



BLUNT CHEST TRAUMA CAUSING DELAYED ATRIAL FIBRILLATION.

Cardiology

Dr. Takshak Shankar	Senior Resident, department Of Emergency Medicine, All India Institute Of Medical Sciences, Rishikesh, India.
Dr. Poonam Arora	Associate Professor, Department Of Emergency Medicine, All India Institute Of Medical Sciences, Virbhadra Road, Rishikesh- 249203, India.
Dr. Parvathy Sasidharan	Junior Resident, Department Of Emergency Medicine, All India Institute Of Medical Sciences, Rishikesh, India.
Dr. Bharat Bhushan Bhardwaj	Associate Professor, Department Of Emergency Medicine, All India Institute Of Medical Sciences, Rishikesh, India.
Dr. Sreejith Jayachandran	Junior Resident, Department Of Emergency Medicine, All India Institute Of Medical Sciences, Rishikesh, India.
Dr. Aishwarya Nair	Junior Resident, Department Of Emergency Medicine, All India Institute Of Medical Sciences, Rishikesh, India.

ABSTRACT

Blunt Cardiac Injuries are injuries acquired due to blunt trauma to the heart. Minor ECG or cardiac enzyme abnormalities and arrhythmias are a subset of BCI, referred to as cardiac contusions. BCI is associated with significant morbidity and mortality, and due to the absence of a definitive diagnostic test, is difficult to diagnose. Delayed presentation of arrhythmias beyond the initial 48 hours of trauma is rare. We present a case of an elderly female, who presented with atrial fibrillation ten days after sustaining a blunt chest trauma. She was managed in accordance with the AHA ACLS guidelines, but ultimately succumbed within an hour of Emergency stay. Elderly patients may require prolonged monitoring after blunt chest trauma.

KEYWORDS

Blunt Cardiac Injury, Chest trauma, myocardial contusion

INTRODUCTION:

Blunt Cardiac Injuries (BCI) are injuries acquired due to blunt trauma to the heart. BCI are associated with significant morbidity and mortality and are extremely challenging to diagnose. Cardiac contusions are a subset of BCI pertaining to minor ECG or cardiac enzyme abnormalities and arrhythmias¹. Most of these arrhythmias present within the initial 48 hours of trauma². Here we present a case of an elderly female who presented with atrial fibrillation, 10 days after sustaining a blunt chest trauma.

Case Presentation:

An elderly female, in her late 50s, pre-morbidly healthy, presented to the Emergency department complaining of palpitations and shortness of breath. She denied any history of chest pain, profuse sweating, vomiting, syncope, prior episode of chest pain, fever, or cough. She, however, reported a history of slip and fall on gravel ground around 10 days back when she sustained blunt trauma to the chest and had chest ecchymosis and pain. A chest X-ray and an ECG performed on the day of injury, was within normal limits. The chest pain lasted for around four days and following that, she was completely asymptomatic for around two days, when she started developing occasional palpitations. The palpitations increased over the following days and she developed shortness of breath for one day. She denied any history of smoking, substance abuse, or alcohol use.

On examination, she was agitated but conscious and oriented to time, place, and person with a pulse rate of 170 beats/minute, which was irregularly irregular, with unrecordable blood pressure and peripheral oxygen saturation. She was also tachypnoeic with a respiratory rate of 32 breaths/minute. She had no pallor, icterus, cyanosis, clubbing or oedema. Her respiratory system examination was significant for bilateral equal air entry with normal vesicular breath sounds, and bilateral basal crepitations. Her cardiovascular system examination revealed an irregularly irregular heart rate with no audible murmurs. The rest of the systemic examination was within normal limits.

