

Clinical Science

# Identifying the broken heart: predictors of mortality and morbidity in suspected blunt cardiac injury



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## KEYWORDS:

Blunt cardiac injury;  
Cardiac contusion;  
Predictors of mortality

## Abstract

**BACKGROUND:** Blunt cardiac injury (BCI) is an infrequent but potentially fatal finding in thoracic trauma. Its clinical presentation is highly variable and patient characteristics and injury pattern have never been described in trauma patients. The aim of this study was to identify predictors of mortality in BCI patients.

**METHODS:** We performed an 8-year retrospective analysis of all trauma patients diagnosed with BCI at our Level 1 trauma center. Patients older than 18 years, blunt chest trauma, and a suspected diagnosis of BCI were included. BCI was diagnosed based on the presence of electrocardiography (EKG), echocardiography, biochemical cardiac markers, and/or radionuclide imaging studies. Elevated troponin I was defined as more than 2 recordings of greater than or equal to .2. Abnormal EKG findings were defined as the presence of bundle branch block, ST segment, and *t*-wave abnormalities. Univariate and multivariate regression analyses were performed.

**RESULTS:** A total of 117 patients with BCI were identified. The mean age was  $51 \pm 22$  years, 65% were male, mean systolic blood pressure was  $93 \pm 65$ , and overall mortality rate was 44%. Patients who died were more likely to have a lactate greater than 2.5 (68% vs 31%,  $P = .02$ ), hypotension (systolic blood pressure  $< 90$ ) (86% vs 14%,  $P = .001$ ), and elevated troponin I (86% vs 11%,  $P = .01$ ). There was no difference in the rib fracture (58% vs 56%,  $P = .8$ ), sternal fracture (11% vs 21%,  $P = .2$ ), and abnormal EKG (89% vs 90%,  $P = .6$ ) findings. Hypotension and lactate greater than 2.5 were the strongest predictors of mortality in BCI.

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**CONCLUSIONS:** BCI remains an important diagnostic and management challenge. However, once diagnosed resuscitative therapy focused on correction of hypotension and lactate may prove beneficial. Although the role of troponin in diagnosing BCI remains controversial, elevated troponin may have prognostic significance.

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Blunt thoracic injury is one of the most common causes of trauma admission in the United States and is often associated with noncardiac injuries. Nearly one quarter of all trauma deaths are attributed to blunt thoracic injuries.<sup>1</sup> Blunt cardiac injury (BCI) is an infrequent but potentially fatal finding in blunt thoracic trauma. Its clinical presentation is highly variable and embeds a spectrum of presentations ranging from clinically silent mild arrhythmias to deadly cardiac wall rupture.

Diagnosing the BCI is highly controversial as there are no definitive diagnostic criteria for BCI. The inconsistency in reported incidence of BCI from 7% to 70% reflects the difficulty in making an accurate diagnosis due to this deficiency.<sup>2</sup> The absence of an accepted gold standard for the evaluation of the sensitivity and specificity of different diagnostic tests makes the diagnosis of BCI challenging and thus the identification of predictors of mortality in BCI patients remains difficult.<sup>3</sup> Furthermore, the published literature on BCI is limited to patient characteristics and injury patterns that predispose them to higher mortality. Early recognition of the patients at risk for adverse outcomes and early detection of predictors of mortality in BCI patients can provide potential avenues of intervention and intensive monitoring.

There are some studies that have proposed scoring systems that could evaluate the degree of injury in BCI patients.<sup>4</sup> However, there are no studies that identify the factors present at admission that could predict a high risk in patients with BCI. The aim of this study was to assess the predictors of mortality in BCI patients.

## Methods

After approval from the institutional review board at the University of Arizona, we performed an 8-year (2006 to 2013) retrospective cohort analysis of all trauma patients who presented at our Level 1 trauma center and diagnosed with BCI.

## Inclusion and exclusion criteria

Patients older than 18 years old with blunt chest trauma and a suspected diagnosis of BCI were included in the study. BCI was diagnosed based on the findings of abnormal electrocardiography (EKG), biochemical cardiac markers, echocardiography or transesophageal echocardiography (TEE), and/or radionuclide imaging studies. Abnormal EKG findings were defined as the presence of bundle branch

block, ST segment, and/or *t*-wave abnormalities. Cardiac biomarkers were defined as creatine phosphokinase (CPK), lactate dehydrogenase (LDH), and troponin I. Elevated troponin I was defined as more than 2 recordings of greater than or equal to .2; elevated LDH was defined as LDH greater than or equal to 280 U/L; and elevated CPK was defined as more than 200 IU/L. We used these biomarkers and respective cut offs based on institutional practice guidelines.

Patients dead on arrival and patients transferred from other institutions were excluded from the study. Patients with a known history of cardiac disease or base line EKG abnormalities were excluded from the study.

We reviewed the patient's electronic medical records and collected the following data points: patient demographics including age, sex, race, and ethnicity; injury characteristics (type and mechanism); vital signs on presentation which included systolic blood pressure (SBP), heart rate, temperature, and Glasgow Coma Scale score; injury details (rib fracture, sternal fracture, clavicular fracture, pleural and pericardial effusion, hemothorax, pneumothorax); laboratory data on presentation (complete blood count, blood chemistry, serum lactate, and base deficit); hospital and intensive care unit length of stay; in-hospital complications; and in-hospital mortality. Elevated lactate was defined as the report of lactate greater than or equal to 2.5 mM/L. We defined hypotension as the emergency department SBP less than or equal to 90 mm Hg. We defined complications as cardiac (significant arrhythmia, pericardial effusion, valvular dysfunction, cardiac rupture) and noncardiac (pneumonia, pulmonary embolism, sepsis). Significant arrhythmias were defined as arrhythmias that required pharmacologic and/or electrical cardioversion. Cardiac rupture, valvular dysfunction, and pericardial effusion were diagnosed based on the findings of echocardiography and/or chest X-ray. The Abbreviated Injury Scale score (AIS) including head AIS, chest AIS, face AIS, abdominal AIS, extremity AIS, external AIS scores, and the Injury Severity Score were obtained from the trauma registry.

Patients were divided into survivors and nonsurvivors for statistical comparisons and to identify predictors of mortality. Autopsy reports were reviewed to determine the cause of death.

## Outcome measures

Our primary outcome measure was mortality after BCI. Our secondary outcome measures were in-hospital complications, differences in injury patterns, injury severity, and laboratory parameters between the survivors and nonsurvivors.

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