Review Article

Thoracic Endovascular Aortic Repair: A Local Single Institution Experience

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Abstract

Introduction: The purpose of this retrospective study was to evaluate the short- to mid-term results of the endovascular repair of thoracic aortic disease and to present an overview of our experience with thoracic endovascular aortic repair (TEVAR) in our institution. Materials and Methods: A retrospective review of all patients who were treated and underwent TEVAR in our institution between August 2004 and November 2009 was conducted. Results: Technical success was achieved in 100% of the patients and the 30-day mortality rate was 0%. Perioperative endoleak was visualised at the end of the procedure in 4 patients. Secondary endoleak was observed in 2 patients. Mean hospital length of stay post-TEVAR was 15.4 days. Postoperative major complications were observed in 4 patients. The 30-day mortality rate was 0%, with 2 mortalities (11.1%) during the follow-up period. Conclusion: This study adds to the growing body of literature that support TEVAR as an effective procedure in the management of thoracic aortic diseases and reflects its feasibility in our population. Further technical advancement in stent grafts, careful selection of patients and standardised peri-procedural care would contribute to further improvements in clinical outcomes.

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Key words: Endovascular, Stent graft, TEVAR, Thoracic aneurysm, Thoracic dissection

Introduction

Diseases involving the thoracic aorta are often associated with high mortality due to the thoracic aorta's propensity to rupture. They include aneurysms, dissections, traumatic pseudoaneurysms, intramural haematomas and penetrating atherosclerotic ulcers. Traditional management comprises optimising medical therapy, in particular, the control of hypertension in conjunction with surgical repair. However, even with remarkable technical advances and improved prosthetic grafts, the surgical mortality rate is 5% to 15% under elective conditions in experienced centers, and the mortality rate under emergency conditions is even more dismal, with a mortality rate in excess of 50%.[1-4] The high mortality rate is, in part, due to the population affected, who are usually elderly and often have poor premorbid function, which makes them poor surgical candidates, if at all suitable.[5-7] Thoracic endovascular aortic repair (TEVAR) is an endovascular technique that offers an attractive and promising alternative to open surgical repair, particularly in this subset of patient group.

TEVAR is a minimally invasive and safe treatment for descending thoracic disease that was first described in 1994 when Dake et al[8] reported in a prospective study where they successfully placed stent graft systems via the femoral artery to repair descending thoracic aortic aneurysms. Since then, several stent graft systems have been commercially available for use in thoracic aortic disease as an alternative to open surgery.

While there is abundant literature detailing TEVAR, studies detailing TEVAR in the Singapore population remains sparse. The purpose of this retrospective study was to evaluate the short- to mid-term results of the endovascular repair of thoracic aortic disease and to present an overview of our experience with TEVAR in the treatment of thoracic aortic lesions in our institution.

Materials and Methods

A retrospective review of all patients who were treated and underwent TEVAR in our institution between August 2004 and November 2009 was conducted. These patients satisfied

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the anatomical criteria for TEVAR and were offered surgery as an alternative management option. Medical records and radiographic imaging information were reviewed to determine the indications, demographic and comorbid information, procedural techniques, complications and outcomes. Long-term follow-ups were carried out by outpatient clinical review and radiographic imaging with a mean follow-up period of 1 to 56 months.

Patient selection was based on consensus by a vascular surgeon and an interventional radiologist for both elective and emergency cases. Diagnosis and planning for endovascular repair were made on the basis of computed tomographic (CT) imaging. Ten patients received Talent Thoracic stent graft (Medtronics, Minneapolis, MN), 2 patients received Gore Tag device (W. L. Gore & Associates, Inc., Newark, DE), 1 received Cook Thoracic device (TX2, Cook Inc., Bloomington, IN) and 5 received Valiant Thoracic stent graft (Medtronics, Minneapolis, MN).

Technical success is defined as successful deployment of stent graft without the need for surgical intervention. Major TEVAR-related complications, in particular, endoleaks and deaths, were documented.

