CASE REPORT

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Left ventricular rupture as a consequence of blunt trauma – case report and literature review

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Abstract

Left ventricular rupture is a form of blunt cardiac trauma that is less common than right ventricular rupture due to the anatomical arrangement of the heart. This case report details the successful surgical treatment of a 63-year-old male patient who suffered a left ventricular apex rupture due to a traffic accident. Despite the low survival rate associated with this condition, the patient recovered well following sternotomy to suture the rupture and evacuate blood from the pericardial sac. In addition, the patient also had a splenic rupture that was managed by general surgeons performing splenectomy. Follow-up echocardiography showed a small amount of fluid in the pericardial sac, and the patient was discharged in good condition with advice to take sotalol for atrial fibrillation. This rare case highlights the importance of prompt diagnosis and immediate surgical intervention for left ventricular rupture in traffic accidents, as it can lead to favourable patient outcomes.

Key words

heart rupture, pericardial tamponade, accidental injuries

INTRODUCTION

A common complication of traffic accidents is blunt cardiac injury, but rupture of the heart is rare and highly fatal [1]. Cardiac rupture is a full-thickness laceration of the myocardium [2]. Autopsy studies have shown that the most frequently ruptured part of the cardiac muscle is the right ventricle, followed by the left ventricle, right atrium, interventricular septum, left atrium, and interatrial septum [3]. Immediate surgical intervention can save lives in traumatic left ventricular rupture [4].

The breakthrough moment in the history of cardiac surgery was in 1896 when the first successful suturing of a heart wound was performed by Ludwig Rehn [5]. The case is presented of a successful surgical treatment of a left ventricular rupture in a 63-year-old male, caused by a traffic accident.

CASE REPORT

A previously healthy 63-year-old man, a driver with alcoholic intoxication, was the victim a traffic accident. He was brought in critical condition to the Hospital Emergency Department. At admission, the patient was in post-traumatic shock, was intubated and mechanically ventilated. On physical examination, low arterial blood pressure, distended neck veins, and muffled heart sounds were observed. In laboratory tests: elevated levels of D-dimer (7025 ng/ml) and slightly decreased haemoglobin level (10.7 g/dl) were noted. The patient did not require a blood transfusion. In the CT, trauma were diagnosed as pericardial tamponade and a splenic rupture (Fig. 1,2). Due to his unstable condition, the patient was transferred to the Department of Cardiac Surgery for immediate surgical treatment.

A sternotomy was performed in the operating theatre. Intraoperatively, blood was evacuated from the pericardial sac. A rupture of the left ventricular apex was visualized with the formation of a large thrombus, partially covering the rupture site. After removable of the thrombus there was intense bleeding. The rupture of the heart was repaired with a 5–0 polypropylene suture and a fibrin-based haemostatic agent (TachoSil), obtaining full haemostasis. The patient was placed in the care of general surgeons who performed laparotomy and splenectomy. After the completed abdominal operation, the pericardial sac was partially sutured. Two drains were left in the mediastinum, and the chest was closed. All procedures were completed without complications.

After the operation, the patient was transferred to the Cardiac Surgical Intensive Care Unit, where he stayed for sixteen days. On the seventh day of hospitalization, due to the clinical and radiological features of the increased fluid in the pleural cavities, left-sided pleurocentesis was performed, and about 500 ml of post-operative haematoma evacuated. The laboratory tests showed elevated levels of troponin I (103 ng/L) and GGTP (207 U/L). Six days later, due to circulatory failure, about another 600 ml of fluid were evacuated.

Follow-up echocardiography revealed a small amount of fluid in the pericardial sac, a reduced left ventricular ejection fraction (LVEF). No other functional abnormalities were observed.

During the hospitalization, two episodes of atrial fibrillation occurred, both of which were inhibited pharmacologically.

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Figure 1. Chest contrast-enhanced CT scan obtained at the level of the ventricles shows a large pericardial effusion flattening the anterior cardiac contour

Figure 2. Contrast-enhanced CT scan of the chest and abdomen shows pericardial tamponade and ruptured spleen with multiple foci of active bleeding

The patient was discharged home in good general condition with a left ventricular ejection fraction above 50%, determined in the bedside echocardiogram. He was advised to take sotalol due to atrial fibrillation and torasemide, perindopril, and eplerenone in the treatment of heart failure. Currently, the patient is being taken care of by a cardiology clinic in his hometown to asses any long-term functional or mechanical cardiac sequelae.

