Long-Term Results From a 12-Year Experience With Endovascular Therapy for Thoracic Aortic Disease

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Background. **Endovascular approaches promise to revolutionize therapy for thoracic aortic disease. This study describes a long-term analysis of endovascular thoracic aortic repair.**

Methods. **Seventy-three patients (mean age, 67.4 years) underwent endovascular thoracic aortic repair from 1993 to 2005. Indications for intervention included aneurysm (38%), dissection (23%), or penetrating ulcer or pseudoaneurysm (34%). Rupture was present in 16 patients (22%). Seventy-one percent were considered high risk for open surgery for reasons of age or comorbid conditions. Treated segments included ascending aorta (n = 1), distal arch (n = 24), and proximal (n = 50) or distal (n = 55) descending aorta. The total descending thoracic aorta was covered in 31 patients. Procedural success was achieved in 96%. Devices were delivered by femoral (79%), retroperitoneal iliac (18%), or carotid (2.7%) exposure. Devices used included Excluder (n = 30), Talent (n = 23), Zenith (n = 3), AneuRx (n = 5), and custom-fabricated (n = 14). Follow-up was 100% complete.**

Results. **Thirty-day mortality was 5.5%. Significant morbidity included stroke (8.2%) and need for dialysis (4.1%). Although 3 patients had transient spinal cord ischemia (4.1%), none had permanent sequelae. Intervention for fusiform aneurysm was independently associated with a composite end point of 30-day mortality, need for dialysis, and stroke ($p = 0.015$). Eight patients (11%) had new or persistent endoleaks, and aortic reintervention was performed in 7 patients (9.6%). Mean survival for the entire cohort was 46.8 ± 5.1 months. Intervention for penetrating ulcer or pseudoaneurysm ($p = 0.045$) was independently associated with long-term all-cause mortality.**

Conclusions. **An endovascular approach produces acceptable results for a broad range of thoracic aortic disease. However, the potential for endoleak or need for reintervention mandates continued close follow-up to achieve satisfactory long-term results.**

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The report by Parodi and colleagues [1] of successful endoluminal abdominal aortic repair (EVAR) in 1991 ushered in the era of minimally invasive approaches for aortic disease. After the seminal report by Dake and associates [2] describing endovascular thoracic aortic repair (TEVAR), several investigators reported early to mid-term results with TEVAR [3–9]. In contrast to EVAR (typically performed for aneurysms), TEVAR has been applied for a variety of pathologic entities including aneurysms, acute aortic syndromes (penetrating ulcers, intramural hematomas, aortic dissections), aortobronchial fistulas, and traumatic aortic disruptions [2–9].

The benefits of TEVAR obviate the significant morbidity and mortality encountered with traditional open surgery [10,11]. Despite the excellent results reported with open repair, there is a perceived lower morbidity with an endovascular approach. Benefits of open repair include the very durable nature of the operation with an extremely low rate for reintervention in the treated aortic segment(s) [10]. In contrast, prior reports of endovascular repair show that there is a significant endoleak rate and need for reintervention [6,8].

This report describes both procedural and late outcomes with an initial 12-year experience with TEVAR. Endovascular thoracic aortic repair in this study was used for a broad spectrum of thoracic aortic disease.

Patients and Methods

Data from all patients undergoing TEVAR at the University of Michigan Hospitals between 1993 and 2005 (n = 73, 60.3% male) were retrospectively analyzed. This study was approved by the Institutional Review Board of the University of Michigan Hospitals (No. 2003–0128; informed consent requirements waived).

