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Research Article

Outcomes of Non-Operative Management of Blunt Aortic Injuries at a Johannesburg Trauma Centre

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Abstract

Introduction: Blunt Aortic injuries have a high mortality rate and can be associated with multiple injuries. Clinical suspicion of high energy impact to the chest should warrant a contrast-enhanced CT scan investigation of the chest cavity to evaluate for possible aortic injury. With current growing evidence on non-operative management, this has not been studied to a great extent in the Sub-Saharan environment. The study aimed to assess the feasibility and outcomes of non-operative management of Grade I and II Aortic injuries at a Johannesburg Trauma centre.

Method: A retrospective review of all Grade I and II blunt aortic injuries presenting at a Level I Trauma Unit from 01 August 2007 till 31 December 2020. All patients had to be managed in an Intensive Care Unit. Demographics, mechanism of injury, and physiological parameters at presentation were documented. The grade of injury was confirmed with minimum 64-sliced contrast-enhanced CT scan, as well as associated injuries. A repeat CT scan was performed at 48 hours, then 7-10 days to assess the progress of the injury. Length of hospital stay, aortic injury-related complications, and in-hospital mortality were also documented. Descriptive statistics using STATISTICA version 14 software was used to analyse the data. A p-value of <0.05 was considered statistically significant. Ethics was sought from the University of the Witwatersrand Human Research Ethics Committee.

Results: Of the 58 Blunt aortic injuries seen in the study period, only 19 had a confirmed Grade I or II injuries (the rest were Grade III-IV). All these 19 were managed conservatively. Most cases were males with a median age of 47(IQR 42-57). Motor vehicle collisions were responsible for most of the injuries. Chest injuries were more common than other concomitant injuries. Anticoagulation was balanced against the risk of bleeding, and blood pressure was managed to control blood tension and pulse rate to minimise rupture. No worsening features were noted in the 48-hr repeat CT scan, and by day 10, all aortic lesions had resolved. The length of hospital stay in days was 28 (IQR 22.5-40.5). There were no aortic-related complications. One patient died of the progression of a severe head injury, whereas most patients were discharged home. Median follow-up in years was 7 (IQR 4-11)

Conclusion: It is possible to safely manage Grade I and II blunt aortic injuries in a Sub-Saharan environment. The mortality was not related to the aortic injury, and no aortic-related complication was noted in the study. Optimal care should be within the context of specialised care with optimal radiological investigations available.

Keywords: Blunt Aortic, Trauma, Injury, Conservative Management, Non-operative management

Introduction

Aortic injuries have a high mortality rate and can be associated with multiple injuries [1,2]. It is estimated that most aortic injuries die before arrival at the hospital, and only the remaining 25% present to the emergency department [2-4]. Systematic evaluation utilising radiological modalities assists in detecting these vascular injuries [5,6]. Although chest X-rays help diagnose aortic injury, they are not specific [7-9]. It has been noted that up to 7% of aortic injuries may remain normal on a chest X-ray [7-9]. The presence of evidence for high energy blunt impact to the chest cavity should warrant a contrast-enhanced Computed tomography scan (CT scan) of the chest to diagnose a possible aortic injury [10,11]. A contrast-enhanced CT scan of the chest can diagnose the aortic injury and delineate the grade and extent of the vascular injury [12-14]. These injuries are then classified into four grades, as proposed by Azizzadeh [5]. The Grade I and II injuries have previously been shown to be amenable to non-operative management [5,15,16]. In our opinion, these injuries should be managed at an appropriate institution with the expertise to manage such complicated patients. These patients should be treated and triaged for management as Priority one patients.

The aorta is a major blood vessel, and if the aortic injury is not managed correctly, this could result in death or even severe morbidity [3,5,17]. The complete wall disruption is fatal within a few minutes [3,17]. The contained injuries that are well enough to present to an institution require prompt evaluation and initiation of therapy to minimise the likelihood of an open rupture [2,18,19]. Fortunately, the natural history of aortic injuries has also shown that minor aortic injuries can heal effectively [18,20]. The challenge remains in diagnosing and following these patients closely for possible complications [16,20,21]. Treatment may require the inclusion of anti-platelets therapy and anticoagulation in certain instances [20-22]. This therapy can be continued until the mucosa has healed completely [15]. The dose, choice and timing of medication should be balanced against bleeding complications in a trauma patient. Long-term follow-up must be considered when managing these injuries.

