

Partial Heart Herniation: An Unusual Manifestation of Trans-Mediastinal Gunshot Injury

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Abstract

Introduction: Gunshot injuries to the thoracic cavity are relatively common and considered high risk for cardiac involvement. However, current literature shows that the incidence of cardiac damage does not differ significantly when comparing various aetiologies of penetrating chest injuries [1].

The most common predictive factors for cardiac injury include clinical manifestations, missile trajectory or anatomical wound location, and the number of chest wounds [2]. However, injuries to the heart and mediastinal vessels are often fatal and are therefore considered leading causes of death following trauma [3].

Most patients suffering from an acute traumatic cardiac injury present with hemodynamic instability and cardiac tamponade, which can subsequently lead to high mortality rates [4, 5]. Therefore, a patient with a gunshot thoracic injury, especially transmediastinal, who is hemodynamically stable and shows no clinical signs or symptoms of cardiac injury, may have underlying injuries.

We present a rare case of a stable gunshot trans -mediastinal wound patient, with initial retained haemothorax after thoracentesis, and finally diagnosed with partial heart herniation.

Conclusion: Partial heart herniation following a transmediastinal gunshot wound is a rare and potentially life-threatening condition that may present without classic signs of cardiac injury. This case emphasizes the importance of maintaining a high index of suspicion for occult cardiac trauma in hemodynamically stable patients with thoracic gunshot injuries. Timely imaging, thorough evaluation, and minimally invasive surgical exploration, such as VATS, can play a critical role in diagnosing and managing such atypical presentations, ultimately improving outcomes.

Keywords: heart herniation, penetrating cardiac injury, thermal pericardial injury, VATS

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Introduction:

Gunshot injuries to the thoracic cavity are relatively common and considered high-risk for cardiac involvement. However, current literature indicates that the incidence of cardiac damage does not differ significantly among various etiologies of penetrating chest injuries [1]. The most common predictive factors for the presence of cardiac injury include clinical manifestations, the trajectory of the missile or anatomical wound location, and the number of chest wounds [2]. Nevertheless, injuries to the heart and mediastinal vessels are often fatal and are therefore seen as leading causes of death following trauma [3]. Most patients

experiencing an acute traumatic cardiac injury present with hemodynamic instability and cardiac tamponade, which can subsequently lead to high mortality rates [4, 5]. Therefore, a patient with a gunshot thoracic injury, especially transmediastinal, who is hemodynamically stable and shows no clinical signs or symptoms of cardiac injury, may have covert injuries.

We present a rare case of a stable gunshot transmediastinal wound patient, with initial retained hemothorax after thoracentesis, and ultimately diagnosed with partial heart herniation.

Case Description:

A 32-year-old man presented himself to our Emergency Room (ER) after being shot in the chest. Upon admission, his systolic blood pressure was 120 mmHg, with a heart rate of 120 beats per minute and an oxygen saturation of 98% on room air.

He appeared clinically pale and diaphoretic. Physical examination revealed two gunshot wounds: one on the middle/left anterior aspect of the chest and another on the lateral aspect of the right chest, at the level of the seventh intercostal space. Auscultation showed decreased breath sounds on the right side of the chest and regular air entry on the left. Cardiac sounds were normal, with no signs of cardiac tamponade or tension pneumothorax.

Immediately after the initial assessment, his systolic blood pressure dropped to 90 mmHg. A chest tube was inserted into the right hemithorax, resulting in immediate drainage of 300 ml of blood. Another chest tube was placed in the left hemithorax, with no indication of a pneumothorax or hemothorax. Rapid sequence induction and intubation were performed promptly, along with blood transfusion using packed red blood cells, which yielded an adequate initial response.

A portable chest X-ray revealed a small residual hemothorax in the right hemithorax and a projectile in the right chest wall. The FAST examination was negative for pericardial effusion. After stabilizing the patient, a Torso Trauma CT scan was performed, which showed a small to moderate amount of pericardial effusion and a right pneumohemothorax (Fig. 1). Additionally, an unstable sternal fracture was detected.