Thoracic surgeons experienced in aortic reconstruction performed the initial preoperative evaluation. Suitability

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of the aortic lesion for TEVAR was based on patient comorbidities, characteristics of available devices, anatomic features of the lesion, and quality of access vessels. This assessment was made collaboratively by surgery and interventional radiology. The surgical team (either thoracic or vascular) was primarily responsible for obtaining access and directing postoperative care, whereas device sizing and delivery were done collaboratively by surgeons and radiologists. Sizing for TEVAR was performed using spiral computed tomography with or without three-dimensional reconstruction, intravascular ultrasound, or calibrated angiography. Operative procedures were performed either in the operating room with fluoroscopy or in an angiography suite with fixed imaging equipment. General anesthesia was used in all except 1 patient (with poor pulmonary function), who was treated in the semi-seated position using local anesthesia. Percutaneous access to obtain necessary angiograms was obtained through either the brachial or contralateral femoral artery. Patients were administered systemic heparin to maintain activated clotting times greater than 250 seconds. The activated clotting time was checked at 30-minute intervals, and heparin was readministered as guided by the activated clotting time. The access vessel was isolated for device delivery. Device positioning and deployment were guided by angiographic landmarks or intravascular ultrasound. Completion aortography was performed, and all type I or type III endoleaks were treated when identified. All catheters were then withdrawn. The access vessel was then repaired, and protamine was administered to reverse the anticoagulation.

Postoperative management for prevention of spinal cord ischemia was conducted according to standardized protocols described as follows. Lumbar drainage was used selectively at the discretion of the operating surgeon in 10 patients (13.5%), and all lumbar drains were placed just after induction of anesthesia. No significant complications identified were directly attributed to lumbar drain placement. All patients were managed with mild permissive hypertension postoperatively to keep spinal perfusion pressures at 80 mm Hg or higher (if a lumbar drain was placed), or a mean arterial pressure of 90 to 100 mm Hg (if no lumbar drain was present). Duration of lumbar drainage was generally 24 to 36 hours. At that time, if no neurologic sequelae had occurred and the patient was hemodynamically stable, the drain was capped for an additional 6 to 8 hours before removal.

Data were collected from clinic visit notes, hospital charts, imaging studies, and interrogation of the National Death Index. Follow-up was 100% complete as of February 2006. The median length of follow-up was 22.5 months (mean, 30.2 ± 29.6 months).

Statistical Analysis

Early outcomes included 30-day or in-hospital mortality, stroke, permanent renal failure, and permanent paralysis or paresis. Late outcomes included presence of new or persistent endoleak, need for aortic reintervention, and vital status.

Table 1. Preoperative Demographics and Comorbidities

Age (y)	67.4 ± 16.8
Diabetes	8 (10.9%)
Coronary artery disease	31 (42.5%)
Prior coronary artery revascularization	14 (19.2%)
COPD	21 (28.7%)
Hypertension	46 (63.0%)
Peripheral vascular disease	15 (20.6%)
Concomitant aortic disease	25 (34.2%)
Previous AAA repair	13 (17.8%)
Patients with preoperative Cr ≥ 1.5	12 (16.5%)
Aortic disease or indication for intervention	
Mean maximum aortic diameter (cm)	5.6 ± 1.8
Fusiform aneurysm	31 (43.1%)
Penetrating ulcer or pseudoaneurysm	25 (33.8%)
Acute dissection	11 (15.1%)
Chronic dissection	6 (8.2%)
Traumatic aortic injury	7 (9.6%)
Aortobronchial fistula	6 (8.2%)
Mycotic aneurysm	6 (8.2%)
Other[a]	3 (4.1%)

[a] Includes congenital coarctation (n = 1), shaggy aortic syndrome (n = 1), and periaortic neoplasm causing compression (n = 1).

AAA = abdominal aortic aneurysm; COPD = chronic obstructive pulmonary disease.

Data were analyzed using SAS V8.2 (SAS, Cary, NC). Dichotomous variables were evaluated using χ^2 analysis; continuous variables using one-way analysis of variance. Multivariate models (logistic regression for dichotomous variables and linear regression for continuous variables) were constructed using a forward selection process to identify factors that were independently associated with each of the outcomes of interest. Survival analysis and freedom from reintervention were analyzed by life table methods. All results with probability less than 0.05 were considered statistically significant.

