TEVAR for Blunt Traumatic Thoracic Aortic Injuries, A Single Centre Experience

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ABSTRACT

Background: *Thoracic aortic injury from blunt trauma is a life-threatening condition with significant mortality and morbidity with open surgical repair. Endovascular means of treatment is an attractive and less invasive option. We report our experience with TEVAR for blunt traumatic thoracic aorta injuries.* ***Aim of study:*** *A retrospective analytic study presenting Cairo University Hospitals' experience in managing traumatic thoracic aortic injuries' patients by TEVAR.* ***Methodology:*** *From Jan 2012 till Jan 2015, 11 patients with post traumatic thoracic aortic injuries presented to our vascular surgery unit were subjected to Endovascular stent graft repair. All patients were followed up for 12 months.* ***Results:*** *All procedures were technically successful; we didn't have any early post-operative mortality. None of our patients experienced neurological deficits, one patient had a Type II endoleak within 6 months that was relieved spontaneously and unfortunately we had one mortality at 6 months that was not aorta related.* ***Conclusions:*** *Our early experience of TEVAR for management of blunt traumatic thoracic aorta injury suggests that this technique is safe for treatment of such pathology. Left subclavian artery may be sacrificed if adequate proximal landing zone is required for the stent-graft with tolerable outcome.*

INTRODUCTION

Patients with blunt traumatic thoracic aorta injuries are increasingly admitted to hospital due to the increasing number of road traffic accidents[1, 2].

This condition is potentially fatal and if untreated the mortality rate can reach up to 90%.

The main aetiology of aortic injury in thoracic blunt trauma is rapid acceleration / deceleration injury. The trauma mechanisms described have included shear forces applied at the ligamentum arteriosum, acute compression by the diaphragm, torsion of the aorta, acute intravascular hypertension and/or compression of the aorta between the sternum and spine (osseous pinch) [3].

Traumatic thoracic aortic injuries are usually located distal to the left subclavian artery because of the fixation of the descending thoracic aorta by intercostal arteries, pleura and the ligamentum arteriosum. Thus the descending aorta is more rigidly fixed than the aortic arch and the heart during its course through the vertebral sulcus.

During a horizontal deceleration trauma, the descending and other parts of the aorta move at different speeds. As a result, the isthmic part of the aorta is under maximum stress, and may yield totally or partially leading to rupture of the vessel. [1]

Fortunately, acute and chronic traumatic lesions of the descending aorta can now be treated via an endovascular approach TEVAR, with low morbidity and mortality rates, [4,5]

The TEVAR procedure involves the placement of an expandable covered stent graft within the thoracic aorta to seal blunt aortic injuries from within, thus avoiding direct aortic surgery. Yet, TEVAR procedure requires suitable proximal and distal landing zones for the stent graft anchoring**(5)**.

Nowadays, Thoracic endovascular aortic repair (TEVAR) has become the standard of care for descending thoracic aortic aneurysms (DTAAs). Mainstream technology had advanced at a rapid pace since the release of the first commercially available endo-graft in 2005 with the TAG device (W.L. Gore and Associates, Flagstaff, AZ)[4].

We at Cairo University hospital, recently adopted TEVAR as a new alternative method to treat patients with thoracic Aortic pathologies.

METHODOLOGY

During the period of three years, from Jan 2012 till Jan 2015, 11 cases with blunt thoracic aortic injuries received TEVAR procedure.

Patients' presentation was either acute at the time of the initial trauma or chronic presenting late with chronic thoracic aortic contained injury

During the initial presentation at the time of their trauma, patients' were received at our causalty department with multiple trauma following RTA.

After the initial management and resuscitation of these patients, according to the ATLS protocol, patients were thoroughly examined and plain chest x-ray, followed by CT chest were done to all patients with suspected thoracic aortic injury to confirm the diagnosis

Other associated non aortic injuries were searched for and evaluated. Our protocol was to manage those with life threatening associated injuries before commencing with the TEVAR

Patients presenting late after their initial trauma event to our OPD department with symptoms suggestive of thoracic aortic injury were scheduled for Multi Slice CT angiography.

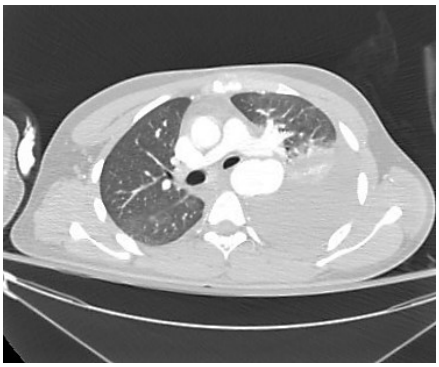


Fig. 1. Pre-op CT showing Massive Left Haemothorax

Sizing and Strategy:

We used Osirix software application for Mac for measurement of the diameters of the proximal and distal landing zones, as well as the intended length of Aorta to be covered.

Device Diameter Selection was based on 1:1 strategy (No oversizing). As for the device length, our goal was to achieve a minimum of 2 cm for the proximal landing zone of and 4 cm for the distal landing zone

Coverage of the left subclavian artery was indicated whenever the lesion was less than 2 cm from its origin, in our study it was done in 7 patients

All patients were admitted to ICU prior to the TEVAR and had the procedure done 2 to 5 days after admission.