A bedside transthoracic cardiac ECHO showed a moderate amount of pericardial effusion with no other acute findings, and the patient was hemodynamically stable. The patient was admitted to the Intensive Care Unit for further observation. During the first 24 hours, a total of 1000 cc of blood was drained through the right chest tube, with no evidence of any respiratory or hemodynamic compromise.

Successful weaning from ventilation occurred on the second day in the intensive care unit (ICU). The patient received daily physiotherapy and prophylactic antibiotics. Both chest tubes drained only a small amount of serous fluid and were removed on day six after minimal changes on the chest x-ray. Three days later, the patient suddenly began to

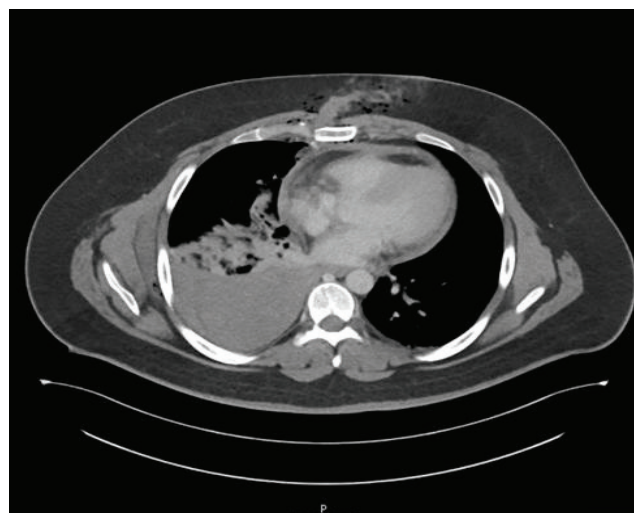


Figure 1: CT scan showing a small to moderate amount of pericardial effusion and pneumohemothoraxright

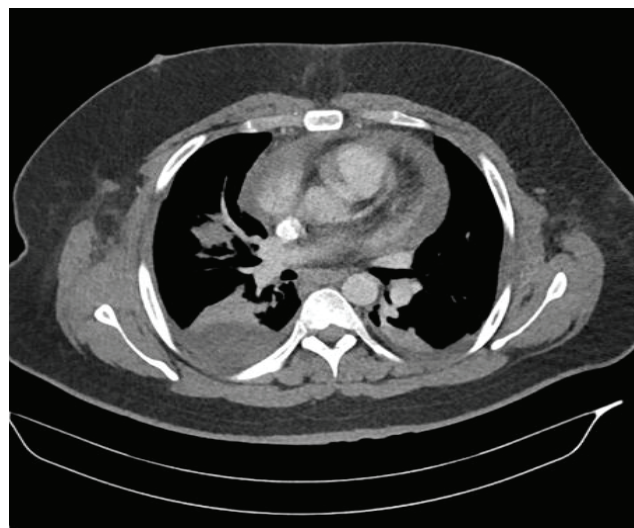


Figure 2: CT scan showing a large pleural effusion in the right pleural cavity and a moderate amount of pericardial effusion

complain of a cough and dyspnea, accompanied by fever and episodes of desaturation. The white cell count was elevated above 20000. A repeat chest CT scan revealed a large pleural effusion in the right pleural cavity and a moderate amount of pericardial effusion, unchanged compared to the admission CT (Fig. 2).

A diagnosis of retained hemothorax was made, and the patient was transferred to the Cardiothoracic Department at a neighboring facility. Upon arrival, the patient underwent immediate video-assisted thoracoscopic surgery (VATS).