Results

Preoperative demographics, comorbidities, and indications for intervention are listed in Table 1. Reasons for proceeding with TEVAR versus open repair included the following. The most frequent reason was the consideration by an experienced thoracic aortic surgeon that the patient was high risk for open surgery (52 patients, 71.2%) on the basis of age of 80 years or older (n = 18, 24.7%) or significant comorbid conditions (n = 51, 69.9%; Table 2). "Anatomic" reasons, such as presentation with a saccular aneurysm or short-segment fusiform aneurysm, that appeared quite feasible with an endovascular approach were present in 22 patients (30.1%). Finally, patient preference for TEVAR was a reason in 18 patients (24.7%).

Procedural Details

The status of the operation was elective in 39 patients (53.4%), and urgent (intervention needed during hospi-

Table 2. Significant Comorbid Conditions Precluding Open Surgical Repair[a]

Comorbid Condition	Frequency (n)
Nonreconstructable CAD, CHF, or MI with reduced EF	8 (10.9%)
Severe COPD, restrictive lung disease, or active pneumonia	23 (31.5%)
Stroke with neurologic deficit	3 (4.1%)
Cirrhosis or portal hypertension	3 (4.1%)
Multisystem trauma with severe associated injuries precluding open repair	7 (9.6%)
Renal failure or hemodialysis	3 (4.1%)
Coexisting malignancy	5 (6.8%)
Poor functional status	12 (16.4%)
Other[b]	2 (2.7%)

[a] May occur more than once in a patient. [b] Includes severe idiopathic thrombocytopenia (n = 1) and aplastic anemia (n = 1).

CAD = coronary artery disease; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; EF = ejection fraction; MI = myocardial infarction.

talization) or emergent (intervention needed during the first 48 hours of presentation) in 34 patients (46.6%). Rupture was present in 16 patients (22%). Procedural success, defined as the implantation of a patent endovascular prosthesis without type I or type III endoleaks, was achieved in 95.9%. In 2 patients, the device could not be negotiated up the abdominal aorta. In the third, the custom-fabricated device did not deploy correctly distal to the intended proximal landing zone, but was partially recaptured and manipulated distally without aneurysm exclusion. Device delivery was accomplished through a transfemoral route in 58 patients (79.5%). Retroperitoneal iliac exposure was required in 13 patients (17.9%), 4 of whom initially had a transfemoral attempt. Finally, carotid exposure was used in 2 patients. One of these patients presented with significant hemoptysis from an aortobronchial fistula, and had poor-quality access vessels precluding delivery through an infradiaphragmatic approach. The other patient required ascending aortic coverage for a mycotic aneurysm presenting with an aortocutaneous fistula.

Details regarding both TEVAR and additional procedures performed at the time of intervention are listed in Table 3. Extension of the proximal landing zone by either partial or complete left subclavian arterial coverage was required in 16 patients (21.9%). Three patients had prior left carotid to left subclavian artery bypass grafting, whereas 2 patients had postoperative procedures for arm ischemia from subclavian coverage (1 requiring bypass in the seventh postoperative month, and 1 treated with a subclavian artery stent hours after TEVAR).

Postoperative Morbidity and Mortality

Median length of stay was 8 days (range, 1 to 72 days). The median intensive care unit stay was 0.5 days (range, 0 to 49 days). Additional in-hospital procedures were required in 8 patients (10.9%; Table 4).

Thirty-day or in-hospital mortality was observed in 4 patients (5.5%; Table 5), with causes described as follows. One patient sustained an iliac artery rupture in the angiography suite and expired in the operating room during attempted repair of the injury. Another patient, treated for an acute type B intramural hematoma with a focal ulcerative lesion with short-segment coverage, died 2 hours after the procedure of an intrathoracic rupture. A third patient, who presented with massive hemoptysis from an aortobronchial fistula, expired from severe refractory hypoxemia despite attempts to occlude the left pulmonary artery with a balloon. Finally, the fourth patient sustained a ruptured abdominal aneurysm on postoperative day 4 and was successfully repaired, but sustained an anoxic brain injury and had care withdrawn.

