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Eight-year-delayed Diaphragmatic Hernia due to a Blunt Trauma: A Case Report

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Abstract: Traumatic diaphragmatic rupture is an uncommon but potentially life-threatening injury, typically caused by blunt or penetrating thoraco-abdominal trauma. While most cases are identified in the acute phase, delayed presentations may occur years after the initial injury, often with nonspecific symptoms. Recognition requires a high index of suspicion to avoid morbidity associated with late diagnosis. We reported a 33-year-old male with a history of blunt chest trauma sustained eight years prior, who presented with incidental findings of a left diaphragmatic hernia. The patient was asymptomatic aside from decreased breath sounds on auscultation. Chest computed tomography revealed herniation of abdominal viscera, including the stomach, colon, omentum, and spleen, into the left thoracic cavity. Surgical management consisted of left posterolateral thoracotomy with reduction of herniated contents, adhesiolysis via laparotomy, and primary repair of a 10 × 5 cm diaphragmatic defect using interrupted non-absorbable sutures. Postoperatively, the patient recovered well with resolution of lung expansion and no evidence of recurrence on follow-up imaging. In conclusion, delayed diaphragmatic hernia following blunt trauma is a rare clinical entity that may remain silent for years before diagnosis. Thorough history-taking, clinical suspicion, and advanced imaging are critical in identifying such cases. Early surgical intervention remains the cornerstone of management, aiming to restore diaphragmatic integrity, prevent visceral complications, and optimize respiratory function.
Keywords: delayed diaphragmatic hernia; blunt trauma; thoracotomy; diaphragmatic rupture

INTRODUCTION

Diaphragmatic hernia is a protrusion of abdominal contents to the thoracic cavity. It occurs when abdominal contents migrate into the thoracic cavity through a defect in diaphragm. This condition might be congenital which results from abnormal development or acquired due to trauma or surgical complications. Acquired diaphragmatic hernias may vary in presentation which showed subtle symptoms to severe complications such as intestinal strangulation which requires urgent surgery. Diaphragmatic injury is rare (3% of all abdominal injuries) and complication is less than 1% of all trauma patients. Isolated diaphragmatic injuries are uncommon and are usually reported in the context of complicated abdominal and thoracic injuries.[1]

Traumatic rupture of the diaphragm is a rare injury and occurs in 0.8% to 7% of all thoracoabdominal blunt trauma. Blunt and penetrating trauma are the most common causes of diaphragmatic injury. Blunt (75%) and penetrating trauma (25%) are the most common cause of diaphragmatic injuries. Sudden increase in abdominal pressure due to blunt trauma might cause injury in the membranous or muscular area of the diaphragm. It is said that the left side rupture of the diaphragm (69%) is three times more common than the right side (24%) due to relative weakness of diaphragm on the left side. Approximately 15% of patients got bilateral diaphragm rupture.[2,3] Diaphragmatic rupture of the right side might give a more challenging surgical procedure which is difficulty in achieving a reduction through the chest, therefore, hepatobiliary surgeons were usually included during surgery. Preoperative surgical plan should be made more cautiously and multidisciplinary preparations.[4]

In developing countries where initial care of severely injured patients and diagnostic facilities are less than optimal, blunt traumatic diaphragmatic rupture (BTDR) may go undiagnosed. Delayed presentation of post traumatic diaphragmatic hernia was explained by Lai et al[3] usually presented symptoms months to years after initial injury with manifestation of visceral herniation, incarceration, obstruction, ischemia from strangulation or perforation. After a span of years trauma, the signs and symptoms might suddenly arise. Therefore, a high index of suspicion is recommended to avoid morbidity associated with delayed and missed diagnosis.[1,3]

Based on all of these matters, we present a case of delayed diaphragmatic hernia due to a blunt trauma. The absence of immediate symptoms often leads to misdiagnosis or late detection which is very challenging to surgeons. To date, surgical repair remains the definitive treatment, aiming to restore diaphragmatic integrity and prevent serious complications such as organ incarceration or strangulation.