DISCUSSION

Blunt cardiac trauma is damage resulting from blunt trauma to the chest and is the most common type of heart injury, commonly caused by motor vehicle collisions.

Blunt cardiac injury (BCI) causes a spectrum of injuries ranging from minor asymptomatic myocardial concussion to ventricular rupture. Due to its anatomically anterior position, the right ventricle is more susceptible to trauma than the left ventricle [3]. Additionally, due to the thicker muscular wall, the left ventricle will most likely close over a small injury when compared with the thin-walled right ventricle. For this reason, increased haemorrhage and pericardial tamponade will be observed with right ventricular injury [6].

The case is presented of a left ventricle apical rupture, which is an uncommon complication of a traffic accident. Additionally, despite the low survival rate after blunt cardiac ruptures, the 63-year-old patient successfully recovered. The features increasing this prospect are male gender and middle age.

The mortality rate in blunt cardiac rupture (BCR) is rated as extremely high, from 50 – 100% percent, with barely 15 survival cases having been describing in the past 60 years [2, 7]. According to Fedakar et al., the most frequently observed cardiac injury pattern in cases of mortality following blunt thoracic trauma, was left ventricular rupture, accounting for 31.3% of cases [8].

Despite the high mortality rate associated with the injury, prompt actions of swiftly transporting the patient to hospital, conducting thorough diagnostics, performing necessary surgical treatment, and closely monitoring post-operative recovery, ultimately enabled the patient to survive, despite the severity and complexity of the injury.

However, the case of a 21-year-old female with multiorgan injuries after fall from a height of a 40-feet, demonstrated a successful operative repair of delayed left ventricle rupture resulting from blunt trauma. Despite initial negative findings on CT and FAST, subsequent echocardiograms revealed an enlarging pericardial effusion and left ventricular diverticulum. Surgical intervention performed ten days after the trauma, including pericardiocentesis and mitral valve replacement, effectively managed the atrioventricular rupture [9].

The exact mechanism of ventricular rupture in motor vehicle accidents can be explained by severe precordial impact to the chest wall, compression between the spine and the anterior chest wall, deceleration injury, rib fractures or propagation of venous pressure due to compression of the abdomen and lower extremities. The impact or compression can cause contusion or injury to the heart muscle, leading to rupture and subsequent cardiac tamponade [7, 10]. The location of the rupture is determined by the phase of the cardiac cycle in which the injury took place: ventricular rupture is more likely to occur during the end-diastolic phase when the ventricle is at its most extended and the compression forces of the ventricle are greatest [11, 12].

In patients hospitalized for BCR, survival is influenced by several factors: physiological condition, type and location

of heart rupture, speed and accuracy of diagnosis, and therapeutic measures taken. Most important of all is the physiological state at the time of admission. Patients in cardiac arrest or without signs of life have a rare survival rate [13].

The primary manifestation of cardiac rupture is a massive pericardial effusion which can quickly lead to the pericardial tamponade. The diagnosis should be fast, considering a clinical triad of hypotension, muffled heart sounds, and distended neck veins symptoms. The primary imaging methods used for blunt cardiac rupture are chest radiographs, MDCT (Multi-Slice Computed *Tomography),* FAST *(Focused Assessment with Sonography* in *Trauma),* TTE (Transthoracic Echocardiography), TEE (Transesophageal Echocardiography), or C-MRI *(Cardiac Magnetic Resonance Imaging).*

The most recent articles and case reports emphasize the importance of focused assessment with CT, TTE/TEE and FAST. MDCT is the current gold standard for evaluating chest trauma due to its excellent spatial, contrast, and temporal resolution, which allows detailed analysis of the heart, pericardium, and great vessels. The technique enables quick and accurate imaging of the entire body, leading to efficient diagnosis and treatment of life-threatening injuries [14, 15]. Furthermore, ultrasonography is useful in both diagnostic as well as a temporary therapeutic measures defined by ultrasound-guided pericardiocentesis [7].

