drawn using these approaches, often because confounding variables might not be distributed within the population in the same fashion as the independent and dependent variables. These issues may be amplified with meta-analyses. In this study, a large number of constituent studies had missing data, some missing data with respect to a particular set of variables and others missing data with respect to another set of variables.

There is no substitute for tracking individuals, and pooled approaches definitionally do not do so. If individual patient data were available, then only those patients with complete data for all variables of interest could be included, and more rigorous analyses could be performed. Interpreting these pooled data is much like jumping into the deep end of the pool; there is a hazard of sinking if one is not skillful.

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Commentary: Rates of spinal cord ischemic injury after aortic surgery: One size does not fit all

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Spinal cord ischemic injury (SCI) is a major complication after open or endovascular procedures on the descending thoracic (DTA) or thoracoabdominal (TAAA) aorta and is associated with substantial mortality and morbidity. Despite modifications in operative technique and introduction of interventions such as drainage of cerebral spinal fluid and monitoring of motor- and sensory-evoked potentials, the risk of SCI, manifested primarily by paraplegia or

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CENTRAL MESSAGE

Pooled rates of permanent postoperative spinal cord ischemic injury that include patients with both thoracic and thoracoabdominal aortic aneurysms do not tell the whole story.

paraparesis, has not been substantially reduced over the past 3 decades, especially in patients with TAAAs.¹⁻³

In this issue of the *Journal*, Gaudino and colleagues⁴ present an extensive meta-analysis of the contemporary (2008-2018) experience with open and endovascular repair of thoracic and thoracoabdominal aortic aneurysms involving 169 studies and 22,634 patients. The primary outcome examined was the prevalence of permanent SCI (paraplegia

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or paraparesis), presented as an overall pooled event rate and as pooled event rates for a number of subgroups. The pooled rate of permanent SCI for all patients was 4.5%. It was 3.5% for DTA and 7.6% for TAAA repair. For patients undergoing open repair, the pooled SCI rates for DTA and TAAA were 4.9% and 7.0%, respectively, and for patients undergoing endovascular repair, the pooled rates for these 2 subgroups were 1.6% and 8.8%, respectively. No significant differences were observed in the pooled rates of permanent SCI between open and endovascular repair when stratified by aneurysm extension (DTA and TAAA), or between the studies on patients operated upon after the year 2000 (5%), and the studies that included patients operated upon before the year 2000 (4%). On multivariable meta-regression analysis, only TAAA repair (open/endovascular) was associated with a significantly greater permanent SCI rate.

How useful are these pooled event rates in assessing the true risk of permanent SCI? The significant difference in the prevalence of SCI between patients treated for DTAs and those with TAAAs noted in the present study⁴ and in many others with either open or endovascular repair argues against the use of a pooled occurrence rate for these 2 subgroups. A pooled study containing a large number of patients with DTAs and a small number of TAAAs, for example, would yield a substantially lower pooled SCI rate than a study with a small number of DTAs and a large number of TAAAs. Similarly, given the statistically significant differences in the prevalence of SCI among the 4 Crawford subgroups of TAAAs noted in this and other studies,^{1,4} a pooled rate of SCI for groups of patients undergoing TAAA repair is also of little value in providing an accurate estimate of the true incidence unless the proportions of patients in the 4 or 5 subgroups of the Crawford classification are identical. A pooled rate of a series containing a large number of patients with Crawford extent I or extent IV aneurysms with a very low prevalence of SCI could differ substantially from a series with a large number of patients with Crawford extent II and III aneurysms, which are associated with the greatest incidence of SCI.¹⁻⁴ A similar argument exists for patients with DTA, since the prevalence of SCI differs according to the extent of thoracic aorta replaced.⁵

In the Discussion section of the manuscript, the authors compare the outcomes of several large studies examining the prevalence of SCI after open repair. They quote a permanent pooled SCI rate of 9.6% for the 3309 patients with TAAAs in the study of Coselli and colleagues.¹ They contrast this figure to a 2% pooled rate of SCI reported in the study of Girardi and colleagues⁶ and a 5.5% pooled rate in the study of Murana and colleagues.⁷ The correct

rate of permanent SCI in the Coselli study is 5.4% (confirmed by personal communication with the authors). The study of Girardi involving 783 patients included 246 patients with DTAs (31.4% of the total), and the study of Murana involved only patients with TAAAs. Thus, this is an “apples and oranges” comparison, and its relevance is questionable.

As noted by Coselli and colleagues in their landmark publication in 2016,¹ comparison of open and endovascular repair of TAAAs is complicated by the fact that the Crawford classification of extent of disease does apply perfectly to endovascular repair. For the same extent of disease, a greater length of aorta is excluded with endovascular repair because secure landing zones are required in more normal aorta. This calls into question the validity of directly comparing the pooled rates of SCI and other outcomes between the 2 modes of therapy, a limitation of the present study. Other important limitations are acknowledged by the authors and include the absence of a substantial number of data points in many of the publications examined, which limits the power of some of the secondary analyses. The effect of intercostal/lumbar artery reimplantation on the occurrence of SCI in patients undergoing open repair was not examined, which is another important limitation.

Sufficient data now exist in the published literature to permit meta-analytic and other comparative studies of the important subgroups of patients with descending thoracic and thoracoabdominal aortic disease managed with open or endovascular repair. These studies should provide more meaningful data on the actual risk of SCI for patients undergoing open or endovascular repair of their aortic disease.

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