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A Case Report of Blunt Cardiac Rupture

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**Highlights**

- Cardiac rupture is a full thickness laceration of the myocardium that occurs after blunt chest trauma.
- They are notoriously fatal, with only a handful of patients documented to have survived this injury.
- In cases where there is laceration of the pericardium, cardiac injury may not be obvious on initial assessment
- A high degree of suspicion due to the mechanism of injury, along with early recognition and prompt operative intervention can help to reduce mortality for these disastrous injuries.
- Blunt chest trauma with associated rib fractures can result in cardiac injury.

- Despite its rarity, a differential diagnosis of cardiac rupture should be entertained in patients with low velocity blunt chest trauma who present with haemothorax.

**Abstract**

**Introduction**

Cardiac rupture is a full thickness laceration of the myocardium that occurs after blunt chest trauma. They are notoriously fatal, with only a handful of patients documented to have survived. These injuries are not commonly associated with low energy chest trauma and may be overlooked as a differential in trauma cases if health care providers are not aware of their possibility. We now report the case of a patient who survived this injury. We believe this is the 16$^{th}$ reported survivor of blunt cardiac rupture.

**Presentation of Case**

A 46-year-old construction worker was brought to the emergency department following blunt chest trauma. On arrival he was hypotensive and tachycardic. There was a transient response to intravenous fluid resuscitation. He was found to have a contusion to the left anterior chest wall and left haemothorax on imaging with normal mediastinum. Emergency left anterolateral thoracotomy revealed a pericardial and left ventricular laceration which was repaired. He was weaned off ventilatory support on day 4 post exploration and had an uneventful recovery.

**Discussion**

Survival after blunt cardiac rupture is extremely low. In the past 60 years, only 15 cases have been described where patients survived this injury. They are usually immediately fatal and are caused by high velocity injuries. Our case was interesting because, this injury was due to a low velocity injury resulting in ventricular laceration due to a displaced rib fracture. We believe this is the 16th reported survivor of blunt cardiac rupture.

**Conclusion**

It is important, therefore, for first responders to recognize that blunt cardiac rupture can also result from seemingly innocuous, low velocity injuries so that the diagnosis can at least be entertained early. Survival depends on early diagnosis and prompt thoracotomy.

**Keywords:** Chest Trauma, Haemothorax, Cardiac Tamponade, Thoracotomy, Blunt Cardiac Trauma, Rib Fracture

## INTRODUCTION

Blunt cardiac rupture is defined as a full-thickness laceration of the myocardium [1]. They are rare injuries that are reported to occur in 0.007% to 0.45%of patients who present to hospital alive after sustaining blunt chest trauma [2,3]. Because of their rarity and obscure clinical presentations, these are notoriously fatal injuries. The presence of such injuries can often be overlooked if first responders are not aware of their clinical presentations and the fact that they can occur after seemingly innocuous blunt chest trauma. This case was successfully managed at a public hospital, despite the disadvantage of lacking a dedicated thoracic surgical unit.

## CASE REPORT

A 46-year-old male construction worker was brought to the emergency department within minutes of sustaining chest trauma. Onlookers reported that he tripped and fell forward onto a metal rod protruding from the ground at a constructions site **(Figure 1).** There was no previous history of drug or alcohol use at the times of the incident or prior, and no family or social history that would contribute to the discussion of this case.

On arrival in the emergency department, he was hypotensive at 90/45mmHg and tachycardic at 115 beats per minute. There was a transient response to intravenous fluid resuscitation. Chest inspection revealed a contusion at the fourth intercostal space and 2cm to the left of sternal edge. Heart sounds were normal and the jugular neck veins were not distended.

There was decreased air entry at the left chest. Chest X-ray revealed a left haemothorax **(Figure 2)**. A focussed abdominal sonogram in trauma (FAST) identified fluid in the left pleura. The pericardium appeared normal. A left sided basal thoracostomy tube was placed which immediately drained 1600mls of fresh blood. No further investigations were possible at this time in view of his haemodynamic instability. He was transferred to the operating theatre for an

emergency thoracotomy. At the time of surgery, there was no thoracic surgical service available at our institution and surgery was performed by the consultant general surgeon on duty.

