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Traumatic Diaphragmatic Rupture Leading to Tension Gastrothorax: A Critical Case Report and Surgical Insight

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Abstract — Traumatic diaphragmatic rupture (TDR) is a serious but relatively uncommon injury, often resulting from blunt trauma, particularly motor vehicle accidents. Among these, blunt TDR presents with more severe outcomes than penetrating injuries, including higher mortality rates. A life-threatening complication of TDR is gastrothorax, which occurs when the stomach herniates into the thoracic cavity, leading to elevated intrathoracic pressure and potentially fatal consequences such as respiratory failure or cardiac arrest. This case reported a 23-year-old male who sustained a motor vehicle collision, presenting with progressive shortness of breath, nausea, and vomiting 15 hours post-injury. Imaging confirmed a diaphragmatic rupture with associated tension gastrothorax. Immediate intervention with nasogastric tube placement provided symptom relief, followed by exploratory laparotomy to repair the diaphragmatic defect. The patient's recovery was uneventful, demonstrating the critical importance of early diagnosis and timely surgical management in cases of TDR with gastrothorax. Traumatic diaphragmatic rupture occurs in approximately 0.8–1.6% of trauma cases, with motor vehicle accidents being the leading cause. Due to its potential for delayed diagnosis, the rupture is often missed initially, leading to higher rates of morbidity and mortality. Early detection is critical, as it can prevent serious complications such as bowel herniation into the thoracic cavity, respiratory distress, or even death.

Keywords — Traumatic Diaphragmatic Rupture; Blunt Injury; Tension Gastrothorax.

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INTRODUCTION

Traumatic diaphragmatic rupture (TDR) is a relatively uncommon but serious injury, occurring in 1% to 7% of patients with major blunt trauma and in 10% to 15% of cases involving lower chest penetration [1]. Among all traumatic diaphragm injuries, 67% are due to penetrating trauma, with gunshot wounds being the most frequent cause (66.5%), while blunt injuries—often resulting from motor vehicle accidents (63.4%)—account for the remaining third. Blunt TDR tends to present with higher injury severity scores and worse outcomes compared to penetrating injuries, with mortality rates of 19.8% versus 8.8%, respectively [2].

Delayed diagnosis of diaphragmatic injuries, particularly when they lead to diaphragmatic hernias, poses significant risks, contributing to increased morbidity and mortality. Murray et al. published a comprehensive case series that revealed that half of the patients with post-traumatic diaphragmatic hernia required emergency surgery, with an overall mortality rate of 11% [3]. One potentially life-threatening complication of a traumatic diaphragmatic rupture is gastrothorax, which occurs when abdominal pressure pushes the stomach through the diaphragm into the chest cavity. This condition leads to a buildup of gastric contents—air, fluid, and food—in the thorax, which in turn raises intrathoracic pressure and causes a mediastinal shift. The pressure can result in respiratory failure, obstructive shock, and even cardiac arrest, mirroring the life-threatening effects of a tension pneumothorax [4,5].

This case report details a life-threatening instance of tension gastrothorax following blunt traumatic diaphragmatic rupture. The patient's condition was successfully stabilized through nasogastric tube placement, followed by exploratory laparotomy and repair of the diaphragmatic defect.

CASE PRESENTATION

A 23-year-old male presented to the surgical emergency department 15 hours after sustaining a motor vehicle collision in which he had fallen to the left side of the vehicle. Initially, the patient was alert and conscious, with no loss of consciousness at the time of the accident. While he initially experienced no symptoms, he later developed progressive shortness of breath, followed by nausea and vomiting. The patient had no significant medical or traumatic history prior to the accident.

On initial assessment, the patient's airway was patent, and cervical spine stabilization was maintained without abnormalities. He was breathing spontaneously with mild dyspnea, a respiratory rate of 24 breaths per minute, and oxygen saturation of 97% on nasal cannula. Blood pressure of 180/120 mmHg and a pulse of 102 beats per minute were recorded. Capillary refill was less than 2 seconds, and there were no signs of conjunctival pallor. The patient was fully alert and oriented, able to comply with instructions.

