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CASE STUDY

Hemodynamically Stable Traumatic Diaphragmatic Rupture with Herniated Shattered Spleen: A Case Report

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ABSTRACT

Background: High-energy blunt abdominal trauma frequently involves multiple organ systems, often resulting in injuries to solid organs and, in some cases, visceral herniation due to diaphragmatic rupture. Hemodynamic stability in such cases is rare, particularly when the spleen is shattered. We present a unique case of a hemodynamically stable patient with these injuries.

Case: A 55-year-old male involved in a motor vehicle accident presented to our facility hemodynamically stable, seven days after initial management for a traumatic hemothorax, with a missed diagnosis of diaphragmatic rupture and herniated, shattered spleen. The diagnosis was confirmed following a thorough physical examination and cross-sectional imaging. Laparotomy was conducted to perform a splenectomy and repair a diaphragmatic rupture, and the patient had an uneventful postoperative recovery.

Conclusion: This case highlights the critical need for a high index of suspicion and comprehensive evaluation in cases of high-energy trauma, emphasizing the importance of detailed examination and cross-sectional imaging in detecting overlooked injuries. The patient's hemodynamic stability, despite a shattered spleen, may have resulted from the compressive effect of the hernia defect on the splenic vessels, a factor that could play a role in similar trauma cases.

BACKGROUND

Diaphragmatic rupture is most often a consequence of either blunt or penetrating trauma and frequently involves the herniation of abdominal organs into the thoracic cavity. [1-4] Although relatively rare, it accounts for 1–7% of cases involving blunt trauma and 10–15% of cases related to penetrating injuries. [1,3-5] The majority of blunt abdominal traumas are attributed to road traffic accidents, while knife stabbings and gunshot wounds are the main causes of penetrating trauma. [3,6] Due to the high-energy impact involved, diaphragmatic rupture is typically seen in polytrauma patients. [1,7]

The pathophysiological mechanism of diaphragmatic rupture following blunt trauma is not entirely clear. However, the most widely accepted explanation is that it results from a sudden increase in intra-abdominal pressure resulting from a traumatic impact. This leads to a pressure gradient that can exceed 100 cmH_2O, significantly higher than the normal 7 to 20 cmH_2O pressure gradient between the abdominal and thoracic cavity. This extreme gradient can cause the diaphragm to rupture and allows for the herniation of abdominal organs into the chest cavity. [3,5]

This case was selected because it represents a rare and clinically significant presentation: a patient with a diaphragmatic rupture and a grade V splenic injury who remained hemodynamically stable throughout. Such a presentation contrasts with the expected rapid deterioration commonly observed in similar cases, thereby offering valuable insight into diagnostic and management considerations. [8]

The clinical problem addressed here is the challenge of recognizing and managing diaphragmatic injuries, especially when accompanied by other life-threatening injuries like high-grade splenic trauma. These injuries often go undiagnosed in the acute setting due to nonspecific symptoms and the presence of more immediately obvious injuries. [9]
Diaphragmatic rupture with concurrent splenic injury typically poses a severe threat to life, often causing rapid respiratory and hemodynamic compromise due to significant hemorrhage and involvement of multiple organ systems.

The standard management for diaphragmatic rupture involves prompt surgical repair, typically through laparotomy or thoracotomy, depending on the associated injuries and hemodynamic status. Grade V splenic injuries are generally managed operatively in unstable patients, though non-operative management may be considered in select stable cases. This report discusses how this rare combination was managed

conservatively in a stable patient, contributing to the ongoing discourse on individualized trauma care. [10]

Here, we describe a rare case in which a patient, despite having both a diaphragmatic rupture and a grade V splenic injury, maintained hemodynamic stability throughout. This exceptional presentation highlights the importance of a thorough, holistic assessment of trauma patients, especially following high-impact accidents.

Ethics Approval and Consent to Participate

This case report was exempt from ethical approval at our institution as it describes a single case encountered during routine surgical practice. It was conducted in accordance with the ethical principles of the Declaration of Helsinki and relevant national guidelines for biomedical research involving human subjects.