The chest was entered via a left anterolateral thoracotomy. Approximately 1 litre of blood was evacuated from the left hemi-thorax. The source of bleeding was identified as a 4cm laceration to the pericardium and left ventricle **(Figure 3)**. This injury was spatially related to a displaced fracture of the fifth rib. No further injuries were identified at the remaining thoracic viscera. Haemorrhage from the left ventricle was controlled by direct finger pressure at the site of injury and use of 3/0 polypropylene sutures in horizontal mattress fashion without pledgets. Using this method, haemostasis was achieved effectively and efficiently, without the need for aortic clamping or extracorporeal circulation. The pericardium was not repaired. Cardiac massage was not necessary in this case, and restitution of the patient's intravascular volume was promptly achieved following establishment of haemostasis. Thoracostomy tubes were placed intra-operatively and the thoracotomy incision was closed in layers.

He was weaned from the ventilator at the fourth post-operative day. Post-operative echocardiogram did not reveal any functional abnormalities and normal sinus rhythm was present on electrocardiography. Apart from a lower respiratory tract infection that was treated with antibiotic therapy (**Clavien-Dindo Grade 2**), no further complications were encountered. He was discharged from hospital at post-operative day fourteen.

On subsequent follow-up that patient appeared to be satisfied with the outcome of the intervention. Despite experiencing mild pain at the site of incision and occasional chest tightness on deep inspiration, he was able to carry out daily activities as before and continued chest physiotherapy at home. In addition to continued surveillance by the surgical team, he also underwent evaluation by the cardiology unit to assess for any long term functional or mechanical cardiac sequelae.

This case has been reported in accordance with the SCARE 2018 Guidelines [4].

## DISCUSSION

Blunt cardiac rupture is defined as a full-thickness laceration of the myocardial wall [3]. This is usually a fatal injury, with most victims exsanguinating before they arrive in the emergency department. Therefore, it is rarely encountered in living patients [5]. Texiera et al reviewed data from the United States-based National Trauma Data Bank and reported that 44% of victims with

blunt cardiac rupture who presented to the emergency department died on arrival or shortly thereafter within the emergency room. A further 45% of those patients with blunt cardiac rupture who initially presented alive eventually died in hospital [1].

When patients do arrive alive, they usually deteriorate rapidly in the emergency department once large volume fluid resuscitation is instituted, restoring end diastolic volumes, and increasing pressure on the injured myocardium. Even in the minority of patients who are fortunate enough to have repair, death can still occur a few days after repair due to necrosis and delayed rupture of the injured ventricular muscle [6].

It is understandable, therefore, that survival after blunt cardiac rupture is extremely low. In fact, a literature review between 1957 and 2017 revealed that there were only 15 reports of patients surviving after sustaining blunt cardiac rupture in the past 60 years [7-22]. To the best of our knowledge, this is now the 16$^{th}$ survivor of blunt cardiac rupture.

Interestingly, 12 (80%) of the reported survivors sustained high velocity injuries in road traffic accidents [7-12,15,17-19]. In these cases, the prevailing theory is that there is a massive, sudden increase in intra-cardiac pressures when the high velocity impact causes thoracic compression, or excessive venous return when the intra-abdominal vena cava is compressed. These injuries are more likely to be immediately fatal because the heart may herniate out of the pericardium causing torsion of the great vessels [23].

Our case was interesting because, this injury was due to a low velocity injury - an uncommon injury mechanism that has only been reported three times in the medical literature [20-22]. In 1968, Suszoko et al reported a similar injury after a man fell over onto a chair [20]. Then in 2006, Kaul et al reported a 55-year-old gardener who sustained a left ventricular laceration from a fifth rib fracture after falling from a ladder at a height of 10 feet [21]. And in 2015, Udayakumara et al reported a 56-year-old carpenter who fell onto a wooden stump and sustained left ventricular injury from a fractured xiphisternum [22]. In these cases, and ours as well, the ventricular laceration was thought to be due to a displaced fracture. It is important, therefore, for first responders to recognize that blunt cardiac rupture can also result from seemingly innocuous, low velocity injuries so that the diagnosis can at least be entertained early.