All procedures were done in our Angio suite under General anaesthesia.

A pre-operative prophylactic CSF drainage catheter was inserted for all patients and Trans-oesophageal echo (TEE) was used whenever the exact site of the aortic injury was not evident on CTA.

We did a femoral cut down access for the Device delivery to all patients with percutaneous right brachial artery cannulation for Diagnostic catheter insertion. The Choice of femoral artery for access was based on patency, size and minimal anatomic tortuosity.

Fig. 2. Intraop showing Femoral exposure and percutaneous brachial cannualtion

All patients were transferred back to ICU for the post-operative management. Patients were closely monitored and examined for vital signs, ischemic manifestations (both Upper and Lower limbs) and any neurological deficit (Lower limbs)

All patients have been followed up by clinical examination and CT imaging in the OPD on 1 month, 6 months and 1 year intervals.

RESULTS

The Duration of our Study was 3 years, from Jan 2012 till Jan 2015.11 patients had TEVAR for blunt thoracic aortic injury, all of them following RTA,10 (90.9%) were car drivers, while 1 (9.1%) were motorcyclist.

Ten patients were males (90.9%). The age varies from 22 till 43 with the mean age 32.5 years.

Seven patients presented during their initial multi-trauma event (70.1%). Other 4 patients presented within one week of their trauma.

All of them presented with multi-trauma (100%), In 10 patients the main presentation was chest pain (90.9%), in 4 patients there was dyspnoea (36,3%). 8 of our patients had an associated Limb fracture, one had Pelvic fracture and one had concussion. One patient had associated abdominal trauma and intraperitoneal haemorrhage, he was the only patient to have an urgent abdominal exploration prior to our TEVAR which revealed ruptured spleen and multiple ileal tears.

Plain x ray imaging showed multiple rib fractures in 9 patients (81.8%), widening of Mediastinum in 6 patients (54.5%) and left haemothorax in 3 patients only(18.2%). In 3 patients CTA revealed intimal fap with intramural haematoma (27.2%) while 8 patients had a pseudoaneurysm (72.8%).

All patients were admitted to ICU prior to TEVAR and were readmitted after the procedure. All patients were done in the Angio suite under GA. All patients had prophylactic CSF Drainage and Trans-oesophageal echo was used in 2 patients only (18.2%).

We used the Cook Zenith TX2® in 6 patients (54.5%), the Medtronic Valiant Captiva® in 4 patients (36.4%) and Bolton Medical Relay NBS device® (with single scallop) in one patient only(9.1%). Graft diameters used ranged from 32 mm to 42 mm. In two patients Zone 3 was used as a proximal Landing zone, in 7 patients it was zone 2, and in only 2 patients it was zone1.

In two patients that we had to land in Zone 1, one patient had a sub-platysmal carotid-carotid bypass 24 hours before the TEVAR while in the other we used a scalloped graft positioned against the left Carotid take off.

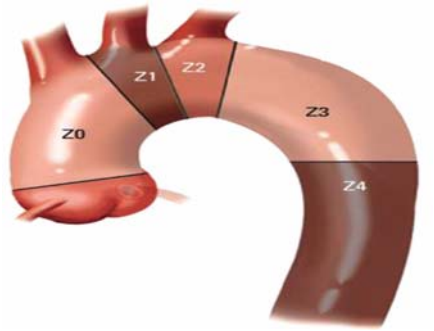


Fig. 3. Different proximal landing Zones for TEVAR

From 7 patients who had LSA coverage only one needed carotid subclavian bypass 4 months after the TEVAR for persistent left arm claudication(14.3%)., while in the others the LSA coverage was well tolerated.

We had a 100% technical success. We didn't have 30 day mortality but, we had one mortality in 6 months which was not aorta related (9.1%). One patient had a minimal Type II endoleak and was followed up closely with spontaneous resolution wthin 6 months (9.1%).

We did not record any spinal cord ischaemia. One patient had non-significant Device migration (9.1%), in that case we intentionally covered the LSA take off, yet in 6 months follow up his CTA study showed partial exposure of the LSA origin with no subsequent endoleak.

DISCUSSION

Traumatic thoracic aortic injury is typically fatal. The thoracic aorta wall ruptures after blunt thorax trauma and if not treated, has very poor outcome with an initial survival rate ranging from 10 to 30%. The hospital mortality rate is up to 32% during the first day, 61% within the first week and 74% after 2 weeks. Moreover, according to the literature, patients surviving the acute phase without surgery had a 30% risk of late traumatic thoracic aorta aneurysm rupture, [(6)]

Absent External Contour Abnormality Present External Contour Abnormality

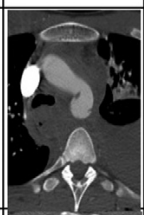
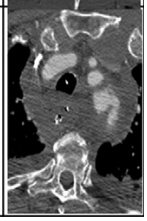
Type of Aortic Injury	*Definition*	*Example*	*Type of Aortic Injury*	*Definition*	*Example*
Intimal Tear	No aortic external contour abnormality: tear and/or associated thrombus is <10mm		**Pseudoaneurysm**	Aortic external contour abnormality: contained	
Large Intimal Flap	No aortic external contour abnormality: tear and/or associated thrombus is >10mm		**Rupture**	Aortic external contour abnormality: not contained, free rupture	