Results

Within the study period, a total of 19 patients underwent TEVAR. In one patient, there was insufficient clinical data and was thus excluded from the study. Patient demographics and related comorbid medical illnesses of this study group are outlined in Table 1. Of the remaining 18, there were degenerative/artherosclerotic aneurysm (n = 10), type B dissection (n = 2), traumatic pseudoaneurysm (n = 2), surgical stent-graft with type III endoleak (n = 1), symptomatic penetrating ulcer (n = 1). The mean age of the patients was 64.3 years (range, 24 to 88 years), with 14 men and 4 women. While the exact choice of the device was decided by the individual operator during the planning stage, in our experience, there were no device/brand specific technical issues or difficulties.

Technical success was achieved in 100% of the patients and the 30-day mortality rate was 0%. The left subclavian artery was covered in 8 patients (44.4%). There was one case of cerebrovascular event where the patient had a subacute anterior circulation infarct 6 weeks post-TEVAR. There was no incidence of upper limb ischaemia or posterior circulation insufficiency. No prophylactic or therapeutic spinal drainage was performed, and there was no paraparesis or paraplegia due to ischaemia of the spinal cord.

Perioperative endoleak was visualised at the end of the procedure in 4 patients (Table 2). They were all type I endoleaks. Three of them sealed spontaneously during follow-up. The fourth patient had a previous TEVAR and had presented with acute type III endoleak. Although endovascular stent was successfully deployed, there was persistent leak at the proximal stent-graft margin, albeit a quantitatively much smaller leak. The patient was stable and well enough to be discharged 11 days post-TEVAR. No adjunctive endovascular treatment was needed in these 4 patients.

Secondary endoleak was observed in 2 patients, which were detected during routine surveillance (Table 2). There was one case of type II and type III endoleak each. These 2 patients did not receive any treatment and were still under follow-up at the time of writing. There were no patients with type IV endoleak.

The mean hospital length of stay post-TEVAR was 15.4 days, ranging from 3 to 103 days. Postoperative major complications were observed in 4 patients (22.2%, Table 3). One patient developed pleural effusions which was self-limiting and managed conservatively; another developed a groin haematoma and an arterial embolus in the contralateral limb that needed surgical intervention.

There were 2 patients who presented with haemothorax that underwent emergency TEVAR. Although the leak was arrested in these 2 patients, one suffered cardiopulmonary

Table 1. Patient's Demographics and Pre-existing Medical Conditions

Demographics	No.	Percentage
Male	14	77.8%
Female	4	22.2%
Singaporeans/PRs	17	94.4%
Overseas	1	5.6%
Medical conditions		
Ischaemic heart disease	3	16.7%
Renal impairment	1	5.6%
Hypertension	12	66.7%
Diabetes	1	5.6%
Chronic pulmonary disease	1	5.6%
Cerebrovascular disease	2	11.1%
Peripheral vascular disease	1	5.6%
SLE	1	5.6%
AAA	1	5.6%
TAA	1	5.6%

AAA: abdominal aortic aneurysm; SLE: systemic lupus erythematosus; TAA: thoracic aortic aneurysm

Table 2. Type of Endoleaks

Types	Early	Late
Type I	4	0
Type II	0	1
Type III	0	1
Type IV	0	0

Table 3. Postoperative Major Complications

Major Complications	No.	Percentage
Mortality	0	0%
Cardiac arrest	1	5.6%
Stroke	1	5.6%
Paraplegia	0	0%
Access site haematoma	1	5.6%
Peripheral vascular thromboembolism	1	5.6%
Haemothorax	2	11.1%
Pneumonia	2	11.1%
Pleural effusion	1	11.1%
Empyema	1	5.6%

arrest with pulseless electrical activity. The patient was resuscitated and stablised, but the hospitalisation stay was further complicated by pneumonia.

The other patient with haemothorax developed pneumonia and empyema, which were managed with antiobiotics and bilateral chest drains. His hospitalisation was further complicated by a cerebrovascular event. This patient had the longest length of stay of 103 days within the study group.

The 30 mortality rate was 0%, with 2 mortalities (11.1%) during the follow-up period. Mortality in these 2 patients were not directly related to the TEVAR procedure. One patient re-presented with respiratory failure which was managed palliatively, in view of his/her poor premorbid state. The other patient re-presented with empyema, which did not repond to therapy.