During the secondary survey, no significant injuries were identified in the head, neck, or thorax. Mild bruising was noted in the left inguinal region, and an excoriation was observed on the left knee. However, on further evaluation of the thoracic region, asymmetric bulging of the left chest was evident, accompanied by reduced movement of the left chest wall compared to the right. The breathing pattern was characterized by thoracoabdominal motion, with a subtle lag in the left chest. Auscultation revealed diminished vesicular breath sounds on the left, and bowel sounds were also audible in the thoracic cavity.

Fig 1. Physical examination reveal asymmetry on the chest and paradoxal breathing pattern

A chest x-ray confirmed a markedly elevated left diaphragm, with air densities around the 5th intercostal space and a compressive atelectasis in the left lung apex. Additionally, a rightward shift of the mediastinum was observed, indicative of a diaphragmatic injury (Fig. 2). These findings were consistent with the diagnosis of tension gastrothorax secondary to diaphragmatic rupture.

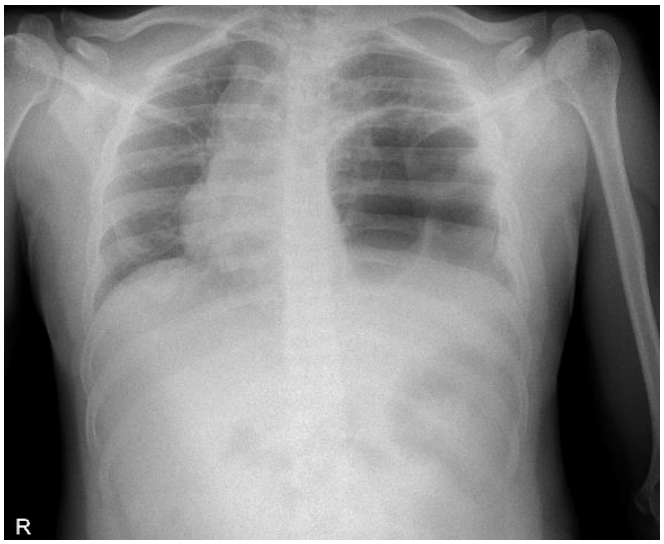

Fig 2. Chest X Ray suggesting a Left Diaphragmatic Rupture, marked by a Lucent Lesion of The Left Hemithorax with Marked Lining on the Lower Zone Causing Deviation of Lung Parenchyma Cranially and the Midline Axis Contralaterally

An 18 French nasogastric (NG) tube was inserted, and approximately 140 mL of gastric contents was aspirated. This intervention provided immediate relief, with a noticeable reduction in the patient's shortness of breath and agitation. Emergency exploratory laparotomy was performed to reduce the herniated bowel contents and relieve of the tension gastrothorax. Intraoperative findings revealed a 4x6 cm defect in the posteromedial portion of the diaphragm, through which a portion of the stomach had herniated into the thoracic cavity (Fig. 3). The herniated stomach was manually reduced, and the stomach was decompressed through suctioning via the NG tube. Notably, no hernia sac was identified, confirming the injury as a traumatic diaphragmatic rupture rather than a pre-existing diaphragmatic hernia. There was no damage to the lung parenchyma or pleura. A 24 French chest tube was placed in the right hemithorax to prevent pneumothorax.

