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Original Research Article

Cardiac injury and mortality after blunt chest trauma: a prospective observational cohort study

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ABSTRACT

Background: Cardiac trauma is a serious injury that can occur after blunt chest trauma, posing a high risk of rapid deterioration and mortality. This study aims to evaluate cardiac injuries and mortality after blunt chest trauma.
Methods: This observational cohort study included 303 patients with blunt chest trauma, comprising 248 males (81.85%) and 55 females (18.15%), resulting in a male-to-female ratio of 4:1. The mean age was 39.26±19.89 years, with a range of 2 to 81 years. All patients underwent a clinical assessment, an injury severity evaluation using the injury severity score (ISS) and received various diagnostic tests.
Results: The overall mortality rate was 14.2% (43 out of 303 patients). Logistic regression analysis identified independent mortality predictors, including the mode of trauma, need for mechanical ventilation, ISS, and blunt cardiac injury (BCI). Our patients were divided into two groups; group I had 91 patients (30.03%) with BCI, showing a mortality rate of 27.5% (25 patients), significantly higher than the 8.5% (18 patients) in group II, without BCI.
Conclusions: BCI is an important independent predictor of mortality in cases of blunt chest trauma. Therefore, physicians need to prioritize early diagnosis and management of this condition.

Keywords: Cardiac, Injury, Mortality, Blunt, Chest, Trauma

INTRODUCTION

Trauma is a significant issue in healthcare, contributing to high morbidity and mortality.[1] Cardiac trauma, particularly blunt cardiac injury (BCI) from high-impact events like road traffic accidents, poses serious risks and diagnostic challenges.[2] BCI can present with varied symptoms, from asymptomatic cases to life-threatening complications, making it crucial to maintain a high index of suspicion, as there is no definitive laboratory test for diagnosis. Early detection is vital to reducing morbidity and mortality related to BCI.[3,4]

This study aimed to evaluate cardiac injuries and mortality rates following blunt chest trauma.

METHODS

Study design

This prospective observational cohort study involved 303 patients with blunt chest trauma who were admitted to the Cardiothoracic Surgery Department at Tanta University Hospitals from 01 December 2023 to 30 April 2025. The cohort included 248 males (81.85%) and 55 females (18.15%), resulting in a male-to-female ratio of 4:1.

The mean age of the patients was 39.26±19.89 years, with an age range from 2 to 81 years. The study received approval from the Ethics Committee of the Faculty of Medicine at Tanta University (approval code: 36264MS213/6/23).

Inclusion criteria

All patients presenting with blunt chest trauma were included in this study.

Exclusion criteria

Patients with penetrating trauma or those who underwent cardiopulmonary resuscitation (CPR) were excluded from the study.

Data collection

Patients received comprehensive clinical assessments, including demographic data, habits, comorbidities, and a thorough examination of thoracic trauma. Vital signs such as heart rate, blood pressure, and the Glasgow coma scale were recorded. Shock index (SI) and modified shock index (MSI) were calculated to evaluate hemodynamic status using established formulas.[5] Injury severity score (ISS) was assessed based on the abbreviated injury scale (AIS) for the three most severely injured regions.[6,7]

Routine electrocardiography (ECG) was conducted on admission, with follow-ups for those exhibiting changes for 48 hours. Chest X-ray and non-contrast computed tomography (CT) scans, focused assessment with sonography for trauma (FAST) were performed; follow-up with these modalities was done according to the clinical needs. Echocardiography and other radiological modalities (CT chest with contrast, CT aortography, coronary angiography, and cardiac MRI) were performed when clinically indicated. Laboratory investigations focused on biomarkers for myocardial and muscular damage (Troponin I, creatine kinase (CK), creatine kinase-myocardial bound (CK-MB), with follow-up measurements for elevated troponin levels for 48 hours. To enhance the diagnostic accuracy for cardiac injury, a relative index (CK-MB/total CK ratio) was calculated. The diagnostic criteria for blunt cardiac injury (BCI) included ECG changes, elevated troponin levels, cardiac systolic wall motion abnormalities (SWMA), and structural cardiac damage confirmed by imaging techniques.

