Original Article

Endovascular Intervention in Blunt Traumatic Aortic Injury: Experience in Ramathibodi Hospital

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Background: Blunt thoracic aortic injury (BTAI) or transection is associated with high morbidity and mortality. Current standard practice recommended endovascular repair over open surgical repair, especially in patients with suitable anatomy.

Objective: The authors reviewed our center experiences with endovascular repair of BTAI.

Materials and Methods: Medical records of patients with BTAI treated with endovascular repair in the past 7 years at Ramathibodi Hospital were reviewed. Baseline demographic data, Injury Severity Score (ISS) at index events, procedure details and follow-up evaluation of clinical symptoms and imaging were obtained and analyzed.

Results: From September 2014 to May 2020, 10 patients (8 men, 2 women) with mean age of 44.9±22.8 years (range 13 to 90), and mean ISS of 35.7±16.1 (range 20 to 66), were diagnosed with BTAI. Nine of them underwent uneventful endovascular repair, while one patient experienced iatrogenic cardiac tamponade. All endovascular repair procedures were performed under general anesthesia, and none of the patients received heparin due to multiple co-trauma or undergoing operation for other associated injuries. Endovascular stent grafts covered left subclavian arteries in 8 of 10 patients. There was no immediate complication in term of dead, post-procedural stroke or paraplegia as well as no symptom of left arm claudication or ischemia was reported. Mean follow-up duration was 25.5±24 months (range 2 to 73), with at least one computerized tomography angiography (CTA) performed in each patient. Neither endoleak nor stent migration were documented.

Conclusion: Despite the small number of patients at our center, endovascular repair of BTAI appeared to be safe and had satisfactory outcomes. However, further long-term follow-up is needed for evaluation of durability and late complications.

Keywords: BTAI; Endovascular stent

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Blunt thoracic aortic injury (BTAI) is the most common cause of death in thoracic trauma patients[1], because of its nature of immediate fatality at the scene from free aortic rupture, and only minority of cases can reach hospital. Moreover, thoracic injuries are usually accompanied by multiple concomitant injuries to other organ systems. In the past, the approach to delay surgical repair for BTAI was used, due to presence of associated injuries and risk of post-operative paraplegia in high-risk patients. It was common to wait until other associated injuries improved before the patients underwent open surgical repair for thoracic aortic injury[2,3]. Since the year 2000, there were many reports regarding the use of endovascular stent graft for repairing BTAI, which consistently demonstrated that endovascular repair was associated with decreased morbidity and mortality[4,5]. Recently, many guidelines advocated endovascular stent over open repair in patients with suitable anatomy. We reviewed our center experiences with endovascular repair of BTAI. To review and evaluate the result of endovascular treatment for BTAI at Ramathibodi Hospital.

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Materials and Methods

We conducted a retrospective study by reviewing medical records of patients diagnosed with BTAI who were treated with endovascular repair during the 7-year period at Thoracic Unit, Department of Surgery, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, from September 2014 to May 2020. Diagnosis of BTAI was confirmed and evaluated with computed tomography (CT) imaging and were managed according to multidisciplinary team consensus. If there was indication for other operation(s) for associated injuries, endovascular operation was carried out first and followed by other operation(s). All endovascular repair operations were performed in either angiographic operation room or other operation room with mobile C-arm. Baseline patient characteristics, Injury Severity Score (ISS) at index event, procedure details and follow-up evaluation with both clinical symptoms and imaging were obtained and analyzed.

The present study was approved by the institutional Investigational Review Board (Trial ID 09-60-27) and the study following ethical clearance from Human Research Ethics Unit, Faculty of Medicine, Ramathibodi Hospital, Thailand (MURA2017/646).

Results

From September 2014 to May 2020, there was no open repair case for treatment of BTAI at our center, all 11 patients received endovascular treatment. One patient did not come to follow-up evaluation and was excluded from the present study. There were 8 male patients and 2 female patients with a mean age of 44.9±22.8 years (range 13 to 90), and a mean ISS of 35.7±16.1 (range 20 to 66). Demographic data was shown in Table 1 and characteristic of the index injury was shown in Table 2.

Most patients were referred from other hospital and underwent operation within the day of arrival upon our center, except in one patient who suffered from severe head injury. In this case, multidisciplinary team agreed to delay surgical intervention until there was sign of neurological recovery and hemodynamic stabilization[6,7], so during that period he was closely monitored for vital signs and neurological status before subsequently underwent successful endovascular repair after neurological recovery, at 11 days after an accident.

All endovascular repair procedures were performed under general anesthesia, while none of the patients received heparin due to presence of multiple co-trauma or planned subsequent operation for treatment other injury. The most common location of BTAI was at the aortic isthmus, consistent with published autopsy report[8]. To ensure adequate proximal landing zone of the endovascular grafts, coverage of left subclavian origin was preferred[9] and in the present study, we performed endovascular stent grafts with covered left subclavian artery in 8 out of 10 patients. We decided not to revascularize left subclavian artery in order to shorten operative duration due to co-trauma and instability of the patients. There were 2 cases whose endovascular stent

Table 1. Patient demographic data

Age	
Mean±SD	44.9±22.8
Median (range)	39 (13 to 90)
Gender, n (%)	
Male	8 (80)
Female	2 (20)
Medical history, n (%)	
Hypertension	2 (20)
Diabetes	0
Dyslipidemia	1/10 (10)
Stroke	0
COPD	0
Heart disease	1/10 (10)
GI condition	0
Kidney disease	0
Other important medical condition	0

