network pressure), where MAP is 110 mm Hg, Km is 26.4 mm Hg (0.264 ratio), and DAP pressure is 83.6 mm Hg. We can see from the previous calculation that the necessary DAP pressure is much higher than that we planned to use. In a situation with suboptimal DAP pressure, subtle and discrete spinal cord ischemia (ischemic penumbra) with all metabolic disturbances might emerge. The spinal cord might be disturbed but not impaired. Now the crucial moment is intercostal artery revascularization associated with discrete or silent spinal ischemia, preparing the field for spinal cord edema. Safi and associates² suggested that this complication is a result of a spinal cord compartmental syndrome that might arise from unstable blood pressure, secondary increased cerebrospinal fluid pressure, or both. Therefore, paradoxically, reattached intercostals arteries might cause postrevascularization compartment. Those observations and assumptions can be investigated by using spinal damage core predictors, such as S-100 protein and C-lactate levels, in correlation with suboptimal DAP pressure and any possible changes in MEP potentials. Until that time, we are forced to fight the battle against neurological deficit with the only choice we have.

Nikola Ilić, MD
Lazar B. Davidovic, MD, PhD
Igor Končar, MD
Marko Dragaš, MD
Miroslav Markovic, MD, PhD
*Clinic for Vascular and Endovascular
Surgery
Clinical Centre of Serbia
Belgrade, Serbia*

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Reply to the Editor:

We appreciate the interest of Ilić and colleagues in our previous work on delayed neurological injury after thoracoabdominal aneurysm (TAAA) repair.¹ They acknowledge that paraplegia remains significant, complicating TAAA repair in as many as 30% of their cases, with 6% occurring in a delayed fashion. They suggest that without neurological monitoring, such as somatosensory evoked potentials (SSEPs) and motor evoked potentials (MEPs), distal aortic perfusion (DAP) remains their primary adjunct in preventing paraplegia. As such, they suggest that by calculating the spinal collateral network pressure for each patient, the necessary DAP pressure can be determined. By maintaining this calculated distal pressure goal, optimal "spinal perfusion dynamics" can provide protection against paraplegia.

We concur that DAP is integral for protection against paraplegia during TAAA repair. However, it is not the only adjunct involved in spinal cord protection. Ultimately, spinal cord protection requires a multifaceted approach that also involves cerebrospinal fluid drainage, intercostal artery reimplantation, and moderate hypothermia. Although no single compo-

nent predominates in importance, some aspects might become more significant in certain patients depending on the conditions encountered. Thus in our opinion all of these measures (DAP, cerebrospinal fluid drainage, intercostal artery reimplantation, and moderate hypothermia) are necessary for spinal cord protection, all of which are provided by most aortic surgeons.

As suggested by Ilić and colleagues, optimizing DAP pressure has become very important. We have generally maintained a DAP pressure of between 60 and 80 mm Hg, as was the case in our previously mentioned study. Maintaining DAP pressure, however, must be balanced with maintaining adequate proximal arterial pressure. It is important not to sacrifice proximal arterial pressure for maintaining DAP pressure. Providing distal aortic pressure likely contributes to protecting against spinal cord ischemia. However, considering the concept of the collateral network for the spinal cord,² the proximal arterial pressure remains an equal, if not more important, contribution. Caution must also be considered in cases of severely atheromatous disease because retrograde DAP can initiate devastating embolization. In such cases DAP is not begun until the ostia of the primary vessels are secured. The main consideration regarding DAP that must be recognized is that this DAP is not pulsatile. Pulsatile antegrade perfusion to the spinal cord and the collateral network is important; what degree of pulsatility is unknown.

In our recent work on neuromonitor-guided TAAA repair, we used SSEPs and MEPs to guide the conduct of our repair and to aid in determining whether reimplantation of intercostal arteries was required (Estrera et al, unpublished data, 2010). We agree with Ilić and colleagues that MEPs are more sensitive than SSEPs, but both were relatively insensitive. Interesting was the fact that the maneuver that was most frequently associated with recovery of MEP and SSEP signals was intercostal artery reattachment.

This was followed by establishing distal pulsatile flow (ie, completing the distal anastomosis) and then increasing DAP pressure. Recovery of MEPs was attributed to increased DAP pressure only 14% of the time. From this study of 105 patients, immediate paraplegia occurred in only 1 (1%) patient, with delayed paraplegia occurring in 3 (3%) patients, supporting our previous work showing that delayed was more frequent than immediate paraplegia.