Stroke was observed in 6 patients (8.2%). It was noted on emergence from anesthesia in 3 patients, whereas a fourth presented 6 hours after intervention. A fifth patient with a preexisting history of multiple strokes with hemiparesis sustained a further persistent decrease in movement on the ipsilateral side after a respiratory arrest

Table 3. Endograft Procedural Details

Treated aortic segments[a]	
Ascending	1 (1.4%)
Arch	24 (32.9%)
Proximal descending	50 (67.6%)
Distal descending	55 (74.3%)
Total descending aortic coverage	31 (40%)
Additional procedures at device implantation[a]	
Ipsilateral iliac transluminal angioplasty	9 (12.2%)
Ipsilateral ileofemoral bypass	4 (5.4%)
Celiac axis stent	2 (2.7%)
Celiac axis coiling	1 (1.4%)
Left subclavian artery coiling	2 (2.7%)
Superior mesenteric artery stent	1 (1.4%)
Mesenteric bypass	1 (1.4%)
Number of patients needing additional procedures at device implantation	19 (26%)
Endografts used	
Median number of endografts (range)	2 (0–7)
Custom-fabricated	14
Excluder	30
Talent	23
Zenith	3
AneuRx	5
Proximal landing zone[b]	
0	0 (0%)
1	0 (0%)
2	13 (17.8%)
3	28 (38.4%)
4	31 (42.5%)

[a] May occur more than once per patient. [b] Defined as follows: zone 0, proximal to innominate artery (including its os); zone 1, from innominate artery to and including left carotid artery; zone 2, from left carotid artery up to and including left subclavian artery; zone 3, within 2 cm of left subclavian artery; zone 4, more than 2 cm distal to left subclavian artery.

Table 4. Additional Procedures Required During Initial Hospitalization

Procedure	Frequency (n)
Access-related procedures	
Brachial artery repair	1
Iliac artery repair	1
Femoral embolectomy and patch femoral angioplasty	2
Device-related procedures	
Type III endoleak requiring repeat endograft	1
Subclavian artery stent for arm ischemia	1
Z-stent for proximal endograft collapse	1
Other procedures	
AAA repair (for rupture)	1

AAA = abdominal aortic aneurysm.

and was classified as a postoperative stroke. Finally, the sixth patient sustained an anoxic brain injury after a ruptured infrarenal abdominal aneurysm. On univariate analysis, the presence of acute dissection and a prior history of coronary artery intervention correlated with postoperative cerebrovascular accident (all $p < 0.05$). No patient with subclavian arterial coverage sustained a stroke after TEVAR.

Permanent spinal cord ischemia was not observed in any patient. In contrast, cord ischemia causing temporary paralysis was diagnosed in 3 patients, all within 48 hours of the intervention. A lumbar drain was inserted in all 3 with immediate complete resolution in 2 patients. The third patient had total return of lower extremity function by discharge, and resolution of bowel and bladder dysfunction by the first postoperative visit. A preoperative history of peripheral vascular disease, total number of stent grafts used, and type of additional in-hospital procedure were all univariate correlates of temporary paralysis (all $p < 0.05$). Although all 3 patients who had transient paralysis had the entire descending thoracic aorta covered, the need for total descending thoracic aortic coverage only approached statistical significance ($p = 0.06$), likely owing to small sample size. In contrast to other reports, a previous history of abdominal aortic aneurysm repair (13 patients) did not correlate with the occurrence of spinal cord ischemia ($p = 0.41$) [8].

Postoperative dialysis was required in 3 patients (4.1%). New-onset renal failure (defined as a rise in postoperative creatinine at any time to ≥2.0 mg/dL) was identified in 9 patients (12.3%). The mean preoperative and discharge creatinine levels were 1.4 ± 1.8 mg/dL and 1.3 ± 1.1 mg/dL, respectively. By univariate analysis, a prior history of peripheral vascular occlusive disease or other concomitant aneurysms, presentation with a rupture, type of stent graft used, need for aortic coverage into the visceral segment, and type of additional in-hospital procedure all correlated with the need for postoperative dialysis (all $p < 0.05$).

