

ORIGINAL ARTICLE

## Early experience of thoracic endovascular aortic repair: a local single hospital experience

Kyung Yun Kim, Seung Jae Byun, Kyeong Ho Yun<sup>1</sup>, Sam Youn Lee<sup>2</sup>, Dae Woong Ryu<sup>2</sup>, Sang Jae Rhee<sup>1</sup>, Byung Jun So

Departments of Vascular Surgery, <sup>1</sup>Cardiovascular Medicine, and <sup>2</sup>Cardiothoracic Surgery, Wonkwang University School of Medicine & Hospital, Iksan, Korea

**Purpose:** The purpose of this retrospective study was to evaluate the short- to mid-term results of thoracic endovascular aortic repair (TEVAR) in Wonkwang University School of Medicine & Hospital. **Methods:** Between February 2009 and May 2011, 8 consecutive patients had undergone endovascular stent-grafting for thoracic aortic diseases. Five patients were treated for traumatic thoracic aortic injuries, two patients were treated for thoracic aneurysms and one patient was treated for a pseudoaneurysm due to penetrating aortic ulcers. Attempted stent-graft deployment was performed electively in 6 patients and emergently in 2. Follow-up was performed at 1-month, 6-month, 1-year, and annually thereafter. **Results:** Technical success rates were achieved in 87.5% and the 30-day mortality rate was 0%. Mean hospital length of stay after TEVAR was 30 days in traumatic thoracic aortic injuries and 10 days in thoracic aneurismal diseases. Intra-operative Type I endoleak due to migration at deflation was visualized in 1 patient, which was treated by insertion of another stent-graft. During follow-up, a major complication was encountered in one patient who received carotid-subclavian bypass to relieve left arm ischemia. After 5 months he was treated with arch replacement for aortic arch aneurysm with type I endoleak at proximal site after endovascular treatment. The 30-day mortality rate was 0%. However, 1 case of mortality (12.5%) was observed during the follow-up period. **Conclusion:** The short and mid-term results of endovascular repair of thoracic aortic diseases are promising. TEVAR is an effective procedure in the management of thoracic aortic diseases.

**Key Words:** Stent graft, TEVAR, Thoracic aneurysm, Traumatic thoracic injury

### INTRODUCTION

Thoracic aortic diseases are often associated with high mortality due to the thoracic aorta's tendency to rupture. The pathophysiology of thoracic aortic disease is complex and is as of yet not fully understood. These diseases include aneurysms, dissections, traumatic injuries, intra-

mural hematomas and penetrating atherosclerotic ulcers. A successful treatment using segmental resection and graft replacement reported by Cooley and DeBakey [1], has been considered the standard treatment in most cases. But, regardless of significant advances in the past decades to improve surgical techniques and postoperative management, perioperative mortality and morbidity rates still

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Correspondence to: Seung Jae Byun  
Department of Vascular Surgery, Wonkwang University School of Medicine & Hospital, 895 Muwang-ro, Iksan 570-974, Korea  
Tel: +82-63-859-1490, Fax: +82-63-855-2386, E-mail: polarisking@hanmail.net

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remains high [2,3]. As an alternative treatment, thoracic endovascular aortic repair (TEVAR) is a minimally invasive, safe treatment for descending thoracic disease that was first described in 1994 when Dake et al. [4] reported in a prospective study that they successfully placed stent graft systems via the femoral artery to repair descending thoracic aortic aneurysms. Since then, many stent grafts have been commercially available for use in thoracic aortic disease as an alternative to open surgery. Although initial reports on the endovascular stent-graft strategy were encouraging in various pathologies, randomized data are relatively scarce and until now since the procedure has limited data of long-term surveillance. The purpose of this retrospective study was to evaluate the short- to mid-term results of the TEVAR and to present an overview of our experience with TEVAR in the treatment of thoracic aortic lesions in Wonkwang University School of Medicine & Hospital.

## METHODS

A retrospective review of eight patients who underwent TEVAR in Wonkwang University School of Medicine & Hospital between February 2009 and May 2011 was conducted. Medical records and radiographic imaging information were reviewed to determine the indications, demographic and co-morbid information, procedural techniques, complications, and outcomes. Short and mid-term follow-ups were carried out by outpatient clinical review and radiographic imaging with a mean 21.7

months follow-up period (6 to 36 months). Patient selection was based on consensus by an endovascular surgeon, a cardiothoracic surgeon and an interventional cardiologist for both elective and emergency cases. Diagnosis and planning for endovascular repair were made on the basis of computed tomography. Four patients received Valiant Thoracic stent graft (Medtronic Inc., Minneapolis, MN, USA) and four patients received S&G Seal device (S&G Inc., Seoul, Korea). Major TEVAR-related complications, in particular, endoleaks and deaths, were documented.

