warranted.'' A larger randomized, controlled trial with patients at higher risk that incorporates imaging in addition to clinical endpoints is needed to determine the impact of filtration. Such a study is being sponsored by the National Heart, Lungs, and Blood Institute.

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NEUROLOGIC IMPACT OF USING EMBOL-X INTRAAORTIC FILTER

Reply to the Editor:

We greatly appreciate the comments of Allen and Horvath and entirely agree with their interpretation of the facts. We reported the safety and feasibility of using the new version of the EMBOL-X intraaortic filter during transaortic transcatheter aortic valve implantation and during conventional cardiac surgery, and we documented successful capture of embolic material.[1] Although capturing emboli might be anticipated to decrease embolic events, it has been difficult to demonstrate a positive clinical effect. This may be in part because the majority of embolic cerebral events after transcatheter aortic valve implantation or conventional cardiac surgery are silent. We completely agree that a much larger, randomized study with a combination of imaging and clinical end points in patients who undergo either transaortic transcatheter aortic valve implantation or conventional cardiac surgery will be necessary for full evaluation of the potential for benefit or harm with any embolic control device.

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AORTIC SURGERY AND SPINAL COLLATERAL FLOW: A CALL FOR STRUCTURED APPROACHES TO FUNCTIONAL CHARACTERIZATION OF THE INTRASPINAL COLLATERAL SYSTEM

To the Editor:

Generating knowledge of spinal collateral physiology spans over decades of scientific efforts. As will be demonstrated, historical and current knowledge of different specialized areas, such as orthopedic surgical, neurosurgical, neuroradiologic, and aortic surgical science, as well as basic research, need to be combined to generate a comprehensive picture of spinal collateral physiology.

Spinal collateral flow has been the subject of surgical large animal studies, which have proved to be the best available option among scientific models for spinal flow research. The mainstay experimental series from the Mount Sinai Hospital in New York [1-3] stand out in this series of experimental efforts. After more than 20 years of translational and basic work shedding light on risks of central nervous deficits after thoracic aortic surgery, tendencies of resignation now can be observed. In their recent letter, Takayama and Borger [4] come to the conclusion that spinal cord protection might be just as ''simple'' as keeping perfusion pressures high and to react on evident spinal ischemia as monitored and detected by evoked potentials. It is ignored that we are still far away from solid, evidence-based individual preoperative risk prediction of spinal ischemia. Strategies with predictive validity of spinal ischemia based on individual anatomic settings still need to be established.

Lazorthes and Gouaze,[5,6] Lazorthes and colleagues,[7] Lazorthes and Manelfe,[8] Lazorthes and colleagues,[9,10] Lazorthes and Zadeh,[11] and Mehta[12] are to be credited for probably the most important anatomic contributions to our understanding of the spinal collateral system, more specifically the intraspinal backup system. It seems as if their work somewhat faded into the background, which is not understandable especially regarding Lazorthes and colleagues' highly detailed and extensive investigations in cadavers. Their results have served as an anatomic basis for the numerous large animal studies by Griepp and colleagues at the Mount Sinai School of Medicine in New York City. Other early contributions are by Kadyi,[13,14] Piscol,[15] and Piscol and Remagen.[16] Paradoxically, orthopedic researchers[17-19] studying venous return from the spinal column primarily described an important piece of the intraspinal collateral system—the serial circular epidural

