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ORIGINAL ARTICLE

The Outcome of Thoracic Endovascular Aortic Repair in Patients with Thoracic Aortic Diseases

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ABSTRACT

Background: Open surgical repair (OSR) for TAAs is associated with a high perioperative morbidity and mortality, depending on the extent of repair. Also, because of the high mortality rates associated with OSR; stable patients with uncomplicated type B AD frequently obtain medical treatment. The aim of this work is evaluation the efficacy and predictors of outcomes of early thoracic endovascular aortic repair in patients with uncomplicated type B aortic dissection and patients with thoracic aortic aneurysms.

Methods: A total of 25 patients with uncomplicated type B AD and descending thoracic aortic aneurysm who underwent endovascular aortic repair in National Heart Institute in the period between 2015 and 2017 were included in the study.

Results: Of the 25 patients, 5 patients had a descending thoracic aortic aneurysm, and 20 patients had uncomplicated type B AD, the total mortality rate was 8 % throughout the follow-up period. Procedure related complications were observed in 8 % of the study population, where 2 patients developed type I endoleak, which resolved spontaneously during the follow up period. Both death and endoleak occurred in subacute and chronic cases, while using TEVAR in acute AD and aortic aneurysms showed no complications.

Conclusion: Early thoracic endovascular aortic repair, along with optimal medical therapy, in uncomplicated type B aortic dissections and thoracic aortic aneurysms is associated with better outcome.

Keywords: Aortic repair, Thoracic aortic disease, Endovascular repair.

INTRODUCTION

Aortic dissection (AD) is a potentially life-threatening condition. Data on the epidemiology of AD are scarce. In the Oxford Vascular study, the estimated incidence of AD is 6/100,000 persons per year. This incidence is higher in men and increases with age. [1]

The prognosis is worse in women, because of atypical presentation and delayed diagnosis. The most common risk factor associated with AD is hypertension, mostly poorly controlled. [2].

Aortic dissection (AD) is classified according either De Bakey (Type I, II and II) or Stanford (Type A and B) classifications. Stanford classification considers the extent of dissection, rather than the location of the entry tear [3]. Type B aortic dissection may be classified as uncomplicated or complicated. Approximately 25% of patients presenting with type B aortic

dissection are complicated at admission by malperfusion syndrome or hemodynamic instability, resulting in a high risk of early death if untreated. [4] Because of the high mortality rates associated with surgery, stable patients with uncomplicated type B dissection usually receive non operative treatment. Aproximately,70% of type B aortic dissections are uncomplicated and are medically treated only which carries a 50% 5-year mortality rate. [5,6]

The incidence of TAA seems to be increasing. In studies done where the population is stable and postmortem examinations are routinely performed, there was an actual increase in the incidence of TAA over the past decades [7]. Open surgical repair (OSR) for TAAs is associated with a perioperative paraplegia rate of about 2% and a mortality rate of approximately 10%, depending on the extent of repair.

Since the approval of the first endograft device by the U.S. Food and Drug Administration (FDA) in 2005, thoracic endovascular aortic repair (TEVAR) has become the preferred approach for management of thoracic aortic pathology. Recently, the total number of thoracic endovascular procedures has risen. The increased use of TEVAR has been motivated by the early mortality and morbidity advantage reported when endovascular therapy is compared with OSR of the thoracic aorta. [8]

In patients with suitable anatomy, TEVAR is now considered the first-line therapy for isolated aneurysms of the descending thoracic aorta [9]. Also, TEVAR is recommended in treatment of complicated type B aortic dissection and should be considered in uncomplicated aortic dissection. [10]

The aim of this study is to evaluate the efficacy and predictors of outcomes of early thoracic endovascular aortic repair in patients with uncomplicated type B aortic dissection and patients with thoracic aortic aneurysms through 18 months follow up.

METHODS

This study included 25 patients recruited from the patients with uncomplicated thoracic type B aortic dissection and descending aortic aneurysm who had expected lifespan longer than 1 year and underwent endovascular aortic repair in National Heart Institute in the period between 2015 and 2017. Patients who had Femoral, iliac, or Aortic disease hampering catheterization, patients with a dissection involving the ascending aorta, patients with a history of bleeding diathesis, sepsis or endocarditis, and patients with severe valvular or CAD needed surgical intervention were excluded.