She was immediately attached to a cardiac monitor and provided supplemental oxygen. The cardiac monitor revealed atrial fibrillation with a fast ventricular rate of around 170 beats per minute. Point of care venous blood gas revealed normal electrolyte levels. It was then

decided to cardiovert the patient owing to unstable atrial fibrillation. After taking consent and providing appropriate sedation, the patient was cardioverted with 150 Joules of synchronized Direct-Current shock, following which the patient's rhythm reverted to a normal sinus rhythm with no ST-T changes. Her vitals improved to a heart rate of 90 beats/min, blood pressure of 100/60 mm Hg, and SpO₂ of 98% on Room Air. A point-of-care 2-dimensional echocardiography performed at this time revealed a left ventricular ejection fraction of around 50-55% with no regional wall motion abnormality, normal right atrium and right ventricle, normal valves, and no pericardial effusion.

Around half an hour later, she became unresponsive with the cardiac monitor rhythm of ventricular fibrillation. Immediately high-quality Cardiopulmonary Resuscitation (CPR) was instituted according to the AHA ACLS guidelines and defibrillation with 200 Joules was done. The ventricular fibrillation persisted after the first shock and hence the patient was defibrillated again with 200 Joules, following which the rhythm was asystole. The CPR continued for 30 mins during which she received 1 mg of Intravenous Adrenaline as per protocol. The rhythm after the second shock was persistently asystole. When no Return Of Spontaneous Circulation (ROSC) could be achieved after 30 mins of CPR, she was declared dead. The patient's relatives were counselled about the need for a clinical autopsy, but they denied for the same.

DISCUSSION:

Blunt Cardiac Injuries (BCI) refer to injuries caused by blunt trauma to the heart. The terms BCI and cardiac contusions are often used interchangeably in the literature. However, according to a consensus statement, BCI refers to all cardiac injuries while the term "myocardial contusion" refers only to minor ECG or cardiac enzyme abnormalities and cardiac arrhythmias^{1, 3}. The incidence of BCI reported in the literature varies widely between 8% and 71%. Unfortunately, the actual incidence remains unknown⁴. Around 15% of trauma admissions to the Emergency Department are attributed to BCI⁵. Motor Vehicle Collisions (MVC), falls and crush injuries are the common injury mechanisms leading to BCI, of which MVC are responsible for the majority of BCI cases⁶.

BCI can result from one or more of several forces- compression of the

heart between the vertebral column and sternum, a direct transfer of energy to the heart, abrupt pressure changes in the abdomen and chest, acceleration/deceleration forces, sternal or rib fractures, and blast injuries⁷⁻⁹. The most commonly implicated mechanism is a direct impact to the chest. The most likely time of cardiac injury is when the ventricles are distended to their maximal capacity at the end of diastole⁷. The right heart is most commonly injured owing to its proximity to the anterior chest wall. Thus, the most commonly injured cardiac chamber is the right ventricle, followed by the left ventricle and right atrium¹⁰. Lower bone densities and decreased chest wall elasticity contribute to significant injuries in the elderly, even with a low energy mechanism¹¹⁻¹³.

Blunt cardiac injury can have a myriad of presentations. These include transient, silent arrhythmias, coronary artery thrombosis, cardiac failure, rupture of chordae tendinae/papillary muscles, septal rupture, and cardiac wall rupture, which may prove fatal^{1,7,14}. The vast majority of patients with BCI are asymptomatic or complain only of pain. Other concomitant chest injuries may also confound the presentation of BCI. BCI patients with a septal rupture and/or free wall rupture and/or coronary artery thrombosis are physiologically unstable, necessitating a swift diagnosis in the Emergency department followed by transfer to the operating room or intensive care unit for definitive care. Thus, it is recommended that all patients with severe blunt trauma chest should be evaluated for the presence of BCI^{1,14}.

The histopathological findings of a myocardial contusion resemble myocardial infarction and include intramyocardial haemorrhage, oedema and localised necrosis. Thus, the ECG abnormalities and cardiac biomarker elevations seen in myocardial contusion, resemble myocardial ischemia^{8,9,15,16}. Common ECG abnormalities include ST depression, non-sustained ventricular tachycardia, heart blocks and atrial arrhythmias^{7,15,16}. However, ECG changes tend to reflect the left ventricular activity, owing to the proximity of the left ventricle to the sternum and larger size as compared to the right ventricle. Thus, right ventricular contusions can easily be missed on the ECG¹⁷.

