# Blunt Cardiac Injury



Introduction

Blunt cardiac injury (BCI) refers to injury sustained due to blunt trauma to the heart. The manifestations of such range from clinically silent, transient arrhythmias to deadly cardiac wall rupture. The absence of a clear definition and gold standard for laboratory testing make the diagnosis of blunt cardiac injury difficult. Treatment is tailored to the severity of injury and ranges from EKG monitoring to sternotomy with complex surgical repair.

The true incidence of BCI is unknown as reported rates vary greatly in the literature, ranging anywhere between 8 and 71%. Blunt cardiac injury is involved in up to 20% of all motor vehicle collision deaths. Although it occurs in only 20% of all blunt thoracic trauma patients, in patients with severe thoracic injury or multiple injuries, the incidence of BCI may be as high as 76%. Clinical studies looking at BCI in chest and abdominal trauma report incidences significantly lower than in autopsy series. This may suggest either that subtler forms of cardiac injury are underdetected when symptoms are minimal, or that many patients with significant BCI die in the field from cardiac or associated traumatic injury. In 2004 Schultz et al found myocardial contusion to be the most commonly reported blunt cardiac injury (60-100%). The distribution of injury amongst the different heart chambers relates to the anterior positioning of the right sided chambers in the chest. RV injury and RA injury are more common (17-32% and 8-65%, respectively), whereas left sided lesions are less frequent (LV~ 8-15%, LA 0-31%). Septal, coronary artery, and valve injuries occur even more rarely, with only a few case reports documented in the literature.

Mechanism of Injury

Because the heart is well encompassed within the bony thorax comprised of ribs and sternum, it requires significant force to cause BCI. This is seen most frequently in motor vehicle crashes and cases of pedestrians struck by motor vehicles. Other mechanisms, such as falls, crush injuries, assault, and sports related injuries with

direct blows to the chest also contribute. Alternatively, severe abdominal compression can lead to rapid increase in blood flow to the heart from the inferior vena cava with chamber rupture due to a sudden increase in intracardiac pressure.

Blunt coronary artery injuries are exceedingly rare but may occur with direct impact leading to intimal disruption and thrombosis. This occurs almost always in conjunction with severe myocardial contusion, usually involving the left anterior descending artery as it lies anterior in the chest beneath the sternum. Sequelae from such injuries may be devastating, and can include myocardial infarction, production of emboli, arrhythmia, ventricular failure, and delayed ventricular rupture.

Valve injuries are equally infrequent and are due to compressive forces of blood during contraction that leads to valve, chordae tendinae, and papillary muscle rupture. The aortic valve is most commonly involved, followed by the mitral. Such injuries usually manifest as a combination of left ventricular dysfunction and cardiogenic shock.

Blunt pericardial rupture is rare but may be the most severe form of blunt cardiac injury. It results from both direct impact to the chest was as well as pressure alterations from compressive force to the abdomen, leading to laceration of the pericardium on both the diaphragmatic and pleural surfaces. This usually occurs parallel to the phrenic nerve and can lead to herniation of the heart into the thoracic or abdominal cavity and well as of torsing of great vessels, with subsequent cardiac arrest and death.

BCI is often part of multi system trauma and is most commonly associated with other thoracic injuries, such as rib fracture, sternal fracture, pneumothorax, hemothorax, and pulmonary contusion. BCI should be highly suspected when these other injuries are presents, and these other injuries may greatly affect the patients overall prognosis.

Diagnosis and evaluation

A high index of suspicion as well as careful evaluation of mechanism is essential to the early diagnosis of blunt cardiac injury. The majority of patients are asymptomatic. Those that do complain most commonly complain of chest pain, but this can be confounded by the presence of chest wall injuries. More substantial BCI may manifest as shock, which must be distinguished from other causes of hypotension such as tension pneumothorax, neurogenic and hypovolemic shock.