Fig. 4: New Classification of Thoracic aorta blunt injuries [12]

Endovascular repair is particularly attractive in managing patients whose associated injuries or comorbid conditions put them at greater risk for open repair. The main advantages include shorter time procedure and lower operative risk. Another benefit acquired from this technique is the absence of cardiopulmonary bypass and the low-dose systemic heparinization [7]

If the patient is not affected by other priority life-threatening injuries, endovascular repair should be performed at first before any other surgical treatment in order to eliminate the risk of sudden aortic rupture,[6].

Results of a meta-analysis, by Tang GL et al, comparing the 30-day outcomes between 278 aortic ruptures managed surgically vs. 355 managed by endovascular means showed no significant differences in injury severity or age between the groups. The endovascular group had significantly lower mortality (7.6% vs. 15.2%, p=0.008), paraplegia (0% vs. 5.5%, p<0.0001) and stroke (0.81% vs. 5.1%, p=0.003) compared to the open surgical repair cohort, [8]

In a similar study by Leong Tan GW,et al, over 6 patients treated by TEVAR for blunt aortic injury technical success was 100%. Five patients (83.3%) had the left subclavian artery intentionally covered by the stent-graft to achieve adequate proximal landing zone. None of them had any left upper limb ischemic complications or cerebrovascular events after the procedure, [9]

Despite great achievements from endovascular stent grafts, several complications of endovascular stenting have yet remained. Although complications do not occur frequently, endoleak, stent collapse, subclavian occlusion, stroke, embolization, post implant syndrome, iatrogenic dissection, migration, and paralysis may develop, [10, 11]. In our cases, procedure-related complications did not develop. Blood flow to left subclavian artery was not disturbed by the endovascular stent coverage except in one case.

More reports and follow up data about endovascular stenting in traumatic thoracic aortic injury have been presented recently. Endovascular treatment for acute traumatic aortic rupture is feasible and represents a valid alternative to conventional open surgery in selected patients.

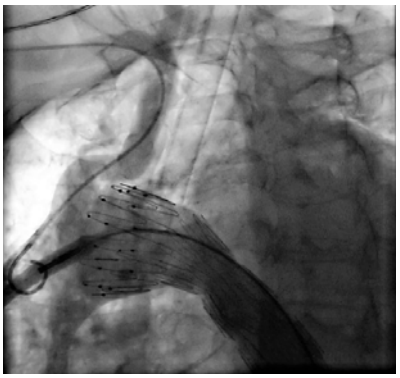


Fig. 5. Case with Landing zone one

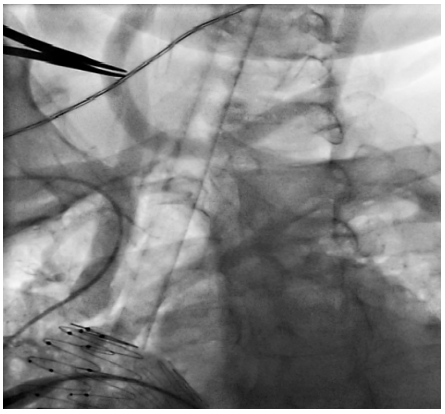


Fig 6: Same case showing Landing zone 1 and Carotid-Carotid Bypass (Marked by instrument)

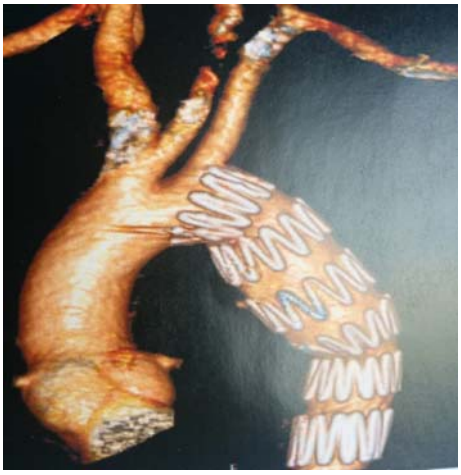


Fig. 7: Another case with landing zone 3

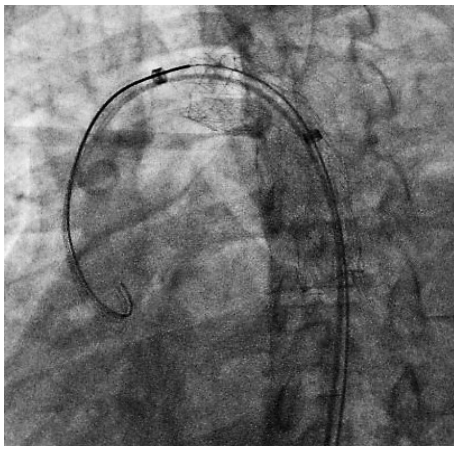


Fig. 8: Another Case during stent graft deployment

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