Consent for Publication

Informed consent for the preparation and publication of this case report was obtained from the patient. This consent document, signed by both the investigator and the patient, is attached to the case file, ensuring compliance with ethical standards for publication and patient confidentiality.

CASE PRESENTATION

A 55-year-old male passenger involved in a high-impact motor vehicle accident, followed by a transient loss of consciousness, presented seven days after the incident with multiple blunt injuries to the chest and abdomen. He reported worsening left-sided chest pain, shortness of breath, and pain in the left upper quadrant. Initial evaluation and management were conducted at a nearby health facility, where decreased air entry was noted in the left hemithorax. A chest X-ray (unavailable for our review) suggested a left-sided hemothorax, prompting the placement of a chest tube with underwater seal drainage, which drained minimal hemorrhagic fluid. Despite analgesic treatment, his chest pain persisted, and air entry in the left hemithorax remained diminished, even after seven days with the chest tube in situ. The decision was made to remove the chest tube, and he was transferred to our facility for further evaluation.

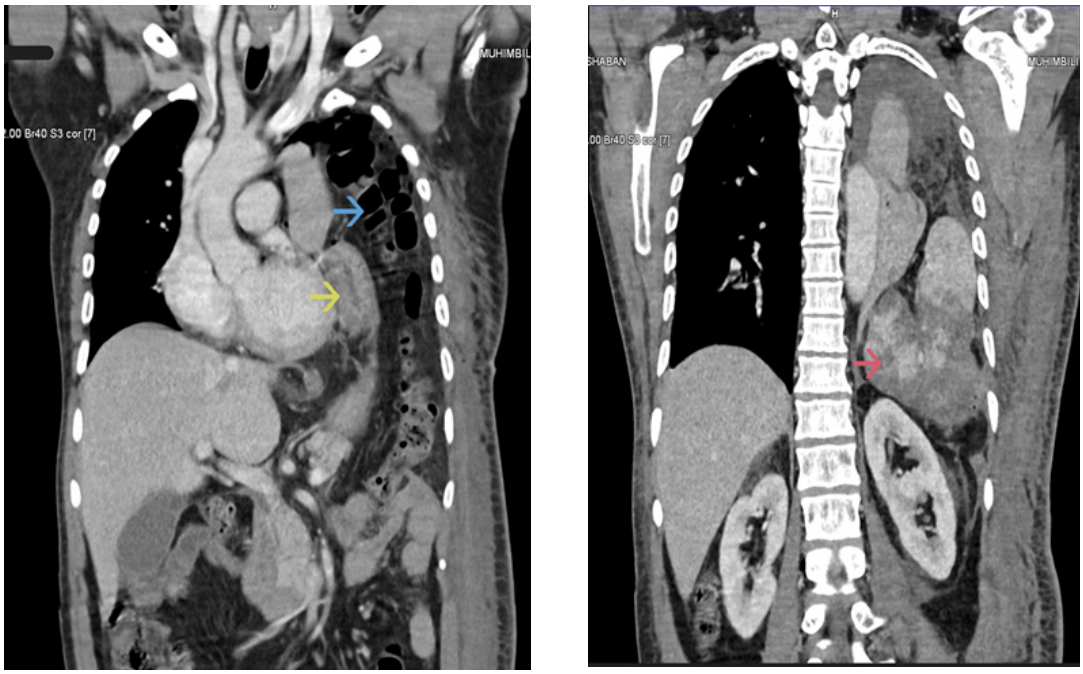
On arrival, the patient was hemodynamically stable, with no signs of anemia and normal vital signs, except for a respiratory rate of 22 breaths per minute. Physical examination revealed reduced air entry in the left hemithorax, with auscultation detecting bowel sounds in the chest. Tenderness was also noted in the left hemithorax and left upper abdominal quadrant. His neurological examination was unremarkable.