A composite end point of postoperative mortality, stroke, or need for hemodialysis was constructed. By univariate analysis, reoperation for access-related bleeding complications or the occurrence of a new endoleak, rupture, or dissection in treated or adjacent aortic segments correlated with the composite end point (all $p < 0.05$). A multivariate analysis of age, date of initial intervention, preoperative comorbidities, and aortic disease demonstrated that only a diagnosis of fusiform aneurysm independently predicted the composite end point (odds ratio, 24.0; $p = 0.015$).

Long-Term Results

Overall survival for the entire cohort was 59.4%. By life table analysis, mean survival was 46.8 ± 5.1 months (Fig 1; median survival, 4.2 years). Univariate analysis demonstrated the type of endograft used (custom-fabricated versus commercially available), the aortic pathologic indication for intervention, and the occurrence of postoperative renal failure were all correlated with long-term mortality (all $p < 0.05$). By multivariate analysis of factors including age, date of initial intervention, preoperative comorbidities, and aortic disease, only intervention for either penetrating ulcer or pseudoaneurysm independently predicted a lower long-term risk for mortality (odds ratio, 0.072; $p = 0.045$).

A graphic illustration for the eventual outcome of the initial TEVAR is shown in Figure 2. Details regarding secondary outcomes are listed in Table 6. Endoleaks were identified in 15 patients (20.3%). Of these, new or persistent endoleaks occurred in 8 patients (11%). Eight patients (10.8%) presented with recurrent aortic disease (eg, new rupture or dissection) in either previously treated or adjacent thoracic aortic segments. Follow-up interventions (either open or endovascular) were performed in 7 patients (9.5%; Table 6). The primary success rate of TEVAR is shown in Figure 3. Finally, aneurysm-related mortality or the need for later open repair occurred in 5 patients (6.8%). This primary assisted success rate is depicted in Figure 4. No correlation between a new or persistent endoleak, primary, or assisted primary endograft success rate with either the type of aortic disease, proximal landing zone location, largest stent-graft diameter, or type of implanted endograft was identified by multivariable analysis.

Table 5. Univariate Correlates With 30-Day Mortality

Variable	*p* Value
Tobacco use	0.028
Prior left carotid to subclavian bypass	0.03
Coexisting aortic aneurysm	0.0018
Presence of rupture	0.0083
Acute dissection	0.045
Left subclavian artery coverage	0.008
Postoperative reintubation	0.013
Reoperation for access site bleeding	<0.0001
Need for additional in-hospital procedures	0.01
New aortic event in treated or adjacent aortic segment	0.011

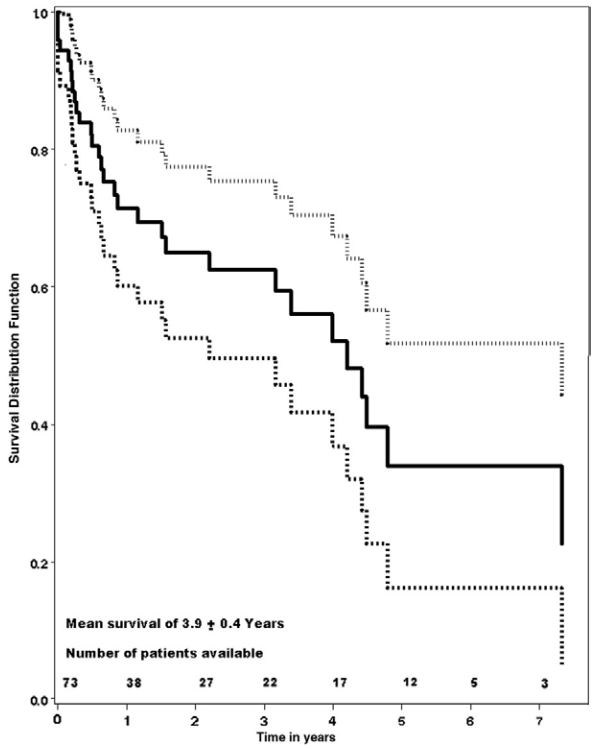

Fig 1. Long-term survival after endovascular thoracic aortic repair. All-cause mortality for the entire cohort was 40.5%. Five-year survival by life table analysis is 35%, likely reflecting the high-risk status of the study group. The solid line represents the survival curve and the dashed lines are the 95% confidence limits.

