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

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ADULT

**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 Kahneman[1] 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 colleagues[2] 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 ≤40% was not found to be associated with reduced survival. Of note, the LVEF ≤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 ≤40% group. Overall, 63.6% of patients had a "clamp-and-sew" approach employed.

These findings contradict previous work[3] 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

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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

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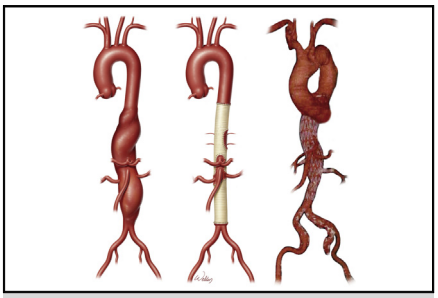

Open and endovascular repair of a TAAA.

**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.

In their recent *Journal* article, Gambardella and colleagues[1] 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.

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

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