## RESULTS

Within the study period, 8 patients underwent TEVAR. Patient demographics and related co-morbid medical illnesses of this study group are outlined in Table 1. There were degenerative/atherosclerotic aneurysm (n = 2), pseudoaneurysm by giant penetrating ulcer (n = 1), traumatic aortic injury with pseudoaneurysm (n = 5) (Table 2). The mean age of the patients was 55.25 years (range, 18 to 83 years), with 4 men and 4 women. Primary technical success, defined as successful deployment and exclusion of the lesion without evidence of type I or type III endoleak, was achieved in 7 (87.5%) out of 8 patients and the 30-day mortality rate was 0%. The left subclavian artery was covered in 2 patients (25%). There was no incidence of upper limb ischemia or posterior circulation insufficiency. No prophylactic or therapeutic spinal drainage was performed, and there was no paraparesis or paraplegia due to ischemia of the spinal cord. Perioperative endoleak was visualized in 2 patients (Table 2). They were both type I endoleaks. One was treated by insertion of an additional stent-graft. The second patient who underwent carotid-subclavian bypass simultaneously for protection of

**Table 1.** Patient's demographics and co-morbid medical conditions

Demographic	No. (%)
Gender	
Male	4 (50.0)
Female	4 (50.0)
Medical conditions	
Ischemic heart disease	0 (0)
Renal impairment	1 (12.5)
Hypertension	4 (50.0)
Diabetes	2 (25.0)
Chronic pulmonary disease	1 (12.5)
Cerebrovascular disease	2 (25.0)

**Table 2.** Etiology

Etiology	No.
Aortic aneurysm (atherosclerotic/degenerative)	2
Pseudoaneurysm by penetrating ulcer	1
Traumatic aortic tear and pseudoaneurysm	5

left arm ischemia, developed an aortic arch aneurysm with type I endoleak at proximal site after 5 months follow-up. He was treated with arch replacement through surgical treatment. Mean hospital length of stay post-TEVAR was 30 days in traumatic thoracic aortic injuries and 10 days in thoracic aneurysmal diseases. The 30-day mortality rate was 0% and mortality rate during the follow-up period was 12.5%. Mortality in this patient was not directly related to the TEVAR procedure.

## DISCUSSION

The use of endovascular stent grafts in the treatment of thoracic aortic diseases is a promising alternative to open surgical repair. Especially, blunt aortic injury is associated in 20% of cases of motor vehicle accidents and with a possible pre-hospital mortality rate of between 80% and 90% [5]. Recently, a comparative meta-analysis reviewed outcomes of 699 patients referred for endovascular or open repair after traumatic aortic trans-sections. With a technical success rate not different to open repair (96.5% vs. 98.5%,  $P = 0.58$ ), endovascular therapy ( $n = 370$ ) was associated with lower periprocedural mortality (7.6% vs. 15.2%;  $P = 0.076$ ), a lower incidence of paraplegia (0% vs. 5.6%;  $P < 0.001$ ) and stroke (0.85% vs. 5.3%,  $P = 0.0028$ ) [6-13] and solved most life-threatening problems in aortic trans-sections. Findings from our experience confirm that TEVAR for traumatic aortic injuries is a feasible option in our hospital and the first choice for most trauma patients with suitable anatomy and high-risk for open surgical repair, regardless of their age. We successfully deployed stent graft in nearly all the patients within our study group, with 1 case (12.5%) of early perioperative endoleak. These rates are in line with published data of a range between 16.7% and 30.0% [13-16]. There was no periprocedural mortality but one patient required conversion to open surgery. There have been questions raised about the durability of early thoracic-aortic stent grafts over longer periods of follow-up, with Demers et al. [14] reporting actuarial freedom from treatment failure of 67%, 56% and 39% at 1, 5 and 8 years, respectively. Although findings from our data have been promising, the aneurysmal

change with type I endoleak of stent graft proximal site in one case will need further discussion. Patency of these stent grafts is reflected by the endoleak rate of 12.5% over a longer period of follow-up, with the study group being followed up for an average of 21.7 months. This compares favorably with a recent large prospective study involving 457 patients by Fattori et al. [15] where they reported endoleak rates of 8.5% over an average of 24 months.

However, durability of the stent grafts over the lifetime of the patient still remains unanswered. Because of this, the need for lifetime imaging surveillance in these patients becomes 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.

Paraplegia from spinal ischemia is one of the most serious and well-described complications of TEVAR, with most studies reporting incidence rates ranging from 0 to 3% [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 is good evidence in the use of lumbar spinal drains in thoracoabdominal aortic surgery [17], with the available literature supporting the use in TEVAR, especially in selective high-risk patients [18]. We did not observe any case of paraplegia though we did not perform any prophylactic spinal drains in our cases, but our results are limited by the small sample size (Table 3). There is no procedure-related mortality within our study group. 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

**Table 3.** Postoperative major complications

Major complication	No. (%)
Mortality	0 (0)
Cardiac arrest	0 (0)
Stroke	0 (0)
Paraplegia	0 (0)
Access site hematoma	1 (12.5)
Hemothorax	1 (12.5)
Pneumonia	1 (12.5)
Pleural effusion	1 (12.5)

series. Hence, even with the outstanding 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 randomized study.