Numerous modalities have been employed to establish the diagnosis of BCI, including CXR, EKG, Holter monitoring, cardiac enzymes, transthoracic (TTE) and transeesophageal (TEE) echocardiography and nuclear medicine scans. Chest X rays are routinely obtained in trauma patients and may detect chest wall injuries such as rib fractures, which are commonly seen in conjunction with BCI. EKGs are a

valuable screening tool and may detect rhythm and conduction disturbances. However, there is no pathonogmotic finding to reliably diagnose BCI. Cardiac enzymes, particularly troponin T, may be elevated in the setting of BCI and measurement of their levels in conjunction with EKG evaluation may aid in diagnosis. Echocardiography can detect segmental wall abnormalities or valvular dysfunction, and generally the tranesophageal route is more sensitive than transthoracic. Hostorically, radionucleotide scans have been used for diagnosis of BCI, but none have been sufficiently sensitive or specific to reliably diagnose BCI. Therefore, their use has since been abandoned.

Spectrum of injury

As mentioned above, the spectrum blunt cardiac injury varies greatly. The AAST organ injury scale is one way of quantifying the extent of injury.

AAST Injury Scale: Cardiac Injuries

| |
|---|
| Grade I<br>1. Blunt cardiac injury with minor EKG abnormality (non specific ST of T wave changes, premature atrial or ventricular contractions, or persistent sinus tachycardia<br>2. Blunt or penetrating pericardial wound without cardiac injury, tamponade, or cardiac herniation |
| Grade II<br>1. Blunt cardiac injury with heart block or ischemic changes without cardiac failure<br>2. Penetrating tangential cardiac wound, up to but not extending through endocardium, without tamponade |
| Grade III<br>1. Blunt cardiac injury with sustained or multifocal ventricular contracations<br>2. Blunt or penetrating cardiac injury with septal rupture, pulmonary or tricuspid incompetence, papillary muscle dysfunction, or distal coronary artery occlusion without cardiac failure<br>3. Blunt pericardial laceration with cardiac herniation<br>4. Blunt cardiac injury with cardiac failure<br>5. Penetrating tangential myocardial wound, up to but not through endocardium, with tamponade |

| |
|---|
| Grade IV<br>1. Blunt or penetrating cardiac injury with septal rupture, pulmonary or tricuspid incompetence, papillary muscle dysfunction, or distal coronary artery occlusion producing cardiac failure<br>2. Blunt or penetrating cardiac injury with aortic or mitral incompetence<br>3. Blunt or penetrating cardiac injury of the right ventricle, right or left atrium |
| Grade V<br>1. Blunt or penetrating cardiac injury with proximal coronary artery occlusion<br>2. Blunt or penetrating left ventricular perforation<br>3. Stellate injuries, less that 50% tissue loss of the right ventricle, right or left atrium |
| Grade IV<br>1. Blunt avulsion of the heart<br>2. Penetrating wound producing more than 50% tissue loss of a chamber |

More comprehensively, BCI can be broken down into different injury patterns.

I. Pericardial injury

Pericardial injury results from direct high energy impact or acute increase in intraabdominal pressure. The pericardium ruptures either on the diaphragmatic or pleural surface usually parallel to the phrenic nerve. This may lead to cardiac evisceration and torsion of the great vessels. Clinical presentation may vary from hemodynamic instability to cardiac arrest. In these patients, SCR may reveal displacement of the cardiac silhouette, pneumopericardium, or abnormal gas pattern due to herniated hollow viscera. FAST and EKG may aid in diagnosis. Treatment requires surgical intervention best approached with median sternotomy.

II. Valvular injuries

Valvular injuries are rare in blunt cardiac injury but may have significant sequelae. The most frequently injured valves are the aortic, followed by the mitral. Important clinical findings include the presence of a new cardiac murmur, thrill, or loud musical murmur. Left ventricular dysfunction with cardiogenic shock and pulmonary edema are more significant and ominous symptoms.

