Ruptured Thoracic Aneurysms
To Stent or Not to Stent?

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Recently published long-term outcomes of the UK Endovascular Abdominal Aortic Aneurysm Repair (EVAR) trial investigators and the Dutch Randomized Endovascular Aneurysm Repair group have continued to demonstrate the superiority of EVAR in the perioperative period, but they have failed to establish long-term sustainable durability compared to open repair because of increased graft-related complications and reinterventions. In 2005, thoracic endovascular aneurysm repair (TEVAR) was approved in the United States for the treatment of descending thoracic aortic aneurysms (DTAAs). This approval, based on the results of a phase II trial evaluating the GORE TAG endovascular prosthesis (W.L. Gore and Associates, Newark, Delaware), led to a nationwide explosion in the use of thoracic endovascular techniques for managing DTAAs. Physicians had already been performing EVAR for more than a decade. Whereas EVAR was initially used to repair abdominal aneurysms with a favorable anatomy, its use later expanded to include complex cases involving a short aortic neck, a tortuous aorta, and (more recently) aneurysmal rupture. Although TEVAR has only a brief history, a similar trend is obvious: This approach is being used with reasonable success to treat dissections and even ruptured aneurysms; in addition, various new debranching techniques are allowing TEVAR to be applied to portions of the aorta previously deemed unapproachable.

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Najibi and colleagues reported the results of the first study to compare TEVAR with open aortic repair. Their series comprised 18 patients, and the control group included a historic cohort of patients who had undergone open aortic repair during the previous 3 years. Short-term follow-up data showed that the endovascular group had significantly shorter operative times, shorter hospital and intensive-care–unit stays, and less operative blood loss. Subsequently, Bavaria and associates reported the results of a phase II multicenter trial that assessed GORE TAG thoracic endograft placement (n=140) versus traditional open repair (n=94). The cohort included a group of low-risk patients selected according to stringent inclusion and exclusion criteria. TEVAR was associated with a lower incidence of spinal cord ischemia, respiratory complications, and renal complications. Nationwide midterm data further support the better outcome profile of TEVAR for elective intervention involving isolated DTAAs. In a recent meta-analysis of 42 studies, Cheng and coworkers demonstrated that, compared with open surgery, TEVAR was associated with lower rates of early death, paraplegia, renal insufficiency, transfusion, reoperation for bleeding, cardiac complications, and pneumonia and with a shorter hospital stay. This technique has now been used successfully in the treatment of thoracic aortic injuries.

In addition, TEVAR is associated with better outcomes in older patients with complex comorbidities who are usually considered at high risk for an open procedure. The midterm results after repair of type B aortic dissections with the TALENT thoracic stent graft (Medtronic Inc, Santa Rosa, Calif) confirm that TEVAR reduces morbidity and mortality. Building on the recent success of endovascular approaches for a wide range of aortic pathology, transcatheter wire-based technology has now been extended to treat structural heart conditions such as transmembral aortic valve implantation for aortic stenosis.

The nationwide incidence of thoracic aneurysms is 7 times less frequent than that of abdominal aneurysms, and this ratio remains approximately the same for ruptures. By virtue of differing anatomic constraints, ruptured thoracic aneurysms are less likely than abdominal aneurysms to lend themselves to several therapeutic options. Moreover, unlike abdominal aneurysms, which can be handled well by either general or vascular surgeons, ruptured thoracic aneurysms require thoracic surgical backup, which is less readily available in the community. In combination, these factors contribute to a relatively high mortality (ranging from 25% to 45%) in this subset of patients.

However, with the advent of TEVAR and the prompt availability of an increasing number of surgeons who possess endovascular skills, a new avenue has opened up for handling this complex and emergent surgical problem.

Most of the literature on TEVAR has come from centers that have successful long-standing endovascular aortic programs and thus extensive experience with this technique. Earlier this year, Jonker and colleagues published a meta-analysis of articles published from 1995 to 2009, in which 143 patients undergoing TEVAR were compared with 81 patients undergoing open repair for ruptured DTAAs. Although constrained by the study design, the authors found that TEVAR was associated with a lower 30-day mortality than open repair. The question now is, should TEVAR be consid-
ered as a primary modality for intervention in patients with ruptured DTAAs? In this issue of Circulation, Jonker and associates present a retrospective analysis\(^\text{17}\) that summarizes the outcomes of endovascular repair of ruptured DTAAs at 7 referral centers. A total of 87 patients (mean age, 69.8 years) underwent TEVAR, with an overall procedural success rate of 95.4%. Eighty-five percent of the patients had an endovascular intervention within 24 hours of admission. The common femoral artery was used for vascular access in 89.7% of the patients, and coverage of the left subclavian artery was required for an adequate landing zone in 37.9% of the patients. The overall 30-day mortality was 18.4%. Age, hypovolemic shock, and hemotherax on hospital admission predicted a heightened mortality. Complications included periprocedural stroke (8%), postoperative paraplegia (8%), and permanent paraplegia (2.3%). Cerebrospinal-fluid drainage was instituted in the postoperative period for all patients who developed parapleagia after TEVAR. At 30 days, the incidence of endoleak was 18.4%, type I leakage being the most common form. During the median follow-up period of 13 months, thoracic aortic reintervention was required in 11 patients. At 4 years, the aneurysm-related mortality was estimated to be 25.4%, and freedom from reintervention and aneurysm-related death was 54.9%.

