European Review for Medical and Pharmacological Sciences 2016; 20: 3743-3747

Aortic rupture of acute aortic dissection type treated with thoracic endovascular aortic repair (TEVAR)

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Abstract. – OBJECTIVE: Acute aortic dissection (AAD) is one of the most frequent aortic emergencies, which occurs to the vascular specialist. Endovascular reconstruction of the true lumen using minimally invasive stent grafting or stenting has become increasingly popular and widespread among institutions. The aim of this paper is to report a case series composed by twenty-eight patients, who underwent endovascular intervention for acute type B aortic dissections complicated by rupture using thoracic endovascular aortic repair (TEVAR).

PATIENTS AND METHODS: All patients with type B-AAD were admitted to the surgical intensive care unit and initially managed with a standing protocol for medical management of AD and observed for evidence of visceral or extremity malperfusion.

RESULTS: No major complications or adverse reactions occurred during the immediate postoperative period. Two patients died in the first three months of the study; both developed a cerebral ischemia. Three patients were lost at follow-up, the remaining twenty-three had a mean follow-up of 41.12±3.55 months (range: 36-58). CT scans were routinely performed at 3 months, 6 months, and yearly after the intervention for all patients.

CONCLUSIONS: Endovascular repair is developing as a strong alternative to surgery and may eventually evolve as a superior method for definitive treatment for patients with appropriate indications, such as complicated dissections. AD rupture may be more common in arch stent-graft patients with an ascending aortic diameter >4 cm and with a multi-stents placement.

Key Words
TEVAR, Acute aortic dissection, B-AAD.

Introduction

Acute aortic dissection (AAD) is one of the most frequent aortic emergencies, which occurs to the vascular specialist[1].

Endovascular reconstruction of the true lumen using minimally invasive stent grafting or stenting has become increasingly popular and widespread among institutions. It may have the potential to emerge as the first-line therapy for acute complicated aortic dissection[2,3].

An accurate classification of AAD is important to discriminate between a medical *vs.* surgical treatment.

The most common classifications are the DeBakey and the Stanford systems.

The majority of AAD are Stanford type A, they have higher mortality rates compared to Stanford type B, and early surgery is considered as the gold standard treatment[3].

Stanford type B dissections are treated by medical therapy, with surgical intervention reserved for patients developing complications. Mortality rates of 8% to 10% for medical treatment and 21% to 34% for surgical treatment have been reported over the years[4-7].

The risk of death in type B aortic dissection is increased in patients, which present with or develop complications such as aortic rupture, retrograde dissection, visceral and renal ischemia, lower extremities ischemia and with a total diameter of 4.5 cm or greater[8-11].

Other predictors of increased in-hospital death include age >70 years, hypotension or cardiac tamponade, kidney failure, and pulse deficits[12].

Moreover, patients with uncomplicated type B dissection report a 10% 30-day mortality. Hence, subjects with ischemic complications, such as renal failure, visceral ischemia, or contained rupture, who often require urgent aortic repair, report a 20% mortality rate by day 2 and 25% by day 30[13].

The landscape of surgical options in the treatment of complicated type B-AAD has changed radically during the last 2 decades, and numer-

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ous reports have demonstrated a significant reduction of mortality rates compared with open surgery[14-16].

In 2008, Svensson et al[16] in an expert consensus document stated that medical therapy remains the best treatment for uncomplicated chronic B-AAD.

Nowadays, there is a consensus[17] that patients with B-AAD should primarily be treated medically with tight blood pressure control, while reserving surgery for evolving complications [e.g. unrelenting pain, progressive aortic dilatation, malperfusion syndromes, or (imminent) rupture].

Intervention is justified in complicated chronic B-AAD; in patients with significant aortic dilatation (maximum thoracic aortic diameter >5.5 mm), rapid aortic growth (>1 cm/year), the development of unrelenting pain, uncontrollable hypertension, end-organ ischemia or aortic rupture[18-21].

The role of thoracic endovascular aortic repair (TEVAR) in TBAAD remains still controversial[22-26].

Once the aortic diameter exceeds 60 mm, the risk of FL rupture is estimated at 30% per annum[27-28].

