

Blunt Cardiac Trauma Review



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KEYWORDS

• Blunt cardiac trauma • Blunt cardiac injury • Rupture • Commotio cordis • Myocardial contusion

KEY POINTS

- Blunt cardiac trauma is a frequently encountered trauma sequela with high morbidity and mortality.
- Injuries include myocardial rupture, pericardial rupture, septal injury, valvular injury, myocardial infarction, myocardial contusion, and commotio cordis.
- Screening for blunt cardiac injury is done by using electrocardiogram and cardiac biomarkers.
- Further evaluation with echocardiography is indicated when abnormalities are found on initial screening or if index of suspicion is high.
- Treatment is injury specific and is often surgical.

INTRODUCTION

Traumatic injuries are one of the leading causes of death worldwide, leading to an estimated 5.8 million fatalities annually.¹ This accounts for 10% of the total world's deaths.¹ These injuries mostly affect a younger population, and numbers are predicted to rise compared with other causes of death, with road traffic crashes predicted to become the fifth leading cause of death by 2030.^{1,2} Thoracic injuries account for significant morbidity and mortality among trauma patients, as significant injury to the myocardium is often instantly fatal. Cardiac and aortic injuries are the predominant cause of hemorrhage-related death in trauma patients. Up to 10% to 25% of all traumatic fatalities were found to have cardiac or aortic injuries.^{3,4} The right ventricle was most frequently found to be the site of injury, followed by left ventricle and right atrium.³

Significant blunt cardiac trauma (BCT) often results from high-impact mechanisms. These include the following⁵:

- Motor vehicle accidents
- Motorcycle crashes
- Fall injuries
- Crush injuries
- Direct high impact to the chest, including being struck by a horse

Blunt trauma to the heart can lead to wide variety of injuries. The types of injuries are listed in **Box 1**.

Most patients with BCT who survive to hospital evaluation have minor injuries. However, it is paramount to maintain a high index of suspicion for critical BCT while evaluating trauma patients, as a fair number may present insidiously with initial hemodynamic stability. Delays in diagnosis may increase morbidity and mortality.

The objective of this review was to discuss the various types of cardiac injuries and their presentations. A diagnostic approach to suspected cardiac injuries is discussed as well as appropriate management for the different identified injuries.

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Box 1**Types of cardiac injury**

Myocardial rupture
 Pericardial rupture
 Septal injury
 Valvular injury
 Myocardial contusion
 Commotio cordis

TYPES OF BLUNT CARDIAC INJURY***Myocardial Injury***

Blunt myocardial injury is defined as the development of a laceration or tear in the walls of the atria, ventricles, or papillary muscles secondary to blunt trauma. Six different mechanisms have been proposed to explain the development of myocardial injury in blunt thoracic trauma⁶:

- Direct impact to the anterior aspect of the chest. Most likely to result in injury at end diastole when the ventricles are at maximal distention. This is thought to be the most common mechanism of injury.
- Indirect or hydraulic pressure caused by a large force applied to the abdominal or extremity veins increases preload, thereby increasing intracardiac pressure, predisposing the myocardium to rupture.
- Bidirectional forces compressing the heart between the sternum and vertebral bodies.
- Acceleration/deceleration forces allow for free movement of the heart, predominantly in the anterior-posterior direction, leading to tears and lacerations to the myocardium or coronary arteries.
- Blast forces can result in septal or ventricular rupture.
- Concussive forces leading to fatal arrhythmia.
- Penetration of the myocardium by displaced rib fractures or a sternal fracture.

Similar to those suffering from penetrating myocardial injury the right ventricle and atrium are more commonly involved than the left ventricle and atrium.⁷⁻⁹

Myocardial injury carries a high mortality rate, and most patients die at the scene or during transport.⁵ Larger tears or lacerations that occur with an intact pericardium rapidly lead to the development of acute tamponade secondary to hemopericardium.⁵ Those with concomitant pericardial lacerations are at even higher risk of mortality, as the pericardial laceration provides an opportunity for

massive hemorrhage into the thoracic cavity.⁷ The estimated overall survival is less than 20%. Those patients who survived to evaluation in the emergency department (ED) were found to have smaller lacerations.⁸ These patients will present with hypotension, tachycardia, and signs consistent with increased central venous pressure. Mortality among those surviving to ED evaluation remains high, estimated at approximately 80%.

Bedside echocardiography as part of the extended focused assessment with sonography for trauma (E-FAST) examination can rapidly diagnose the presence of a pericardial effusion and tamponade at the bedside and is considered standard of practice for the evaluation of patients with blunt thoracic trauma.^{10,11} The presence of pericardial effusion should raise the concern for myocardial injury.

Pericardiocentesis can be performed at the bedside or in the operating room depending on hemodynamics to aid in the diagnosis and can temporarily restore filling pressures by drainage of a small volume of pericardial blood.⁸ A subxiphoid window also can be considered for drainage of hemopericardium.^{11,12} However, profuse and persistent bleeding should be anticipated, and therefore a thoracotomy is often considered superior to pericardiocentesis or a subxiphoid window, as this surgical procedure allows for direct visualization of the myocardium to control the bleeding.¹²

Septal Injury

Septal injuries are in fact a form of myocardial injury, but are discussed separately due to their unique clinical features. Septal defects may occur secondary to mechanical rupture or due to a delayed inflammatory response.¹³ Ventricular septal defects are extremely rare, with atrial septal defects being even less frequently encountered, with only a few cases described in the literature.^{9,13-15} Mechanisms leading to mechanical septal injury are thought to be similar to those leading to myocardial injury. Ventricular septal injury is most likely to occur in early systole and late diastole while the ventricles are filled and all valves are closed. The atrial septum is most susceptible to injury in late systole, while the atria are filled with closed valves.^{6,16} In ventricular septal defects, the apical septum is most commonly involved.¹⁶ Inflammatory rupture occurs due to localized edema and disruption of vascular flow secondary to an inflammatory response to septal contusion, leading to perforation in a delayed fashion. Inflammatory perforation most commonly occurs within 2 to 3 days after the

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