CASE PRESENTATION

A 33-year-old male was referred to the cardiovascular surgery department for evaluation of a suspected left diaphragmatic hernia. His medical history was notable for a blunt chest trauma in year 2017, but he had remained asymptomatic since, without dyspnea or other cardiopulmonary complaints. On clinical examination, breath sounds were markedly reduced over the left hemithorax. Preoperative chest X-ray showing elevated left hemidiaphragm (Figure 1).

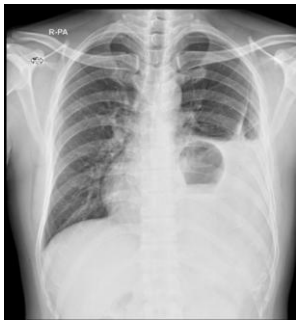

Figure 1. Preoperative chest X-ray showing elevated left hemidiaphragm

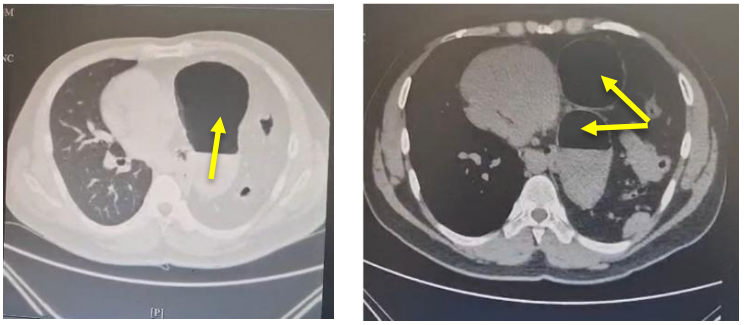

Figure 2. Preoperative axial CT images showed herniation

Chest computed tomography (CT) demonstrated a diaphragmatic defect on the left side, with herniation of multiple abdominal organs including the transverse colon, stomach, spleen, and omentum into the pleural cavity (Figure 2). Laboratory examination was normal. The differential diagnosis included diaphragmatic eventration; however, imaging findings favored traumatic rupture. The patient underwent sternotomy, explorative thoracotomy without cardiopulmonary bypass (CPB), placation of diaphragma and adhesiolysis per laparotomy and explorative laparotomy.

The patient underwent surgical repair under general anesthesia. A left posterolateral thoracotomy was performed through the sixth intercostal space. Intraoperatively, herniated abdominal viscera were identified within the left thoracic cavity, causing collapse of the lower lobe of the lung. The omentum was adherent to the superior lobe and was carefully mobilized. A digestive surgery team proceeded with laparotomy for adhesiolysis, facilitating reduction of the abdominal contents to their normal anatomic positions. Exploration revealed a 10 × 5 cm defect in the left hemidiaphragm. The defect was repaired with plication using interrupted non-absorbable sutures (monofilament polypropylene 1-0 and polyester 2-0). Pleurodesis was performed, followed by pleural irrigation with 0.9% saline. The lung was re-expanded successfully, and a 28 Fr chest tube was placed (Figure 3).

The postoperative course was uneventful. The patient received ceftriaxone, tranexamic acid, ranitidine, N-acetylcysteine, ibuprofen, and metoclopramide. A transient leukocytosis was noted but resolved with treatment. Follow-up chest radiographs demonstrated satisfactory lung expansion and no evidence of recurrent herniation (Figure 4, 5).