The aim of this paper is to report a case series of 28 patients treated for acute type B aortic dissections complicated by rupture using TEVAR, assessing the short- and mid-term results.

Patients and Methods

The study sample was composed of a population derived from patients presenting at the Department of radiological sciences, at "Sapienza" University of Rome, for type B AAD management, who were treated by TEVAR in an interval of time between 2010 and 2012.

During the study period, there were 114 patients admitted to the surgical intensive care unit for aortic dissections: they were initially managed with a standing protocol for medical management of AD and observed for evidence of visceral or extremity malperfusion.

Rising serum lactate levels, persistent abdominal pain, inability to advance to an oral diet, rising serum creatinine levels, and inability to wean intravenous anti hypertensive medication were all considered evidence of persistent malperfusion. Pain alone was not used as an indication for endovascular intervention.

Our study group included 28 patients with AD complicated with rupture, which underwent endovascular intervention (Table I).

They were both males (n=19, 67.85%) and females (n=9, 32.15%), with a mean age of 47.4±5.13 (range: 40-69) years.

All surgeries were carried out upon general anesthesia and a controlled hypotension (90 mm/Hg) was maintained.

Endografts were sized based on anatomic measurements performed on the admission computed tomography (CT) scans, the diameter of the normal aorta proximal to the dissection and the diameter of the crescent formed by the true lumen collapse in the descending aorta were calculated.

The Cook Zenith stent graft (Cook Medical, Bloomington, IN, USA) was used as endograft to cover the entry site in all patients treated in the study.

Access for endograft delivery was performed using a femoral cutdown (n=17, 60.71%) or the Left brachial artery (n=11, 39.29%).

Adequate true lumen and visceral flow were verified by completion angiography, in order to evaluate endoleak absence and the correct graft position (Figures 1, 2, 3).

Table I. Study group.

Demographics	
Age	47.4±5.13 (range: 40-69)
Male	19 (67.85%)
Female	9 (32.15%)
Patient's history	
Hypertension	20 (71.4%)
Marfan syndrome	2 (7.14%)
Atherosclerosis	14 (50%)
Prior cardiac surgery	4 (14.28%)
Presenting hemodynamics	
Hypertension	25 (89.28%)
Hypotension	3 (10.72%)
Pain severity	
Moderate	7 (25%)
Severe/Worst ever	21 (75%)
Malperfusion	
Acute renal failure	3 (10.71%)
Limb ischemia	3 (10.71%)
Leg pain	6 (21.42%)
Any pulse deficit	7 (25%)
Aortic diameter	
>4.5 cm	9 (32.14%)
<4.5 cm	19 (77.86%)
TEVAR access	
Femoral cutdown	17 (60.71%)
Left brachial artery	11 (39.29%)

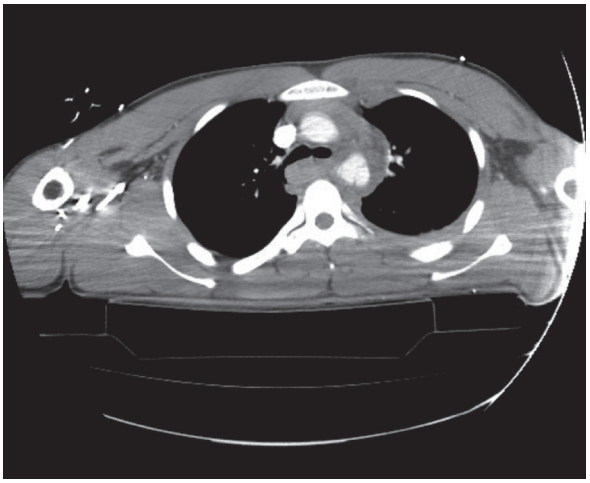

Figure 1. Pre-operative CT angiography of a 53 years old male (G.S.), which shows the rupture of the aortic isthmus and a mediastinal haemorrhage.

Figure 2. Intra-operative angiography of the same patient.

Medical management was performed after the procedure: patients received oral antihypertensive drugs.

Spinal drainage was not used prophylactically but was instituted emergently if evidence of lower extremity weakness was developed.