Comment

Patients with descending thoracic aortic disease often either present at an advanced age or have significant associated comorbid conditions that make successful open repair a challenge. The introduction of an endoluminal approach to treat descending thoracic aortic disease represents a significant advance in the care of these patients.

Our initial 12-year experience described here demonstrates that satisfactory perioperative results can be achieved with TEVAR for a wide variety of pathologic entities. In this "learning curve" series, 71% of patients were considered high risk for conventional open approaches after evaluation by thoracic surgeons experienced in thoracic aortic reconstruction. In addition, 29% presented either with rupture or with pathologic entities (aortobronchial fistulas, mycotic aneurysms, acute dissection) traditionally considered high-risk operative procedures.

Prior reports have also documented the safety and feasibility of TEVAR in both low-risk and high-risk settings [2–9]. The multicenter phase II trial of the Gore TAG endoprosthesis (performed in acceptable surgical candidates) documented a mortality rate of 1.5% along with a 7% incidence of neurologic events (4% stroke, 3% transient or permanent paralysis) [4]. Similar results have been demonstrated in institutional series, as well as the combined EUROSTAR/United Kingdom Thoracic Registries [5–9].

Despite improving results, adverse neurologic events after either open or endovascular thoracic aortic repair remain the focus of continued concern [2–11]. Reported outcomes of TEVAR focus on the proposed decrease in postoperative paralysis [2–5]. Although this approach likely minimizes hemodynamic instability, the need to cover more thoracic aorta (for landing zone fixation) as well as the inability to reimplant critical intercostal vessels may limit the benefit of TEVAR with regard to spinal cord ischemia. Endovascular thoracic aortic repair also introduces new challenges with respect to the postoperative complication of stroke, a relatively underemphasized complication of endovascular therapy. Device delivery in TEVAR mandates manipulation of large-bore sheaths and stiff guidewires through heavily diseased segments of both arch and descending aorta, thereby increasing the risk for atheroembolism. In this study, three of the six strokes were diagnosed at emergence from anesthesia, suggesting that a frequent cause of this complication is atheroembolism during device deployment. Improvements in device design or delivery mechanisms, such as hydrophilic sheaths with precurved shapes (similar to the arch contour), may decrease this complication.

Although early success of TEVAR has been demonstrated, the question of durability remains unanswered. Traditional open repair is exceedingly secure, with a low failure rate in treated aortic segments [10]. In contrast, post-TEVAR endoleak can predispose treated patients to aneurysm-related mortality [8]. Both abdominal and thoracic aortic endovascular repair have an overall endoleak rate of 10% to 25%, which may be device-specific [2–9,

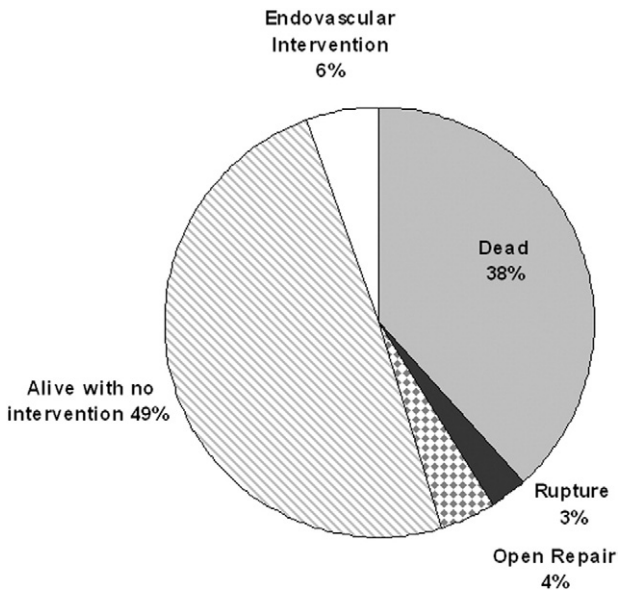

Fig 2. Eventual outcome after initial endovascular thoracic aortic repair. In this cohort, in which approximately 75% were considered high risk for open surgery, almost 50% of patients are alive without reintervention at last follow-up.

