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Case Report

Traumatic rupture of heart due to blunt trauma to chest: an autopsy case report with review of literature

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ABSTRACT

Road traffic accidents (RTA) result in the deaths of approximately 1.3 million people around the world each year; among them, more than half of all road traffic deaths and injuries involve vulnerable road users, such as cyclists, motorcyclists, along with pillion riders and pedestrians. Blunt cardiac trauma (BCT) often results from high-impact mechanisms caused by motorcycle crashes, motor vehicle accidents, fall injuries, and crush injuries. Thoracic injuries, causing a significant injury to the myocardium, account for morbidity and mortality (often instantly fatal) among trauma patients. We encountered a case of RTA in which 24 years old male sustained blunt trauma to chest. Autopsy findings revealed traumatic rupture of anterior wall of left ventricle leading to hemopericardium. Cardiac contusions were found over the right ventricle and left atrium. Histopathology of heart ruled out the myocardial infarction. Present case highlights the plausible mechanism involved in traumatic rupture of the heart. Finding out the exact cause of cardiac rupture in such cases have profound medicolegal significance.

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1. Introduction

Road traffic accidents (RTA) result in the deaths of approximately 1.3 million people around the world each year; among them, more than half of all road traffic deaths and injuries involve vulnerable road users, such as cyclists, motorcyclists, along with pillion riders and pedestrians. Death due to road traffic injuries is the leading cause for children and young adults aged 5-29 years. Young males under 25 years are almost three times more likely to be killed in road traffic accidents than young females.¹ Thoracic injuries, causing a significant injury to the myocardium,² account for morbidity and mortality (often instantly fatal) among trauma patients. In haemorrhage-related deaths in trauma cases, cardiac and aortic injuries are the predominant cause.²⁻⁴ Blunt trauma to the chest may produce injuries to the pericardium,

myocardium, coronary arteries, great vessels, and valves and can also cause rhythm and conduction disturbance.^{5,6} Blunt cardiac trauma (BCT) often results from high-impact mechanisms caused by motorcycle crashes, motor vehicle accidents, fall injuries, and crush injuries.^{4,7} Types of BCT may be listed as pericardial rupture, commotio cordis, septal injury, valvular injury, myocardial contusions, and myocardial rupture.⁴ The heart is somewhat very much safeguarded inside the thoracic pit, being situated in the focal point of the chest with the lungs on either side and sternum and the vertebral section shielding it from the front and back angles, individually.^{8,9} The heart is vulnerable to both blunt and penetrating injuries. Penetrating injury is more common due to stab injury, whereas blunt injuries to the heart are more commonly in cases of RTA's, fall from height, and in stamping assault.^{8,10} Blunt myocardial injury is defined as the development of a laceration or tears in the walls of the atria, ventricles, or papillary muscles secondary to blunt trauma. The commonest mechanism

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involved is direct impact-to the front of the chest resulting in injury to heart and other mechanisms are; Indirect or hydraulic pressure causing increased intracardiac pressure as a result of increased preload and abdominal pressure, which predisposes the myocardial rupture. Bidirectional force from sternum and vertebra causing compression of the heart. Heart can move freely in the pericardium and acceleration/deceleration force causes sudden movement of the heart which results tear/laceration and contusion of the myocardium. Blast force may lead to septal or ventricular rupture and concussive force causing fatal arrhythmia. Penetrative force i.e., penetrative injury to the precordial area or displaced fracture of ribs causes injury to the pericardium and myocardium.^{4,11}

In the present case, we explored the mechanism of left ventricular rupture due BCT with interesting autopsy findings.

2. Case Description

A previously healthy 24 years old adult male met with a road traffic accident while returning home on his motorcycle. His motorcycle collided with a truck, and he sustained injuries overhead, face, and chest. The patient was hospitalized in our institute and died within an hour. Cardio-pulmonary resuscitation was attempted. Investigating police officials ordered a medico-legal autopsy to find out the exact cause of death. Post-mortem interval was 12 hours, and BMI-24.2 kg/m².

Following bodily injuries were present on the deceased:

1. Contusion over midline of chest at the level of 4th intercostal space extending on both the sides measuring 8.5 cm x 3.5 cm.
2. Contusion present over left side of chest in anterior Axillary line at 5th intercostal space, measuring 2.5 cm x 1.5 cm (Figure 1)
3. Perforating laceration of left upper lip extending to angle of mouth, measuring 3 cm x 2 cm.
4. Laceration present over left lower lip measuring 2 cm x 1 cm x 0.5 cm.
5. Abrasion present over left side of neck, situated 2 cm left to midline and 5 cm above to the level of sternal notch, measuring 8 cm x 4 cm, horizontally placed. All injuries were red in colour and antemortem in nature.