In our institution, all patients with a severe blunt mechanism to the chest are evaluated and managed according to the ATLS principles of Primary and Secondary survey, with appropriate radiological investigations. Once considered haemodynamically stable enough for a CT scan, at least a 64-slice CT scanner will be used to identify and confirm injuries, including the aortic injury. The aortic injury is then confirmed by the Trauma surgeon, radiologist and vascular surgeon. All the Grade I and II injuries that present at our institution are appropriately diagnosed and selected for non-operative management. Medical treatment is offered according to the standard of care when the blood pressure is elevated to manage the differential pressure and the rate [18]. We aim to keep the systolic blood pressure between 100-110mmHg.

To our knowledge, no large studies have been done in the Sub-Saharan environment. We thought our study could shed some light on this merging topic and application in middle-income countries. The study aimed to assess the feasibility and outcomes of non-operative management of Grade I and Grade II Aortic injuries who presented at our Johannesburg Trauma centre.

Method

This was a retrospective study of all Trauma patients who presented with a Grade I or Grade II Aortic injury at the Level 1 Trauma Unit in Johannesburg from 01 August 2007 to 31 December 2020. All consecutive trauma cases seen at this institution in this period were included. All patients were managed in a Trauma ICU unit with state-of-the-art monitoring and 1:1 nursing ratios. Data was collected from the Trauma data banks (Medibank) and collaborated with the hospital clinical notes. All data was anonymised for safekeeping and subsequently exported to an Excel spreadsheet for characterisation and analysis. Demographics (age, sex) and physiological parameters on presentation (BP on arrival, Pulse rate, Lactate, Base excess) were documented. The mechanism of injury and grade of aortic injury were specified. Other relevant data included Injury Severity Score (ISS) and New Injury Severity Score (NISS). Associated injuries (head, spine, abdomen, limbs, pelvis) were noted. Further description of mild, moderate and severe injuries was guided by the Abbreviated Injury Scale (AIS), with AIS of 1-2 representing mild injuries, 3 Moderate and 4-5 severe injuries. Contrast-enhanced CT finding on admission and at follow-ups were documented. Aortic-related morbidity during hospitalisation, in-hospital mortality, and outpatient complications findings related to aortic injury were also collected.

Descriptive statistics were used to analyse the anonymised data. Frequencies and percentages were used to describe the categorical data. A p-value of < 0.05 was considered statistically significant. Multivariate analysis, univariate analysis and stepwise logistic regression were used to assess independent predictors of outcomes. STATISTICA version 14 software was used for analysis. Ethics for the study was obtained from the University of the Witwatersrand Human Research Ethics Committee and allocated M1800548 as an identification number. The hospital CEO and research committee also approved the study to be conducted in the facility.

Results

Of the 58 aortic injuries noted in the study period, only 19 were Grade I and II, and these were managed conservatively in an intensive care unit, as depicted in Table 1. The remaining 39 of the 58 were Grade III and IV injuries that received surgical intervention.

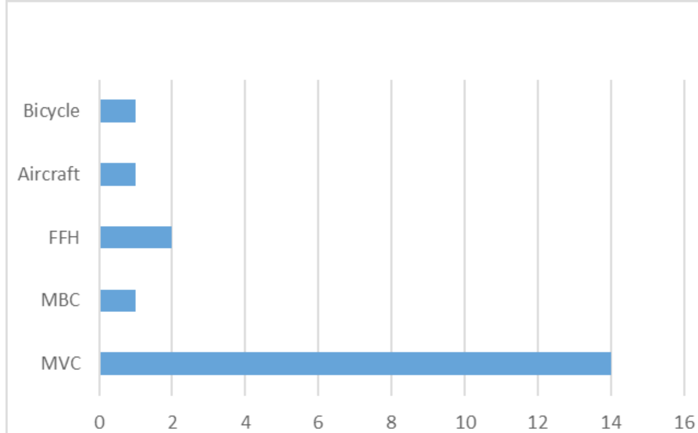
Most subjects recruited for the study were male (n=18/19) with a median age of 47(IQR 42-57) (Table 1). Motor vehicle collisions were the most common mechanism in the study group accounting for injuries in 14/19 subjects (Figure 1). All cases had sustained Grade I or Grade II Aortic injuries, with 84,2% (16/19) having Grade II injuries. The radiologist, Trauma surgeon and Vascular surgeon on call reviewed all CT scans. Associated chest injuries were more common than other concomitant sustained injuries, with a median ISS of 32 in keeping with major injuries (Table 1). The statistically significant increased NISS was in keeping with the more associated chest injuries in this cohort (NISS 42 vs ISS 32, p-value 0.0001). Fractured ribs were noted in 16, haemothorax in 14 and significant pulmonary contusion in 14 cases (Table 2, Figure 2). No worsening features were observed on the repeat CT at 48hrs, and all aortic lesions showed resolution on the second follow-up CT at 7-10 days. No aortic-related complications were observed in the study group, with a median follow-up of 7 years (IQR 4-11). Most cases were discharged home after successful treatment (Figure 3). Only one patient died due to further developments of the head injury; it was not related to the aortic injury. The ISS and NISS were both calculated to be 50 in this mortality case.

