Authors have nothing to disclose with regard to commercial support.

2. Hameed I, Rahouma M, Khan FM, Wingo M, Demetres M, Tam DY, et al. Cerebral protection strategies in aortic arch surgery: a network meta-analysis. *J Thorac Cardiovasc Surg*. February 21, 2019 [Epub ahead of print].
3. Küçük SA, Ozatik MA, Sarıtaş A, Taşdemir O. Arch repair with unilateral antegrade cerebral perfusion. *Eur J Cardiothorac Surg*. 2005;27:638-43.

<https://doi.org/10.1016/j.jtcvs.2019.05.037>

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

Authors have nothing to disclose with regard to commercial support.

randomized, controlled trials can investigate not only major complications, such as embolic stroke and mortality but also vascular complications, operative time, other secondary outcomes.

Charles M. Wojnarski, MD, MS

Andrew M. Vekstein, MD

Division of Cardiovascular and Thoracic Surgery

Duke University Medical Center

Durham, NC

Department of Surgery

Duke University

Durham, NC

References

1. Hameed I, Rahouma M, Khan FM, Wingo M, Demetres M, Tam DY, et al. Cerebral protection strategies in aortic arch surgery: a network meta-analysis. *J Thorac Cardiovasc Surg*. February 21, 2019 [Epub ahead of print].
2. Taşdemir O, Sarıtaş A, Küçüker Ş, Özatik MA, Şener E. Aortic arch repair with right brachial artery perfusion. *Ann Thorac Surg*. 2002;73:1837-42.
3. Sabik JF, Lytle BW, McCarthy PM, Cosgrove DM. Axillary artery: an alternative site of arterial cannulation for patients with extensive aortic and peripheral vascular disease. *J Thorac Cardiovasc Surg*. 1995;109:885-91.
4. Neri E, Massetti M, Capannini G, Carone E, Tucci E, Diciolla F, et al. Axillary artery cannulation in type A aortic dissection operations. *J Thorac Cardiovasc Surg*. 1999;118:324-9.
5. Yan TD, Bannon PG, Bavaria J, Coselli JS, Elefteriades JA, Griep RB, et al. Consensus on hypothermia in aortic arch surgery. *Ann Cardiothorac Surg*. 2013;2:163-8.
6. Gillinov AM, Sabik JF, Lytle BW, Cosgrove DM. Axillary artery cannulation. *J Thorac Cardiovasc Surg*. 1999;118:1153.
7. Kim JH, Lee SH, Lee S, Youn YN, Yoo KJ, Joo HC. Axillary artery cannulation reduces early embolic stroke and mortality after open arch repair with circulatory arrest. *J Thorac Cardiovasc Surg*. March 15, 2019 [Epub ahead of print].
8. Gleason TG. Commentary: does right axillary artery cannulation prevent aorto-cerebral embolic phenomena? *J Thorac Cardiovasc Surg*. April 24, 2019 [Epub ahead of print].
9. Sarıtaş A, Kervan U, Vural KM, Kucuker SA, Yavas S, Birincioglu LC. Visceral protection during moderately hypothermic selective antegrade cerebral perfusion through right brachial artery. *Eur J Cardiothorac Surg*. 2010;37:669-76.
10. Singh A, Bahadorani B, Wakefield BJ, Makarova N, Kumar PA, Tong MZ, et al. Brachial arterial pressure monitoring during cardiac surgery rarely causes complications. *Anesthesiology*. 2017;126:1065-76.

<https://doi.org/10.1016/j.jtcvs.2019.06.031>