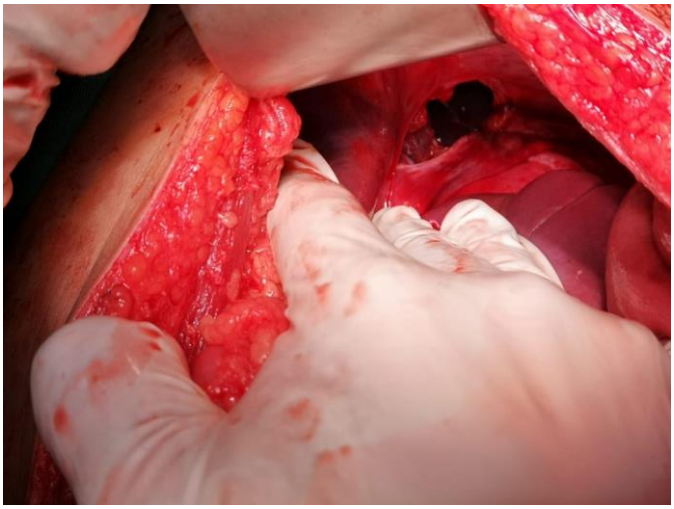

Fig 3. 4x6 cm Diaphragmatic Defect on the posteromedial part of diaphragm was found during the laparotomy surgery

The diaphragmatic defect was repaired with continuous non-absorbable multifilament sutures (size 0). Postoperatively, the patient’s shortness of breath and other symptoms resolved, and his breathing pattern returned to normal. The chest tube was removed on the fourth postoperative day, with no signs of pneumothorax. Follow-up evaluations at one and two weeks post-surgery showed excellent wound healing, and the patient made a rapid and uneventful recovery.

DISCUSSION

The diagnosis of traumatic diaphragmatic rupture remains a complex clinical challenge, even with advancements in both patient history taking and imaging technologies. Chest radiographs, while a common diagnostic tool, have a relatively low sensitivity for detecting diaphragmatic ruptures, with findings only present in approximately 25% of cases. This limitation often leads to delayed or misdiagnosed cases. In contrast, computed tomography (CT) demonstrates higher sensitivity for identifying left-sided diaphragmatic injuries (78%) compared to right-sided injuries (50%), although specificity remains high for both sides (100% and 83%, respectively). A retrospective study by Corbellini et al., analyzing 14 patients, revealed that 57% were diagnosed preoperatively, while 43% were diagnosed only during surgery, further highlighting the diagnostic challenges [6,7].

Blunt traumatic mechanisms typically require high-energy forces to cause diaphragmatic rupture, often accompanied by other severe or potentially fatal injuries. An epidemiological study by Ryb et al. highlighted that lateral crashes and substantial changes in velocity (ΔV >40 km/h) were strongly associated with diaphragmatic injuries. This study also found that patients with diaphragmatic ruptures were more likely to sustain concurrent injuries to the head, chest, and abdomen, suggesting that these associated injuries were more often the cause of mortality than the diaphragmatic injury itself. This underscores the importance of considering diaphragmatic rupture as a marker of significant trauma, prompting clinicians to thoroughly assess for other concurrent injuries [8,9].

The American Association for the Surgery of Trauma (AAST) has developed a classification system for diaphragmatic injury, which ranges from Grade 1 (contusion) to Grade 5 (large lacerations with significant tissue loss). Based on this system, the patient in this case sustained a Grade 3 injury, characterized by a laceration between 2 and 10 cm in size.

Table 1. Grading of diaphragmatic injury according to American Association for the Surgery of Trauma (AAST)

Grade	Injury Description
I	Contusion
II	Laceration ≤2 cm
III	Laceration 2-10 cm
IV	Laceration >10 cm with tissue lost ≤ 25 cm^2
V	Laceration with tissue loss >25 cm^2

Data from Fair et al., derived from the National Trauma Data Bank, provides insights into the incidence and outcomes of diaphragmatic injuries. Their analysis of over 800,000 cases identified 3,873 (0.46%) patients with diaphragmatic injury, the majority of which (67%) were the result of penetrating trauma. Blunt injuries were associated with higher Injury Severity Scores (ISS) and significantly higher mortality rates (19.8% compared to 8.8% in penetrating injuries) [9]. Moreover, blunt injuries were more likely to result in damage to critical structures such as the thoracic aorta, lungs, bladder, and spleen, suggesting that these injuries frequently occur in conjunction with diaphragmatic tears and contribute significantly to patient mortality [10].