The Ethical approval for research was obtained from the Research Ethics Committee, Faculty of Medicine, Zagazig University. Written informed consent was obtained from all participants. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

All patients were subjected to full history and physical examination. 12 lead ECG, chest X-ray, full echocardiographic evaluation was performed for all patients. CT scan was done for all patients including the whole aorta (thoracic and abdominal) and iliac-femoral axis. The following parameters were calculated: Diameter of the aorta at different levels (ascending, aortic arch, thoracic and abdominal aorta),size and morphology of the aneurysm and its relationship to the side branches, associated abdominal aortic aneurysms, length of the healthy proximal and distal landing zones (typically $\geq$ 20mm) and diameter (typically $\leq$ 40mm), site of the proximal entry tear of the dissection, its extent and the involvement of important aortic branches (e.g. left subclavian artery), and anatomy of the coronary arteries. (Figure 1)

Team of TEVAR included 2 interventional cardiologists, 1 cardiac surgeon and an anesthesiologist. The procedure was done under general anesthesia and mechanical ventilation using fluoroscopy with contrast injection and intra-operative TEE for accurate positioning. In situations involving important aortic side branches (e.g., left subclavian artery), TEVAR was often preceded by limited surgical revascularization of these branches (the 'hybrid' approach)

Clinical follow-up data was collected at one, three, six, twelve and eighteen months thereafter. Clinical follow-up events included: death from all causes, Aorta related deaths, neurological deficits (stroke or TIAs), symptoms of chronic peripheral malperfusion syndrome (claudication, abdominal pain) and 2^{ry} endovascular or surgical re-intervention. Multi-slice CT was performed at three, twelve and eighteen months after intervention, and according to the clinical situations, to detect procedure related complications e.g., presence of endoleak and its type, stent migration, and/or aneurysmal expansion of aorta (Figure 2).

Primary outcome measures

The primary endpoints were technical success during implantation, 30-day all-cause mortality and surgical conversion. The technical success of TEVAR was defined as successful deployment of the stent graft with complete coverage of the primary entry tear and no signs of type I endoleak at the end of the procedure. Technical success during using hybrid technique included successful open visceral bypasses.

Secondary outcome measures

The secondary endpoints were the number of procedure-related complications and secondary procedures. A complication was defined as any graft-related complication: endoleak, endotension, migration, kinking, or thrombosis of the stent-graft. Possible risk factors for graft related complications were also assessed. A secondary procedure was defined as any endovascular or surgical intervention to restore or maintain proper stent-graft function after the initial procedure.

STATISTICAL ANALYSIS

Analysis of the data obtained from the database was done by Statistical package for social sciences version 20 (SPSS 20) program. Data was expressed in terms of frequency as numbers and percentages for categorical variables and as mean value ± standard deviation (SD) or median for numerical variables.

RESULTS

This prospective observational study included 25 patients who were divided into two groups based on the nature of the aortic disease (Table 1).

Group A: Included twenty patients who had uncomplicated Type B-AD (uTBAD), fifteen patients underwent absolute TEVAR and five patients needed a Hybrid technique. Patients presenting with acute AD were nine patients, while patients presenting with subacute AD were five patients and those presenting with chronic AD were six patients.

Group B: Included five patients who had thoracic descending aortic aneurysm who underwent absolute TEVAR.

In our study population, male gender predominated (88% males versus 12% females), with mean age (56.9 ± 8.2). Smoking and elevated blood pressure were the predominant risk factors. Twenty-two patients were hypertensives (88%) and the same number for smoking. Only five patients were diabetics (20%), while sixteen patients had dyslipidemia (64%) and eight patients had CAD (32 %)

The median follow-up time was 18 months. None of the patients were lost during follow-up. Two cases of type I endoleak (8%) were reported at 12 and 24 weeks, respectively, after the initial procedure, one of them had chronic AD and the other case had subacute AD. Both improved spontaneously during the first 12 months of follow up. The mortality rate was (8%). Two cases died during the first month of follow up period; both had chronic AD. The main causes of death were sepsis and acute kidney injury (Table 2 & Figure 3). Complications reported mainly in patients who underwent hybrid technique (p-value 0.01). Two out of the five cases that underwent hybrid technique died (both had chronic AD) and one case developed type I endoleak (had subacute AD) (Figure 4). None of neither thoracic aortic aneurysm cases nor acute cases of aortic dissection died or developed endoleak after the procedure.

None of our patients developed stroke/TIA, spinal cord ischemia or graft-related complications (e.g., endotension, migration, thrombosis, and kinking). Also, none of them underwent TEVAR re-intervention during the 18 months of follow up.