Endovascular treatment for thoracic aortic diseases provides clinicians and patients with an alternative to the significant morbidity and mortality of open surgical procedures, but only when used in appropriately selected cases.

## CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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## REFERENCES

1. Cooley DA, DeBakey ME. Resection of the thoracic aorta with replacement by homograft for aneurysms and constrictive lesions. *J Thorac Surg* 1955;29:66-100.
2. Svensson LG, Crawford ES, Hess KR, Coselli JS, Safi HJ. Experience with 1509 patients undergoing thoracoabdominal aortic operations. *J Vasc Surg* 1993;17:357-68.
3. Trimarchi S, Nienaber CA, Rampoldi V, Myrmet T, Suzuki T, Bossone E, et al. Role and results of surgery in acute type B aortic dissection: insights from the International Registry of Acute Aortic Dissection (IRAD). *Circulation* 2006;114(1 Suppl):I357-64.
4. Dake MD, Miller DC, Semba CP, Mitchell RS, Walker PJ, Liddell RP. Transluminal placement of endovascular stent-grafts for the treatment of descending thoracic aortic aneurysms. *N Engl J Med* 1994;331:1729-34.
5. Fabian TC, Richardson JD, Croce MA, Smith JS Jr, Rodman G Jr, Kearney PA, et al. Prospective study of blunt aortic injury: Multicenter Trial of the American Association for the Surgery of Trauma. *J Trauma* 1997;42:374-80.
6. Tang GL, Tehrani HY, Usman A, Katariya K, Otero C, Perez E, et al. Reduced mortality, paraplegia, and stroke with stent graft repair of blunt aortic transections: a modern meta-analysis. *J Vasc Surg* 2008;47:671-5.
7. Orend KH, Kotsis T, Scharrer-Pamler R, Kapfer X, Liewald F, Gorich J, et al. Endovascular repair of aortic rupture due to trauma and aneurysm. *Eur J Vasc Endovasc Surg* 2002;23:61-7.
8. Lachat M, Pfammatter T, Witzke H, Bernard E, Wolfensberger U, Künzli A, et al. Acute traumatic aortic rupture: early stent-graft repair. *Eur J Cardiothorac Surg* 2002;21:959-63.
9. Orford VP, Atkinson NR, Thomson K, Milne PY, Campbell WA, Roberts A, et al. Blunt traumatic aortic transection: the endovascular experience. *Ann Thorac Surg* 2003;75:106-11.
10. Scheinert D, Krankenberg H, Schmidt A, Gummert JF, Nitzsche S, Scheinert S, et al. Endoluminal stent-graft placement for acute rupture of the descending thoracic aorta. *Eur Heart J* 2004;25:694-700.
11. Melnitchouk S, Pfammatter T, Kadner A, Dave H, Witzke H, Trentz O, et al. Emergency stent-graft placement for hemorrhage control in acute thoracic aortic rupture. *Eur J Cardiothorac Surg* 2004;25:1032-8.
12. Pitton MB, Herber S, Schmiedt W, Neufang A, Dorweiler B, Düber C. Long-term follow-up after endovascular treatment of acute aortic emergencies. *Cardiovasc Intervent Radiol* 2008;31:23-35.
13. Cambria RP, Crawford RS, Cho JS, Bavaria J, Farber M, Lee WA, et al. A multicenter clinical trial of endovascular stent graft repair of acute catastrophes of the descending thoracic aorta. *J Vasc Surg* 2009;50:1255-64.e1-4.
14. Demers P, Miller DC, Mitchell RS, Kee ST, Sze D, Razavi MK, et al. Midterm results of endovascular repair of descending thoracic aortic aneurysms with first-generation stent grafts. *J Thorac Cardiovasc Surg* 2004;127:664-73.
15. Fattori R, Nienaber CA, Rousseau H, Beregi JP, Heijmen R, Grabenwoger M, et al. Results of endovascular repair of the thoracic aorta with the Talent Thoracic stent graft: the Talent Thoracic Retrospective Registry. *J Thorac Cardiovasc Surg* 2006;132:332-9.
16. Dialeto G, Reginelli A, Cerrato M, Rossi G, Covino FE, Manduca S, et al. Endovascular stent-graft treatment of thoracic aortic syndromes: a 7-year experience. *Eur J Radiol* 2007;64:65-72.
17. Safi HJ, Campbell MP, Miller CC 3rd, Iliopoulos DC, Khoynezhad A, Letsou GV, et al. Cerebral spinal fluid drainage and distal aortic perfusion decrease the incidence of neurological deficit: the results of 343 descending and thoracoabdominal aortic aneurysm repairs. *Eur J Vasc Endovasc Surg* 1997;14:118-24.
18. Gowda RM, Misra D, Tranbaugh RF, Ohki T, Khan IA. Endovascular stent grafting of descending thoracic aortic aneurysms. *Chest* 2003;124:714-9.