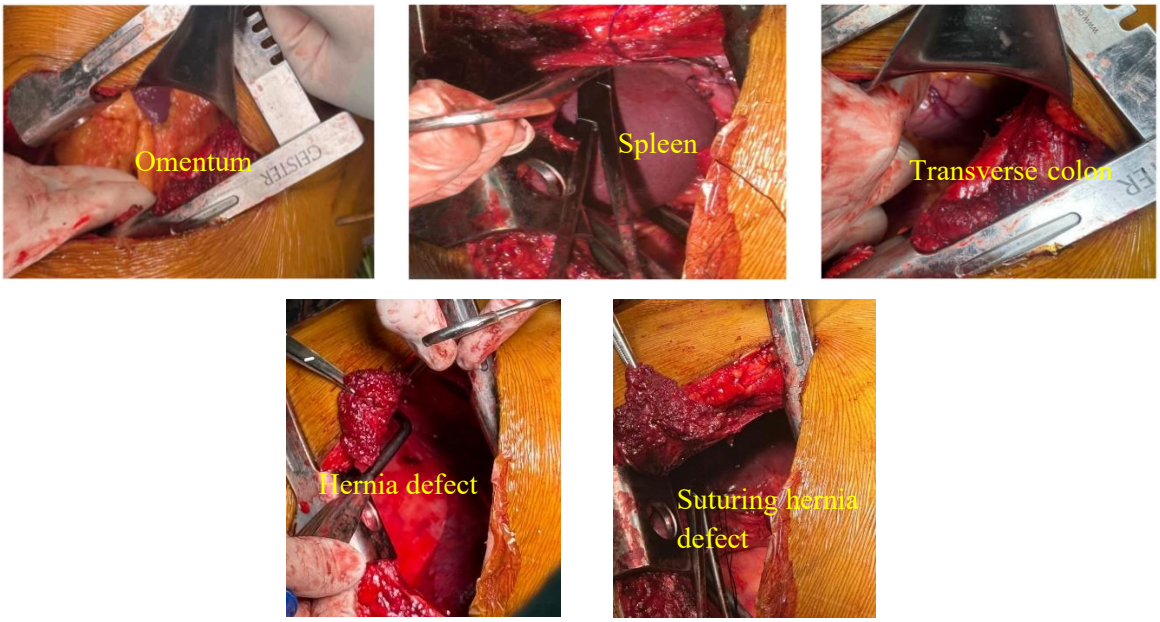

Figure 3. Intraoperative findings during thoracotomy content of diaphragm hernia

Figure 4. Immediate post-operative chest X-ray

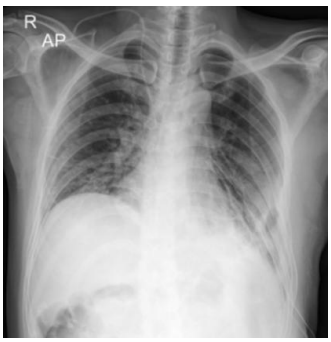

Figure 5. Chest X-ray four days after surgery

DISCUSSION

In this patient delayed presentation of post traumatic diaphragmatic hernia was usually presented symptoms months to years after initial injury. since 2017 he had remained asymptomatic, with manifestation of visceral herniation, incarceration, obstruction, ischemia from strangulation or perforation. observed a delay in diagnosis in 8% cases of diaphragmatic injury from 18 hours to 15 years after injury. A significant increase in intra-abdominal pressure is required for diaphragmatic rupture in the mentioned clinical scenarios. The diaphragm, a critical skeletal muscle for breathing, has a bi-domed shape with dense collagen fibers arranged diagonally from the lateral to medial direction. It includes muscular attachments peripherally to the xiphoid process of the sternum, costal cartilage of the seventh through tenth ribs, bony portion of ribs eleven and twelve, and the lumbar vertebra. Centrally, the muscle fibers integrate to form a central tendon, which ascends to fuse with the inferior portion of the fibrous pericardium. Posteriorly, the right crus rises from the L1–L3 vertebral bodies and their discs, and the left crus rises from L1–L2.[4,6] The crus ascend to encircle the outlet of the esophagus in a sling-like loop at the level of T10. The medial margins additionally converge to form a tendinous arc anterior to the aorta called the median arcuate ligament. The diaphragm's mechanical behavior under tension is comparable to the tensile stress-strain behavior of other skeletal muscles. When at rest, the muscle fibers appear randomly oriented. However, under load, they align parallel to the direction of the tension. Initially, elastin fibers stretch linearly, but as the load increases, collagen fibers reorient to bear more load, occurring in the toe region of the stress-strain curve. With further load, the muscle experiences a transition from low to high stiffness, known as strain stiffening, where overstretched fibers eventually rupture until failure. During the inspiration phase and with the diaphragmatic contraction, the diaphragm flattens. The flattened diaphragm increases the thoracic cavity's volume, which then the pleuroperitoneal pressure gradient can increase from +7 to +20 cm H2O in the supine position to +100 cm H2O for maximum respiratory effort. During severe blunt abdominal trauma, the pressure can suddenly increase to +200 cm H2O.