As we reported in 2003, delayed paraplegia occurred more frequently than immediate paraplegia. We determined that the combination of adjuncts, DAP and cerebrospinal fluid drainage, was independently associated with delayed paraplegia. We hypothesized that this was related to the fact that patients who previously would have awoken paraplegic were now neurologically intact but still vulnerable to ischemia and injury. If a second unfavorable event occurred, such as hypotension or cerebrospinal fluid drain catheter malfunction, delayed paraplegia could ensue. Unlike immediate paraplegia, however, delayed paraplegia can be reversed.

In summary, we do agree with the authors that DAP is important and that optimizing perfusion to the collateral network of the spinal cord might be crucial. Collateral network preservation not only involves optimization of DAP but also cerebrospinal fluid drainage, moderate hypothermia, and intercostal artery reimplantation. In essence, spinal cord protection requires a standardized team approach incorporating a combination of adjuncts that should be available to most surgeons.

Anthony L. Estrera, MD^a

Charles C. Miller III, PhD^b

Hazim J. Safi, MD^a

^aCardiothoracic and Vascular
Surgery

University of Texas Medical School
Houston Memorial Hermann Heart
and Vascular Institute
Houston, Tex

^bBiomedical Sciences
Texas Tech University Medical School
El Paso, Tex

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IN SITU RIGHT INTERNAL THORACIC ARTERY IS USUALLY LONG ENOUGH FOR GRAFTING THE CIRCUMFLEX ARTERY THROUGH THE TRANSVERSE SINUS

To the Editor:

We read with great interest the article by Hayward and colleagues¹ about comparable patencies of the radial artery and free right internal thoracic artery (RITA) or saphenous vein at a mean of 5 to 6 years' follow-up after coronary artery bypass grafting (CABG) surgery. We congratulate the authors for their excellent results. Nonetheless, their article raises some concerns, and the conclusions should be debated.

The CABG procedure with bilateral internal thoracic artery (ITA) is associated with a better long-term survival, a lower incidence of cardiac events, and lower necessity of reoperation when compared with those seen in patients who receive a single ITA.

In situ ITA grafts are considered the gold standard for arterial conduits, and better long-term results are achieved when ITAs are primarily grafted to the left-sided coronary arteries, thus leaving the right coronary arteries to be grafted with other conduits. The common technique is to use the in situ left ITA to bypass the left anterior descending coronary artery and the in situ RITA to bypass the obtuse marginal branches of the circumflex artery through the transverse sinus.² How-

ever, the number and length of ITAs can limit their use. Many methods of increasing ITA length, mostly for the RITA, have been suggested.³

Although previous anatomic studies have shown that any coronary arteries can be reached with an in situ ITA,⁴ the Melbourne group reported that pedicled RITA conduits were not often able to reach the more distal circumflex marginal arteries, advocating use of a free RITA to overcome the anatomic limitations of the in situ RITA.⁵ Now the patencies of the radial artery and free RITA are similar at a mean of 5 to 6 years' follow-up.¹

These conclusions need to be taken with some caution because in their study it was mandatory that the RITA had to be proximally interrupted for comparison with other grafts. In our opinion ITAs should always be used as in situ grafts because ITAs are already perfectly connected to the arterial circulation and we have to perform only the distal anastomoses, avoiding proximal connection on the aorta. Free RITA proximal anastomosis on the ascending aorta is often difficult for the narrow diameter of the artery and for the diseased aortic wall.

Moreover, the in situ RITA is long enough for grafting the first or second branch of the circumflex artery through the transverse sinus. Literature articles reported the best results with bilateral in situ ITAs versus a single ITA,^{2,3} leaving free RITA use only in selected cases (third branch of the circumflex artery, sequential bypass, and injured ITA during harvesting). In the study by Hayward and colleagues,¹ all grafts have been performed with single distal anastomoses, and we do not know which marginal branch has been grafted.

In conclusion, in situ bilateral ITAs have to be considered in CABG procedures for their better results, leaving free RITA use only in some cases or selected trials.

Marco Agrifoglio, MD, PhD
Samer Kassem, MD