Kim et al. described the case of a 28-year-old man with a left ventricular rupture due to a car accident. The damage could only be visualized through MDCT, which proved to be superior to the echocardiogram (ECHO) that did not detect any pathology [16]. Haprula et al. presented the case of a 19-year-old male who underwent evaluation after a tractor-trailer accident. Initial examinations, including ECG and TTE, revealed non-specific abnormalities, with findings of a mildly dilated left ventricle and normal systolic function, displaying an ejection fraction of 60%. Subsequently, an ECG-gated cardiac CT confirmed the presence of a subepicardial aneurysm. Throughout the study, the patient received conservative management and remained stable. A subsequent MRI provided valuable insights, revealing a subendocardial fibrous scar in the mid-lateral wall segment, and a transmural fibrous scar covering the aneurysm. In cases of left ventricular rupture, the formation of pseudoaneurysms can occur, making it crucial to carefully observe and assess them during the diagnostic process.

This case highlights the vital role of multimodal imaging in accurately diagnosing complications of left ventricular rupture, such as subepicardial aneurysms. Instant diagnosis, despite the asymptomatic course of the injury, enabled the implementation of appropriate treatment and thus cured the patient [17]. In the current case, the MDCT method was selected based on the patient's condition, and the presence of a CT scanner in the emergency department enabled arrival at a diagnosis within minutes.

Nevertheless, the signs of cardiac tamponade may be diminished. A patient with haemorrhage and hypotension cannot have distended neck veins. Singh et al. described the case of a 46-year-old male who presented the attenuated signs of the myocardial tamponade due to the pericardial laceration that allowed blood to vent into the larger left pleural space, which could have caused a diagnostic delay [2].

In the current case, a rupture of the left ventricle was accompanied by a rupture of the spleen. A study conducted by Yun et al. showed that most patients with BCR have multi-organ injuries, the most common being liver laceration, spleen injury, pelvic bone fracture, spinal fracture, and fractures of the extremities, which highlights an even greater need for prompt diagnosis using whole-body computed tomography [18].

The elevated Troponin I level frequently occurs in patients with BCR. In the current case, the level of troponin I determined on the 7th day after the injury was 107 ng/ml. Dou et al. have proven that patients with elevated levels of this marker showed longer stay in hospital and higher in-hospital mortality, which indicates the validity and prognostic value of troponin I level in BCR [19].

The results from different cases regarding patients who undergo surgery after BCR suggest that the degree of pre-operative haemodynamic instability can be a pivotal predictor of outcome, with survival rates ranging from 39 – 100%. In order to identify the appropriate area of the myocardium, surgical access is commonly performed off-pump. Subsequently, a well-implemented cardiography and the use of the proper surgical materials will help in acute surgical management. To provide suitable closure, oncutting sutures in a buttress technique and artificial patches and glues are used. In the current case, a single 5–0 polypropylene suture and a fibrin-based haemostatic agent (TachoSil) was applied. Nevertheless, to handle the issue that the weakened tissue serves as a very poor scaffold site for suturing, a new technique was designed. The patches which can be applied without sutures using cyanoacrylate glue are large enough to cover the area of the rupture and surrounding weakened tissue, and also incorporate the neighbouring viable myocardium [20]. At the present time, pericardiotomy with pericardial window creation and ventricular rupture suture remains the 'gold standard' in the treatment of blunt cardiac and pericardial injuries [21].

CONCLUSION

The presented case report is significant for cardiovascular medicine and trauma surgery. It emphasizes the importance of early diagnosis and immediate surgical intervention in left ventricular ruptures caused by traumatic injuries. Despite the low survival rate associated with this condition, prompt medical attention and skilled surgical procedures can lead to favourable patient outcomes. The presented case also highlights the value of a multi-disciplinary approach in managing complex cases, as evidenced by the involvement of general surgeons in addressing the patient's splenic rupture. The findings can influence clinical practices and protocols for managing similar cases, stressing the need for increased awareness among healthcare professionals. Overall, this report contributes to improving patient care and outcomes in critical scenarios.

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