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• Original Article •

Management of Thoracic Aortic Injury after Blunt Trauma: Nine Cases at a Single Medical Center

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Purpose: Traumatic aortic injuries are rare, but life threatening condition. They usually occur after high velocity impact on the chest or abdomen such as traffic accident or fall. We report the experiences of the traumatic aortic injuries at a single center.

Methods: We retrospectively reviewed the medical records of nine patients with aortic injury resulting from the blunt trauma from Jan. 2010 to May. 2016.

Results: The mean age was 51.1 ± 20.8 years old, and ten (90.9%) were men. The mechanisms of injury were traffic accidents in seven patients (motorcycle accidents; 3, car accidents; 4), and four in fall injury. Most common injured sites were thoracic aorta (9, 81.8%). Aortic injuries were repaired by endovascular approach in four patients, and by open graft surgery in four. Two patients were managed conservatively. Nine patients survived without any complications.

Conclusion: We had experienced different approaches for management of aortic injuries after blunt trauma according to locations and severity of lesions. [J Trauma Inj 2016; 29: 146-150]

Key Words: Traumatic thoracic aortic injury, Endovascular repair, Open graft surgery

I. Introduction

Traumatic aortic injuries are rare but life threatening. In patients with thoracic aortic injury, up to 50% of initial survivors die within the first 72 hours without appropriate management.(1) Parmley et al. report that, following aortic injury, 88% of patients die during the first hour, and 10% die within two weeks.(2) Blunt trauma to thoracic aorta usually occurs after high velocity impact to the chest, as often occurs in motor vehicle accidents or falls, due to sudden deceleration and shearing of the relatively immobile aortic isthmus, which is located distal to the left subclavian artery and proximal to the third intercostal artery (a slight constriction, at the point of attachment of the ductus arteriosus), and is the junction between the relatively mobile aortic arch and the fixed descending aorta.(3) Endovascular repair is now widely used for various aortic injuries. It is a less invasive option for managing traumatic aortic injuries in patients with multiple traumas, as it does not require thoracotomy or lapatotomy.(4) However open graft surgery and conservative management remain treatment options in some cases.(5)

II. Materials and Methods

We retrospectively reviewed the medical records of

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eleven patients with aortic injury resulting from the blunt trauma, an admitted to one medical center from January 2010 to May 2016. All patients were diagnosed using computed tomography. Blunt thoracic aortic injury was classified into 4 grades based on CT imaging that were followed clinical guidelines for treating thoracic aortic injury are released by the Society of Vascular Surgery.(6) Grade I: intimal injury; Grade II: mural hematoma or defect; Grade III: pseudoaneurysm; Grade IV: rupture or transection. Interventions (surgery or endovascular repair) were performed in a hybrid operating room. We also reviewed concurrent injuries, and calculated three trauma scores – the Injury Severity Score, the Revised Trauma Score, and the Trauma and Injury Severity Score – based on patients medical records. Approval for this study was obtained from our institutional review board (IRB No. 2016-2141-001).

III. Results

The mean patient age was 48.1±21.3 years (range: 20-85 years). The mechanisms of injury were motor vehicle accidents in 5 patients (3 motorcycle accidents, 2 car accidents), and falls in 4 patients. Descending aortic injury without isthmus was documented in 2 patients, and injury including isthmus in 7. Their Injury Severity Score were from 20 to 59. Thoracic aortic injuries were repaired by endovascular approach in 4 patients, and by open graft surgery in 3. Endovascular approach was chosen for aortic repair, preferentially. However, open approach was chosen for three patients who had concurrent injuries to need surgical management (case 2, 6) or had congenital anomaly that was difficult to repair by endovascular approach (case 3). One patient was managed conservatively. Eight patients survived without any complications, but one patient died during hospital stay. Length of hospital stay and ICU stay of survivors was from 4 to 158 days and from 4 to 52 days, respectively. The mean of Acute Physiologic and Chronic Health Evaluation II scores was 18.8±6.8 (range: 6-26) and mean American Society of Anesthesiologists score was 3.7 ±1.1 (Table 1).

All patients had concurrent injuries (Table 2). Intracranial hemorrhage and cerebral concussion were observed in 11.1% and 44.4% of patients, respectively. Observed injuries of intrathoracic organs were lung contusion or laceration, hemothorax, pneumothorax, and hemomediastinum (22.2%, 66.7%, 44.4%, and 22.2%). Five patients (55.6%) had multiple rib fractures. Injured to the intra-abdominal organs were reviewed; liver injuries were observed in 33.3% of patients, splenic injuries in 11.1%, and injuries to the pancreas, and bowel in 11.1%. Fractures of the skull, facial bones, cervical spine, thoracic spine, lumbar spine, pelvic bone, upper, and lower extremities were observed in 11.1%, 33.3%, 11.1%, 11.1%, 11.1%, 22.2%, 22.2% and 55.6% of patients, respectively.

IV. Discussion

The comprehensive review on thoracic aortic injuries was published in 1958 by Parmley et al., who reported an out-of-hospital mortality of 86.2% in 275 cases of aortic injury.(2) In 1994, Wiliams et al. reported a 75% mortality rate in patients with aortic injury secondary to blunt trauma caused by aortic transection or acute rupture.(7) Even today, thoracic aortic injury remains difficult to manage.

Patients with hemodynamic stability, no vessel occlusion, and minimal periaortic hematoma of the injured site may be managed conservatively. For instance, Shalhub et al. published a study in which 6 pseudoaneurysms were all successful managed conservatively. In this study, one of patients had thoracic aortic injury with grade I who had been successful managed by medical treatment without any interventions. The thoracic aortic injury with grade II or more were repaired by surgical or endovascular repair (surgical; 3, and endovascular 5).

