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Blunt cardiac injury in critically ill trauma patients: A single centre experience

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ABSTRACT

Purpose: This study describes the incidence and outcomes of blunt cardiac injury (BCI) in a single trauma intensive care unit (TICU), together with the spectrum of thoracic injuries and cardiac abnormalities seen in BCI.

Methods: We performed a retrospective observational study of 169 patients with blunt thoracic trauma admitted from January 2010 to April 2013. BCI was diagnosed using an elevated serum troponin in the presence of either clinical, ECG or transthoracic echocardiography (TTE) abnormalities in keeping with BCI. The mechanism of injury, associated thoracic injuries and TTE findings in these patients are reported.

Results: The incidence of BCI among patients with blunt thoracic trauma was 50% (*n* = 84). BCI patients had higher injury severity scores (ISS) (median 37 [IQR 29–47]; *p* = 0.001) and higher admission serum lactate levels (median 3.55 [IQR 2.4–6.2], *p* = 0.008). In patients with BCI, the median serum TnI level was 2823 ng/L (IQR 1353–6833), with the highest measurement of 64950 ng/L. TTEs were performed on 38 (45%) patients with BCI, of whom 30 (79%) had abnormalities. Patients with BCI had a higher mortality (32% vs. 16%; *p* = 0.028) and trended towards a longer length of stay (17.0 days [standard deviation (SD) 13.5] vs. 13.6 days [SD 12.0]; *p* = 0.084).

Conclusions: BCI was associated with an increased mortality and a trend towards a longer length of stay in this study. It is a clinically relevant diagnosis which requires a high index of suspicion. Screening of high risk patients with significant blunt thoracic trauma for BCI with serum troponins should be routine practise. Patients diagnosed with BCI should undergo more advanced imaging such as TTE or TOE to exclude significant cardiac structural injury.

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Introduction

Blunt cardiac injury (BCI) describes the myriad of cardiac lesions that can occur following blunt chest trauma. These range from minor arrhythmias to cardiac rupture [1]. The diagnosis of blunt cardiac injury in polytrauma can be difficult due to multiple distracti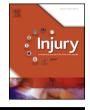ng injuries that occur with high velocity chest trauma. The lack of definitive diagnostic criteria for blunt cardiac injury has also hampered efforts to identify the incidence of this condition [2,3].

The modalities commonly used to diagnose BCI include clinical or surgical findings, the use of electrocardiograms (ECG), serum cardiac troponin I (TnI) or T (TnT) and cardiac imaging (either transthoracic echocardiography (TTE) or transoesophageal echocardiography (TOE). A combination of these modalities may be required for diagnosis [2]. Serum cardiac troponin levels (either I or T) are increasingly being used as a diagnostic tool for patients who have sustained blunt thoracic trauma [4].

In this study, we describe our experience of BCI in a single trauma intensive care unit (TICU) with regard to the incidence, outcomes and the spectrum of cardiac abnormalities seen in patients diagnosed with blunt cardiac injury.

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Methods

We conducted a retrospective observational study of patients admitted to the TICU at Inkosi Albert Luthuli Central Hospital (IALCH) in Durban, South Africa, from January 2010 to April 2013. This 10 bedded trauma unit is dedicated for critically injured patients and serves a drainage area of approximately eleven million people. Admissions are either directly from the scene of the incident, or as inter-hospital transfers from facilities lacking the necessary surgical or intensive care expertise to manage the patient. All patients presenting to the unit with blunt thoracic trauma were included in the study irrespective of age. This included patients with either isolated thoracic trauma, or multisystem trauma that included thoracic trauma. Patients with penetrating thoracic injuries, those with blunt non-thoracic injuries, and those declared dead on arrival to the resuscitation area were excluded from the analysis.

The trauma unit database and hospital information systems (Medicom® and Soarian®) were used to retrieve patient data for this analysis. We extracted:

1. Patient demographics: age, sex, mechanism of injury, Injury Severity Score (ISS) and site of referral (either scene or inter-hospital transfer).
2. Initial lactate and serum TnI or TnT measurement if performed.
3. Presence of pulmonary contusion, rib fractures, flail segments, sternal fracture or blunt aortic injury.

Study outcomes

The primary study outcomes are the incidence of BCI, length of ICU stay and mortality in patients presenting with blunt thoracic trauma.