COHORT (n=19)	
Gender	Male 18/19
Age in yrs (IQR)	47 (42-57)
Systolic BP in ED (IQR) on mmHg	121 (113-127)
RTS in ED (IQR)	6.4(4-7.8)
ISS (IQR)	32 (21.5-39.5)
NISS (IQR)	41 (19-48)
LOS in days (IQR)	28 (22.5-40.5)
Length of follow-up in yrs (IQR)	7 (4-11)
All-Cause Mortality n(%)	1 (5.26%)
Aortic related Mortality n (%)	0(0%)

yrs (years), IQR(Interquartile Range), RTS (Revised Trauma Score), ISS (Injury severity score)

NISS (New Injury Severity Score), LOS (length of hospital stay),

Table 1: Overall Study Group Data.



(FFH=Fall from height, MBC =Motor bike collision, MVC =Motor vehicle collision)

Figure 1: Mechanism of injury N=19.

INJURIES	N
Rib #	18
Haemo or Pnemothorax	14
Pulmonary contusion	12
Mild abdominal injury	1
Moderate abdo	4
Mild Pelvis	1
Moderate Pelvis	2
Severe Pelvis	2
Long bone #	4
Mild head injury	1
Moderate head injury	5
Severe head injury	2
Mild facial injury	4
Severe facial injury	4
Blunt cardiac injury	2
Cervical spine injury	2
Thoracic spine injury	4
Lumbar spine	1
Spinal cord injury	1
(Mild=AIS 1-2, Moderate=AIS3, Severe = AIS 4-5, AIS=Abbreviated Injury Scale)	

Table 2: Specified Associated Injuries Per Region.

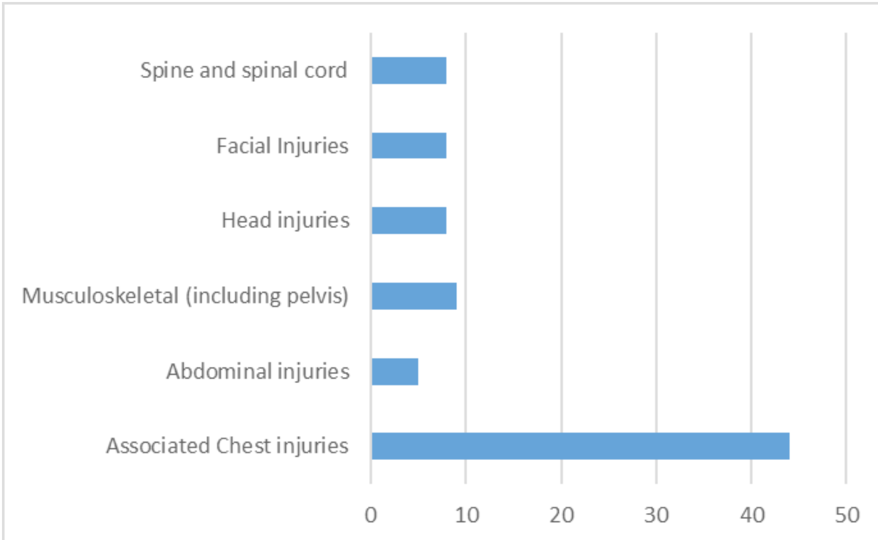


Figure 2: Associated injuries.