Thoracic aortic injury after blunt trauma usually has concurrent injuries. Fabian et al. and Wahl et al. report high incidence of multiple organ injuries in patients with traumatic aortic injury, such as closed head injury in 51% of patients, intracranial hemorrhage in 24%, multiple rib fractures in 20%, pulmonary contusions in 35%, fractures of upper extremities in 20%, pelvic injuries in 31%, liver injuries in 22%, spine fractures in 4%, spinal cord injuries in 4%, and maxillofacial injuries in 13% of patients.(8) In our study, intracranial hemorrhage (subarachnoid hem-

Table 1. Demographics of patients

Cases	Age	Sex	Initial BP	PR	ISS	RTS	TRISS	Injury mechanism	Severity	Location of injury	Management	Hospital stay (days)	ICU stay (days)	APACHE II score	ASA	Survival
1	85	F	103/88	118	20	5.967	72.34%	Fall	III	Thoracic aorta (including isthmus)	Endovascular	4	4	26	5	Deceased
2	41	M	162/100	91	48	7.841	86.78%	Motorcycle accident	II	Thoracic aorta (including isthmus)	Open	46	46	23	4	Survived
3	44	M	147/99	95	21	7.841	98.43%	Car accident	IV	Thoracic aorta (including isthmus)	Open	27	20	26	4	Survived
4	20	M	105/45	98	34	7.841	95.48%	Car accident	II	Thoracic aorta (Descending aorta without isthmus)	Endovascular	158	52	6	3	Survived
5	40	M	99/81	083	43	7.841	90.88%	Motorcycle accident	III	Thoracic aorta (including isthmus)	Open	025	08	10	4	Survived
6	62	M	111/61	92	43	7.841	63.55%	Fall	III	Thoracic aorta (including isthmus)	Endovascular	28	14	20	4	Survived
7	23	M	98/48	78	59	7.108	59.16%	Motorcycle accident	II	Thoracic aorta (including isthmus)	Endovascular	38	18	17	4	Survived
8	54	M	52/35	85	36	4.502	17.18%	Fall	I	Thoracic aorta (including isthmus)	Conservative	30	12	21	4	Survived
9	74	M	108/60	80	24	7.841	89.50%	Fall	III	Thoracic aorta (Descending without isthmus)	Endovascular	18	5	20	1	Survived

BP: blood pressure, PR: pulse rate, ISS: injury severity score, RTS: revised trauma score, TRISS: trauma and injury severity score, ICU: intensive care unit, APACHE II: acute physiologic and chronic health evaluation, ASA: American Society of Anesthesiologists

Table 2. Associated injuries

Injury location/type	Number (%)
Intracranial hemorrhage	1 (11.1)
Cerebral concussion	4 (44.4)
Skull fractures	1 (9.1)
Facial bone fractures	3 (33.3)
Injuries of intrathoracic organs	
Lung contusion/laceration	2 (22.2)
Hemothorax	6 (66.7)
Pneumothorax	4 (44.4)
Hemomediastinum	2 (22.2)
Multiple Rib fractures	5 (55.6)
Injuries of intra-abdominal organs	
Liver injury	3 (33.3)
Pancreas injury	1 (11.1)
Splenic injury	1 (11.1)
Bowel/Mesentery injury	1 (11.1)
Spine fractures	
Cervical spine	1 (11.1)
Thoracic spine	1 (11.1)
Lumbar spine	1 (11.1)
Pelvic bone fractures	2 (22.2)
Fractures of upper extremities	2 (22.2)
Fractures of Lower extremities	5 (55.6)

orrhage) and cerebral concussion were observed in 9.1% and 36.4% of patients, respectively. Observed injuries of intrathoracic organs were lung contusion or laceration, hemothorax, pneumothorax, and hemomediastinum (18.2%, 54.5%, 45.5%, and 18.2%). Six patients had multiple rib fractures (54.5%). Injuries to the intra-abdominal organs were reviewed: liver injuries were observed in 36.4% of patients, splenic injuries in 18.2%, and injuries to the pancreas, adrenal gland, and bowel in 9.1%. Evaluating the severity of multiple injuries in these patients is critical and can be performed using ISS. In the study by Fabian et al., the mean ISS was 42.1. In their study, all patients had serious concurrent, traumatic injuries and received a high ISS (17-66).(9) In our study, ISS levels were from 20 to 59. These concurrent injuries could be confused to decide priority of management in multiple trauma patients with aortic injury. We thought that grade I injury could be managed conservatively. However, grade III or IV injury should be performed repair of aortic lesion prior to other injuries because Grade III or IV aortic injury could be life threatening condition itself. Grade II injury should be able to repair delayed in hemodynamic stable patients. In this study, one of grade I patients had severe liver injury with hemodynamic instability, liver injury was managed first. We thought that aortic injury could have harmful effect for management of other injuries due to its hemorrhage, aortic repair was necessary even grade II. Two of three patients with grade II were performed delay aortic repair within 48 hours after close observation and managed other injuries. One patient with grade II aortic injury were performed aortic repair first because we suspected hemorrhage from aortic lesion was increasing in emergency room.

One of the patients whose records we reviewed died during their hospital stay. This patient arrived at the hospital too late for further intervention to be successful. Both had undergone cardiopulmonary resuscitation in the emergency room, and their vital signs were very unstable after return of spontaneous circulation. Although the patient had undergone endovascular repair, not recovered. One of the non-survivors had a lower ISS than their actual injuries warranted because their poor condition made further evaluation impossible.

V. Conclusion

We reviewed these cases, multiple approaches were taken in the management of traumatic aortic injury after blunt trauma, informed by the severity of lesion. Grade I injury could be managed conservatively with close observation. On the other hand, injury with grade II or more should be performed surgical or endovascular interventions, we thought.

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