During the surgery, a large retained hemothorax was evacuated, and the pleural cavity was extensively irrigated. Additionally, thoracoscopy identified a pericardial laceration with partial right atrium herniation (Fig. 3). Due to the absence of cardiac arrhythmias since the initial admission and any hemodynamic consequences, no

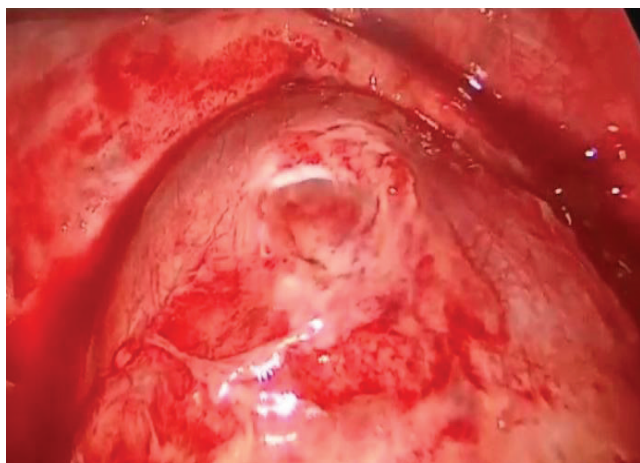


Figure 3: Pericardial laceration, with partial right atrium herniation demonstrated on VATS (Video Assisted Thoracoscopic Surgery)

intervention was performed. The patient was discharged without complications on day four, with a recommendation for three months of NSAIDs therapy. The outpatient clinic follow-up was unremarkable, and the controlled cardiac echocardiogram (ECHO) showed normal cardiac function with complete resolution of the pericardial effusion.

Discussion:

Penetrating gunshot wounds to the “cardiac box” are not uncommon. In 2001, Mandal et al. reported a 6.4% incidence of penetrating cardiac injury among all patients with penetrating thoracic trauma [6].

Despite the current approach using anatomical location as a predictor for heart injuries, recent studies raise serious questions about this perspective. For instance, Kim, in a study involving 330 patients with penetrating thoracic injuries, found that gunshot wound (GSW) injury to the cardiac box was not associated with a higher incidence of cardiac injury [1].

Typically, the clinical presentation is cardiac tamponade, which is linked to very high mortality rates. However, in some cases, damage to the heart may not be due to penetration but rather to the potential mechanism of blast wave shock [7, 8].

Certain case reports indicate the possibility of delayed myocardial rupture [9, 10]. The high kinetic energy of a bullet, described in some studies as blast or overpressure injury, can lead to various cardiac injuries such as myocardial contusions, manifested arrhythmias, cardiac chamber rupture, and valvular disruptions.

Some modalities may help validate the diagnosis. FAST may indicate the presence of pericardial effusions. However, Kong, in a study of 134 consecutive cases, reported a sensitivity of only 20% for cardiac injury [11].

Chest CT angiography, considered the modality of choice, can help characterize multiple cardiac abnormalities.

However, in our case, two consecutive CT scans, along with both FAST and bedside cardiac echocardiography, only demonstrated a moderate amount of pericardial effusion, yet failed to show the pericardial injury and herniation.

Isolated pericardial injuries are rare. In recent medical literature, we have found only a few case reports describing pericardial tears without accompanying heart injury, and in all cases, these were the result of blunt trauma [12, 13].

To the best of our knowledge, our manuscript is the first to describe possible heart herniation due to gunshot injury. The pericardial rupture and partial heart herniation were accidentally diagnosed during VATS performed for retained hemothorax.

We may assume that the bullet merely ‘glanced’ off the pericardial sac, and the laceration was caused either by an overpressure wave or by delayed thermal injury. However, our case demonstrates the potential for such injuries in patients with a retrosternal gunshot trajectory, including asymptomatic injuries.

This awareness may aid in early diagnosis and potentially prevent life-threatening complications. We also believe that the possible sequelae of such injuries include worsening herniation or even myocardial rupture; therefore, this warrants further investigation, and the appropriate management of these patients still needs to be better defined based on future studies.

Conclusion:

Partial heart herniation following a transmediastinal gunshot wound is a rare and potentially life-threatening condition that may present without classic signs of cardiac injury. This case emphasizes the importance of maintaining a high index of suspicion for occult cardiac trauma in hemodynamically stable patients with thoracic gunshot injuries. Timely imaging, thorough evaluation, and minimally invasive surgical exploration, such as VATS, can play a critical role in diagnosing and managing such atypical presentations, ultimately improving outcomes.

COI Statement: This paper has yet to be submitted in parallel, presented fully or partially at a meeting, podium, or congress, published, or submitted for consideration beforehand.

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