACP preceded retrograde cerebral perfusion (RCP), the latter would be scarcely used for cerebral protection during operations on the aortic arch. RCP has been used since the 1970s to flush air from the cerebral circulation in the event of massive air embolism.³ Its repurposing as an adjunct to cerebral protection during aortic arch surgery⁴ was a natural progression, but the ability to provide nutritive flow to the brain is inferior to that of ACP.⁵ Despite this, RCP use in aortic surgery persists.

In this issue of the *Journal* our colleagues from the University of Pittsburgh report on their experience in 500 patients using RCP as an adjunct to aortic hemiarch replacement.⁶ They examined the same procedure (aortic hemiarch replacement using RCP with profound hypothermic circulatory arrest [HCA]) applied to 2 different patient populations (acute type A aortic dissection vs ascending aortic aneurysm as the indication for surgery). Concomitant procedures were included. They found operative mortality was not different, and admirably low, between patients with acute dissection and patients with aneurysm. In their study, longer HCA and cardiopulmonary bypass (CPB) times were associated with mortality, but nadir temperature was not associated with mortality.

However, taken in context that all of the operations included cooling to $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$, a minor temperature difference ($<1^{\circ}\text{C}$), seen between survivors and nonsurvivors

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CENTRAL MESSAGE

Outcomes are similar when RCP is applied to patients with aneurysm or dissection undergoing hemiarch procedures, but that is not an endorsement over ACP.

should not convince anyone that nadir temperature during arch interventions is not associated with mortality or morbidity. This was not an assessment of the impact of nadir temperature.

It is more germane that HCA time and CPB time were associated with mortality. Not that these were all routine hemiarch procedures, because approximately one-quarter also involved root replacement, but noncomplex hemiarch procedures can be done with low morbidity and mortality using any number of, or no, cerebral perfusion techniques. It is when the operations become prolonged that the shortcomings of RCP might be appreciated, as this study found: When HCA time exceeded 23 minutes, mortality was 13.5% compared with 3.1% when less than 23 minutes. What we do not know is whether this inflection point would have been seen in a cohort undergoing ACP.

Further, operative nonsurvivors had longer CPB time by approximately 1 hour. Because no nutritive flow is provided, RCP necessitates profound cooling even when anticipated HCA time will be short, as is the case with most hemiarch procedures. If aortic root work is also needed, then rewarming can occur while doing so. But if root replacement is not needed, this obligatory prolongation to CPB time while rewarming is unwarranted and could be avoided with ACP at near normothermia. Current techniques for ACP, especially if using the innominate artery, are simple⁷ and do not add more than a few minutes to the operation. ACP at near normothermia allows for shorter CPB times and thereby arguably less mortality, especially in the hemiarch cases requiring little additional surgery.

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