Author has nothing to disclose with regard to commercial support.

difficult. We are reminded of the herculean efforts of Hameed and colleagues¹ to assess the optimal strategy to mitigate the prolonged cerebral and distal aortic ischemic times necessitated by aortic arch repair. Among the three approaches studied—antegrade cerebral perfusion (ACP), retrograde cerebral perfusion, and isolated deep hypothermic circulatory arrest—superiority could not be determined by Hameed and colleagues.¹

In his letter, Vural² asks us to consider yet another factor—the site of arterial cannulation to provide ACP. In the earliest days of aortic arch repair, the innominate artery was used to provide ACP³; however, this was thought to increase the risk of stroke, and the site of cannulation soon shifted to the femoral artery. The femoral artery in turn was found to be an imperfect choice and often heavily atherosclerosed. With time, attention turned to the right axillary artery for the role of primary location for arterial cannulation, which became widespread for many years.^{4,5} Vural² and his colleagues in Turkey⁶ remind us that there is more to the armpit than the right axillary artery and suggest the routine use of the right brachial artery when providing ACP. Potential benefits include ease of cannulation and avoidance of the use of a conduit graft that is commonly applied to the right axillary artery, as well as providing a remote option in case of dissection extending into the brachiocephalic arteries. Although right brachial artery cannulation is a potentially valuable tool in the surgeon's armamentarium, one should proceed with caution in the case of friable tissue (which is common in patients with connective tissue disorder) or small brachial arteries.

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REPLY: PERFUSION: IS HIGHER BETTER?

Reply to the Editor:

We thank Vural¹ for his letter regarding our recently published network meta-analysis² on cerebral protection strategies in aortic arch surgery. We read with great interest his description of right brachial artery selective antegrade cerebral perfusion and its possible benefits.³ Our network meta-analysis² lends further evidence to the benefits of more physiologically natural cerebral protection techniques during aortic arch surgery. We found both antegrade and retrograde cerebral perfusion techniques to be associated with better postoperative outcomes than deep hypothermic circulatory arrest. It is therefore an interesting prospect to reexamine current variations of these cerebral perfusion strategies to standardize the choice of perfusion site and possibly to define patients that could benefit from the individual strategies. Although the potential advantages of the brachial selective cerebral perfusion approach relative to axillary cannulation are interesting, perfusion site remains an important issue in aortic surgery. Larger studies and trials comparing different approaches are clearly needed.

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REPLY: ALTERNATIVE ARTERIAL CANNULATION IN AORTIC ARCH SURGERY

Reply to the Editor:

In this issue of *The Journal of Thoracic and Cardiovascular Surgery*, Dr Vural writes to the Editors in response to a novel network meta-analysis of cerebral protection strategies during aortic arch surgery by Hameed and colleagues.¹ Dr Vural shifts the focus to alternative cannulation approaches for antegrade cerebral perfusion, specifically the potential advantages of brachial artery cannulation relative to axillary artery cannulation, which is the standard approach at most institutions. He cites his own institution's case series from 2002,² which demonstrated outcomes after brachial artery cannulation for antegrade cerebral perfusion in 104 patients. In that series, there was 1 vascular complication, specifically distal occlusion requiring reoperation and embolectomy, and 2 cerebral complications—with 1 patient dying after presenting with neurologic deficits associated with type A dissection and another patient having transient right hemiparesis postoperatively, with no residual long term deficits. Dr Vural and his colleagues are to be commended for their novel approach and seemingly low rates of vascular and neurologic complications.

Since axillary artery cannulation began to be used for thoracic aortic surgery in the mid 1990s, the approach has been shown to be safe and effective, and is favored by most institutions relative to the previous standard of femoral artery cannulation.^{3,4} The axillary artery is typically free of both atherosclerotic and aneurysmal disease, and cannulation of this site reduces the risk of atheroembolic disease, promotes perfusion of the true lumen, and decreases incidence of retrograde propagation in the context of dissection.⁵ Particularly since the technique has evolved to include end-to-side anastomosis of a Dacron polyester fabric graft through which cannulation occurs, there is no period of distal ischemia in the right upper extremity and lower incidence of injury to the artery as a result of direct cannulation.⁶ In a notable study in a recent

volume of the *Journal*, Kim and colleagues,⁷ with a propensity score-matched analysis, showed lower incidence of embolic stroke and operative mortality after axillary artery cannulation when compared with femoral or direct aortic cannulation for arch replacement with circulatory arrest. This is certainly compelling evidence that, for most institutions, axillary should be the cannulation site of choice during arch replacement.

As Dr Gleason⁸ reminds readers in his commentary on the article of Kim and colleagues,⁷ readers should remember that the ideal cannulation site has not been adjudicated in large volume randomized, controlled trials. Thoracic aortic surgeons should therefore certainly keep an open mind to alternative approaches that may prove to be the superior strategy. The previously proposed benefits of brachial artery relative to axillary artery cannulation are that this approach is less invasive, is technically easier, and promotes a better cosmetic result with less risk of infection.⁹ Dr Vural's institution has not tested these hypotheses in previous studies, however, the outcomes of which have been focused on safety and effectiveness of this approach. No study has compared this approach with axillary artery cannulation directly in terms of cerebral or vascular complications, cannulation time, or incidence of infection to support their hypotheses. For those desiring to start using the brachial artery for cannulation, more interesting would be a description of who would not be a good candidate for the site, rather than an account of a retrospective, preselected group of patients who did well.

On the basis of experience with axillary and femoral cannulation, there are multiple potential pitfalls to brachial artery cannulation as described by Dr Vural. First, the artery is cannulated directly, rather than through anastomosis of side graft. Not only does this mean that the distal extremity is not directly perfused from cannulation to decannulation, but an arteriotomy large enough to facilitate a 16F to 18F cannula will frequently require repair, which is prone to stricture in a smaller caliber vessel. Second, the limited space within the brachial sheath makes consequences of vascular injury very morbid, including median nerve palsies. Cannulation of the brachial artery has perhaps been best studied by cardiac anesthesiologists, who frequently use the brachial artery for arterial blood pressure monitoring with a 20-gauge catheter. Among 21,597 patients who underwent brachial artery monitoring studied by Singh and associates,¹⁰ 777 had a vascular complication, a small but not insignificant percentage. Extrapolating these numbers to significantly larger 16F to 18F cannulas concerns us that a larger series might show more catastrophic limb-threatening injuries. Although Dr Vural's approach represents a creative alternative cannulation approach for antegrade cerebral perfusion, the benefits relative to axillary artery cannulation remain theoretic until