Internal examination revealed intercostal haemorrhage in 4th and 5th intercostal space in the anterior axillary line without fracture of the ribs. The anterior surfaces of the lower lobes of both the lungs were contused and about 100 ml and 200 ml fluid blood was present in the right and left pleural cavity, respectively. Haemorrhage was present over parietal pericardium measuring 4cm x 3cm, and it was found to be intact. On dissection, hemopericardium amounting to 200 ml of fluid blood was present in the pericardial cavity. (Figure 2) Gross examination of the heart

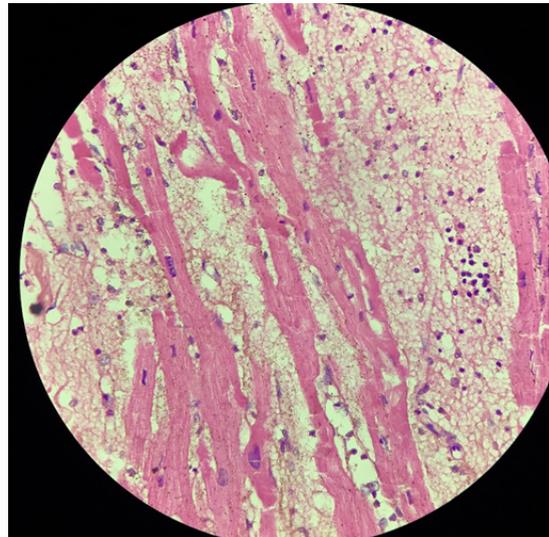


Fig. 1:

revealed laceration over the anterior surface of left ventricle at middle 1/3rd measuring 1.5cm x 0.5cm x cavity deep. (Figure 3) Contusion present over the anterior surface of left atrium measuring 4cm x 2cm, red in colour. Contusion present over the posterior wall of the right ventricle at the upper part, measuring 2cm x 1.5cm, red in colour. (Figure 4) No evidence of old or fresh myocardial infarction was noted in the ruptured area. Coronaries: no evidence of coronary atherosclerosis. Epicardial vein was torn at the site of ventricular laceration. Thickness of the left ventricle was 1.5cm. Remaining heart was unremarkable.

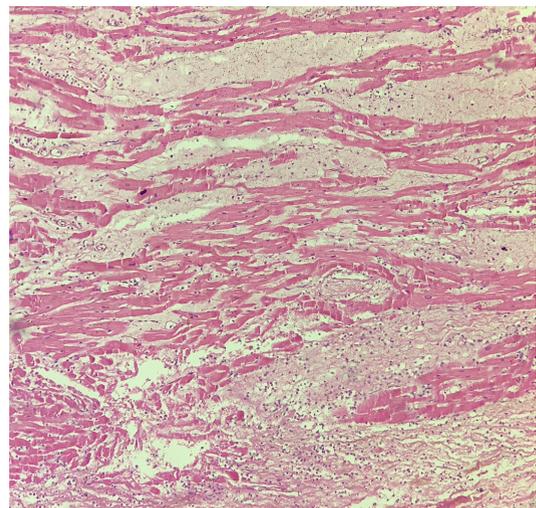


Fig. 2:

Congestion of the brain was present. Patchy subarachnoid haemorrhage was present over the inferior surface of occipital and temporal lobes. Contusion present



Fig. 3:

over inferior surface of right temporal lobe measuring 2 cm x 2 cm. Sternum, vertebra (cervical, thoracic, and lumbar), and diaphragm were intact, and the abdominal cavity was unremarkable. Toxicological analysis did not reveal any intoxicant.

Histopathology of ruptured heart depicted intact myocardial fibres with infiltration of neutrophils, lymphocytes and pigment laden macrophage and haemorrhage ruling out myocardial infarction. (Figures 5 and 6).