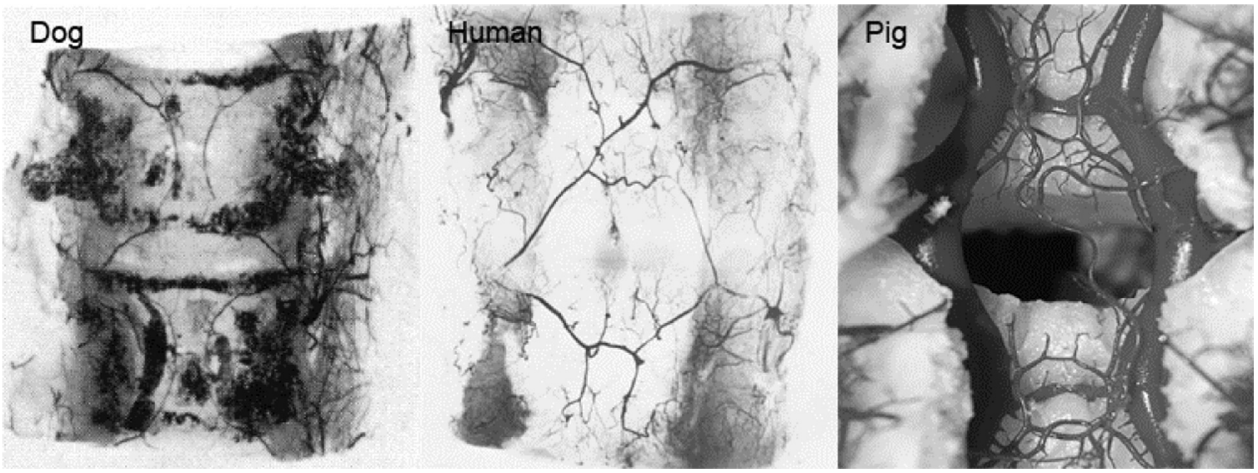

FIGURE 1. Intraspinal arcades: canine, human, and porcine (from *left* to *right*). The view is the same as shown in Figures 2-5. All are cadaver casts using different plastic or contrast agent dyes. The 2 large parallel structures at the 2 sides of the spinal canal in the *right* image are the 2 major intraspinal veins, casted in the pig but not in the canine and human examples. The *left* and *middle* images are by Crock and colleagues,[18] and the *right* image is by the Mount Sinai Group.[22]

arcades (Figure 1)—as we chose to call them, although without transferring this knowledge to aortic surgical problems or spinal flow physiology. Adamkievicz's work[20] must be mentioned in the same line of research, although the hypothesis of a spinal blood supply depending mainly on 1 critical arterial input is obsolete.[21]

The spinal collateral network should be divided in a paraspinous compartment and an intraspinal compartment. These

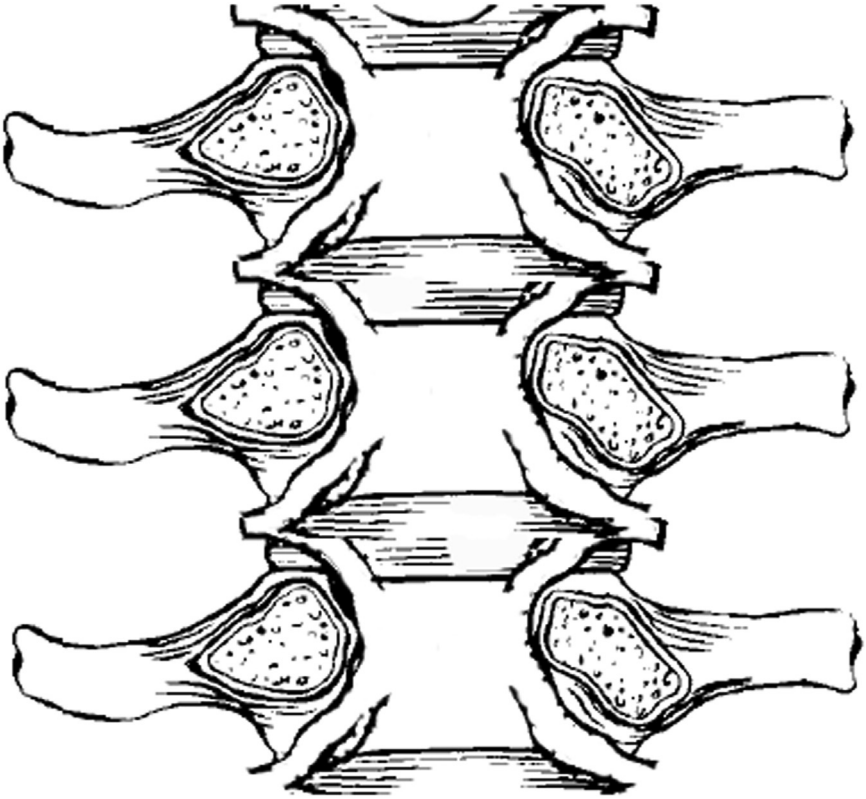

FIGURE 2. The spinal canal seen from the back, after bilateral laminectomy of 3 vertebrae and removal of dorsal processes. The posterior surface of the vertebrae is exposed. The posterior longitudinal ligament is not shown. The large vessels leaving the spinal canal on every segmental level, 2 at the level of each intervertebral disk, are the major intraspinal veins, draining in a valveless venous system directly connected to the major caval venous systems.