The clinical course monitored included intensive care unit (ICU) admissions, need for mechanical ventilation, and mortality rates. Statistical analysis divided our patients into two groups: group I (91 patients with blunt cardiac injury, 30.03%) and group II (212 patients without blunt cardiac injury, 69.96%).

Statistical analysis

Data were fed to the computer and analysed using IBM statistical package for the social sciences (SPSS) software package version 20.0. (Armonk, NY: IBM Corp). Qualitative data were described using numbers and percentages. The Shapiro-Wilk test was used to verify the normality of the distribution. Quantitative data were described as mean and standard deviation. We utilized the census approach as our targeted population represented the study sample, in addition to the Cochrane 's sample size formula based on data from previous literature.8 In the statistical comparison between the different groups, the significance of difference was tested using one of the following tests: Chi-square test, Fisher's Exact or Monte Carlo correction, student t-test, Mann-Whitney test. To find relationships between variables, Spearman's rank correlation was used for continuous, abnormally distributed data and for ordinal data.9 Binary logistic regression was performed to predict or classify an outcome that has only two possible categories by modelling the probability of the outcome occurring based on one or more independent variables. The sensitivity of a test is its ability to correctly identify patient cases. The specificity of a test is its ability to correctly identify healthy cases. The accuracy of a test is judged quantitatively by the area under the receiver operating characteristic (ROC) curve. The greater the area under the curve, the more accurate the test.10 A p value <0.05 was considered statistically significant (*), while a p value >0.05 was statistically insignificant.

RESULTS

The demographic data, thoracic injuries, and associated injuries of our patients are presented in Table 1. Road traffic accidents (RTA) were the predominant cause of trauma, accounting for 68% (206 out of 303) of cases, with a mortality rate of 88.37% (28 out of 43).

The three most common chest injuries due to blunt trauma were rib fractures in 188 patients (62%), lung contusion in 162 patients (53.5%), and pneumothorax in 77 patients (25.5%). Notably, 123 patients (40.59%) suffered from two or more injuries simultaneously. Associated extra-thoracic injuries were primarily pelvis and extremities (44%), followed by abdominal injuries (38%) and head injuries (18%).

BCI was diagnosed in 91 out of 303 patients, representing 30.03%, utilizing clinical parameters, ECG, laboratory tests, and radiological investigations. Nineteen patients presented with pericardial effusion, eight patients experienced pneumopericardium, two patients exhibited SWMA, one patient had an obstruction of the left anterior descending (LAD) coronary artery, and one case involved a left ventricular pseudoaneurysm. In addition to these patients, the remaining 60 patients also showed abnormalities in their ECGs and cardiac biomarkers in various combinations. Troponin I showed low sensitivity (8.8%) but high specificity (98.1%). CK-MB had the highest sensitivity (68.1%) and specificity (50.9%). Combining ECG and cardiac biomarkers with clinical parameters improved accuracy, with the combination of CK-MB and the Modified Shock Index (MSI) as well as the triad of ECG + CK-MB + MSI, achieving the highest sensitivity of 81.3% (Table 2 and Figures 1 and 2). Univariate analysis indicated several dependent predictors, while regression analysis highlighted age, injury severity score (ISS), and pneumomediastinum as independent predictors of BCI (Table 3).

Patients were categorized by ISS into four groups. Among BCI patients, 38.5% were in group 3 (ISS 16-25), whereas the majority of non-BCI patients (59%) were in group 2 (ISS 9-15) (Table 4). A positive correlation (r=0.356, p<0.001) between trauma severity and BCI presence was noted.

ICU admission was required for 69.3% of patients (210 out of 303), including 79 out of 91 patients (86.8%) in group I and 131 out of 212 patients (61.8%) in group II. The need for mechanical ventilation was reported in 19.8% of patients (60 out of 303), with higher rates in group I (35.2%) 32 out of 91 patients compared to group II (13.2%) 28 out of 212 patients.

Mortality

The overall mortality rate in this study was 14.2% (43 out of 303). In group I (BCI), the rate was 27.5% (25 out of 91), significantly higher than 8.5% (18 out of 212) in patients without (BCI). Among ICU-admitted patients, the mortality rate was 20.5% (43 out of 210), and 68.3% (41/60) of those requiring mechanical ventilation died. In group I, 71.9% (23 out of 32) of mechanically ventilated patients died, compared to 64.3% (18 out of 28) in group II. Significant differences between living and deceased patients were observed in various factors. Still, logistic regression analysis identified trauma mode, mechanical ventilation need, injury severity score (ISS), and BCI as independent mortality predictors (Table 5).