Table 6. Secondary Events During Long-Term Follow-up

Patient	Disease	Event	Outcome
1	Penetrating ulcer	Proximal type I endoleak at 1 month	Open repair
10	Aortocutaneous fistula	Hemoptysis, new distal site pseudoaneurysm at 4 years	Left against medical advice, died next day
20	Aneurysm	Small type I or II endoleak	Persistent at predischarge CT scan—no further imaging
22	Aortobronchial fistula	Graft reinfection at 4 years	Open repair
32	Mycotic aneurysm	Small type I or II endoleak	Persistent at predischarge CT scan—no further imaging
36	Penetrating ulcer with intramural hematoma	Descending thoracic aortic rupture POD 1	Dead of rupture
37	Postcoarctation repair pseudoaneurysm	1) Type III endoleak 2) Persistent left arm ischemia for 7 months	1) Repeat endograft same admission 2) At 7 months: left carotid to subclavian bypass
43	Penetrating ulcer with intramural hematoma	Pseudoaneurysm at distal landing zone	Redo endograft at 13 months, then open repair after 3 months for recurrent problem
44	Saccular aneurysm	Type 1 endoleak in region of high curvature of arch at 8 months	Repeat endograft, then recurrent type I endoleak—refused further therapy
46	Aneurysm	Type I endoleak at 1.5 years	Repeat endograft
58	Penetrating ulcer with intramural hematoma	Pseudoaneurysm at proximal landing zone	Refused further treatment—continued aortic dilation
66	Chronic dissection	Persistent type I or II endoleak on 1 month CT	Observation—stable aorta and decrease in leak
68	Coarctation, chronic dissection in postcoarctation aneurysm	Type II endoleak (large collateral) on 1 month CT	Observation and decreasing sac size, endoleak

CT = computed tomography; POD = postoperative day.

12]. However, endoleaks after TEVAR are frequently the more virulent type I (proximal or distal attachment zone) or type III (junctional) varieties [8]. In contrast, post-EVAR endoleaks are more often type II endoleaks (backflow from aortic side branches), which may portend a better prognosis [8,14]. If needed, however, additional procedures to treat endoleaks can also be performed with an endoluminal strategy (Fig 3 versus Fig 4).

Aortic disease may also determine TEVAR durability [5]. Dilatation of the proximal neck after open infrarenal aortic aneurysmectomy has been demonstrated previously [13]. This occurrence may vary in thoracic aortic aneurysmal disease depending on the initial disease. A neck in fusiform aneurysmal disease may behave differently than that in aortic dissection, or traumatic injury. The large EUROSTAR/United Kingdom registry has demonstrated differences in outcomes according to the aortic disease [5]. In our study, we failed to identify a correlation between aortic disease and the success rate of the initial endograft procedure, likely because of the sample size. However, we have noted late adjacent aortic problems in all 4 patients who underwent attempts at stent graft placement to cover only a penetrating ulcer when the ulcer was associated with intramural hematoma. Three of these patients presented within a year with pseudoaneurysm formation at the landing zone(s), and the fourth ruptured the descending thoracic aorta on