III. Coronary artery inuries

Injury to the coronary arteries is extremely rare. Direct impact may cause arterial thrombosis, resulting in intimal disruption and the possibility of MI or ventricular aneurysm potentiating chamber rupture, ventricular failure, and production of emboli or malignant arrhymthmias.

IV. Cardiac chamber rupture

Although uncommon, it is often fatal. Patients that do survive to hospital presentation present with signs of profound hypotension or pericardial tamponade. The right sided chambers are more frequently involved, though left sided injuries as well as multiple chamber injuries have also been reported.

V. Myocardial contusion

Perhaps this is the most common, albeit usually the most innocuous form of BCI. This involves direct injury to the muscle of the heart, generally manifested as EKG changes or elevation in cardiac enzymes. After multiple clinical studies, The Eastern Association for the Surgery of Trauma (EAST) has generated the following guidelines for evaluation and treatment of myocardial contusion.

| |
|---|
| Level I<br><br>Admission EKG should be obtained in all patients where there is suspected BCI |
| Level II<br><br>1. If admission EKG is abnormal, the patient should be admitted for continuous EKG monitoring for 24-48 hours . If admission EKG is normal, further pursuit of diagnosis should be abandoned.<br>2. If the patient is hemodynamically unstable, an imaging study such as TTE or TEE should be obtained.<br>3. Nuclear medicine scans add little compared with echocardiography and are not useful if echocardiography has been performed. |

Level III

1. Elderly patients with known cardiac disease, unstable patients, and those with abnormal admission EKGs can be safely operated on provided that they are closely monitored.
2. The presence of a sterna fracture does not predict the presence of BCI, and does not necessarily indicate that monitoring should be performed.
3. Neither CPK analysis nor measurement of circulating cardiac troponin T are useful in predicting which patients have or will have complication related to BCI.

Conclusions

Blunt cardiac injuries are generally seen in the setting of high impact trauma. Presentation varies greatly, however more severe injuries may lead to exsanguinations, pericardial tamponade, or death. Therefore, a high index of suspicion, as well as knowledge or the appropriate evaluation and diagnostic work-up, is essential to the optimal care of patients sustaining BCI.

The followings are links to other resources for more information regarding the blunt cardiac injury:

http://www.east.org/tpg/chap2.pdf (http://www.east.org/tpg/chap2.pdf)

References

1. Schultz JM, Trunkey DD. Blunt cardiac injury. Crit Care Clin. 2004; 20(1):57-70.
2. Mattox KL, Flint LM, Carrico CJ et al. Blunt Cardiac Injury. J Trauma 1992; 33:649-650
3. Roy-Shapira A, Levi I, Khoda J. Sternal Fractures: a red flag or a red herring? J Trauma 1994; 37:59-61
4. Pasquale MD et al. Practice Management Guidelines for Screening of Blunt Cardiac Injury. Eastern Association for the Surgery of Trauma 1998
5. Asensio J A et al. Trauma to the Heart in Trauma, 6th edition, Feliciano DV, Mattox KL, Moore EE, Macgraw Hill, New York 2008

Julie Ottosen MD, W Alan Guo, MD, PhD, FACS (November 2012)

(800) 789-4006 | aast@aast.org (mailto:aast@aast.org) | Contact Us
633 N Saint Clair St, Suite 2600, Chicago, IL 60611

(http://twitter.com/traumadoctors) (http://www.facebook.com/AASTtraumasurgeons)

(http://www.youtube.com/user/AASTTrauma)

(http://www.linkedin.com/company/3610560?trk=tyah&trkInfo=tas%3Aamerican%20association%20for%20the%20surgery%20of%20trauma%2Cidx%3A1-2-2)

(https://www.instagram.com/traumadoctors/) (https://www.pscp.tv/traumadoctors)

DONATE (/donate)

(https://smile.amazon.com/ch/36-2985865)



Corporate Partners (/corporatepartners.aspx)

Disclaimer (/Disclaimer/Default.aspx)