Discussion

The use of endovascular stent grafts in the treatment of thoracic aortic diseases is a promising alternative to open surgical repair. Endovascular techniques were first used in abdominal aortic aneurysms,[9] and have stimulated investigation into the feasibility of endovascular repair of the thoracic aorta. Since then, multiple authors have reported a relatively low risk of death and perioperative complications.[2,10-15] Findings from our experience confirm that TEVAR is a feasible option in our population.

There is successful deployment of stent graft in all the patients within our study group, with 4 cases (22.2%) of early perioperative endoleak. These rates compare well with published data of a range between 16.7% and 30.0%.[2,13-16] There is no peri-procedural mortality and no patients required conversion to open surgery. These findings, while encouraging, may be biased due to our small study cohort.

There have been questions raised about the durability of early thoracic-aortic stent grafts over longer periods of follow-up, with Demers et al[13] reporting actuarial freedom from treatment failure of 67%, 56% and 39% at 1, 5 and 8 years, respectively. However, findings from our data have been promising. Patency of these stent grafts is reflected by the endoleak rate of 11.1% over a longer period of follow-up, with the study group being followed-up for an average of 22 months.This compares favourably with a recent large prospective study involving 457 patients by Fattori et al[14] where they reported endoleak rates of 8.5% over an average of 24 months. A recent Japanese paper also reported a similar endoleak rate of 11%, following up 94 patients over an average period of 43 months.[17] However, durability of the stent grafts over the lifetime of the patient still remains unanswered and the need for lifetime imaging surveillance in these patients remains an economic and logistic issue.

Due to the retrospective nature of the study, there is large variation in the follow-up length with a standard deviation of 19 months within the group. This is further accentuated by the heterogeneity of the Singapore population, where temporary residents (e.g. domestic helpers) make up a sizable proportion. Surveillance in this subgroup of patients (1 in our series) is a significant issue, as repatriation to home country following successful treatment is fraught with attendant surveillance challenge and perhaps, may be considered a relative contraindication to TEVAR.

Paraplegia from spinal ischaemia is one of the well-described and most serious complication of TEVAR, with most studies reporting incidence rates ranging from 0% to 3%.[2,13–16] It is not known which effect of TEVAR results in paraplegia, but Dialetto et al[16] have suggested that the coverage of intercostal arteries, embolic events, blood loss, or insufficient collateral circulation may be related to it. There are good evidence in the use of lumbar spinal drains on the thoracoabdominal aorta in surgery,[4,18,19] with the available literature supporting the use in TEVAR especially in selective high-risk patients.[20,21] We did not observe any case of paraplegia nor was there prophylactic use of spinal drain in our study, but our findings are again limited by the small sample size and lack of standardised protocol for spinal drainage during the study period.

There is no case of procedure-related mortality within our study group, with the 2 deaths observed not directly related to the procedure. However, due to the retrospective nature of this study, assessment of patients' well-being and longer term morbidity is limited. This is one of the limitations of our study, and can be overcome by performing a prospective study for future case series.

It is likely that the outcome of TEVAR depends on the different permutations of aortic disease. There are also several articles in the literature discussing the ecnomics and cost benefits of TEVAR over open surgical repair with mixed conclusions.[22-24] The high cost of the endovascular

stent, the need for life long survellience and the potential for future restenting do raise questions on the overall economics of TEVAR. However, the wide range of pathologies and the variety of patient's premorbid state, along with the limitation of a small study cohort preclude such assessments in our series.

Hence, even with the tremendous technical advancement with regard to the design and manufacture of current devices, longer term follow-up and additional improvements are essential before TEVAR becomes the standard of care. The true potential of TEVAR in the various aortic diseases should be studied in a large randomised fashion, such as the INSTEAD trial for aortic dissection.[25] However, this would be challenging in the local context given limitations in resources and cost of the endografts.

Conclusion

TEVAR is an attractive alternative to open surgery. While questions about its durability in the longer term have been raised and yet to be answered, this lack of certainty about its long-term durability may be less of an issue in older population with comorbidities.

The primary allure of TEVAR is the promise of marked reduction in perioperative morbidity, shorter in-hospital stay and rapid postoperative recovery. This study adds to the growing body of literature that support TEVAR as an effective procedure in the management of thoracic aortic diseases and reflect its feasibility in our population. Further technical advancement in stent grafts, careful selection of patients and standardised peri-procedural care would contribute to further improvements in clinical outcomes.

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