

# Thoracic Endovascular Aortic Repair in 300 Patients: Long-Term Results

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**Background.** The aim of this analysis was to assess short and mid-term results of patients undergoing thoracic endovascular aortic repair (TEVAR) for 4 different indications.

**Methods.** From 1996 to 2010, 300 patients (80 female, 220 male, median age 67 years [20 to 88]) underwent TEVAR at our department. Among them were 137 descending thoracic aneurysms (DTA), 80 type B dissections (60 acute, 20 chronic), 59 perforating aortic ulcer (PAU), and 24 traumatic aortic transections (ATAT). Hospital mortality and mid-term survival among different indications for TEVAR were evaluated.

**Results.** Overall hospital mortality in our series was 5% (n = 15). Seven patients with DTA (5%), 4 patients with type B dissections (5%), 2 patients with PAU (3.4%), and 2 ATAT (8%) patients died during their

hospital stay. Kaplan-Meier survival analysis revealed significant differences in survival rates according to the various indications for TEVAR ( $p < 0.001$ ). Overall long-term mortality was 86%, 63%, and 44% at 1, 5, and 10 years. Early and late endoleak rate was 18% and 8%, respectively.

**Conclusions.** The TEVAR has evolved into a safe and effective therapy for different aortic pathology resulting in promising long-term results. Nevertheless, the indication for TEVAR has direct impact on the success of the procedure. Patients with acute type B aortic dissections and acute traumatic aortic lesions seem to benefit the most from TEVAR.

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Descending aortic pathologies such as type B dissection (TBD), descending thoracic aortic aneurysms (DTA), penetrating ulcers (PAU), and acute traumatic aortic injuries (ATAT) still represent a potentially life-threatening situation and a formidable risk for cardiac surgeons as well as interventional radiologists [1–3]. Conventional resection and graft replacement of DTAs has been the treatment of choice but is still associated with high morbidity and mortality rates despite improved surgical techniques, intraoperative monitoring of somatosensory evoked potentials as well as spinal cord fluid [4–7]. The patient population is usually of older age and present at time of operation with various comorbidities such as hypertension, chronic obstructive pulmonary disease, and coronary artery disease. All of these comorbidities have significant impact on the surgical outcome resulting in considerable postoperative mortality and morbidity. Postoperative complications such as paraplegia and renal and pulmonary insufficiency attribute to prolonged hospital stays and higher medical cost.

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Since the first endovascular stent-graft experience in an abdominal aortic aneurysm [8], various groups have started to investigate the feasibility of thoracic aortic aneurysmal repair with endovascular stent-grafts (TEVAR) [9, 10]. Over the last decade, endovascular techniques have revolutionized the management of descending thoracic aortic disease, with the benefit of exclusion of the pathologically altered aorta without direct surgical exposure. Although endovascular techniques were initially reserved for patients not suitable for conventional surgery, clinical success led to rapid expansion of indications [11, 12]. Nevertheless, both the potential risk of device failure and the concern about long-term durability remain unsolved issues with this emerging treatment modality.

This study was undertaken to report our clinical experience and mid-term results in patients treated with TEVAR for 4 different indications. After collecting data over the course of 15 years on a relatively large group of patients, we were eager to determine which indication would have the most benefit from TEVAR.

## Patients and Methods

### Approval and Consent

The study has been Institutional Review Board approved. All patients provided informed consent. Individual

**Abbreviations and Acronyms**

ATAT	= acute traumatic transection
CAD	= coronary artery disease
COPD	= chronic obstructive pulmonary disease
CSF	= cerebral spinal fluid
DTA	= descending thoracic aortic aneurysm
DTx	= double transposition
EVAR	= endovascular aortic repair
LSA	= left subclavian artery
PAU	= perforating aortic ulcer
TBD	= type B dissection
TEVAR	= thoracic endovascular aortic repair
Tot Arch	= total arch replacement

consent for the study was waived. Individual patients are not identified.

**Enrollment**

The entire cohort study consisted of 300 consecutive patients (220 male and 80 female) who underwent endovascular thoracic aortic repair at the University of Vienna between November 1996 and March 2010. Median age at the time of intervention was 67 years, ranging from 20 to 88 years (Table 1). The spectrum of thoracic aortic diseases comprised the following: 137 (45%) atherosclerotic aneurysms that had reached a diameter of over 55 mm; 59 (20%) penetrating ulcers, defined as focal bulge of contrast through an intimal calcification of the aorta; 80 (27%) thoracic aortic dissections (32 acute complicated, 28 acute uncomplicated, and 20 chronic); and 24 (8%) traumatic aortic transections (Table 1). Previous aortic surgery was reported on 44 patients (15%). Out of these, 6 patients were previously treated for type A dissection. Twelve patients were treated for ascending

aortic aneurysm, and the remaining 26 had undergone abdominal aortic surgery. Only 2 patients with Marfan syndrome were treated with TEVAR in this series.