Most patients with blunt cardiac rupture present with signs of cardiac tamponade [8], although the signs may be attenuated because the patients are often hypovolaemic by the time they arrive at the emergency department. Our patient did not present with signs of cardiac

tamponade because the pericardial laceration allowed blood to vent into the larger left pleural space. In these cases, the diagnosis becomes more difficult and may lead to diagnostic delay [5,9].

Once the diagnosis is suspected, these patients demand emergent thoracotomy to preserve life - done in the emergency room if they are in extremis [1,24]. Patients who are initially stable but have initial thoracostomy drainage >1L or a bleeding rate >200 ml/hr for four consecutive hours warrant emergent thoracotomy, preferably in the controlled operating room environment [24,25]. We should aim to achieve the following five goals at emergency thoracotomy: (1) release cardiac tamponade, (2) control bleeding, (3) facilitate internal cardiac massage, (4) clamp the descending aorta to isolate circulation to the upper torso in damage control surgery and (5) achieve rapid, large-volume intra-cardiac fluid resuscitation [2].

There is much debate surrounding the choice of incision. In emergency room thoracotomies, the usual choice of incision is an antero-lateral thoracotomy because it provides very rapid entry [24]. Opponents suggest that this incision provides limited access to mediastinal structures and, although extension across the sternum is possible, there is increased bleeding from the interrupted internal thoracic vessels [8]. However, division of the internal thoracic vessels can be anticipated from their anatomic location, allowing rapid control [24]. In any event, ventricular lacerations were documented in 10 (63%) of the 16 cases reviewed in this manuscript– a location that is easy to reach across an anterolateral thoracotomy [7,8,10-12,14,19,21,22].

## CONCLUSIONS

Because of their rarity and obscure clinical presentations, blunt cardiac injuries are notoriously fatal. Survival depends on early diagnosis and prompt thoracotomy. To achieve this, first responders in the emergency department must be aware of the injury patterns and presentations, especially that they can occur after seemingly innocuous blunt chest trauma. As demonstrated by this case, prompt identification and rapid intervention can deliver positive outcomes even in low volume centres.

## Informed Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

## Additional Information

- No financial support was available for this research. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
- This research was approved by the institutional review board at the University of the West Indies (CEC355/11/17)
- Conflict-of-interest statement: The authors declare that there are no financial relationships, personal relationships or other scenarios that may represent potential conflicts of interest.

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**funding**

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## Ethical Approval

This research was approved by the institutional review board at the University of the West Indies (CEC355/11/17)

## Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

## Author contribution

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Cawich SO: Conceptualization, Supervision, Writing - Review & Editing Preparation,

Ramlaksingh S: Conceptualization, Writing - Review & Editing Preparation

Naraynsingh V: Supervision, Writing - Review & Editing Preparatio

## Registration of Research Studies

The BPG policy for clinical trial registration applies only to prospective, randomized, controlled trials. Therefore, this manuscript does not require clinical registration as it is not randomized, controlled trial.

