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Commentary: Thinking, fast and slow—and even slower—about thoracoabdominal aortic aneurysm repair

Faisal H. Cheema, MD,^{a,b,c}
Charles C. Miller III, PhD,^d and
Keshava Rajagopal, MD, PhD^{a,c}

Faisal H. Cheema, MD, Charles C. Miller III, PhD, and
Keshava Rajagopal, MD, PhD

CENTRAL MESSAGE

Deep analysis of surgical data occasionally may confirm intuition and clinical experience, while contradicting typical or standard “intermediate” levels of data analysis.

In the 1970s, Amos Tversky and Daniel Kahneman¹ radically altered our understanding of human reasoning. They showed that reasoning exists along 2 tracks: (1) fast and “intuitive,” also conditioned by experience; (2) slow and “thoughtful.” Although the second track is used for stepwise logical analysis generally, it is particularly vital to probabilistic thinking, because it is counterintuitive. Yet, the validity of probabilistic thinking rests on underlying assumptions. The system being studied must either be indeterministic, or alternatively, particular knowledge gaps in a deterministic system must be present. In the latter instance, values of specific variables are unknown, but a probabilistic distribution of values that these variables may take is known.

Occasionally, deeper second-track analysis may validate the first track over the initial impressions of the second. In this issue of the *Journal*, Gambardella and colleagues² group investigated whether left ventricular systolic dysfunction, as expressed by the left ventricular ejection fraction (LVEF), would relate to survival outcomes following descending thoracic aortic (DTA) and thoracoabdominal aortic aneurysm (TAAA) repair. They identified an inverse relationship between LVEF and post-DTA/TAAA outcomes, with a cutoff LVEF of 40% discriminating between poorer and better outcomes. However, after propensity matching and multivariable analyses, LVEF $\leq 40\%$ was not found to be associated with reduced survival. Of

note, the LVEF $\leq 40\%$ group comprised only 7.9% of patients. The population was disproportionately composed of patients with extent I DTA/TAAA. Coexistent important cardiac valvular and coronary artery disease was addressed pre-DTA/TAAA repair. Mechanical circulatory support and distal arterial perfusion approaches were employed such that only patients with extent II underwent routine left heart bypass and only patients with extent II and III underwent routine distal arterial perfusion. Cardiopulmonary bypass with deep hypothermic circulatory arrest was only rarely employed, but disproportionately so in the LVEF $\leq 40\%$ group. Overall, 63.6% of patients had a “clamp-and-sew” approach employed.

These findings contradict previous work³ demonstrating that low LVEF is associated with poorer outcomes following DTA/TAAA repair, as the authors acknowledge. Moreover, the findings are at odds with what our first track “knows” about other cardiac operations. Survival following coronary artery bypass grafting, aortic valve replacement, and other proximal thoracic aortic operations, mitral valve repair/replacement, and abdominal aortic aneurysm repair, all are inversely related to LVEF. Furthermore, sound physiological causal mechanisms explain those findings. Why should DTA/TAAA be any different?

Finally, although complex statistical tools were employed, concern may be raised as to how they were employed. Propensity matching is often used as a remedy for nonrandomly distributed data in retrospective studies. However, a fundamental assumption of propensity score methods is that the group assignments—almost always in the form of treatment groups—are exchangeable, that is, at least theoretically assignable at random. Fixed characteristics such as LVEF

From the ^aHCA Houston Healthcare, Gulf Coast Division, Houston, Tex; ^bHCA Research Institute, Nashville, Tenn; ^cUniversity of Houston—College of Medicine, Houston, Tex; and ^dDepartment of Cardiothoracic and Vascular Surgery, McGovern Medical School, University of Texas-Houston.

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Address for reprints: Keshava Rajagopal, MD, PhD, HCA Houston Healthcare and the University of Houston College of Medicine, 1200 Binz St, Suite 900, Houston, TX 77004 (E-mail: keshava.rajagopal@uth.tmc.edu).

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are not appropriate targets for propensity score adjustment, largely because score-based alignment of observed characteristics may create distortions in unobserved characteristics—a phenomenon that has been described as “squeezing the balloon”—when group assignment is fixed by nature and cannot be made probabilistically.⁴ These findings are potentially very important, but does our second track tell us that they are novel truths, or outliers that we should disregard? Or even more, is our fast track correct?

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Commentary: Patients with descending and thoracoabdominal aortic aneurysms need expert centers and expert surgeons

Ourania Preventza, MD

In their recent *Journal* article, Gambardella and colleagues¹ at Weill Cornell show that although a low left ventricular ejection fraction (LVEF) indicates an unfavorable preoperative state, it does not predict adverse outcomes in patients undergoing descending and thoracoabdominal aortic surgery, whereas preoperative pulmonary and renal impairment do. Dr Girardi's group at Cornell is well known for its contributions to open repair of descending thoracic (DTA) and thoracoabdominal aortic aneurysm (TAAA), and Dr Gambardella and colleagues must be congratulated for their research efforts and for bringing to our attention this important subject.

From the Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine and Department of Cardiovascular Surgery, Texas Heart Institute, Houston, Tex.

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Address for reprints: Ourania Preventza, MD, Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, BCM 390, One Baylor Plaza, Houston, TX 77030 (E-mail: preventz@bcm.edu).

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Open and endovascular repair of a TAAA.

CENTRAL MESSAGE

Taking care of patients with descending and thoracoabdominal aneurysms requires expertise and judgment regarding open or endovascular procedures or both. Expert centers are needed.

Others, too, have shown that impaired preoperative pulmonary and renal function affects postoperative outcomes in these patients.^{2–5} In patients scheduled for TAAA repair, preoperative echocardiographic assessment combined with continuous medical therapy, percutaneous coronary intervention (PCI), or both can help identify and reduce their risk of postoperative adverse events and facilitate close monitoring. The Weill Cornell group has advocated elegantly that patients with single- or double-vessel coronary artery disease should undergo PCI before elective TAAA repair. Others have shown that impaired LVEF is independently associated with mortality.⁶ However, using LVEF as the sole metric of preoperative left