Laboratory investigations, including complete blood count, renal function tests, liver function tests, and serum electrolytes, were all within normal limits. Specifically, hemoglobin was 12.8 g/dL, white blood cell count was 8.0 $\times 10^9$/L, and platelet count was 165 $\times 10^9$/L. Serum creatinine was 85 µmol/L, and urea was 3.5 mmol/L. Liver enzymes were within normal limits, with AST at 25 U/L and ALT at 25 U/L. Serum electrolytes were also normal, with sodium at 142 mmol/L, potassium at 3.9 mmol/L, and chloride at 102 mmol/L. A contrast-enhanced thoracoabdominal CT scan revealed findings consistent with a left-sided diaphragmatic rupture and multiple rib fractures, with herniation of the stomach, bowel loops, and spleen into the left hemithorax. Other abdominal organs appeared normal (Figure 1).

An emergency laparotomy, lasting two and a half hours, was performed. It revealed a small amount of hemoperitoneum and a 10 cm defect in the left hemidiaphragm. Herniated structures, including the stomach, splenic flexure of the colon, omentum, small bowels, and a shattered spleen, (Figure 2) were identified within the left thorax. The herniated contents were reduced, a splenectomy was performed, and a tube thoracostomy with underwater seal drainage was placed. The diaphragmatic defect was repaired using a continuous suture with No. 1 Prolene. Lavage of the peritoneal cavity was performed. The estimated blood loss was approximately 500 mL.

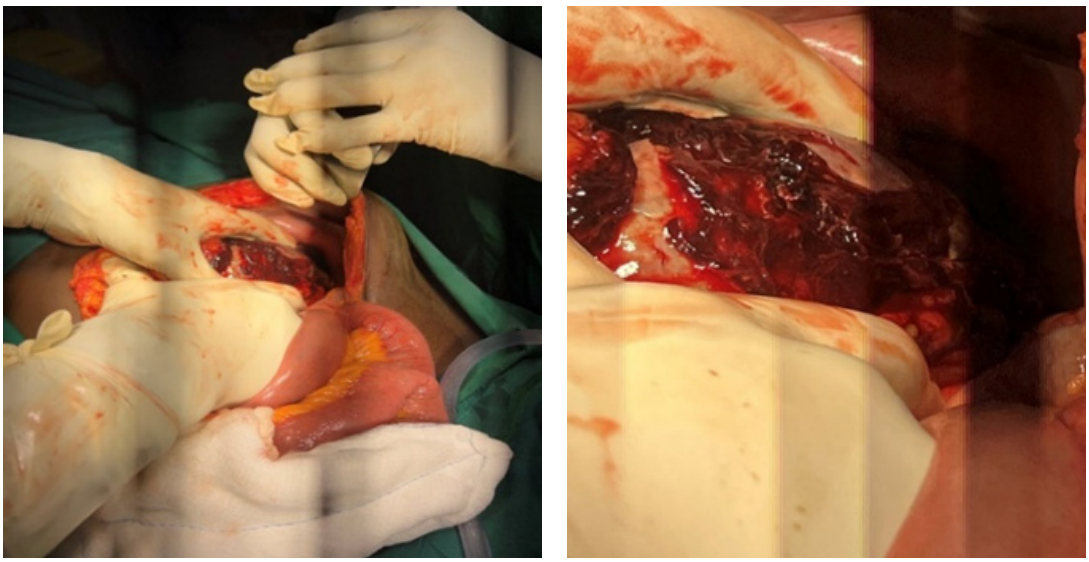
Postoperatively, the patient was admitted to the high-dependency unit and transferred to the general ward on the second postoperative day. A follow-up chest X-ray confirmed lung re-expansion, and the chest tube was subsequently removed on postoperative day five. The patient was discharged on the seventh postoperative day, and his outpatient follow-up was uneventful. He was discharged from surgical clinic care one month later.

FIGURE 1: Coronal CT Scan of the Chest and Abdomen



Coronal CT Scan of the Chest and Abdomen Demonstrating Herniation of the Shattered Spleen (marked by a red arrow), Bowels (indicated by a blue arrow), and Stomach (highlighted with a yellow arrow) into the Left Thoracic Cavity.

FIGURE 2: Shattered Spleen being Repositioned



Intraoperative Findings Demonstrate a Shattered Spleen being Repositioned from the Thoracic Cavity to the Abdominal Cavity in Preparation for Splenectomy.