Fig. 5:

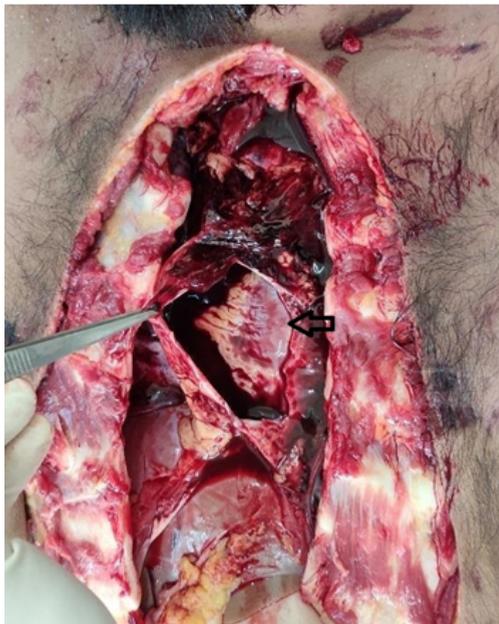


Fig. 4:



Fig. 6:

Patient was non-smoker, non-alcoholic and his past history was unremarkable.

Hence, we confirmed the cause of death as "complications of hemopericardium as a result of traumatic rupture of anterior wall of left ventricle

due to blunt trauma to chest associated with bilateral haemothorax".

3. Discussion

The first documented case of blunt trauma chest causing cardiac rupture was by Berard in 1826, he reported a left atrial laceration in a young man who fell from the window and expired within 2.5 hours the development of cardiac tamponade.¹² Heart rupture might include the right and left atria, the right and left ventricles, the atrial septum, as well as the intrapericardial portion of the superior or inferior vena cava, the atrioventricular valves, and their chordae tendineae.⁵ Non traumatic free wall rupture of Left ventricle is most commonly due to Acute Myocardial Infarction (AMI) with incidence less than 1%. Hemodynamic factors such as structural weakness of the myocardium by the necrosis of myocytes, collagen matrix resolution, intense inflammation, and increased intracavitary pressure play essential roles in leading to the rupture of the left ventricle (most commonly observed within 3 to 5 days post-AMI) and occurs in the anterior or the lateral wall at the mid-papillary level. Myocardial rupture can also occur in cardiac infection, primary or secondary cardiac tumours, infiltrative diseases of the heart and penetrating or blunt cardiac trauma.^{13,14} Traumatic rupture of the heart might occur in any chamber but often seen in the ventricles, especially in the anterior and inferior surface.^{8,15} Among the ventricles, traumatic rupture mostly occurs in the right ventricles, followed by left ventricle, right atrium, and left atrium.⁶ Traffic accidents (involving motor vehicles, motorcycles, pedestrians struck) are the most common cause of blunt cardiac laceration, followed by crushing and falls.^{5,7} Cardiac rupture after blunt trauma is usually fatal and carries a high mortality rate. Most of the patients die at the scene or during transportation.^{4,8} Rupture of any chamber of the heart or epicardial laceration involving epicardial vessels results in haemorrhage in the pericardial cavity and if pericardium is intact it may lead to fatal cardiac tamponade. Rupture of right ventricle is relatively more dangerous than the left ventricle because it has less muscle mass, whereas thick musculature of left ventricle can temporarily seal the rupture site due higher contractibility.¹⁰

In our case, victim sustained blunt trauma to the chest due to RTA. Despite of hard and blunt force impact, sternum, ribs and thoracic vertebrae found to be intact. Haemorrhage was evident on parietal pericardium without any breach. Hence, compressive force was just contributory factor in aggravating effect of acceleration and deceleration forces.

Acceleration-deceleration forces result in the free movement of the heart, especially in the anterior-posterior direction leading to lacerations or tears to the myocardium or epicardial vessels.⁴ Hence, in the present case plausible mechanism for cardiac rupture could be acceleration followed by sudden deceleration associated with direct

impact over the chest. The cardiac contusions may be produced due to sudden anterior-posterior movement of heart with it fixed base causing contusion over its anterior and posterior surface at upper part.

The timing of impact would have been during the late diastole or early systole (because chambers are full and valves are closed, causing higher pressure within ventricles than the atrium), which is a predisposing factor for increased vulnerability of ventricle rupture.⁸

Hence, the present case highlights important mechanism involved in cardiac rupture due to BCT. It may look trivial on external examination; however internal complications can be catastrophic. Therefore, in the trauma triage protocol, immediate assessment of the injured part is crucial as observed from the internal findings in the present case.

Histological examination should be done to rule out post AMI rupture of the heart and document healthy myocardium. Differentiating between natural and traumatic cardiac pathology may be medicolegally important in deciding the cases of blunt cardiac trauma.

4. Source of Funding

None.

5. Conflict of Interest

None.

6. Ethical Consideration

Written informed consent for publishing data was collected during the medico-legal autopsy from the investigating officer and relatives of the deceased. In our case paper, images used are entirely unidentifiable and data described in manuscript does not disclose the identity of any individual. Hence, institutional ethical committee approval is not warranted.

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