[4,7] The pleuroperitoneal gradient surpasses the diaphragmatic tensile strength which results in diaphragmatic rupture or avulsion. Diaphragm ruptures occur about 3 times more frequently on the left side in cases of blunt trauma, primarily because the diaphragm's left medial and posterolateral sections are less robust during embryonic development. Additionally, the liver provides a protective barrier on the right side, reducing the incidence of ruptures. This laceration or defect of the diaphragm results in the loss of the physiologic pressure gradient between the pleural cavity and peritoneal cavity, allowing for migration of intra-abdominal organs into the thoracic cavity. It can also cause impairment of the respiratory and circulatory system. With the continuous movement of the diaphragm and constant pressure differential, defects in the diaphragm generally do not spontaneously heal. Moreover, these defects have been shown to increase in size over time, with greater risk of morbidity and mortality.[3,5]

In this case several theories can be used, in which the blunt trauma might tear partially or very small so the abdominal contents do not immediately be pushed to the thorax so there no obvious symptoms. The diaphragm moves constantly with respiration and additionally, coughing, sneezing and any straining of the diaphragm can worsen the defect. Additionally, ongoing inflammation or micro ischemia might weaken the margin and allow the defect to propagate. Ongoing inflammation can produce fibrous tissue and traction which adhesions can later pull more tissue into a configuration that enlarges the muscular gap. Overtime, the defects might increase in size and the symptoms and the intra-abdominal organs might slowly move to the thoracic cavity.[5,6] The most common intra-abdominal organ herniating was the stomach, followed by omentum, small intestine, colon, and liver.[7] The omentum is the abdominal policeman which readily migrates to injured surfaces and adheres the area which forms a plug that physically blocks the defect. Omentum mounts a local immune response which promotes adhesion and sealing.[8] In elderly population, transdiaphragmatic pressure decreases by 20-41% with a decline in the overall strength of 30% because of loss of muscle mass and strength. Aging alters collagen turnover,

increase cross-linking and reduces elastic compliance. The tissue will get stiffer, brittle and does not redistribute stress which might propagate the tear. This shows that with ageing, the diaphragm muscle becomes less strong which might help in pushing the intra-abdominal organs to the thoracic cavity.[9,10]

Patients in this case with traumatic diaphragmatic rupture have three clinical presentations: the acute, latent, and obstructive phases depending on the herniating organ, the time period after trauma, and clinical symptoms. In the acute phase, the patients have dyspnea, cyanosis, orthopnea, cough, and chest pain. If the herniating organ is the stomach and if there is progressive dilatation due to obstruction, the lung on the same side becomes atelectatic due to compression. The mediastinum moves towards the other side and venous return to the heart is blocked. This clinical situation is mortal, like tension pneumothorax, and becomes fatal if untreated. The application of a nasogastric tube may decrease the symptoms. Before herniation, the symptoms are minimal, but after it has occurred, sounds of peristalsis instead of breathing sounds are typical.[7]

