# Descending Thoracic Aortic Syndromes. Initial Experience with the Endovascular treatment at King Hussein Medical Center

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## ABSTRACT

**Objective:** To study the outcomes of thoracic endovascular aortic stenting for a variety of descending thoracic aortic pathologies at King Hussein Medical Center and to compare outcomes with other multi-institutional centers.

**Methods:** The charts of patients who had thoracic endovascular aortic stenting at King Hussein Medical Center in the period between January 2012 and December 2013 were reviewed. 31 patients (28 males), in the age range of 23-77 years (mean 56.6 years). 7 patients had the endovascular procedure for acute type B descending aortic dissection, while 19 patients had the procedure for aneurysmal disease, and the remainder 5 patients had stenting for traumatic transection. Endpoints included are: Early mortality, stroke, endoleak, myocardial infarction, spinal cord ischemia and groin vascular complications. The mean follow up period was 180 days. All adult patients who had descending thoracic aortic syndromes and have thoracic endovascular aortic stenting performed were included. Patients with marfan syndrome were excluded from the study group.

**Results:** One out of thirty one patients developed early postoperative stroke, with complete recovery, the average in-hospital stay was 3.4 days. 2 patients developed vascular complications in the groin vessels related to the endovascular procedure, and were managed successfully. 2 patients had early mortality, while 2 patients had spinal cord ischemia. 1 patient had endo-leak during their follow up period.

**Conclusion:** Thoracic endovascular aortic stenting is a viable therapeutic option in descending thoracic aortic pathologies and can be performed safely with minimal risks.

**Key words:** Aneurysm, Aortic dissection, Aortic transaction, Descending Thoracic Aortic Syndromes, Endovascular Interventions.

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## Introduction

Therapeutic modalities for descending thoracic aortic syndromes have been described in literature and ranged from totally medical treatment to a major open surgery under certain indications such as aortic rupture or mal-perfusion syndromes.[1] Thoracic Endovascular Aortic Repair (TEVAR) has emerged as a therapeutic option following the successful outcomes described by Dake *et al.* [2] and Nienaber *et al*.[3]

Over the past decades, there has been a wide spread of the application of such therapy,[4,5] with more refinement of the skills among thoracic surgeons, vascular surgeons and interventional radiologists.

The natural history of the acute and chronic aortic pathologies such as aortic dissection, aortic aneurysm, IntraMural Hematoma (IMH) and aortic transections has been recently more clarified, and described as different entities, and no more place to describe one entity as a variant of another.[6]

The encouraging role of endovascular intervention in descending thoracic aortic catastrophes is promising,[7] since it can mitigate flow mal-perfusion and prevent aortic rupture in the acute settings, potentiates false lumen thrombosis process and obviate possible aneurysmal formation in a later stage.[8]

In our study, we retrospectively looked at the records of the patients who underwent TEVAR for different descending thoracic aortic pathologies in King Hussein Medical Center, in the period between January 2012 till December 2013, and our aim is to study the outcomes of the TEVAR and compare our status with the outcomes published from larger institutions.

## Methods

The records of consecutive series of 31 patients who had endovascular stenting for descending thoracic aortic syndrome in the period between January 2012 and December 2013 in King Hussein Medical Center were included in our retrospective study. Patient's assessment and decisions for treatment options were discussed thoroughly between the vascular surgeon and interventional radiologists. Patient fitness and suitability for the intervention were based upon consults with medical, cardiology, pulmonology and anesthesiology teams. Patients who are considered unfit for the procedure based upon their medical assessment or who have Marfan syndrome were excluded from the study. Pathological entities included are summarized in Table I. The endpoints we looked at were: Early mortality, stroke, endoleak, myocardial infarction, spinal cord ischemia and groin vascular complications.

Early Mortality was defined as any death during the same admission. Stroke was defined as any cerebrovascular accident that had clinical implications being confirmed by neurological examination and brain computed tomography. Outcome measures were calculated as percentages from the total cohort volume.

Since the TEVAR was introduced as a treatment option in King Hussein Medical Center, it was mainly used for patients with super added co-morbidities and preferentially in emergency settings such as traumatic aortic transections and acute type B aortic dissections. Patients who are having Marfan syndrome are usually referred for surgical or conservative therapy according to the clinical scenario.

Stent graft selection was based upon accurate evaluation of the descending thoracic aortic pathology using 3-dimentional diagnostic images with reconstructions. Prophylactic antibiotics are administered in the operating room andafter induction of general anesthesia and endotracheal intubation, heparin is used for adequate anticoagulation, the femoral artery is used as an access, with a Dacron graft inserted to minimize vascular trauma. The Valiant stent graft (Medtronic, Minneapolis, MN, USA) was exclusively used in all the patients included in our study. Vascular surgery and interventional radiologist teams are available in the operating room all through the procedure. Patients were usually strictly observed in the intensive care unit for the first 24 hours to assure adequate analgesia and strict control of blood pressure. All of our

**Table I:** Preoperative Demographics for the Patients.

| Variable | Total N = 31 | % |
|---|---|---|
| Age at surgery (years) | 23-77 years | |
| Sex | Male 28 | 90 |
| Smoker | 6 | 19 |
| Hypertension | 23 | 74 |
| DM | 3 | 10 |
| PVD | 7 | 23 |
| Stroke | 1 | 3 |

Legend: N- Number, DM – Diabetes Milletes, PVD – Peripheral Vascular Disease

**Table II:** Pathologic Categories of the included patients

| Descending Thoracic aortic pathology | Number of patients N=31 |
|---|---|
| Acute Type B aortic Dissection | 7 |
| Aortic Transection | 5 |
| Aortic aneurysm | 19 |

**Table III:** Primary Outcomes

| Outcome | N=31 | % |
|---|---|---|
| Stroke | 1 | 3.2 |
| Death | 2 | 6.5 |
| Myocardial Infarction | 1 | 3.2 |
| Endoleak | 1 | 3.2 |
| Spinal Cord Ischemia | 2 | 6.5 |
| Groin Vascular Complications | 2 | 6.5 |

studied patients were followed up by our team staff during their visits to the vascular surgery clinic and the mean follow up period was 180 days (range 30-410 days).