In our series, the complications were more evident in the non-acute cases of AD, this may indicate, that the early use of TEVAR in acute presentation of dissection was associated with better outcome. Also, the complications were more evident when using the Hybrid technique.

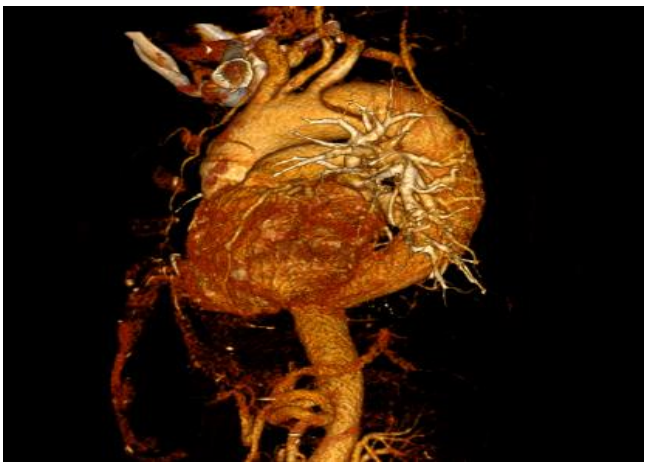

Fig. (1): CT scan image showed dissecting flap in descending aorta.

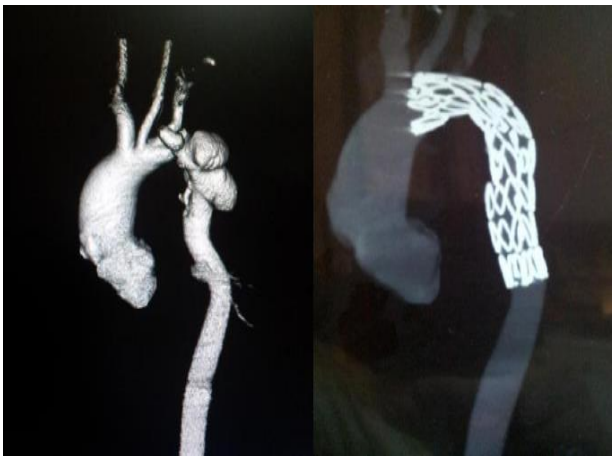

Fig. (2): CT scan image shows the multiple thoracic aneurysm and post TEVAR

Table 1: Distribution according to the nature of the aortic disease.

Nature of aortic disease		All patients
Number (%)		25 (100%)
Group (A)	Acute AD	9 (36%)
	Subacute AD	5 (20%)
	Chronic AD	6 (24%)
Group (B)	TAAs	5 (20%)

Table 2: In-hospital and 18 months outcome of the whole study population.

In-hospital and 18 months outcome	All patients
Number (%)	25 (100%)
Outcome	
Stroke / TIA	0 (0%)
Spinal cord ischemia	0 (0%)
Death	2 (8%)
Endoleak	2 (8%)
Re-intervention	0 (0%)

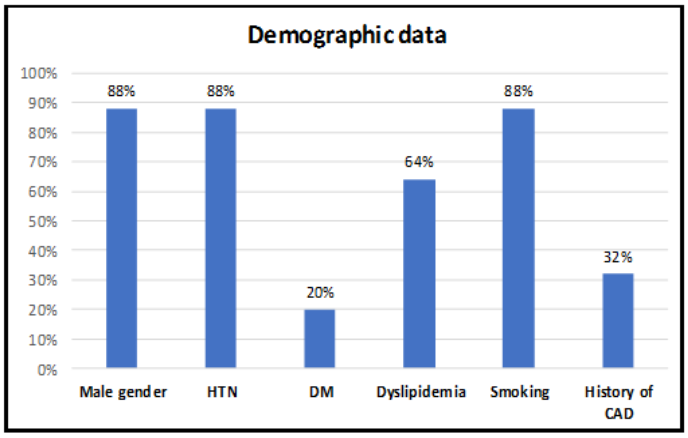

Fig. (3): Distribution of the study cases according to history of hypertension, diabetes, dyslipidemia, CAD and smoking.

