CASE SERIES

Traumatic aortic transection repair with distal perfusion — single center experience

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Abstract

Blunt aortic injury is associated with significant mortality. A large number of patients loose their lives before reaching the hospital, those who survive half die within a day.

Isthmus is the commonest site of aortic injury. Aortic injury is usually associated with other injuries of the body hence a multidisciplinary approach is required. For aortic transection the treatment options have evolved from proximal and distal aortic cross clamping and repair with distal perfusion technique using shunt or partial heart bypass (extracorporeal circulation) to endovascular stenting depending upon the available facilities and expertise. Distal perfusion technique helps in avoiding paraplegia.

We present our institutional experience of polytrauma associated with blunt aortic injuries managed with open surgical repair with distal perfusion using cardiopulmonary bypass.

Keywords: Aortic injury, Extracorporeal circulation, Paraplegia, Cardiopulmonary bypass.

Introduction

Aorta is the most common vessel injured due to blunt thoracic trauma as the result of high speed motor vehicle accident or fall from significant heights due to rapid deceleration. Such Blunt traumatic aortic injury (BTAI) is the second most lethal condition after head injuries in a trauma patient, and is associated with significant mortality.[1] As per literature review, 75% of the patients expire before reaching a trauma center, while 50% of the survivors die within the first 24 hours of injury. Further research showed that 24% of the patients are either dead on arrival or die during triage.[2] Motor vehicle accidents account for over 70% of the cases of BTAI followed by motorcycle crashes (13%), falls from height (7%), auto versus pedestrian (7%) and other mechanisms.[3] Multiple organ injuries have been associated with blunt aortic injury, an analysis showed major abdominal injuries in 29% of cases, head injuries in 31% and pelvic injuries in 15%, respectively with a mean injury severity score of 40.[2,4]

The most common site of aortic injury is found to be the isthmus, area just distal to the left subclavian artery, in various case studies.[4-6]

Successful outcome depends upon multidisciplinary approach because of associated injuries. The treatment options have evolved from proximal and distal aortic cross clamping and repair with distal perfusion technique using shunt or partial heart bypass (extracorporeal circulation) to endovascular stenting depending upon the available facilities and expertise. Distal perfusion technique helps in avoiding paraplegia.

We present our institutional experience of polytrauma associated with blunt aortic injuries managed with open surgical repair with distal perfusion using cardiopulmonary bypass.

Methods

We performed a retrospective review of BTAI presenting to Agha Khan University Hospital from January, 2009 to December, 2017. All the patients who suffered BTAI involving the thoracic aorta and underwent surgical correction with distal perfusion technique were included in the study. However, patients who underwent any medical treatment or Endovascular repair were excluded from the study. The study was granted exemption by the institutional ethical review committee.

Patients' demographics including age and gender, haemodynamic parameters, length of hospital stay and clinical outcomes were reported. Injury related details were collected including mechanism of injury, history of loss of consciousness, initial Glasgow comma scale (GCS) and associated systemic injuries. Investigations performed on arrival were also reviewed in diagnosing traumatic aortic injuries. Details regarding the surgery were extracted from the medical records, including; technique, aortic cross clamp time, cardio-pulmonary bypass time and the operative time. Post-procedure complications were captured from the medical record

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including death, acute respiratory distress syndrome (ARDS), sepsis, laryngeal injury, acute kidney injury, thromboembolism and surgical re-interventions. The management of associated injuries was also taken into account.

All statistical calculations were carried out using SPSS version 19. Mean and standard deviation was estimated for continuous variables including age, while frequency and percentage were computed for categorical variables such as gender, co-morbidities including hypertension, Glassgow comma score (GCS), preoperative echocardiography.

Results

A total of twelve patients with blunt traumatic aortic injury (BTAI) were included in the study with a mean age of 37 years (range 16-46). Of the total, 66.7% were males with an average hospital stay of 14 days (range 2-29). Eight patients had a GCS of 15/15 on arrival while the remaining four patients had a GCS score ranging between 9 to 11.

Road traffic accident (RTA) was found to be the cause of aortic injury in 11(92%) out of total 12 patients admitted. Of all the patients, 83.3% patients were stable at the time of arrival to the hospital. Orthopaedic injuries were the most common secondary injuries accounting to

Table-1: Baseline Characteristics of Blunt traumatic aortic Patients (N=12).

Variables		
Age (years)	Mean ± SD	30.58 ± 11.04
	Range	16-46
		N (%)
Gender		
	Male	8 (66.7)
	Female	4 (33.3)
Cause of aortic injury		
	Road traffic accident	11(91.7)
	Others'	1(8.3)
Secondary injuries		
	Orthopaedic	9(75.0)
	Neurosurgical	4(33.3)
	Abdominal	3(25.0)
	Urological	1(8.3)
Patient at the time of Admission		
	Non stable	
	Stable	
GCS*		
	Mild Injury	8(66.7)
	Moderate Injury	4(33.3)

'Fall while playing cricket, * Glasgow coma scale.

Table-2: Clinical Parameters of Patients admitted with Blunt traumatic aortic (N=12).

Variables		
Length of stay (days)	Mean ± SD	14.6 ± 13.09
	Range	2--29
		N (%)
Reopened		
	No	11(91.6)
	Yes*	1(8.3)
Morbidities		
	Prolonged Respiratory support	8 (66.7)
	Laryngeal Injury	1(8.3)
	Acute Kidney Injury	4 (33.3)
	Sepsis	3(25.0)
	Thrombocytopenia	2(16.7)
	Urinary Tract Infection	1(8.3)
	Brain Injury	1(8.3)
Mortality		
	No	10(83.3)
	Yes	2(16.7)
Additional Procedures		
	Orthopaedic	8(66.7)
	Thoracic	1(8.3)
	Dental	1(8.3)

*Due to post-operative bleeding.