COPD = chronic obstructive pulmonary disease; GI = gastrointestinal

Table 2. Patient injury characteristics

Mechanism of BTAI, n (%)	
MCA	5/10 (50)
MVA	4/10 (40)
Pedestrian hit by vehicle	1/10 (10)
Severity of overall injury	
Mean injury severity score (ISS)	35.7±16.1
Median injury severity score (ISS)	33 (20 to 66)
Grade of aortic injury*, n (%)	
Grade 1	0
Grade 2	1 (10)
Grade 3	7 (70)
Grade 4	2 (20)
Associated injury by region, n (%)	
Head & Neck injury	7 (70)
Face injury	1 (10)
Chest injury	10 (100)
Abdominal injury	4 (40)
Extremity	7 (70)
External	1 (10)

MCA = motorcycle accident; MVA = motor vehicle accident
* According to the Society of Vascular Surgery classification[10]

Table 3. Results

Technical success, n (%)	10 (100)
Cover LSA, n (%)	8 (80)
Death from any cause, n (%)	0
Complication, n (%)	
Stroke	0
Paraplegia/paraparesis	0
Cardiac tamponade	1 (10)
Endoleak from CTA	0
Left arm claudication	0
Length of stay (days)	
Mean	18.2±15.6
Median (range)	18 (2 to 51)
Follow-up (months)	
Mean	25.5±24.0
Median (range)	12 (2 to 73)

LSA = left subclavian artery; CTA = computer tomography angiography

were placed distal to the origin of left subclavian artery; one patient's aortic lesion was distal to isthmus and had adequate proximal landing zone, another patient had no obvious tear of the aorta but presence of thick intramural hematoma at proximal descending aorta (grade 2 injury according to The Society of Vascular Surgery classification)[10].

All patients were successfully treated with endovascular operations, which intra-operative angiogram demonstrated proper sealing of the injured site. Nine of ten patients underwent uneventful operation. One patient had iatrogenic cardiac tamponade from right atrium injury during central venous catheter insertion via right internal jugular vein, and underwent immediate median sternotomy with successful repair of right atrium. There was no immediate complication in term of dead, post-procedural stroke or paraplegia. No symptom of left arm claudication or ischemia was reported (Table 3). Mean length of hospital stay was 18.2±15.6 days (range 2 to 51). Mean follow-up duration was 25.5±24 months (range 3 to 73), with at least one computerized tomography angiography (CTA) performed in each patient. Neither endoleak nor stent migration were documented during the follow-up period.

Discussion

Traditional treatment of BTAI is open surgical repair using graft interposition, with usage of technique for distal perfusion (shunt or extracorporeal circulation), or without distal perfusion (clamp and saw). Open repair with either techniques were associated with high rate of complication and mortality[11]. Since endovascular stent repair was introduced for the treatment of BTAI, several publications reported favorable outcomes compared to open surgical repair. In a prospective multicenter study which included 193 patients from trauma centers by Demetrios Demetriades et al[12], endovascular stent graft repair was associated with lower mortality and less blood transfusion, compared to open repair procedures. Ali Azizzadeh et al[13] reported a retrospective single center study comparing between 50 patients who underwent endovascular repair and 56 patients with open repair with the use of distal perfusion. The result demonstrated that open repair group had three times higher the odds for complication or in-hospital mortality. Also, Ali Khoynezhad et al[14,15] reported in a prospective multicenter study that stent graft treatment for BTAI was safe in term of 30-day mortality, as well as at 1-year follow-up. A meta-analysis of 139 studies for treatment of BTAI by endovascular repair, open repair, or non-operative management by Mohammad Hassan Murad et al[16] found that endovascular repair was associated with better survival and lower risk of spinal cord ischemia compare to other two treatment modalities. With numerous data showing consistent satisfactory outcomes of endovascular repair, The Society of Vascular Surgery currently recommended endovascular repair over open repair for BTAI[10].

Because our center is a university hospital, the patients in our study had many associated injuries and high ISS. However, the result of endovascular treatment for BTAI was comparable to other studies, with zero hospital mortality. There were 3 patients who were specifically referred for the management of BTAI solely, because of the lack of specialists at other hospital, and then referred back for management of other associated trauma. All 3 patients came to follow-up evaluation at our center after discharged from the referral hospital. Most of our patients required placement of endovascular stent to cover left subclavian artery origin in order to ensure adequate proximal landing zone of the stent. Michele Antonello et al[9] reported a result of endovascular repair in BTAI in 31 patients, in which there was a need to cover left subclavian artery in 27 patients. During follow-up, no increased risk of stroke, paraplegia or left arm claudication was reported. In our study, there was also neither posterior circulation stroke nor symptom of left arm claudication, both at immediate post-operative day and at follow-up evaluation. The result is encouraging, especially in emergency setting or in cases with multiple co-trauma, revascularization of the occluded left subclavian artery from stent placement could be deferred and indication for revascularization should be evaluated afterward.

The follow-up period ranged from 3 to 73 months in the present study, because some patients were referred back to other hospital. To date, only 5 out of 10 patients still attend to regular follow-up visit at our hospital, with follow-up time ranging from 10 to 73 months. All have been doing well and reported no symptom of left arm claudication and there was no incident of re-intervention, exhibited good result in midterm period.

Conclusion

Despite the small number of patients at our center, endovascular repair of BTAI is a safe procedure and provides excellent short to medium-term outcomes. However, further long-term follow-up is needed for evaluation of durability and late complications.

What is already known on this topic?

Endovascular intervention for blunt thoracic injury is preferred over open surgical repair.

What this study adds?

Short term and medium term result of endovascular for BTAI in a tertiary hospital in Thailand

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Potential conflicts of interest

The authors declare no conflict of interest.

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