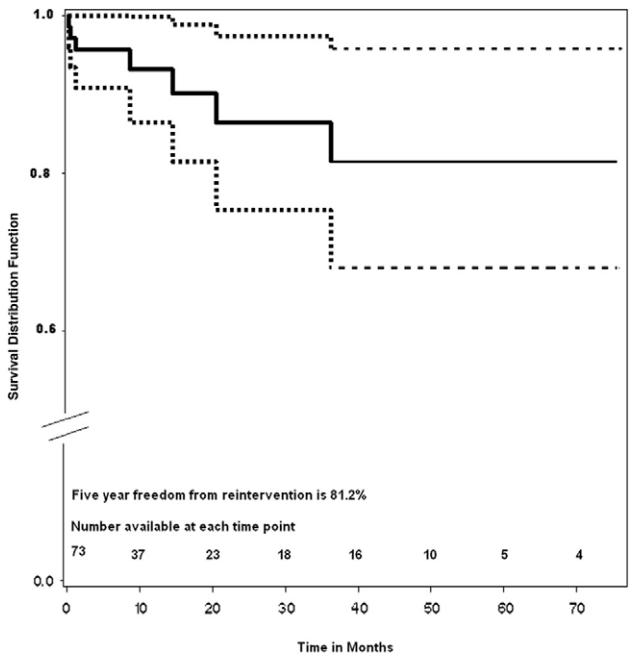

Fig 3. Life table analysis of freedom from aortic reintervention. Freedom from aortic reintervention was 81.2% at 5 years, with the mean time to reintervention of 31.6 ± 1.8 months. The solid line represents the survival curve and the dashed lines are the 95% confidence limits.

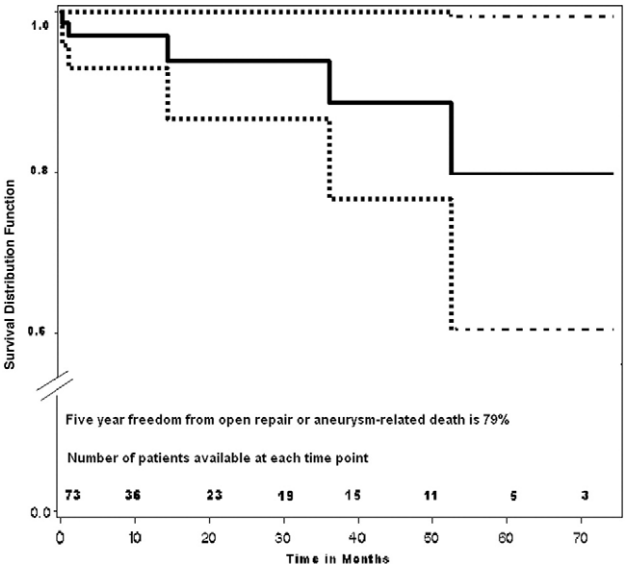

Fig 4. Life table analysis of freedom from open surgery or aneurysm-related mortality. Freedom from open surgery or aneurysm-related death was 79% at 5 years, with a mean time to occurrence of the event of 48.1 ± 2.3 months. The solid line represents the survival curve and the dashed lines are the 95% confidence limits.

the night of the operation. These results underscore the absolute necessity to fixate the device in healthy aorta both proximally and distally to avoid long-term failure of TEVAR.

The acceptable periprocedural and long-term success rates demonstrated here suggest that the primary mode of therapy in the high-risk patient should be an endovascular approach. Since the approval by the US Food and Drug Administration of the first thoracic endograft, our current approach for the patient with descending thoracic aortic disease is to offer either an open or endovascular repair to those both anatomically and physiologically suitable for both types of therapy. For those patients with a good life expectancy (eg, 50 to 70 years with minimal comorbid conditions), our preference, however, is an open approach, given its demonstrated long-term durability. For those patients with suspected limited life expectancy (eg, age older than 70 years or significant comorbid conditions making open repair a higher risk), our preference is an endovascular approach, given its relatively lower morbidity and mortality.

In conclusion, this report demonstrates that an endovascular approach can be performed with acceptable early morbidity and mortality for a broad spectrum of thoracic aortic disease. However, the development of a new or persistent endoleak, or recurrent disease in either treated or adjacent aortic segments in the long-term, mandates continued close follow-up to prevent thoracic aortic aneurysm-related mortality. Finally, this series describing outcomes from an initial endovascular approach presents an encouraging picture of the potential for this new technology.

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