Severe traumatic brain injury was the leading cause of death in both groups: 44.0% (11 out of 25) in group I and 50.0% (9 out of 18) in group II (Table 6). The need for mechanical ventilation emerged as a strong independent predictor of mortality in group I (BCI), with mechanically ventilated patients exhibiting a markedly increased risk of death (OR=98.38, 95% CI: 6.51–1487.19, p=0.001). In addition, ISS was found to be a significant predictor of mortality in BCI, where each unit increase in ISS was associated with a 25% increase in the odds of death (OR=1.25, 95% CI: 1.08–1.45, p=0.003), reflecting the impact of overall trauma severity on BCI patient outcomes (Table 7).

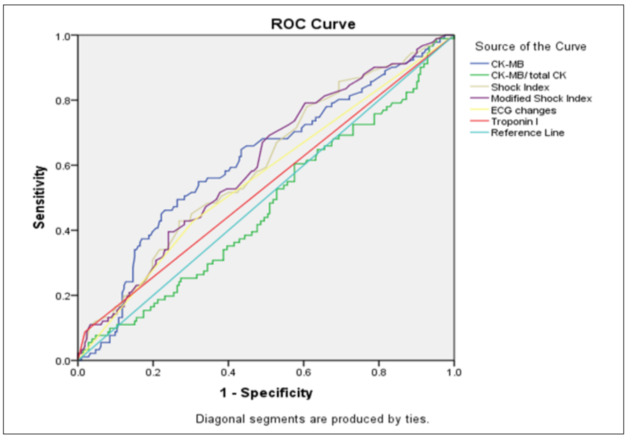

Figure 1: ROC curve of CK-MB, CK-MB/total CK, shock index, modified shock index, ECG changes and troponin I for diagnosis of blunt cardiac injury.

Table 1: Demographic data, chest injuries and associated injuries in all patients, group I and group II.

Variables		All patients (n=303) (N, %)	BCI (n=91) (N, %)	No BCI (n=212) (N, %)	χ^2 test	P value
Age	Mean±SD	39.26±19.9	43.48±18.63	37.45±20.18	-2.439[a]	0.015*
Sex	Male	248 (81.85)	78 (85.7)	170 (80.2)	1.308	0.253
	Female	55 (18.15)	13 (14.3)	42 (19.8)		
	M:F ratio	4:1	6:1	4:1		
Mode of trauma	Road traffic accident	206 (68)	63 (69.2)	143 (67.5)	3.184	0.364
	Falling from a height	44 (14.5)	16(17.6)	28 (13.2)		
	Sliding on the ground	43 (14.2)	11(12.1)	32(15.1)		
	Direct blow to the chest	10 (3.3)	1(1.1)	9 (4.2)		
	Fracture ribs					
	Yes	188 (62)	58 (63.7)	130 (61.3)	8.765	0.067
	No	115 (38)	33 (36.3)	82 (38.7)		
	Pleural injury					
	Yes	185 (61)	64 (70.3)	121 (57.1)	4.748	0.191
	No	118 (39)	27 (29.7)	91 (42.9)		
	Lung contusion					
	Yes	162 (53.4)	56 (61.5)	106(50)	4.965	0.173
	No	141 (46.5)	35 (38.5)	106 (50)		
	Sternum fracture					
	Yes	28 (9.2)	14 (15.4)	14 (6.6)	7.095[a]	0.117
	No	275 (90.8)	77 (84.6)	198 (93.4)		

Continued.