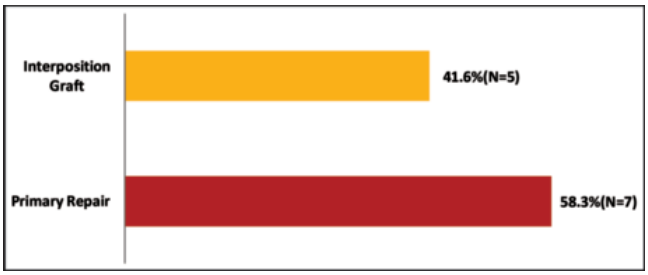

Figure-1: Type of treatment.

75% cases, followed by neurosurgical (33.3%), abdominal (25.0%) and urological (8.3%) injuries respectively. In our study all the patients had ACT scan of the Chest showing aortic abnormality (transection) Figure-2.

Primary repair was received by 58.33% patients, while 41.6% underwent placement of an interposition graft (Figure-1). Only one patient was reopened due to post-operative bleeding. Need of prolonged respiratory support (n=7, 58.3%) Acute kidney injury (n=3, 25%), sepsis (n=3, 25%), and thrombocytopenia (n=2, 16.7%), urinary tract infection (n=1, 8.3%) were some of the major morbidities encountered in the injured patients. There were two deaths recorded in the postoperative course.

Additional procedures were also carried out, among

which 8 (66.7%) patients underwent orthopaedic surgeries, whereas only 1 patient had thoracic and one underwent a dental procedure. Thus, a multidisciplinary approach was used to tackle each injury at hand.

Discussion

It is estimated that 15% of all deaths in road traffic accidents are the result of injury to the thoracic aorta.[7] In our study, we also found Road traffic accident (RTA) as the major cause of aortic injury. Many subjects die at the scene of injury and those who make it to the hospitals have either small or partial tears of the wall of the aorta or develop pseudoaneurysm.[8] Though the injury can occur to any part of aorta but the proximal thoracic aorta is the most vulnerable site due to sudden shearing forces of deceleration.[9] The Aorta is injured in cases with front impact or fall from height, with other reasons being compression between the sternum in front and spine at the back.[6] These patients can present with varied symptoms and signs ranging from haemodynamic stability to instability among patients with haemorrhage from other site, organs to being dead on arrival.

In our study, only two patients were in an unstable condition upon arrival to the hospital. Survivors reaching hospital should be treated with initial management of blood pressure followed by definite repair. In patients who are haemodynamically unstable, the aim is to rapidly determine and control persistent bleeding and prevent over resuscitation.[10]

Basis of diagnosis is having high clinical suspicion. However, chest tube drainage of more than 1500 ml suddenly or ongoing drainage of more than 200ml per hour necessitates immediate transfer to the operating theater. Chest X-ray is usually the first investigation performed, but has a low sensitivity and a 98% negative predictive value if normal.[11] CT scan is a helpful modality in planning operative strategies if the patient is stable, with a reported sensitivity of 97-100%.[7] In our study, all the patients had an ACT scan of the Chest showing aortic abnormality (transection).

Passaro and Pace[12] in 1959 described the first successful primary repair of an acute traumatic thoracic aortic transection. Since that time, open surgical repair has remained the standard treatment for Traumatic thoracic aortic transaction (TTAT).

Thoracic endovascular aneurysm repair (TEVAR) is an emerging treatment modality because it avoids thoracotomy, single lung ventilation, aortic cross-clamping, cardiopulmonary bypass, and systemic heparinization in these multiple injured patients.[13]

Figure-2:

Cardarelli MG et al. in 2002 from Maryland reported on 219 patients. There was 15% paraplegia and 28% mortality in non CPB group while no paraplegia and 18% mortality in CPB group.[14]

Aortic transections are not quite as common in our part of the world as in the West due to congestion of traffic, lack of highways and absence of good medical care. However the cases that we do see are all referrals as some hospitals may not be equipped to cater such high risk patients.

In the current series, we experienced, 33.3% patients with neuro-surgical injuries, but no patient had any postoperative paraplegia and paraparesis. As per the recent data, the use of endovascular stent grafts for traumatic aortic rupture reduces the risk of paraplegia and neurological events.[15-17] Endovascular stent-grafting is superior in polytrauma patients in a number of ways like rendering cardiopulmonary bypass unnecessary, shorter operating time, patients not having to undergo thoracotomies, thus all resulting in better outcomes. Forbes et al.[18] reported in his paper that on performing laparotomy, splenectomy had to be performed in order to get control of continuous intra-abdominal bleeding, exposing the infrarenal aorta as an access route for endovascular repair of thoracic aortic injury. In this context, endovascular treatment for acute traumatic aortic rupture is a reasonable and an effective alternative to conventional open surgery in selected patients, if available. To improve surgical mortality, we suggest endovascular repair as the primary care with other surgical procedures. The limitations of our study includes a small sample size and retrospective study design.

Conclusion

Traumatic artic transection is a highly lethal condition

that requires high index of suspicion by initial trauma team. A multidisciplinary team approach along with appropriate preoperative planning is the key feature in such cases to achieve acceptable outcomes. This report further highlights that open surgical repair using distal perfusion technique to avoid paraplegia is a viable option at places where there is a lack of endovascular repair facilities and expertise.

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