

## Thoracic endovascular aortic repair for acute pathologies of descending thoracic aorta

*İnen torasik aortun akut patolojilerinde torasik endovasküler aort tamiri*

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**Background:** This study aims to analyze early and midterm results of thoracic endovascular aortic repair performed in acute pathologies of descending aorta.

**Methods:** Between September 2006 and April 2010, 25 patients (21 males, 4 females; mean age 62.1±14.8 years; range 26 to 82 years) with acute aortic syndrome who underwent emergent surgery in our clinic through endovascular approach were included in this study. Demographic characteristics, preoperative and postoperative data were analyzed retrospectively by means of file scanning method.

**Results:** The procedure was successful in all patients. A total of 29 thoracic endograft were implanted in 25 patients. Three patients (12%) died before hospital discharge. Major complications of this procedure including neurologic event and type 1 endoleaks were not observed in any patient. The mean follow-up was 20.2±16.8 months. During this period, none of the patients had need procedure-related complications, while only one patient treated for penetrating atherosclerotic ulcer died at 20 months due to malignancy.

**Conclusion:** Although our study was designed retrospectively with a small sample size, we detected low morbidity and mortality rates. These results are consistent with the literature, however further studies reflecting the long-term safety results are required. Thoracic endovascular aortic repair is a feasible option of treatment for acute pathologies of descending thoracic aorta.

**Key words:** Descending thoracic aorta; endovascular; malperfusion; mortality; rupture.

**Amaç:** Bu çalışmada inen aortun akut patolojilerinde uygulanan torasik endovasküler aort tamiri işleminin erken ve orta dönem sonuçları analiz edildi.

**Çalışma planı:** Eylül 2006 - Nisan 2010 tarihleri arasında kliniğimizde endovasküler yöntemle acil olarak ameliyat edilmiş olan 25 akut aortik sendrom hastası (21 erkek, 4 kadın; ort. yaş 62.1±14.8 yıl; dağılım 26-82 yıl) çalışmaya dahil edildi. Hastaların demografik özellikleri, ameliyat öncesi ve ameliyat sonrası verileri dosya tarama yöntemi ile retrospektif olarak analiz edildi.

**Bulgular:** Tüm hastalarda işlem başarısı sağlandı. Yirmi beş hastaya toplam 29 adet torasik endograft yerleştirildi. Üç hasta (12%) hastaneden taburcu edilmeden önce kaybedildi. Bu işlemin ana komplikasyonları olan nörolojik olay veya tip 1 kaçak, hiçbir hastada görülmedi. Ortalama takip süresi 20.2±16.8 ay idi. Bu sürede hiçbir hastada işleme bağlı komplikasyon görülmezken, penetran aterosklerotik ülser nedeniyle tedavi edilmiş bir hasta 20. ayda maligniteye bağlı olarak kaybedildi.

**Sonuç:** Çalışmamız retrospektif olarak hazırlanmış olmasına ve kısıtlı sayıda olgu içermesine rağmen, analizlerde düşük morbidite ve mortalite oranları saptandı. Sonuçlar literatür ile paralellik göstermekle beraber, güvenilirlik açısından uzun dönem sonuçlara gereksinim duyulmaktadır. Torasik endovasküler aort tamiri, inen aortun akut patolojilerinin tedavisinde uygulanabilir bir tedavi seçeneğidir.

**Anahtar sözcükler:** İnen torasik aort; endovasküler; malperfüzyon; mortalite; rüptür.



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Despite improvements in surgical therapy and postoperative care of thoracic aortic diseases, morbidity and mortality rates are still high, especially in emergency cases.<sup>[1]</sup> The term acute aortic syndrome (AAS) defines a group of life-threatening thoracic aortic pathologies, including aortic dissection with malperfusion or rupture, intramural hematoma (IMH), penetrating atherosclerotic ulcer (PAU), traumatic aortic transection (TAT), aortitis, and ruptured descending aortic aneurysm.<sup>[2]</sup> If not treated, the risk of mortality in this group increases every hour. Graft replacement is the best and most permanent therapy for AAS, even though it has drawbacks like systemic heparinization and aortic clamping. Disadvantages with this procedure include renal and respiratory problems along with neurological complications such as a spinal cord injury or cerebral embolic events, and these are seen even in large series.<sup>[3,4]</sup>

