

We congratulate the authors on this study and using DW-MRI to more thoroughly assess neurologic injury following aortic arch surgery.

References

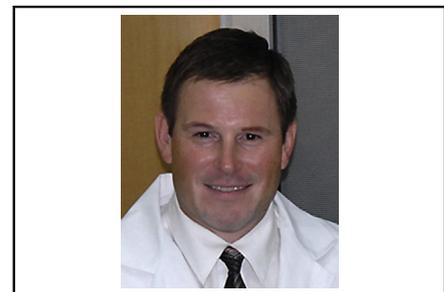
1. Peterson MD, Garg V, Mazer CD, Chu MW, Bozinovski J, Dagenais F, et al. A randomized trial comparing axillary versus innominate artery cannulation for aortic arch surgery. *J Thorac Cardiovasc Surg.* 2022;164:1426-38.e2.
2. Leshnowar BG, Rangaraju S, Allen JW, Stringer AY, Gleason TG, Chen EP. Deep hypothermia with retrograde cerebral perfusion versus moderate hypothermia with antegrade cerebral perfusion for arch surgery. *Ann Thorac Surg.* 2019;107:1104-10.
3. Thomas M, Li Z, Cook DJ, Greason KL, Sundt TM. Contemporary results of open aortic arch surgery. *J Thorac Cardiovasc Surg.* 2012;144:838-44.
4. Vermeer SE, Longstreth WT, Koudstaal. Silent brain infarcts: a systematic review. *Lancet Neurol.* 2007;6:611-9.

See Article page 1426.



Commentary: Axillary versus innominate artery cannulation for proximal aortic arch surgery

John S. Ikonomidis, MD, PhD



John S. Ikonomidis, MD, PhD

The efficacy of cerebral protection measures during operations on the aortic arch likely remains the most important determinant of favorable postoperative neurologic outcomes. Deep hypothermia with complete circulatory arrest was the gold standard for years, but surgeons were always concerned about the actual “safe” duration of cold ischemia on the brain, the deleterious systemic effects of profound hypothermia, and the untoward sequelae of the prolonged cardiopulmonary bypass (CPB) times required to cool and then rewarm. In response to this, surgeons began to experiment with warmer circulatory arrest temperatures, requiring shorter cooling and rewarming times, supplemented with either retrograde or antegrade cerebral perfusion.

Antegrade cerebral perfusion was originally delivered directly, simultaneously through the ostia of both the innominate and left common carotid arteries with the arch open during the circulatory arrest period. However,

CENTRAL MESSAGE

A unique randomized trial comparing axillary versus innominate artery perfusion for cerebral protection during proximal aortic arch surgery is reviewed.

this strategy can be a bit cumbersome in terms of cluttering the operative field, and also may create confusion in terms of true lumen perfusion in the setting of aortic dissection. Subsequent to this was the introduction of selective antegrade cerebral perfusion (SACP), delivered via perfusion of the right common carotid artery via the right axillary artery. Excellent results have been achieved with this technique, owing to the high percentage of patients with an intact circle of Willis. However, accessing the axillary artery requires an incision distinct from the sternotomy incision, partial division of the pectoralis major and minor muscles, dissection within the brachial plexus, and manipulation of an arterial vessel that probably is secondary only to the pulmonary artery in fragility. From here, direct cannulation of the more stout innominate artery was introduced. This is a more attractive SACP option because this artery can be accessed via a sternotomy incision

From the Division of Cardiothoracic Surgery, Department of Surgery, University of North Carolina School of Medicine, Chapel Hill, NC.

Supported by National Heart, Lung, and Blood Institute Grants 2R01 HL102121 and 1R21 HL148363.

Disclosures: The author reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication Nov 11, 2020; revisions received Nov 11, 2020; accepted for publication Nov 13, 2020; available ahead of print Nov 25, 2020.

Address for reprints: John S. Ikonomidis, MD, PhD, Division of Cardiothoracic Surgery, Department of Surgery, UNC School of Medicine, 3034 Burnett Womack Building, 160 Dental Circle, Chapel Hill, NC 27599-7065 (E-mail: john_ikonomidis@med.unc.edu).

J Thorac Cardiovasc Surg 2022;164:1440-1
0022-5223/\$36.00

Copyright © 2020 by The American Association for Thoracic Surgery
<https://doi.org/10.1016/j.jtcvs.2020.11.050>

(perhaps extended a little cephalad) and is easier and less dangerous than an axillary dissection; however, there are concerns that the proximal nature of this arterial access could result in downstream embolization via the right common carotid and vertebral arteries, events that appear to be less likely with axillary cannulation, which is distal to these 2 arteries.