Variables	All patients (n=303) (N, %)	BCI (n=91) (N, %)	No BCI (n=212) (N, %)	χ^2 test	P value
Pneumo-mediastinum					
Yes	17 (5.6)	11 (12.1)	6 (2.8)	10.304	0.001*
No	286 (94.4)	80 (87.9)	206 (97.2)		
Traumatic thoracotomy					
Yes	2 (0.7)	0 (0)	2 (0.9)	0.864[b]	1.000
No	301 (99.3)	91 (100)	210 (99.1)		
Head injury	55 (18)	26 (28.6)	29 (13.7)	9.504	0.002*
Face injury	16 (5.3)	6 (6.6)	10 (4.7)	0.448[b]	0.577
Neck injury	0 (0)	0 (0)	0 (0)	-	-
Spinal injury	23 (7.6)	7 (7.7)	16 (7.5)	0.002	0.965
Abdomen and pelvic content injury	115 (37.9)	42 (46.2)	73 (34.4)	3.714	0.054
Extremities and bony pelvis	132 (43.6)	44 (48.4)	88 (41.5)	1.212	0.271

Data are presented as frequency (%). ECG: electrocardiogram, CK: creatine kinase, CK-MB: creatine kinase myocardial bound, ISS: injury severity score; * significant as p value ≤0.05

Table 2: Diagnosis of blunt cardiac injury.

Test variables	Cut off point	Sensitivity (%)	Specificity (%)	Asymptotic 95% confidence interval		AUC	P value
				Lower bound	Upper bound		
Troponin I	0.50	8.8	98.1	0.462	0.607	0.535	0.341
CK-MB	29.5	68.1	50.9	0.544	0.684	0.614	0.002*
CK-MB/Total CK	8.57	60.4	42	0.402	0.544	0.473	0.460
Shock Index	0.81	59.3	50	0.530	0.667	0.599	0.006*
Modified shock index	1.05	69.2	49.1	0.535	0.672	0.603	0.004*
ECG changes	0.50	42.9	69.3	0.490	0.632	0.561	0.092
ECG+ Troponin I	0.20	44	68.9	0.502	0.646	0.574	0.042*
ECG+CK-MB	0.046	71.4	50.9	0.544	0.681	0.612	0.002*
ECG+ Troponin I + MSI	0.604	71.4	47.6	0.539	0.676	0.608	0.003*
ECG+CK-MB+ MSI	0.784	81.3	39.2	0.544	0.677	0.611	0.002*
Troponin I + MSI	0.612	80.2	39.2	0.540	0.677	0.609	0.003*
CK-MB+ MSI	0.803	81.3	40.6	0.544	0.677	0.611	0.002*

Data are presented as number (%). ECG: electrocardiogram, CK: creatine kinase, CK-MB: creatine kinase myocardial bound, MSI: modified shock index. AUC: area under curve; * significant as p value ≤0.05

Table 3: Logistic regression analysis of variables in group I (BCI) and group II (No BCI).

Variables	B	SE	Sig.	OR	95% C.I.	
					LL	UL
Age	0.026	0.008	0.001*	1.026	1.010	1.042
Shock index	-4.188	4.748	0.378	0.015	0.000	166.851
Modified shock index	3.285	3.340	0.325	26.697	0.038	18585.627
ECG changes	0.194	0.450	0.666	1.214	0.502	2.936
Total CK	0.000	0.000	0.862	1.000	1.000	1.000
CK-MB	0.001	0.002	0.619	1.001	0.997	1.004
Troponin I	1.262	0.732	0.085	3.532	0.842	14.819
ISS	0.068	0.021	0.001*	1.071	1.027	1.116
Pneumomediastinum	1.199	0.565	0.034*	3.318	1.095	10.051
Head injury	0.082	0.467	0.860	1.086	0.435	2.710

B: Unstandardized coefficients, SE: standard error, OR: odds ratio, CI: confidence interval, sig.: significant, LL: lower limit, UL: upper limit, *statistically significant at p≤0.05, ECG: electrocardiogram, CK: creatine kinase, CK-MB: creatine kinase myocardial bound, ISS: injury severity score; *significant as p value ≤0.05

Table 4: Categorization of all patients into four groups based on their injury severity score (ISS).

Injury severity score	BCI, n=91 (N, %)	No BCI, n=212 (N, %)	Spearman's correlation	
			r	P value
Group 1 (<9)	1 (1.1)	19 (9)	0.356	<0.001*
Group 2 (9-15)	26 (28.6)	125(59)		
Group 3 (16-25)	35 (38.5)	41 (19.3)		
Group 4 (>25)	29 (31.9)	27 (12.7)		

Data are presented as number (%). BCI: blunt cardiac injury, *significant as p value ≤0.05

Table 5: Logistic regression analysis of variables in (alive and dead) patients.