Thoracic endovascular aortic repair (TEVAR) is another treatment modality that has grown in popularity due to the search for less invasive methods for treating AAS. This procedure is often performed in the descending thoracic aorta (DTA). The main rule for implementing this procedure is anatomical eligibility since the thoracic endograft is implanted to exclude the diseased segment of aorta. The primary advantages of TEVAR are the short duration of intervention, the use of low-dose heparin, and the fact that it is minimally invasive. Recently published data reflects the satisfactory early and midterm results of TEVAR, though the studies did not cover very large series.<sup>[5-8]</sup>

In this article, our goal was to analyze the early and mid-term results of our own TEVAR experience in treating AAS and compare them with the literature.

## PATIENTS AND METHODS

### Patient characteristics

This study was initiated after the approval of the Ege University Medical School, Non-Drug Research Ethics Committee. Between September 2006 and April 2010, 25 patients (21 males, 4 females; mean age 62.1±14.8 years; range 26 to 82 years) who underwent TEVAR due to AAS were included in this study. The preoperative and postoperative data was analyzed retrospectively using the file scanning method, and the long-term follow-up data was recorded during normal hospital visits at the sixth month and once a year thereafter. All 64-slice multidetector computed tomography (CT) scans were analyzed to acquire the necessary anatomical data.

### Surgical technique

All patients were operated on under general anesthesia in a hybrid operating room with an installed digital

angiography device. The mean time from the time of diagnosis to the operation was 41 hours. This long period was required due to the legal processes needed to supply the graft. For vascular access, the femoral artery was surgically explored (bilaterally in 3 patients), and a guidewire was introduced to the axillary artery. The Gore-TAG® thoracic endoprosthesis (W.L. Gore & Associates Inc., Flagstaff, Arizona, USA) and the Medtronic Vailant Endograft® (Medtronic Vascular, Santa Rosa, California, USA) were then implanted.

### Statistical analysis

For statistical analysis, the Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA), Windows version 15.0 was used, and the mean and median values with standard deviation for quantitative data were calculated employing the descriptive analysis method.

## RESULTS

The majority of the patients were diagnosed as having a type B dissection with complications (Table 1). In the dissection group, rupture occurred in 13 patients and malperfusion in five. Seven of the patients suffered from both of these complications. In these cases, however, the rupture was contained, and the malperfusion was not critical. The main risk factors of AAS are hypertension (76%) and smoking (56%), which are also associated with atherosclerosis. Before the procedure, eight patients had renal failure with no need of hemodialysis. In addition, three patients were diagnosed with different malignancies, and two had liver failure and an ischemic neurological event.

A total of 29 thoracic endografts were implanted in 25 patients. The idea behind the selection of the graft was primarily based on the anatomical features of the patients. The mean diameter of the aorta in the proximal landing zone (PLZ) was 27.68±3.5 mm. In the dissection group, the diameter of the endograft was chosen based on the diameter of the PLZ, but this was done without oversizing. In eight patients, zone 2 was used since we did not need to perform revascularization of the subclavian artery. In three patients, renal artery stents

**Table 1. The diagnosis of cases**

Diagnosis	n	%
Complications associated with		
type B dissection	15	60
Ruptured aneurysm of the descending aorta	2	8
Penetrating aortic ulcer	2	8
Traumatic aortic transection	4	16
Intramural hematoma	2	8

**Table 2. Postoperative events**

Complication	n
Respiratory	
Pneumonia	2
Prolonged mechanical ventilation	1
Cardiac	
Low cardiac output	3
Renal	
Acute renal failure	3
Infection	
Sepsis	2
Wound infection	1
Liver abscess	1
Vascular access complication	
Iliac artery rupture	1

were used, and in another, combined hepatic-superior mesenteric and renal artery stents were implanted due to the ischemic complication of the type B dissection. The patients were observed in the intensive care unit (ICU) for a mean time of 55.9±59.6 hours. Cerebrospinal fluid (CSF) drainage was not required for any of the patients.