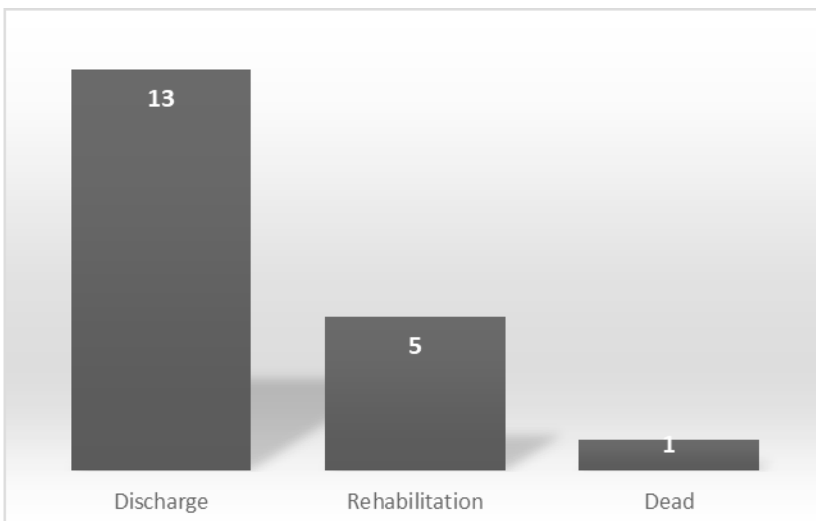


Figure 3: Overall outcome from Hospital.

Discussion

Male predominance in this study is in keeping with our local trauma experience. We have seen a similar gender distribution in cardiac studies and other intensive care study populations in our environment [23-26]. We cannot make any conclusion regarding the only female in the study. Though South Africa is known to have a significant amount of penetrating trauma, this study group was all blunt traumatic aortic injuries in keeping with an aortic theme [27-30]. In contrast, the age group in the study was slightly older than our trauma population, as demonstrated in other local studies [23-26,31].

The trauma mechanism was in keeping with a high energy transfer to the chest cavity, comparable to other studies [1,5,6,15,17,19]. This was further confirmed by other multiple associated chest injuries seen in the study. The further statistically increased NISS over the ISS reinforced the amount of local trauma to the chest. The NISS will allow for other significant injuries to be included in the calculation, even if on the same region as the chest, compared to the ISS that requires recognition of the highest injury scores in the different areas of the body only [32]. Therefore ISS tends to underestimate multiple injuries in a body region or cavity. It is not surprising since the deceleration features in aortic injuries require significant energy transfer. Of note was the bicycle-related mechanism included in the cohort. This association with traumatic aortic injury is unusual in our experience

As these are complex injuries, we believe conservative management requires an appropriate monitoring environment and specialised care. There should be enough resources to perform follow-up contrast-enhanced CT scans and assess the progression of the injuries. We were able to do monitoring and book CT scans at appropriate times. None of our cases progressed further, in contrast with other studies where 5% of the aortic injury progressed, requiring further intervention [16,20,21]. Our series is not large enough to make a conclusive statement regarding the lack of progression of the injury. Successfully managing these cases without further need for surgical intervention is critical in our environment. Over time there has been a shift from open surgical repair of Traumatic aortic injuries to the current standard of thoracic endovascular repair (TEVAR) of these lesions [5,17,33]. The early data that looked into taking this further with conservative management was a step further [16,17,20-22]. We prefer to only manage Grades I and II conservatively despite other studies including Grade III injuries [5,17,34]. In our environment, Grade III injuries are subjected to TEVAR. This highly selective approach may have been the catalyst for the overall good outcomes of the study.

Mortality was related to the progression of the severe head injury. Even though the study had eight head injuries, only two were classified as severe head injuries. ISS and NISS of this mortality case were in keeping with a guarded outcome [32]. The remaining severe head injury was discharged to a rehabilitation centre for further recovery. The low mortality rate in the study, despite very high ISS and NISS, was encouraging. It further confirmed that the correct selection of aortic injuries could result in effective care [17,21,22].

Conclusion

No mortality was directly related to the aortic injury. There were no direct aortic injury-related complications in the study group. The associated injuries were indicative of the high-energy mechanism, as seen in most of the injuries depicted in the study. It is possible to safely manage Grade I and II injuries in a middle-income country, provided the resources are available for sound monitoring. The excellent selection of cases in the study period is testament to the specialised care offered in this facility. We would only recommend this care in well-resourced and specialised units. A prospective multicentre study is required in our middle-income environment to evaluate the impact of conservative strategy for Grade I and II traumatic aortic injuries.

Limitations of the Study

This was a single-centre experience with potential for selection bias, even though all patients were included. Our unit is a referral centre with the possibility to accumulate more cases than what is seen at other facilities in the region. All patients were seen in a critical care environment with good availability of resources, which may not reflect most trauma centres in this country. The limited number accrued in the study is reflective of the rarity of this condition in our environment, with resultant limitations on the statistics we could perform.

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