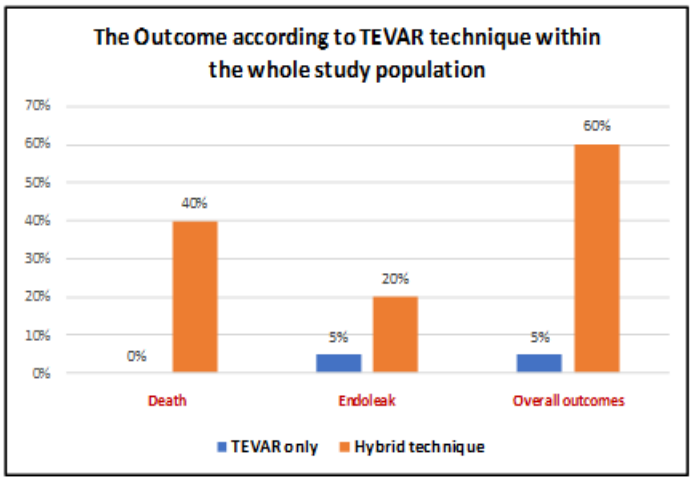

Fig. (4): The outcome according to TEAR technique in whole study population.

DISCUSSION

Thoracic endovascular aortic repair (TEVAR) as a management option for type B aortic dissection patients is considered lifesaving in the setting of complications such as malperfusion syndrome or contained rupture [11], although its role in uncomplicated cases is not well known. Traditionally, stable patients are managed with

medical treatment with annual survival ≥80%, however long-term outcomes are sobering because of aneurismal expansion and a 30% cumulative mortality at 5 years [12]. Consistently, false lumen perfusion is considered a signal of adverse outcome, whereas complete thrombosis of the false lumen may evoke remodeling and improve outcomes [13]. The role of TEVAR as a treatment option of uncomplicated type B aortic dissection has remained a controversial debate. Although short-term results of conventional medical therapy have been acceptable, suboptimal long-term results have frankly been disappointing, with about (20%) of patients developing late complications requiring intervention and (30% - 40%) cumulative mortality risk at 5 years. The development of late aortic complications and compromised long-term survival have encouraged investigators to achieve a more effective therapeutic approach and evaluate the potential role of TEVAR in this patient population [14]. Booher AM, et al. reported in the international registry of acute aortic dissections (IRAD) that placement of an endograft in the acute setting increased the risk for retrograde type A dissection, distal malperfusion, stroke and paraplegia. [15]

Luebkeb et al., demonstrated that TEVAR may not be the treatment of choice in all patients with uncomplicated type B AD because of the intrinsic periprocedural and stent graft induced complications. [16]

By contrast, in our study we observed that the early use of TEVAR in acute cases with uncomplicated Type B AD and thoracic aortic aneurysm had a favorable outcome. The primary technical success rate was excellent, with no primary conversions. All complications occurred during the follow-up period were observed only in patients with subacute and chronic AD, mainly in patients underwent hybrid technique.

These findings were like that of several studies: in the ADSORB trial, which evaluated TEVAR + BMT vs. BMT alone in patients with acute type B AD, Hughes GC. demonstrated a zero neurological complications and aorta related mortality rates in both groups but aortic remodeling after one year was in favor of TEVAR [17]. Nienaber et al. also reported in INSTEAD XL Trial, a study of survivors of type B aortic dissection, that TEVAR in addition to BMT was associated with delayed disease progression and improved 5-year aorta-specific survival. [18] Oikonomou et al. also, reported also that early TEVAR enhances false lumen thrombosis, provokes remodeling of the aortic wall, and should be considered preventively in selected patients with suitable anatomy [19]. Siwen Wang, et al. in a study compared TEVAR in addition to BMT vs. BMT alone in patients with acute uncomplicated type B AD, found also a better long-term survival rate and favorable aortic remodeling rates in TEVAR group. [20] *Bell et al.* reported low rates of reintervention after TEVAR and a low risk of complications, particularly neurological complications. They therefore encouraged the use of endovascular approach for certain aortic arch and descending aortic pathologies, particularly in elderly patients [21]. *Patel et al.* in VALOR trial, reported a superior 30-day and 1-year outcomes of TEVAR in patients considered low or moderate risk for OSR compared with surgical repair of descending thoracic aneurysms. [22] In VALOR II trial, Fairman *RM et al.* reported that TEVAR was an effective and safe treatment for patients with descending thoracic aortic aneurysms of degenerative etiology at the 1-year follow up. [23]

CONCLUSION

According to our observational study, early TEVAR in acute cases with uTBAD and thoracic aortic aneurysms along with optical medical therapy has a favorable outcome. Also, we noticed that complications were more common when TEVAR was accompanied by hybrid technique, so more caution should be taken when we use TEVAR in these circumstances.

Conflict of Interest

The authors of this manuscript declare no relevant conflicts of interest, and no relationships with any companies, whose products or services may be related to the subject matter of the article.

Financial Disclosures: None.

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