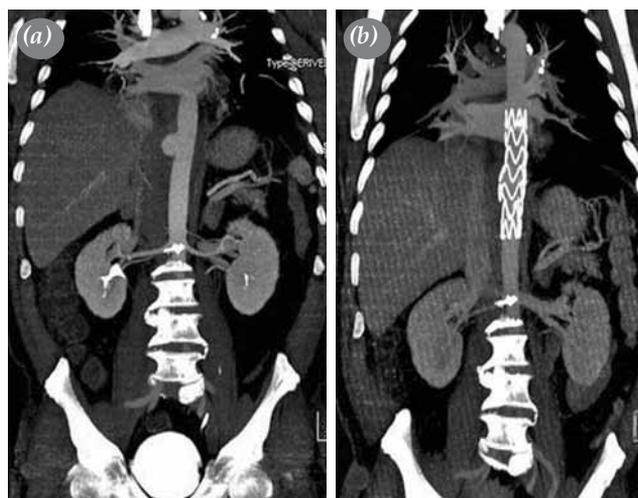
All patients were treated successfully with TEVAR, and none needed to switch to open surgery; however, one patient did need a graft interposition due to iliac artery rupture. Type 1 endoleak, a common complication related to this procedure, was not seen in any of the patients. One patient had type 2 endoleak, but no intervention was required. The distribution of other postoperative complications is shown in Table 2. It is important to emphasize that no new cerebral or spinal neurological events were seen in any of the patients. The

use of blood products was restricted since it contributes to a poor postoperative course. The mean use of the red cell product was 1.4 U/patient, but 10 patients required no transfusions. The mean time for hospital stay was 8.04±6 days, and the hospital mortality rate was 12% (n=3), with the causes of death being multiple trauma, sepsis, and multiorgan failure. In the dissection group, partial thrombosis of the false lumen occurred in two patients, and total thrombosis was achieved in the rest. The mean follow-up time was 20.2±16.8 months. Unfortunately, one patient died due to lung cancer at the 20<sup>th</sup> month of the procedure.

**DISCUSSION**

Since AAS pathologies can be lethal, they require emergency intervention. However, open repair of the DTA is associated with high mortality and catastrophic complications such as paraplegia and stroke. Hence, endovascular therapy has emerged as an alternative in recent years in order to decrease the early risks associated with open surgical repair.

Acute type B dissection, if there are no complications, can be treated successfully with anti-impulse therapy, including vasodilator agents, β-blockers and angiotension-converting enzyme inhibitors.<sup>[9-11]</sup> However, complications such as malperfusion or rupture require emergent intervention. The goal of TEVAR when complications are present is to close the entry of the dissection with stents in case of visceral ischemia fenestration of the aorta. A number of authors have had satisfactory results in their small series of type B dissections treated with this relatively new procedure.<sup>[1,5,6,12,13]</sup> Svensson et al.<sup>[4]</sup> did a meta-analysis on the endovascular treatment of thoracic aortic pathologies, and TEVAR was highly



**Figure 1. (a)** Penetrating aortic ulcer in the descending thoracic aorta in a 64-year-old male; **(b)** Shrinkage of the ulcer after a week of thoracic endovascular aortic repair.



**Figure 2. (a)** Computed tomography image of the traumatic aortic transection in a 26-year-old male; **(b)** Control computed tomography image 15 months after the procedure.

recommended in cases of type B dissections with ischemic complications. In our group, 15 patients were operated on because of complications associated with the dissection, and the mortality rate was 13% (n=2). One patient suffered a rupture and an ischemic neurological event prior to the procedure, and the other had visceral malperfusion. In the long-term follow-up, secondary intervention was not needed due to procedure-related events.

A ruptured aneurysm in the DTA has a mortality rate of over 50% because of the accompanying risk factors.<sup>[14]</sup> With open repair, the risk of paraplegia is 3.74%, and the risk of mortality is 4.8%, even when the surgery is performed by the most experienced team.<sup>[4]</sup> There are promising low morbidity and mortality rates with endovascular treatment, but it is necessary to know the extension of the aneurysm before undergoing this procedure. Because of the limited quantity of patients and the lack of comparative analyses in recent reports, the indication for TEVAR is controversial.<sup>[5,12,15]</sup> However, in our study, two patients with a ruptured thoracic aneurysm were discharged without any complications after this approach was used.

