

References

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Key Words: thoracoabdominal aortic aneurysm, survival, population-based

Discussion



Dr Marek Ehrlich (Vienna, Austria). Your group from Toronto performed a multicenter, population-based, propensity-scored study across the province of Ontario comparing early and late outcomes of endovascular versus open TAAA repair. Although the 2 groups are relatively small, this article provides further information on the ongoing debate of TEVAR versus open repair. I would like to raise a few questions related to your patients.

First, I didn't find any information on the indication of the disease. Second, 44% of patients in the open group were

operated on an urgent or emergency basis. What was the reason for this? Third, what are the group's evolving strategies to reduce perioperative complications after TAA repair? How have these data influenced the Ontario group's decision on which patients get TEVAR and which open repair?



Dr Maral Ouzounian (*Toronto, Ontario, Canada*). Because this study was based on administrative data and not detailed clinical data, we do not have information on several important variables, including the indication for surgery, size of the aneurysm, Crawford extent, and technical details of

the operation such as whether or not we used circulatory arrest or left heart bypass. Therefore, we can't answer those questions because of the limitations of the data. The proportion of patients who had urgent or emergency operations in the open repair group was in fact 19%, not 44%. It's still a high proportion, higher than most expert series.

In looking for an explanation, when we looked at our own patients at Toronto General Hospital, we found that the average aneurysm size for patients undergoing TAAA repair was 7 cm, so quite a bit larger than the threshold for surgery. We suspect that patients may be getting referred late for evaluation and repair. In the more recent era, we have found greater regionalization of care such that in the last 6 years, 4 hospitals are doing 90% of the open procedures. We believe that this centralization of cases to higher-volume centers may be contributing to the improved outcomes we have observed, but we can't say for certain.

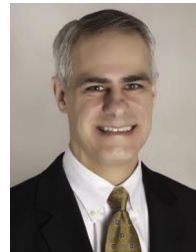
In terms of what we are doing to improve outcomes, at our hospital we have a multidisciplinary team approach to patients with complex aortic disease. We have a multidisciplinary clinic where these patients are seen by cardiac surgery, vascular surgery, and anesthesia teams, and the decision regarding which modality to use is made as a team. We selectively perform preoperative spinal cord embolization when we think it would be helpful, and we use prophylactic spinal drains and left heart bypass liberally in these patients. We also use intraoperative neuromonitoring and rescue therapy with hyperbaric oxygen in the event of spinal cord ischemia. Those are the few steps that we have recently taken.



Dr John Elefteriades (*New Haven, Conn*). Maral, that was a beautiful article. Every question that came to my mind was answered in the next slide. The only major area that I could see that was not analyzed has to do with how often the aneurysm was fully controlled by the endovascular means and how often there may have been major endoleaks. You

may not have access from your administrative database, but could you possibly do that now from a clinical chart and other avenues?

Dr Ouzounian. We were not able to identify exactly what type of secondary procedures were performed in these patients. We are unable to tell from administrative data whether it was for preexisting disease or if disease developed after the index repair. What we did observe was that the endovascular group had more interventions on the aorta—the thoracic aorta, abdominal aorta, and branches. The open repair group seemed to have a more definitive operation, as we would suspect. With our local patients at Toronto General, we are currently analyzing how many have late endoleaks and what the long-term outcomes are in those that do.



Dr Scott A. LeMaire (*Houston, Tex*).

This points out one of the problems with administrative data. Could you comment on your propensity score analysis? In addition to not having data to describe the groups and their outcomes, you also don't have all of the variables you would like to use for

balancing the groups in your propensity score analysis. So, without those data, your groups may not be as well matched as you might hope. What were the challenges with this aspect of the analysis?

Dr Ouzounian. We did an exhaustive PSM based on the variables we had, but the variables we had were limited to mostly baseline demographics, clinical comorbidities, the Charlson index, and those types of things, not on more pertinent issues related to the thoracoabdominal repair. We can't say, for example, what proportion of patients were even eligible for an endovascular repair based on anatomic considerations. We are starting out with a heterogeneous group with significant selection bias.

From the original cohort of 664, we ended up with 241 in each group, and the patients who we lost were mostly younger patients in the open group. We just couldn't match them to the endovascular group; the age distribution was different. We suspect that many of those unmatched patients are those who are younger with connective tissue disorders and chronic dissections who almost exclusively receive open repair.

Dr LeMaire. How did you define the lower-volume centers versus the higher-volume centers, and what is the take-away about volume, at least from the Ontario perspective?

Dr Ouzounian. We found this observation to be interesting. Four centers in Ontario were doing the bulk of the volume in both endovascular and open repair during the study period. The mean volume in the high-volume centers is still not high; for open repairs, it was 17 per year and for endovascular it was 14 to 15 per year. The low-volume centers were doing less than 5 per year. Because of privacy

rules, we aren't able to disclose numbers less than 5; we have to suppress those small cells.

We did find that over time, however, more patients in Ontario are being repaired in high-volume centers. In the recent era, 90% of patients undergoing open repair are being done in high-volume centers. Endovascular repair seems to be distributed widely with 70% of cases being currently done in higher-volume centers.

We also found that the volume effect on mortality was more pronounced in the open group than in the endovascular group. Results were better after endovascular repair in the higher-volume centers, but the difference was really not as pronounced than in patients undergoing open TAAA repair. Centers that were doing a handful of patients, potentially ruptured and too sick to be transferred. Well those patients were essentially nearly all dying.



Dr Malakh Lal Shrestha (*Hannover, Germany*). I have 2 short questions. One would be that in your series I don't see the adverse events normally associated with open surgery like, let's say, bleeding or length of stay in the intensive care unit has been documented, but adverse events and

possible adverse events associated with endovascular group have not been documented, namely, the amount of radiation given to these patients.

The amount of radiation that the patient received, not only in the initial one, but also if you say that because of endoleaks you have to go back in again, you have to document that also, and in the long run the cause of mortality in these patients, whether it was aortic-related problems or malignancy due to the radiation, which has been documented as a possibility.

Dr Ouzounian. We don't have data about endoleaks or radiation dose in the endovascular group. We are looking

at those end points within our own institutional series.

In terms of cause of death, we suspect that these patients have a high burden of atherosclerotic disease. When we looked at long-term adverse events at 10 years, for example, 40% of patients had an MI and 10% of patients had a stroke in follow-up. We suspect that these patients may be dying of atherosclerotic events, including coronary events and strokes, but we don't know for sure.



Dr D. Craig Miller (*Stanford, Calif.*).

You practice in a socialized environment, albeit one without a NICE Committee, so you must know all the costs incurred for both groups of patients. I wonder if anyone has calculated a Canadian dollar per quality-adjusted life year (QALY) quotient on this and

derived an economic ICER. Can the Canadian healthcare system or Canadian society really afford treatment of thoracoabdominal pathology in these patients given their limited life expectancy? As a corollary, what is the Canadian society's "willingness to pay" threshold for medical care today? In the United States, this benchmark has hovered around the annual cost (or cost per QALY) of permanent dialysis therapy, something in the range of \$55,000 to \$70,000/QALY.

Dr Ouzounian. In Canada, we try to take care of every patient in the best way possible. The endovascular repair patients had a custom-made fenestrated or branch graft. These are expensive, about \$60,000 per graft. The open repair cases have a very high cost in the hospital because of the length of stay in the intensive care unit. Our PhD student is actually doing a cost analysis on cost that will be presented at the Society of Vascular Surgeons. Overall, endovascular repair is more expensive in terms of cost in the early phase.