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Figure: 1

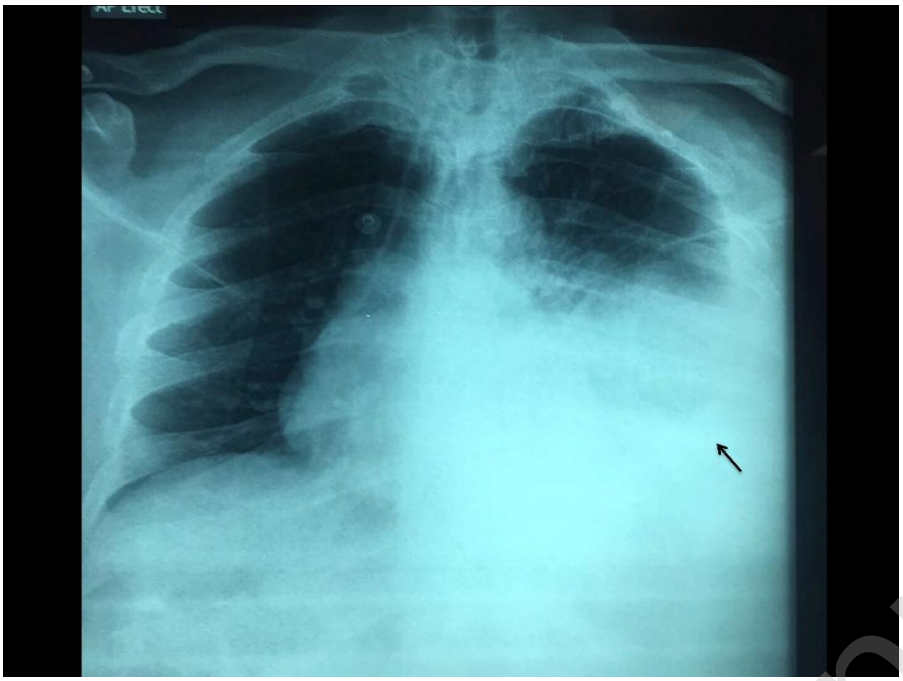

Figure: 2

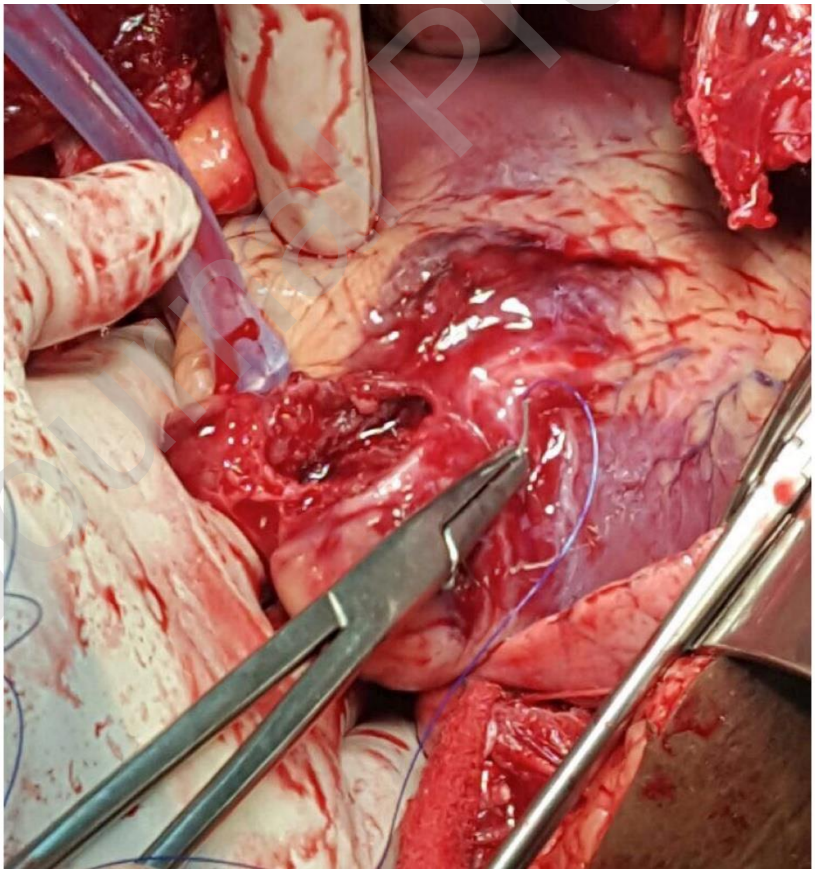

Figure: 3