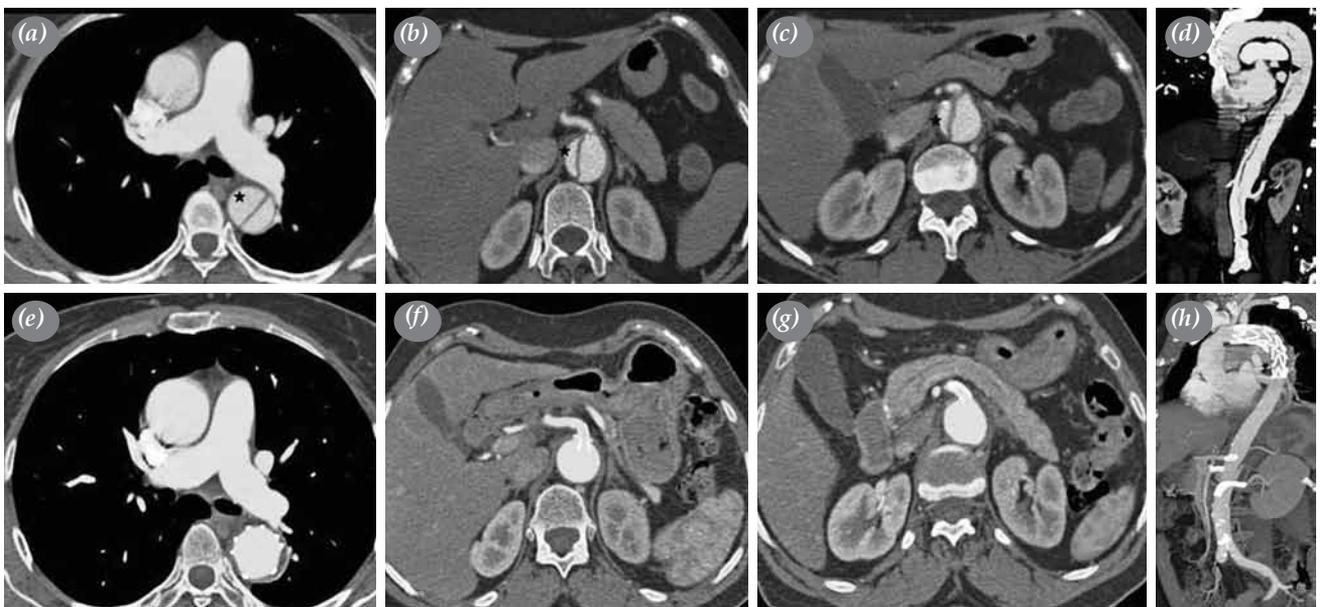
The isthmic part of the DTA is the most affected region because of blunt chest trauma. Open aortic graft replacement, which requires heparin administration, increases the risk of bleeding due to multiple traumas to treat TAT. In contrast, endovascular graft implantation is a quick and easy procedure, even without the use of heparin, for this

lethal disease since the anatomical features allow for easy implementation of the procedure. Buz et al.<sup>[8]</sup> and Barnard et al.<sup>[16]</sup> compared open repair and the endovascular approach and found that TEVAR presents a low risk of paraplegia and death in the early period. We operated on four patients with TAT, but one of them died during the postoperative course due to cranial bleeding.

Penetrating atherosclerotic ulcers and IMH, despite involving short segments of the aorta, carry a high risk of rupture. These diseases are members of the same AAS group and should be treated like aortic dissection.<sup>[17,18]</sup> With the advantages of the anatomical features of these pathologies, the success of intervention is higher. For example, in our study, two patients were operated for PAU and another one for IMH with no reports of any complications.

Because of the low numbers of patients and events, appropriate statistical analysis has not been sufficiently performed for TEVAR, but the low morbidity and mortality rates associated with it have proven to be satisfactory when compared with the literature.

As a result, TEVAR has become a viable option for the AAS group involving the DTA. However, prospective and randomized trials are needed to provide more evidence as to the efficacy of this procedure. Nevertheless, the early and midterm results of previously published studies have indicated that TEVAR is a safe and reliable treatment.



**Figure 3.** (a-d) Computed tomography images of a case of aortic dissection with visceral and renal malperfusion; (e) Control computed tomography images after the implantation of the endograft with the hepatic (f), mesenteric (g), and renal (h) stents.

### Declaration of conflicting interests

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