Variables	B	SE	Sig.	OR	95% C.I.	
					LL	UL
Sex	3.338	1.993	0.094	28.16	0.566	1400.89
Mode of trauma	-5.045	1.927	0.009*	0.006	0.000	0.281
Road traffic accident	-0.690	1.427	0.629	0.502	0.031	8.22
Falling from height	-0.521	1.803	0.773	0.594	0.017	20.36
Shock index	1.940	9.548	0.839	6.959	0.000	933051424.89
Modified shock index	-1.977	6.330	0.755	0.139	0.000	33859.31
Need for mechanical ventilation	6.565	1.963	0.001*	709.83	15.138	33284.29
Need for ICU admission	18.27	2607.833	0.994	86435809.66	0.000	.
ECG changes	1.645	1.381	0.234	5.180	0.346	77.62
CK-MB/total CK	-0.059	0.036	0.106	0.943	0.878	1.01
Troponin I	2.052	1.901	0.280	7.782	0.188	322.85
BCI	2.201	1.094	0.044*	9.030	1.058	77.08
ISS	0.334	0.109	0.002*	1.397	1.129	1.73
Fracture sternum	0.062	0.443	0.888	1.064	0.446	2.54
Lung contusion	-0.514	0.445	0.248	0.598	0.250	1.43
Pneumomediastinum	1.172	1.134	0.301	3.228	0.350	29.78
Head injury	-0.504	1.195	0.673	0.604	0.058	6.28

B: Unstandardized coefficients, SE: standard error, OR: odds ratio, CI: confidence interval, sig.: significant, LL: lower limit, UL: upper Limit, *statistically significant at p≤0.05. Data are presented as number (%). ICU: intensive care unit, ECG: electrocardiogram, CK: creatine kinase, CK-MB: creatine kinase myocardial bound, BCI: blunt cardiac injury, ISS: injury severity score, *significant as p value ≤0.05

Table 6: Causes of death in group I (BCI) and group II (no BCI).

Variables		BCI (n=91) (N, %)	No BCI (n=212) (N, %)	χ^2 test	P value
Cause of death	Severe traumatic brain injury (TBI)	11 (44.0)	9 (50.0)	4.856^b	0.747
	Hypoxic arrest (ARDS)	2 (8.0)	1 (5.6)		
	Hypovolemic shock (MOF)	1 (4.0)	2 (11.1)		
	Brady arrest (myocardial injury)	2 (8.0)	0 (0.0)		
	Brady arrest (cervical injury)	1 (4.0)	1 (5.6)		
	Ventilator-associated pneumonia (VAP)	1 (4.0)	1 (5.6)		
	Ventilator-associated pneumonia (VAP)/sepsis	4 (16.0)	4 (22.2)		
	Hypoxic arrest (ARDS)/ventilator-associated pneumonia (VAP)/sepsis	3 (12.0)	0 (0.0)		

BCI: blunt cardiac injury, TBI: traumatic brain injury, ARDS: acute respiratory distress syndrome, VAP: ventilator-associated pneumonia, MOF: multiorgan failure

Table 7: Predictors of mortality in BCI (group I).

Variables	B	SE	Sig.	Exp. (B)	95% C.I.	
					LL	UL
Sex	1.91	1.62	0.237	6.768	0.285	160.909
Mode of trauma	-10.95	9788.15	0.999	0.000	0.000	.

Continued.

Variables	B	SE	Sig.	Exp. (B)	95% C.I.	
					LL	UL
Road traffic accidents	-21.57	19576.2	0.999	0.000	0.000	.
Falling from height	-13.47	9788.14	0.999	0.000	0.000	.
Need for mechanical ventilation	4.59	1.39	0.001*	98.379	6.508	1487.186
Need for ICU admission	16.48	3359.27	0.996	14411522.5	0.000	.
ECG changes	1.03	1.27	0.417	2.798	0.234	33.49
Troponin I	2.53	1.62	0.117	12.59	0.531	298.42
Fracture sternum	-0.02	0.41	0.962	0.981	0.442	2.18
Fracture ribs	0.44	0.29	0.137	1.553	0.869	2.77
Pleural injury	-0.46	0.391	0.242	0.633	0.294	1.36
Surgical emphysema	0.33	1.094	0.763	1.390	0.163	11.85
Traumatic thoracotomy	0.50	1.041	0.631	1.650	0.214	12.70
Shock index	-3.22	9.158	0.725	0.040	0.000	2505302.9
Modified shock index	1.85	6.159	0.764	6.342	0.000	1107551.7
ISS	0.23	0.075	0.003*	1.252	1.081	1.449
CK-MB/total CK ratio	-0.04	0.030	0.174	0.960	0.905	1.018

