For the arch: Where there is urine, there is hope

Joseph S. Coselli, MD

See related article on pages 127-33.

For the treatment of patients undergoing open surgical correction of pathology involving the transverse aortic arch, deep or profound hypothermic circulatory arrest as originally described in 1975 by Griep and colleagues¹ remains the standard approach for cerebral and systemic protection. Deep hypothermic circulatory arrest successfully allows for a bloodless operative field and visceral protection as a consequence of a reduction, although not the elimination, of systemic metabolic demands. The optimal protection strategy remains a source of debate, investigation, and evolution.² Since the advent of selective antegrade cerebral perfusion, there has been a progressively increasing interest in carrying out such procedures at higher temperatures, specifically, moderate hypothermia in the 20°C to 28°C range. This has been in part an effort to offset the negative consequences of deeper temperatures, which include coagulopathy, renal failure, respiratory failure, and endothelial dysfunction. Although the use of selective antegrade cerebral perfusion and higher temperatures may ameliorate some of these consequences, it can place noncerebral organs at increased risk if subjected to prolonged ischemia at higher temperatures.

Others have investigated the benefits of higher temperature and direct cerebral perfusion from a neuroprotective standpoint.^{3,4} In this issue of the *Journal*, Pacini and colleagues⁵ provide insight and analysis into the identification of the incidence and risk factors for postoperative acute renal failure after such thoracic aortic surgery in their series of patients using antegrade selective cerebral perfusion at moderate hypothermic temperature levels. They evaluate 641 consecutive patients undergoing surgery of the transverse aortic arch using antegrade cerebral perfusion at moderate hypothermic levels. The authors analyzed their data focusing on the primary outcome of postoperative acute kidney injury (AKI). They define this by an increase of creatinine by

100% or more above baseline or the need for temporary or permanent dialysis. Their overall results are both instructive and elucidating. For the entire group, the incidence of AKI was 19% (122 patients); dialysis was required in 59 patients (9.2%) and was temporary in 36 patients (5.6%) and permanent in 23 patients (3.6%). Of note, the in-hospital mortality was significantly greater in the renal injury group (33.6% vs 6.7%; $P < .001$). Patients who required dialysis had a mortality rate of 45.8%: 60.9% in those in whom it was permanent and 36.1% in whom it was temporary.

Pacini and colleagues⁵ carry out a thorough and appropriate statistical analysis. The analysis is somewhat confounding in that they use intraoperative and postoperative variables to develop a predictive model. Nevertheless, they identify 8 variables that were significantly associated with AKI postoperatively; 4 of these were preoperative, 2 were operative, and 2 were postoperative. Their models, as tested, demonstrated that surgery carried out on an emergency basis, preoperative glomerular filtration rate, and preoperative weight were all significantly associated with the development of postoperative AKI. Of note, they did not find that the perfusion time, crossclamp time, visceral ischemic time, or selective cerebral perfusion times were different between those with and without postoperative AKI.

Pacini and colleagues⁵ provide an important contribution in their focus on acute renal failure after thoracic aortic arch surgery, a procedure that has received a great deal of attention for postoperative stroke and its prevention, and much less so regarding visceral issues. Their overall incidence of AKI of 19% is in line with what others have reported, but nevertheless underscores the importance of this issue. As with postoperative stroke, the morbidity, mortality, and financial cost of AKI are unquestionably substantial. The authors select preoperative renal status as one area for potential improvement. For patients with time for preoperative preparation, specific efforts to improve kidney function, including hydration, hemodynamic optimization, and pharmacologic intervention, may prove beneficial and are worthy of further investigation. Another area of investigation and clarification will be the various strategies of distal perfusion in patients with systemic circulatory arrest at more moderate temperatures.

Pacini and colleagues⁵ are to be congratulated for their excellent results and adding the focus of AKI to the pantheon of issues surrounding thoracic aortic surgery. The benefits of operating on the transverse aortic arch at

From the Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine; Adult Cardiac Surgery, Texas Heart Institute; and Adult Cardiac Surgery Section and Cardiovascular Service, Baylor St Luke's Medical Center, Houston, Tex.

Disclosures: Author has nothing to disclose with regard to commercial support.

Received for publication April 20, 2015; accepted for publication April 24, 2015.

Address for reprints: Joseph S. Coselli, MD, Baylor College of Medicine, Texas Heart Institute, Baylor St. Luke's Medical Center, One Baylor Plaza, BCM 390, Houston, TX 77030 (E-mail: jcoselli@bcm.edu).

J Thorac Cardiovasc Surg 2015;150:134-5

0022-5223/\$36.00

Copyright © 2015 by The American Association for Thoracic Surgery

<http://dx.doi.org/10.1016/j.jtcvs.2015.04.044>

higher temperatures are clear and consequently being carried out at increasing frequency. The challenge going forward will be to focus on visceral protection with the same intensity as neuroprotection.

References

1. Griep RB, Stinson EB, Hollingsworth JF, Beuhler D. Prosthetic replacement of the aortic arch. *J Thorac Cardiovasc Surg.* 1975;70:1051-63.
2. Tian DH, Wan B, Bannon PG, Misfeld M, Lemaire SA, Kazui T, et al. A meta-analysis of deep hypothermic circulatory arrest versus moderate hypothermic circulatory arrest with selective antegrade cerebral perfusion. *Ann Cardiothorac Surg.* 2013;2:148-58.
3. Luehr M, Bachet J, Mohr FW, Etz CD. Modern temperature management in aortic arch surgery: the dilemma of moderate hypothermia. *Eur J Cardiothorac Surg.* 2014;45:27-39.
4. Algarni KD, Yanagawa B, Rao V, Yau TM. Profound hypothermia compared with moderate hypothermia in repair of acute type A aortic dissection. *J Thorac Cardiovasc Surg.* 2014;148:2888-94.
5. Pacini D, Pantaleo A, Di Marco L, Leone A, Barberio G, Parolari A, et al. Risk factors for acute kidney injury after surgery of the thoracic aorta using antegrade selective cerebral perfusion and moderate hypothermia. *J Thorac Cardiovasc Surg.* 2015;150:127-33.e1.