## Results

Baseline characteristics and demographics for the patients included in the study are outline in Table II. Procedural success without major complications in the TEVAR was achieved in 29/31(94%) of the patients, and none of our patients needed conversion into the open surgical method during and after the procedure. Endpoint summary is outlined in Table III.

2/31 early mortality was noticed in our cohort, one patient had a TEVAR stent insertion for acute type B aortic dissection,

after which he had some element of spinal cord ischemia, despite all application of maneuvers to improve his spinal cord circulation, like cerebrospinal fluid drainage, and vasopressor support, however he developed multi-organ failure. The other patient had acute myocardial infarction after the procedure, and died because of low cardiac output syndrome. 2/31 patients had lower extremity weakness, luckily one of them was temporary with full recovery, and the other had grave outcome and died as we mentioned before.

1/31 patients had endo-leak during his follow up period; he was managed successfully by coiling, and did not need surgical intervention. Two of our patients had vascular complications in the groin area in the form of groin hematoma. Both of them were managed successfully.

## Discussion

The prevalence of descending thoracic aortic disease had increased over the past two decades.[6] Whether this increase is due to the aging population or due to the improvement in the diagnostic tools remains unknown. With the increased risk of the open surgical repair in the elderly people, especially the comorbidities they are having beside their aortic pathology such as Chronic Obstructive

Pulmonary Disease (COPD), renal impairment, myocardial dysfunction and others. The evolving technology of the endovascular intervention appears to be an attempting solution for these patient categories as a lesser invasive method.[9]

The transition in the treatment of descending thoracic aortic syndrome from open thoracotomy to TEVAR has dramatically occurred over the past two decades. Published data showed noticeable difference in the early outcomes such as in-hospital mortality according to the type of treatment given to patients presenting with acute type B aortic dissection.[10] Reported outcomes from the International Registry of Acute Aortic Dissection(IRAD) for patients with acute type B aortic dissection showed that the early mortality is 32% for patients treated by open repair, 10% treated by medical therapy and 7% for those who were treated by TEVAR.[11] More recent reports for 148 patients with different descending thoracic aortic pathologies treated by TEVAR showed that the in-hospital mortality is 8.1%.[12] Despite non published data for open surgical repair for descending thoracic aortic syndromes from our center, an early mortality of 6.5% in our patients who underwent TEVAR procedure is favorably comparable to the other centers performing this procedure in a larger volume. One patient from our cohort died because he developed acute myocardial infarction, while the other had some element of spinal cord ischemia, and later developed multi-organ failure.

The arterial blood supply to the thoracic segment of the spinal cord is solely via anterior and two posterior spinal arteries, augmented by radicular branches from the posterior intercostal arteries. However the continuity of these arteries is not always present.[13] Of particular importance in this manner is the second thoracolumbar branch which originates from T9-T12 posterior spinal segments, known as the artery Adamkiewitz. The watershed infarction induced by stent coverage of the anterior spinal artery branches may explain the early spinal cord ischemia in this procedure, so preservation of this artery is highly crucial and always taken in our consideration during the case study and plans to prevent spinal cord ischemia.[14]

However, in many times the artery on Adamkiewitz originates below the stent coverage area, but patients who underwent previous abdominal aortic aneurysm repair in the past may have lost this important blood supply during their previous surgery, and being more vulnerable for spinal cord infarction. Our policy in decreasing this risk is to insert a cerebrospinal fluid drain in all patients who have previous abdominal aortic surgery or have extensive aortic stent coverage. We don't apply CSF drains for all patients, since this drain is not without complications such as meningitis, subdural hematomas, drain fractures, headaches and lengthening of hospital stays.[15]

Endoleak remains a challenging outcome of TEVAR. Endoleak is defined by authors as the persistence of blood flow leaking outside the lumen of the prosthesis, but within the aortic sac.[16] It was first described and classified in the late 1990 as follows:[17]

Type Ia: Proximal seal failure.

Type Ib: Distal seal failure.

Type II: Retrograde branch vessel filling of sac.

Type III: Failure of device component seal or graft fabric tears.

Type IV: Graft porosity failure

One of our patients had proximal type Ia endoleak during the follow up period. With the recent evolution in coil designs, we managed to treat him successfully.

Two of our patients had lower limb weakness after application of the TEVAR stent, luckily one of them was temporary and resolved completely over few days, we think that the addition of multiple vasopressors that we used, to augment his spinal perfusion pressure in his management regimen was helpful in his full neurological recovery. The other patient developed multi-organ failure and succumb death as we mentioned previously.

### *Strengths and limitations*

This study represents the largest series for patients who underwent TEVAR treatment in Jordan; we admit that the patients need more

long term follow up to determine the status of these applied stents after years.

## Conclusion

TEVAR is a viable option in the management of descending thoracic aortic pathologies, in particular for the group of patients who cannot tolerate the highly invasive open surgical repair. Nevertheless this procedure carries the risk of morbidity and mortality. Our results are comparable with others from larger institutions that perform this procedure. Our experience in this field is growing and encouraging, and we are expecting our volume of patients treated with TEVAR will expand over the coming few years.

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