B: Unstandardized coefficients, SE: standard error, OR: odds ratio, CI: confidence interval, sig.: significant, LL: lower limit, UL: upper limit, *statistically significant at $p \leq 0.05$; ICU: intensive care unit, ECG: electrocardiography, ISS: injury severity score, CK: creatine kinase, CK-MB: creatine kinase-myocardial bound

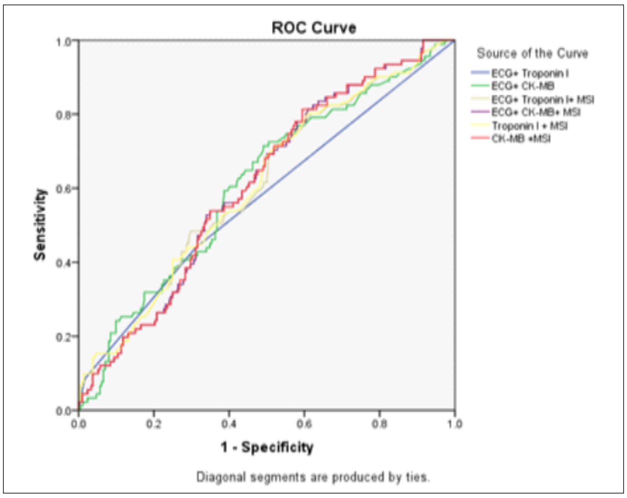

Figure 2: ROC curve of ECG+ troponin I, ECG+ CK-MB, ECG+ troponin I+MSI, ECG+ CK-MB+ MSI, troponin I+MSI and CK-MB+ MSI for diagnosis of blunt cardiac injury.

DISCUSSION

Trauma is a leading cause of disability and death in all age groups, with chest injuries contributing to about 25% of trauma-related fatalities.[11] In our patients with blunt chest trauma, the mortality rate was recorded at 14.2%, aligning with a previous study from our centre, which reported a mortality incidence of 14.9% (25 out of 168) in patients with blunt chest trauma.[12] This is consistent with previous studies showing rates between 10% and 40%.[13] This variability may stem from changes in patient care based on assessments of trauma severity, complications, and the identification of independent predictors for mortality. In this study, factors predicting mortality included the mode of trauma, mechanical ventilation need, ISS, and BCI.

RTAs were the most common cause of trauma, accounting for 68% of cases and 88.37% of deaths. These findings are in agreement with those of Sikander et al, who reported that RTAs not only represented the most frequent mode of blunt chest trauma but were also responsible for a majority of deaths.[14]

Mechanical ventilation, required in 95.34% of mortality cases, was particularly needed for severe chest and head injuries. Head injuries were the leading cause of death, with a 46.5% incidence, and their presence significantly impacted mortality rates.[12,15] Among the 55 patients with head injuries, 35 required mechanical ventilation (63.63%), and the mortality rate in this group was 30 out of 55 (54.54%). In the context of mechanical ventilation in this study, ventilator-associated pneumonia (VAP) was another significant cause of death, accounting for 30.23% of mortality cases in this study, higher than the previously reported rate of about 20% in trauma patients.[16] Multiple studies suggest that ventilator-associated pneumonia (VAP) is more indicative of injury severity than a direct cause of mortality. Most research focuses on severely injured patients, complicating the evaluation of VAP and injury severity's contributions to mortality.[17] Therefore, severity scales are crucial for trauma care, research, and public health strategies.[18] Accurate assessments of chest trauma severity are vital for predicting morbidity and mortality and trauma scoring systems can help identify high-risk patients in the emergency department (ED) and improve outcomes.[19,20]

In our study using the ISS, we found that it significantly influences mortality in patients, which is consistent with previous research linking ISS to prognosis in blunt chest trauma.[13,21]