Sinus tachycardia is the most common dysrhythmia seen in BCI. This is followed by premature atrial or ventricular contractions, atrial fibrillation and bundle branch blocks. Right bundle branch block is the most common conduction abnormality, while the left bundle branch blocks are rare^{2,6,18,19}.

There is no definitive diagnostic test for diagnosing BCI. Multiple investigation modalities may be required for making a diagnosis- chest x-ray, electrocardiogram, cardiac enzymes, echocardiography, and nuclear medicine scans. The Eastern Association for the Surgery of Trauma (EAST) guidelines recommend an admission ECG for all patients suspected to have a BCI. They also recommend routine measurements of troponin I in these patients. If the admission ECG shows a new abnormality, or if the troponin I is elevated, admission for continuous cardiac monitoring is indicated. Normal ECG and normal troponin I levels rules out BCI. Nevertheless, even these criteria may miss patients who have a delayed presentation, such as those with a septal injury. Hence, the optimal timing of these measurements is yet to be determined^{6,7,19}.

A proposed algorithm for the diagnosis of BCI from a recent systematic review and meta-analysis recommends obtaining an electrocardiogram and Troponin I levels in all patients with blunt chest trauma. If these initial investigations are normal, repeat measurements are recommended at 4-6 hours after the trauma and if repeat investigations are normal as well, cardiac injury is considered to be excluded with no further cardiac monitoring required. If any or both of the initial investigations are abnormal, transthoracic, or transesophageal (if transthoracic echocardiography is contraindicated) echocardiography is recommended for definitive diagnosis³.

The treatment of sinus tachycardia is supportive in the form of volume resuscitation and pain management. Treatment of other arrhythmias such as atrial fibrillation, paroxysmal supraventricular tachycardia, ventricular tachycardia, ventricular fibrillation, and conduction blocks such as atrioventricular blocks should be in accordance with the AHA ACLS/ERCALS guidelines^{18,20,21}.

Our patient was an elderly female who developed atrial fibrillation around a week after sustaining a blunt chest trauma. She was premonitory healthy, as determined from previous regular health

check-ups and had no reported addictions. Although the patient's relatives denied consent for a clinical autopsy, in the absence of other risk factors, previously normal ECGs and a normal 2-D ECHO and the presence of a chest ecchymosis, the arrhythmia was attributed to the presence of a cardiac contusion in our patient. Most arrhythmias develop within 48 hours after the patient has sustained a blunt chest trauma². Delayed arrhythmias although reported before^{2,23} are rare.

CONCLUSION:

All patients, who sustain blunt trauma to the chest, should be evaluated for the presence of blunt cardiac injury. The diagnosis of BCI can be extremely challenging for most patients. A seemingly trivial mechanism may lead to a serious injury in elderly patients and thus they should be monitored and followed-up regularly.

Acknowledgments

The authors thank the patient, hospital staff involved in care of this patient.

Conflict Of Interest

The authors have no conflict of interest to declare.

Ethics Statement

The manuscript was approved by the Ethics Committee of our hospital.

Consent

Written informed consent was obtained to publish this report.

REFERENCES:

- Mattox KL, Flint LM, Carrico CJ, Grover F, Meredith J, Morris J, et al. Blunt cardiac injury. *J Trauma*. 1992;33:649-50.
- Sakka SG, Huettemann E, Giebe W, Reinhard K. Late cardiac arrhythmias after blunt chest trauma. *Intensive Care Med*. 2000;26(6):792-795. doi:10.1007/s001340051248
- Kyriazidis IP, Jakob DA, Vargas JAH, et al. Accuracy of diagnostic tests in cardiac injury after blunt chest trauma: a systematic review and meta-analysis. *World J Emerg Surg*. 2023;18(1):36. Published 2023 May 27. doi:10.1186/s13017-023-00504-9
- Blunt cardiac injury [Internet]. The American Association for the Surgery of Trauma. 2013 [cited 2023 Jul 12]. Available from: <https://www.aast.org/resources-detail/blunt-cardiac-injury>
- El-Chami MF, Nicholson W, Helmy T. Blunt cardiac trauma. *J Emerg Med*. 2008;35(2):127-133. doi:10.1016/j.jemermed.2007.03.018
- Marcolini EG, Keegan J. Blunt cardiac injury. *Emerg Med Clin North Am*. 2015;33(3):519-527. doi:10.1016/j.emc.2015.04.003
- Huis in 't Veld MA, Craft CA, Hood RE. Blunt cardiac trauma review. *Cardiol Clin*. 2018;36(1):183-191. doi:10.1016/j.ccl.2017.08.010
- Gao JM, Li H, Wei GB, Liu CP, Du DY, Kong LW, Li CH, Yang J, Yang Q. Blunt cardiac injury: a single-center 15-year experience. *The American Surgeon*. 2020 Apr;86(4):354-61.
- Eghbalzadeh K, Sabashnikov A, Zerrouh M, et al. Blunt chest trauma: a clinical chameleon. *Heart*. 2018;104(9):719-724. doi:10.1136/heartjnl-2017-312111
- Saar S, Lomp A, Laos J, et al. Population-Based Autopsy Study of Traumatic Fatalities. *World J Surg*. 2017;41(7):1790-1795. doi:10.1007/s00268-017-3929-3
- Birse F, Williams H, Shipway D, Carlton E. Blunt chest trauma in the elderly: an expert practice review. *Emerg Med J*. 2020;37(2):73-78. doi:10.1136/emmermed-2019-209143
- Fulda G, Brathwaite CM, Rodriguez A, Turney SZ, Dunham CM, Cowley RA. Blunt Traumatic Rupture of the Heart and Pericardium: A Ten-year Experience (1979-1989). *Journal of Trauma and Acute Care Surgery*. 1991 Feb;131(2):167-73.
- Schultz JM, Trunkey DD. Blunt cardiac injury. *Crit Care Clin*. 2004;20(1):57-70. doi:10.1016/s0749-0704(03)00092-7
- Clancy K, Velopoulos C, Bilaniuk JW, et al. Screening for blunt cardiac injury: an Eastern Association for the Surgery of Trauma practice management guideline. *J Trauma Acute Care Surg*. 2012;73(5 Suppl 4):S301-S306. doi:10.1097/TA.0b013e318270193a
- Tenzer ML. The spectrum of myocardial contusion: a review. *Journal of Trauma and Acute Care Surgery*. 1985 Jul;125(7):620-627.
- Bansal MK, Maraj S, Chewaproug D, Amanullah A. Myocardial contusion injury: redefining the diagnostic algorithm. *Emerg Med J*. 2005;22(7):465-469. doi:10.1136/emj.2004.015339
- Girón-Arango L, D'Empaire PP. Is there a role for transesophageal echocardiography in the perioperative trauma patient? *Curr Anesthesiol Rep*. 2022;12(2):210-216. doi:10.1007/s40140-022-00526-0
- EL-Andari R, O'Brien D, Bozzo SJ, Nagendran J. Blunt cardiac trauma: a narrative review. *Mediastinum*. 2021;5:28-28. doi:10.21037/med-21-19
- Yousef R, Carr JA. Blunt cardiac trauma: A review of the current knowledge and management. *Ann Thorac Surg*. 2014;98(3):1134-1140. doi:10.1016/j.athoracsur.2014.04.043
- Bock JS, Benitez RM. Blunt cardiac injury. *Cardiol Clin*. 2012;30(4):545-555. doi:10.1016/j.ccl.2012.07.001
- Kaye P. Myocardial contusion: emergency investigation and diagnosis. *Emerg Med J*. 2002;19(1):8-10. doi:10.1136/emj.19.1.8
- Lazaros GA, Ralli DG, Moundaki VS, Bonoris PE. Delayed development of complete heart block after a blunt chest trauma. *Injury*. 2004;35(12):1300-1302. doi:10.1016/j.injury.2003.10.018