Although TEVAR was the preferred approach in this study, it must be emphasized that the participating centers had a stringent protocol for selecting patients who would benefit from an endovascular approach. This is key to the success of TEVAR, and any center contemplating the use of TEVAR should have such a protocol in place. Patients who have short aneurysmal necks, aneurysms too wide to accommodate commercially available devices, or tortuous/calciﬁed access vessels are considered unsuitable for TEVAR. However, these characteristics can be detected only by obtaining a computed tomographic angiogram preoperatively. Thus, the ability to obtain a computed tomographic angiogram is the most important factor in selecting patients for TEVAR versus open surgical repair, which requires a fully equipped, standby surgical team. Unlike the work-up for abdominal aneurysms, a computed tomographic angiogram in these circumstances necessitates a total evaluation, from the ascending aorta through the iliac vessels, with rapid assessment by the radiologist and the endovascular team to determine TEVAR feasibility. This calls for a strict protocol, with a vigilant emergency department team that ensures adherence to the protocol when a ruptured thoracic aneurysm is suspected. Not only does the availability of hybrid suites influence the physician’s decision to consider TEVAR as a viable option, but also the availability of open surgical back-up in the event of a TEVAR failure should be duly taken into account. Possible transfer to a different center should be considered even before TEVAR is begun in these cases.

The concept of using an endovascular approach to manage an impending or a contained DTAAs rupture is supported by the experience gained in treating abdominal aortic aneurysms.\(^\text{18}\) A multicenter nonrandomized clinical trial of the GORE TAG device for treating thoracic aortic catastrophes (dissections, ruptures, and traumatic tears) showed a combined 30-day death/paraplegia rate of 13.6%; in contrast, a composite literature control group of >800 patients had a combined death/paraplegia rate of 29.6%.\(^\text{19}\) When Patel and coworkers\(^\text{20}\) compared standard open DTAAs repair with TEVAR for treating ruptured thoracic aneurysms, they found that TEVAR resulted in lower morbidity and mortality; moreover, this approach provided equivalent late outcomes even in an older group typically considered at high risk for open repair. Therefore, in isolated centers of excellence, TEVAR has been shown to offer better outcomes than open repair, thus supporting the feasibility of TEVAR for ruptured DTAAs.

As would be expected, urgent TEVAR for ruptured DTAAs is consistently associated with a higher mortality than elective TEVAR.\(^\text{21}\) Yet this has not precluded the use of TEVAR for patients with ruptured aneurysms, as evidenced by reports from multiple centers. This trend reﬂects the commencement of a paradigm shift in the approach to treating this formidable surgical challenge. Although TEVAR is superior to traditional open repair in this setting, the endovascular approach can pose challenges to hospitals from a logistic standpoint. A hybrid suite is preferred, an operating team should be on standby, and emergency department physicians and radiologists should be familiar with the imaging modalities needed. In an era of reduced reimbursement, another challenge involves overhead expenses for hybrid suites and maintaining a broad inventory for an array of expensive devices designed to handle a rare condition. Unlike the open surgical approach, which is centered primarily on the efficiency of the surgical team, TEVAR depends on a cohesive team effort that spans several disciplines. In addition, the surgical team should be prepared to perform debranching procedures, such as carotid-subclavian, carotid-carotid, or celiac artery bypass, which are not commonly done otherwise. After TEVAR, endoleaks may need reintervention, so tomographic imaging is necessary before hospital discharge and during follow-up evaluation. Such imaging poses an additional risk because of the cumulative effects of increased exposure to radiation and nephrotoxic intravenous contrast agents. Reliable data on long-term results are not yet available for elective TEVAR; even fewer data are available on urgent TEVAR for ruptured aneurysms. The results reported by the UK EVAR Trial Investigators and the Dutch Randomized Endovascular Aneurysm Repair Study Group are likely to impact the use of elective EVAR, and the current paradigm shift for elective TEVAR is likely to be similarly inﬂuenced as more pertinent data are available. However, these results should not be extrapolated in their entirety for cases of rupture, where the primary goal is to rescue a patient in extremis.\(^\text{1,2}\)

Although TEVAR involves unique challenges, they are surmountable with appropriate institutional support and multidisciplinary cooperation. Although the current use of TEVAR for ruptured thoracic aneurysms remains off label, the success demonstrated by Jonker and colleagues and by several others establishes a strong foundation that would support the use of TEVAR as the primary modality for treating ruptured DTAAs in the near future.\(^\text{3,14,17,18}\) It is
crucial that major hospitals and emergency departments be equipped with stringent protocols that will allow rapid triage of these patients and expedite the imaging work-up, thereby ensuring better outcomes.

Disclosures

Dr Coselli has served as principal investigator for the TX2 Thoracic Stent Graft trial, sponsored by Cook Inc, for the Valor II and Descending Thoracic Aortic Aneurysm Endovascular Repair Post-approval Study stent graft trials, sponsored by Medtronic Inc, and for the Gore Conformable Descending/Dissection Thoracic Stent Graft trial, sponsored by W.L. Gore and Associates Inc. He has been a consultant for Vascutek Terumo and a consultant and speaker for Medtronic Inc and W.L. Gore and Associates Inc. He has also received an educational grant and royalties for the Coselli Branched Graft for thoracoabdominal aortic aneurysm repairs from Vascutek Terumo. Dr Gopaldas reports no conflicts.

References


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