Definitions

The diagnosis of BCI was made in all patients with a serum TnT or TnI above the 99th centile for the diagnosis of acute myocardial infarction, measured at or within 12 h of presentation following blunt thoracic trauma and who fulfilled any one of the following criteria:

1. Clinical findings of pericardial rupture, cardiac herniation or central tendon rupture.
2. Hypotension requiring inotropic support not explained by haemorrhagic, septic or neurogenic shock.
3. ECG abnormalities in keeping with blunt cardiac injury (i.e., atrial or ventricular arrhythmias, ST or T wave abnormalities or conduction abnormalities).
4. TTE findings in keeping with blunt cardiac injury.

A flail chest was defined as two or more ribs broken in two or more places or sternal dissociation with costochondral dysjunction. Pulmonary contusions were defined as typical parenchymal changes noted on X-ray or CT scan with the presence of hypoxaemia.

Statistical analysis

Means and standard deviations are reported for normally distributed data; median and inter-quartile range for data not normally distributed. The $\chi 2$ or Fisher's exact test were used for categorical data, and Student's t-test and Mann–Whitney U test for continuous data where appropriate. A p value of <0.05 was considered significant.

Results

Two hundred and thirty nine patients were identified as having sustained blunt thoracic trauma over the 3 year study period. Seventy patients were excluded from the analysis due to serum troponin measurement being not performed, or performed outside of the 12 h time limit. Of the remaining 169 patients, the majority were male (73%) with a median age of 34 years (interquartile range [IQR] 25–43). The median ISS was 34 (IQR 25–43). Admission serum lactate measurements were significantly higher in the BCI cohort (3.55 [IQR 2.4–6.2] vs. 2.4 [1.4–4.3]; $p = 0.008$). Eight patients with BCI were under the age of 18, of whom six were under the age of 10 (Table 1).

Eighty four patients were diagnosed with BCI, of whom two were diagnosed on clinical grounds. The incidence of BCI in the entire cohort was 50%. Patients diagnosed with BCI were of similar age (median 34 [25–42] vs. 35 (25–41); $p = 0.514$) but had a higher ISS (37 [29–47] vs. 31 [21–38]; $p = 0.001$) than those without. Two patients had serum TnT measurements performed, with the remainder diagnosed from serum TnI measurements. The median serum TnI level was 2823 ng/L (IQR 1353–6833), with the highest measured at 64950 ng/L. 59 patients with BCI presented with hypotension requiring inotropic support. The average time spent on inotropes was 3.1 days.

ECG findings were documented in only 29 patients in whom BCI had initially been confirmed by troponin estimation. The abnormalities ranged from bradycardia, ventricular and supra-ventricular tachycardia, non-specific ST segment elevation or depression, T wave inversion and one patient developed a third degree heart block requiring pacing. The dysrhythmias were treated according to standard Advanced Cardiovascular Life Support (ACLS) algorithms either pharmacologically or electrically.

TTEs were performed on 38 (45%) patients with BCI, of whom 30 (79%) had abnormal findings. Twenty-two (73%) patients with abnormal TTEs presented with hypotension. Some patients had more than one abnormality documented. Despite 6 patients being diagnosed with posterior or anterior mitral leaflet chordal rupture, none had clinically significant mitral regurgitation. In 10 (26%) patients there was one or more regional wall motion abnormality (Table 2). The majority of echocardiograms were performed within the first 3 days of admission to the TICU.

Table 1
Demographics of patients admitted to the TICU at IALCH with blunt thoracic trauma January 2010–April 2013.

	All thoracic trauma	No BCI	BCI	p-Value
n (%)	169	85 (50)	84 (50)	
Age median (IQR)	34 (25–41)	35 (25–41)	34 (25–42)	0.514
Male n (%)	123 (73)	61(72)	62 (74)	0.900
Injury severity score (median, IQR)	34 (25–43)	31 (21–38)	37 (29–47)	0.001
Admission lactate (median, IQR)	2.85 (1.7–5.1)	2.4 (1.4–4.3)	3.55 (2.4–6.2)	0.008
Referral from scene n (%)	44 (26)	20 (24)	22 (26)	0.824

TICU, trauma intensive care unit; IALCH, Inkosi Albert Luthuli Central Hospital; BCI, Blunt Cardiac Injury; SD, standard deviation; ISS, injury severity score; IQR, interquartile range.