DISCUSSION

Left-sided diaphragmatic rupture is approximately three times more common than right-sided, likely due to the protective effect of the liver. [2,5,6,10] This injury frequently involves herniation of abdominal organs, such as the spleen, stomach, colon, and omentum. [6,11] The high-impact forces associated with such trauma often result in additional visceral injuries, including splenic rupture, bowel perforation, and kidney avulsion.[1,7] This constellation of injuries can lead to compromised diaphragmatic function, bleeding, herniation-related bowel strangulation, and impaired venous return. Consequently, patients with diaphragmatic rupture often present with hemodynamic instability due to these factors. In our case, the patient's hemodynamic stability may be attributed to the compressive effect of the hernia defect on the splenic vessels, which could have limited hemorrhage.

Diaphragmatic rupture often presents with non-specific symptoms, necessitating a high level of clinical suspicion, particularly in cases of thoracoabdominal trauma[3]. Physical findings such as reduced air entry and bowel sounds in the left hemithorax may suggest diaphragmatic injury, guiding clinicians to consider further diagnostic imaging. [11] In our patient, these subtle signs were evident he presented with moderate chest and abdominal pain, diminished breath sounds on the left side, and bowel sounds auscultated in the left thorax indicating potential organ herniation into the chest cavity. Hence, underscoring the importance of thorough physical examination in trauma settings, as even small clinical clues can lead to timely diagnosis and appropriate management of diaphragmatic injuries.

Herniation of a ruptured spleen into the left hemithorax frequently leads to a left-sided hemothorax, which can sometimes result in the overlooked diagnosis of a shattered spleen, particularly when using plain radiography. This imaging method may yield non-specific findings in 20-50% of patients with diaphragmatic injuries.[7] In contrast, a CT scan of the chest and abdomen is considered the most effective diagnostic tool for diaphragmatic rupture, [11] as demonstrated in our case upon evaluation at our facility. In hemodynamically stable patients, conventional CT offers a sensitivity of 14-61% and a specificity of 76-99% for diagnosing diaphragmatic injuries.[3,7] Radiological signs indicative of diaphragmatic rupture include an abnormally elevated diaphragm, obscured diaphragmatic borders, and abnormal gas patterns within the thoracic cavity. [11]

The management of diaphragmatic rupture, along with herniation of viscera and associated injuries, is typically surgical. [4] The main goal of treatment is to prevent or address complications such as respiratory compromise, hemorrhage, and bowel strangulation. [6] In our case, the patient underwent a laparotomy via an upper midline incision, with reduction of the herniated bowels, omentum, and spleen. The bowel was inspected for viability, and a splenectomy was performed due to the shattered spleen. Additionally, a tube thoracostomy was placed in the left hemithorax under direct visualization, with underwater seal drainage, and the diaphragmatic defect was repaired using Proline 1 with continuous fashion.

Several meta-analyses suggest that, in emergency settings, patients with large defects often undergo laparotomy followed by defect repair using either synthetic or biological mesh. This approach is particularly recommended for grade 4 defects, which involve significant tissue loss. Another technique mentioned in the literature involves the use of a double-layer closure with interrupted and continuous or mattress sutures to prevent recurrence. [12, 13] However, none of these methods were applied in our case. The defect in this patient was repaired without mesh, utilizing a single-layer continuous suturing technique. Notably, in this specific case, the patient did not experience tissue loss but rather a simple tear, making it feasible to approximate and close the defect directly.

During the follow-up of the patient's general condition, a review was conducted one-month post-surgery. The patient was found to be clinically stable and was subsequently discharged from the clinic. As of today, more than six months have passed since the procedure, and the patient has resumed normal activities.

CONCLUSION

This case highlights the diagnostic challenge of traumatic diaphragmatic rupture, especially in hemodynamically stable patients with non-specific symptoms. It underscores the importance of maintaining a high index of suspicion and the value of thorough physical examination and cross-sectional imaging in trauma settings. The case is relevant in demonstrating how delayed diagnosis can occur despite initial management, and how clinical vigilance led to appropriate surgical intervention, ultimately resulting in a favorable outcome. However, as a single case report, the findings may not be generalizable. Additionally, the unavailability of initial imaging and limited long-term follow-up data are key limitations that should be considered when interpreting the case.

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