Hypertension was the most frequently seen comorbidity, followed by chronic obstructive pulmonary disease (COPD), coronary artery disease, and previous aortic surgery. Almost half of all patients (47%) were treated on an acute base and 57 had signs of aortic rupture (defined as computed tomography [CT]-verified hemorrhagic effusion in the pleural space) at the time of intervention (Table 1).

**Endovascular Prosthesis and Procedure**

All patients were treated with commercially available stent grafts. A Talent endoprosthesis (Medtronic, Minneapolis, MN) was used in 122 patients (41%), The Thoracic Excluder device (W. L. Gore & Assoc, Flagstaff, AZ) was used in 115 patients (38%), the Bolton Relay (Bolton Medical, Sunrise, FL) device in 58 patients (19%), 3 patients received the Endomed device (LeMaitre Vascular Inc, Burlington, MA), and 2 patients (2%) received the Cook stent-graft device (LeMaitre Vascular Inc) (Table 2). The diameter of the stent graft was calculated from the largest diameter of the proximal anchoring zone and an oversizing factor of 10% was added. All procedures were performed with an angiography suite equipped with digital subtraction angiography (Multistar T.O.P.; Siemens, Erlangen, Germany) and were done under general anesthesia. In elective cases where large portion of the descending aorta were intent to be treated with TEVAR, a cerebral spinal fluid catheter was inserted 24 hours before the procedure and was kept 2 days post-intervention. Antibiotic prophylaxis was administered intravenously in all patients before the procedure. In patients without rupture, 5,000 IU of heparin sodium was given after the access site was surgically exposed. Subsequently, a 260-cm-long steerable hydrophilic guide wire (Terumo Europe N.V., Leuven, Belgium) was advanced to

Table 1. Preoperative Parameters

Variable	Overall n 300	DTA n 137	PAU n 59	TBD n 80	ATAT n 24	p Value
Age	67 (20 88)	73 (52 88)	67 (37 86)	59 (29 86)	46 (20 74)	<0.001 <sup>a</sup>
Male gender	220 (73%)	93 (68%)	47 (80%)	58 (73%)	22 (92%)	0.059
Hypertension	240 (80%)	131 (96%)	45 (76%)	57 (71%)	7 (29%)	<0.001 <sup>a</sup>
COPD	85 (28%)	66 (48%)	15 (25%)	3 (4%)	1 (4%)	<0.001 <sup>a</sup>
CAD	71 (24%)	46 (34%)	19 (32%)	6 (8%)	0	<0.001 <sup>a</sup>
Prev aortic surgery	44 (15%)	31 (23%)	6 (10%)	7 (9%)	0	0.003 <sup>a</sup>
Renal insufficiency	20 (7%)	9 (7%)	10 (17%)	0	1 (4%)	0.001 <sup>a</sup>
Prev neurologic event	13 (4%)	5 (4%)	5 (9%)	2 (3%)	1 (4%)	0.335
EuroSCORE linear	9 (3 18)	9 (3 15)	11 (5 18)	8 (3 16)	8 (3 12)	<0.001 <sup>a</sup>
EuroSCORE logistic	16 (2 80)	16 (2 69)	27 (5.5 80)	13 (3 68)	13 (13 37)	<0.001 <sup>a</sup>
Rupture	57 (19%)	18 (13%)	24 (41%)	6 (8%)	9 (37%)	<0.001 <sup>a</sup>
Acute at referral	140 (47%)	19 (14%)	39 (66%)	64 (80%)	18 (75%)	<0.001 <sup>a</sup>
Number of prosthesis	2 (1 6)	2 (1 6)	1 (1 2)	1.5 (1 4)	1 (1 3)	<0.001 <sup>a</sup>

<sup>a</sup> Statistically significant (p < 0.05).

ATAT = traumatic aortic transections; CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; DTA = descending thoracic aneurysms; EuroSCORE = European system for cardiac operative risk evaluation; PAU = perforating aortic ulcer; TBD = type B dissection.

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