The question of neurologic outcomes related to these 2 SACP techniques has been addressed with several studies. Eldeiry and colleagues¹ studied 206 patients undergoing elective and emergent replacement of the proximal aortic hemiarch and found shorter cardiopulmonary bypass times, less blood product use, and similar overall outcomes compared with axillary access with innominate cannulation.¹ Preventza and colleagues² studied 938 patients undergoing elective hemiarch or total arch surgery and demonstrated with a propensity-matched analysis that axillary and innominate artery cannulation were associated with equivalent composite adverse event rates, operative death rates, and overall stroke rates. Harky and colleagues³ published a meta-analysis of 5 studies including 1338 patients that showed no significant outcome differences between axillary and innominate artery cannulation.³ In contrast to these studies, in a cohort of 140 patients, Chu and colleagues⁴ found similar outcomes in the 2 groups, except that adverse neurologic events were twice as frequent with innominate artery cannulation, prolonged mechanical ventilation was more common with axillary cannulation, and total operating time was reduced in the innominate group.⁴

It is important to note that the latter study was performed before the other studies that showed no significant differences between the 2 cannulation approaches, and the results raised enough concern so as to prompt a randomized controlled trial (RCT). The results of that trial, a unique, 6-center, 2-arm, noninferiority RCT that compared innominate to traditional axillary cannulation for providing ACP in adults undergoing elective repair of the ascending aorta and proximal arch requiring HCA and an open distal anastomosis, are presented in this issue of the *Journal*.⁵ In addition to the usual outcomes, the appearance of new severe ischemic lesions on diffusion-weighted magnetic

resonance imaging were studied. The results, tabulated for 102 patients, showed comparable outcomes in total operative times, stroke/transient ischemic attacks, 30-day mortality, seizures, delirium, and duration of mechanical ventilation. Perhaps most interesting was the finding of new severe ischemic lesions in 19 participants (38.8%) in the axillary group compared with 18 (34%) in the innominate group (P for noninferiority = .0009). Thus, the overarching conclusion of this trial is that there is no downside to using the innominate artery as a means of SACP for proximal aortic arch surgery, and thus this would be the default strategy of this research group moving forward.

This trial provides the first truly rigorous evidence of noninferiority of these 2 approaches to SACP. The high frequency of new cerebral lesions in both groups is of concern but somewhat difficult to sort out, given that similar results have been reported in the setting of other cardiac surgical operations.⁶ However, the trial focused specifically on elective proximal hemiarch surgery, leaving many questions regarding outcomes in emergent aneurysm surgery, aortic dissection, and more complex arch work. Nevertheless, the authors are to be congratulated for an outstanding effort in addressing an important question in a very specific patient population.

References

1. Eldeiry M, Ghincea C, Aftab M, Cleveland JC, Fullerton D, Reece TB. Innominate versus axillary artery cannulation for the hemiarch repair. *J Surg Res*. 2018;232:234-9.
2. Preventza O, Price MD, Spiliotopoulos K, Amarasekara HS, Cornwell LD, Omer S, et al. In elective arch surgery with circulatory arrest, does the arterial cannulation site really matter? A propensity score analysis of right axillary and innominate artery cannulation. *J Thorac Cardiovasc Surg*. 2018;155:1953-60.e4.
3. Harky A, Grafton-Clarke C, Hadlett M, Shuttleworth E. In thoracic aortic surgery, is innominate artery cannulation a safe and effective alternative to axillary artery cannulation? *Interact Cardiovasc Thorac Surg*. 2019;29:604-7.
4. Chu MWA, Losenno KL, Gelinis JJ, Garg V, Dickson J, Harrington A, et al. Innominate and axillary cannulation in aortic arch surgery provide similar neuroprotection. *Can J Cardiol*. 2016;32:117-23.
5. Peterson MD, Garg V, Mazer CD, Chu MA, Bozinovski J, Dahenais F, ACE CardioLink-3 Trial Working Group. A randomized trial comparing axillary versus innominate artery cannulation for aortic arch surgery. *J Thorac Cardiovasc Surg*. 2022;164:1426-38.e2.
6. Barber PA, Hach S, Tippett LJ, Ross L, Merry AF, Milsom P. Cerebral ischemic lesions on diffusion-weighted imaging are associated with neurocognitive decline after cardiac surgery. *Stroke*. 2008;39:1427-33.