Another critical mortality factor was BCI, with an incidence of 30.03% (91 out of 303 patients), coinciding with literature reporting rates from 20% to 76%.[22] Discrepancies in reported BCI rates can likely be attributed to variations in diagnostic criteria and differences in sample sizes. For instance, Gao et al reported an incidence rate of 18.3%, while Gregorian et al noted a significantly lower rate of just 0.3%.[4,23] This inconsistency highlights the necessity for standardized diagnostic protocols. Additionally, studies often exclude patients who die immediately at the accident's scene from cardiac injuries, suggesting the actual prevalence may be higher than reported.[24]

In our statistical analysis, age, the ISS, and the presence of pneumomediastinum were independent predictors of BCI. The average age in group I was significantly higher (43.48±18.63 years) compared to group II (37.45±20.18 years). Advanced age is often associated with reduced cardiovascular reserve and heightened susceptibility of the myocardium to traumatic stress.[25]

Most BCI patients fell into ISS group 3 (16-25), while those without BCI were primarily in group 2 (9-15), indicating a strong correlation between ISS and BCI ($r=0.356$; $p<0.001$). Previous studies emphasize the ISS's effectiveness in predicting cardiac involvement in trauma patients.[26]

Pneumomediastinum is also an independent predictor of BCI, often occurring along pneumopericardium (a known type of BCI) as a complication of blunt chest trauma.[27] This correlation can be explained by one of three mechanisms: air penetration along the pulmonary venous perivascular sheaths from ruptured alveoli to the pericardium, pneumothorax with a pleuro-pericardial tear, and direct communication between the tracheobronchial tree and the pericardium.[28] The presence of air in mediastinal compartments could serve as a triage tool for emergency department doctors, alerting them to the possibility of potentially lethal cardiac injuries.

Diagnosing BCI remains challenging without a gold standard test.[3,4] In our study, troponin I showed low sensitivity (8.8%) for BCI diagnosis despite high specificity (98.1%) for ruling it out, as the nature of myocardial contusion in BCI may not consistently result in elevated troponin levels due to the transient or non-transmural nature.[29] Other studies have noted similar limitations with troponin as a reliable marker for detecting BCI.[30] Salim et al noted that a normal troponin level is a strong indicator for the absence of cardiac injury in patients with blunt chest trauma.[31] However, Yousef and Carr found that abnormal serum troponin is associated with cardiac injury in only 60% to 70% of patients following blunt chest trauma.[32] Our study found that CK–MB had the highest diagnostic performance for BCI, with a sensitivity of 68.1% and a specificity of 50.9%. This contradicts Clancy et al, who deemed CK-MB ineffective for BCI diagnosis.[33] Combining biomarkers and ECG with clinical parameters significantly improved diagnostic accuracy, particularly the CK-MB, MSI and the triad of CK–MB, MSI, and ECG, which reached a sensitivity of 81.3%. This supports the necessity of an integrated diagnostic approach, as emphasized by Salim et al.[31] Velmahos et al and Kyriazidis et al noted that a normal ECG combined with normal levels of cardiac troponin I can effectively rule out BCI.[30,34] However, this poses challenges for emergency physicians, as missed diagnoses can lead to a high risk of mortality.[3,4]

Our findings showed a significant mortality rate associated with BCI: 27.5% in group I (25 out of 91 patients) versus 8.5% in group II (18 out of 212 patients). The leading cause of death in group I was TBI, consistent with the literature indicating indirect cardiac injury from head trauma.[35] It is important to highlight that TBI did not serve as a predictor for BCI mortality in our findings. However, the need for mechanical ventilation and the ISS were found to be independent predictors of mortality in patients with BCI. This indicates that the overall severity of trauma has a significant impact on the outcomes for BCI patients.

Limitations

This single-centre study did not use certain cardiac biomarkers known for higher sensitivity in diagnosing blunt cardiac injury. A longer follow-up is needed to assess the long-term effects of BCI on mortality after blunt chest trauma.

CONCLUSION

BCI is an independent predictor of mortality in blunt chest trauma, highlighting the need for early diagnosis and management. Combining the modified shock index, routine ECG, and cardiac biomarkers improves diagnostic accuracy. The ISS is crucial for predicting BCI and mortality in patients with blunt chest trauma, especially those who develop BCI.

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