Results

No major complications or adverse reactions occurred during the immediate postoperative period.

Two patients died in the first three months of the study; both developed a cerebral ischemia.

Three patients were lost at follow-up, the remaining twenty-three had a mean follow-up of 41.12±3.55 months (range: 36-58).

CT scans were routinely performed at 3 months, 6 months, and yearly after the intervention for all patients.

Discussion

Endovascular repair is developing as a strong alternative to surgery and may eventually evolve as a superior method for definitive treatment for patients with appropriate indications (complicated dissections).

The principle goals of endovascular management are:

1. Establish access to the true lumen.
2. Cover the entry tear with an endograft.
3. Correct any static or dynamic obstruction to the true aortic lumen and the visceral, renal, and lower extremity arteries.

Frequently, after the first two goals have been accomplished, the third goal is fulfilled by a windsock effect, restoring the true lumen flow.

Intuitive advantages include the ability to obliterate the false lumen by sealing the aortic tear with an aortic endograft, thereby repressurizing

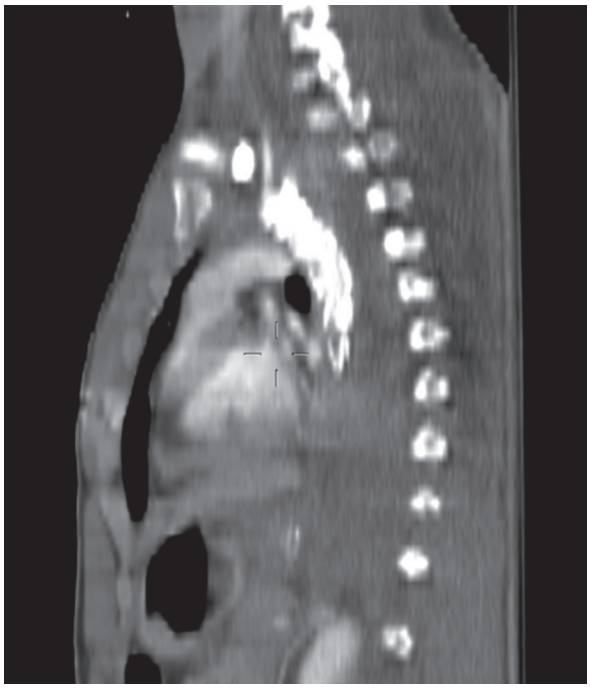

Figure 3. Post-operative CT angiography.

the collapsed true lumen and abolishing any distal malperfusion.

Among patients with acute type B aortic dissection, false lumen rupture causes _60% of associated deaths.

Continued patency of the false lumen has been reported as leading to aneurysmal dilatation; but even if only partial thrombosis of the false lumen is achieved, the endograft may still protect the false lumen from enlarging over time[29].

Several studies have reported results of TEVAR for complicated acute type B aortic dissections (c-ABAD)[30-32].

However, the term "complicated" brings together a large range of clinical presentations and indications, from the most dreaded rupture, to softer ones such as unrelenting chest pain or rapid aneurysmal enlargement.

In the management of a rupture, TEVAR is usually performed as an emergent procedure, using off the shelf stent grafts, which are not always the most appropriate. In addition, in the setting of this specific complication, some questions remain about the role and length of the stent graft: is coverage of the proximal entry tear sufficient only to stop bleeding or should the stent graft cover the entire dissected aorta with an increased risk of paraplegia (30-32)?

The perioperative aortic dissection (AD) rupture is a severe event after endovascular stent graft placement for treatment of type B AD. However, this life-threatening complication has not undergone a systematic investigation.

Conclusions

Thoracic AD endovascular repair is a safe and effective treatment option for AD with relative low in-hospital mortality. AD rupture may be more common in arch stent-graft patients with an ascending aortic diameter = 4 cm and with severe dissection that needs multi-stent placement. Attention should be paid to a proximal bare spring stent that has a higher probability of inducing an AD rupture. Post balloon dilation should be performed with serious caution, particularly for the migration during dilation.

Conflict of Interests

The authors declare they have no competing financial interest.

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