Posteroanterior chest X-ray is still the standard in the Advanced Trauma Life Support (ATLS) for trauma workup. Approximately 23-73% of traumatic diaphragmatic ruptures will be detected by initial chest radiograph with an additional 25% found with subsequent films. Chest x-ray usually showed abdominal contents in the thorax with or without signs of focal constriction, nasogastric tube in the thorax, an elevated hemidiaphragm, and distortion of diaphragmatic margin. Barium meal usually confirms the presence of the cardia and fundus of stomach above the diaphragm. When blunt traumatic diaphragmatic rupture (BTDR) occurs without herniation, diagnosis becomes even more difficult. Conventional CT scan has been reported to have a sensitivity of 14%-82%, with a specificity of 87%. Helical CT has increased sensitivity 71-100%, with higher sensitivity for left vs right. Ultrasonography (focused assessment with sonography for trauma [FAST] scan) has been reported to detect diaphragmatic hernias.[3,7]

Surgery management is the most successful and effective treatment for a delayed diaphragmatic rupture. The surgical treatment includes reducing any herniated viscera, repairing the diaphragm and restoring the circulation, respiration and digestive functions. Surgical approaches, such as thoracotomy, laparotomy, and thoracotomy with laparotomy, are often used for the treatment of a diaphragmatic rupture. Laparotomy is usually used due to the complete exploration of the abdominal viscera, though it is easier to reduce the herniated tissues and repair the diaphragm via thoracotomy when there are no abdominal injuries. Lai et al[3] reported a case of blunt traumatic diaphragmatic hernia in a 32-year-old man presenting four years after the initial abdomino-thoracic injury due to fall from height. The patient had herniation of the spleen and stomach. Therefore, a left sub costal incision was performed, the herniated organs were reduced and diaphragmatic defect closed with interrupted prolene suture. This study concluded that all cases whether diagnosed pre-operatively or intraoperatively must be repaired surgically either by laparotomy, thoracotomy, a thoraco-abdominal approach or by minimal access surgery. Moreover, laparotomy should be the preferred approach in unstable patients. Study of Cobanoglu et al[7] analyzed retrospectively the characteristics, and the diagnostic and therapeutic approaches of 41 patients with thoracoabdominal trauma and traumatic diaphragmatic ruptures (TDR). They concluded that TDR may have a fatal course depending on the strangulation of the herniating abdominal viscera. Traumatic rupture of diaphragm should be suspected in all multitraumatic patients and these cases should be seriously evaluated for the definitive diagnosis and treatment plan. According to Zhao et al[4] who reviewed 40 patients from the Peking Union Medical College Hospital who underwent surgery between January 2000 and December 2018, thoracotomy is chosen as the first surgical approach. Most patients with delayed diaphragmatic ruptures have no acute rupture and injury of the abdominal viscera. The separation of adhesions and the repair may be safer and more productive by thoracotomy due to the heavier adhesions between the herniated viscera, the diaphragm, and the lung tissues. recommended laparoscopy and video-assisted thoracic surgery for the diagnosis of traumatic rupture of the diaphragm, especially in cases involving liver herniation into the thorax. The disadvantages of video-assisted thoracoscopic surgery (VATS) are

related to using double-lumen endobronchial tube and the fact that the contralateral hemidiaphragm cannot be visualized.[7]

CONCLUSION

Patient in this case has diagnostic challenges of delayed diaphragmatic hernia, which can present long after blunt thoracoabdominal injury. The absence of immediate symptoms often leads to misdiagnosis or late detection. Comprehensive clinical assessment combined with proper imaging is essential for patients with a history of chest or abdominal trauma. Surgical repair remains the definitive treatment, aiming to restore diaphragmatic integrity and prevent serious complications such as organ incarceration or strangulation. Achieving optimal surgical outcomes often requires collaboration between thoracic and gastrointestinal surgeons.

Conflict of Interest

No conflict of interest in this study.

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