Historically, the surgical approach to diaphragmatic rupture from blunt trauma involves an abdominal approach via laparotomy, which allows for simultaneous repair of both the diaphragm and associated intra-abdominal injuries. Giuffrida et al., in a recent meta-analysis, reviewed 68 studies and found that laparotomy or laparoscopy was the preferred acute treatment (75%) in cases of blunt traumatic diaphragmatic injury, whereas thoracotomy was more commonly utilized in chronic or elective repairs (69%) [11].

The study by Lim et al. further supports the importance of initial surgical approach in managing blunt traumatic diaphragmatic injuries [12]. Their findings suggest that laparotomy, compared to thoracotomy, is associated with lower rates of additional explorations, shorter operative times, and reduced morbidity. Specifically, patients who underwent thoracotomy had

a significantly higher additional exploration rate (56.2% vs. 9.1%) and experienced longer operative durations (330 min vs. 237.5 min) and higher morbidity (72.7% vs. 22.2%). These findings advocate for laparotomy as the optimal initial surgical approach in the majority of blunt diaphragmatic injury cases [13].

The repair of acute diaphragmatic ruptures generally involves reduction of herniated organs and watertight closure of the diaphragm, often with the placement of a chest tube to drain the hemithorax. While there are no definitive randomized controlled trials recommending specific suture materials or techniques, smaller defects (less than 2 cm) can usually be repaired with simple running sutures or interrupted figure-of-eight sutures [12].

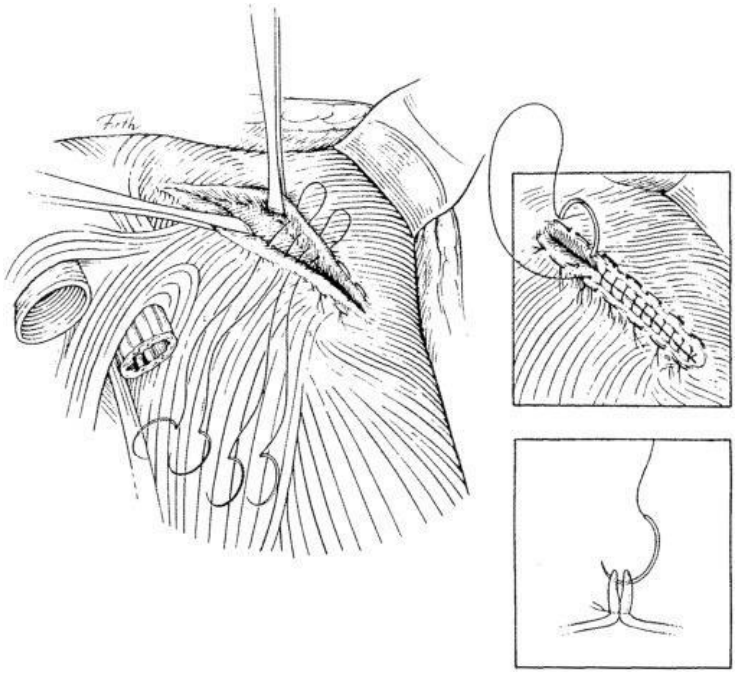

Fig 4. Illustrations for Diaphragmatic Rupture Repair

For larger defects (AAST Grade 4–5), more advanced techniques, such as tension-free closure with rib fixation or prosthetic mesh reinforcement, may be necessary. In our case, the herniated organs appeared viable, and the absence of perforation allowed for a straightforward, watertight repair using a one-layer closure with non-absorbable sutures [9].

Missed diagnoses of diaphragmatic injuries remain a significant concern. According to Reber et al., the rate of initially missed diaphragmatic injuries can be as high as 60%, which is associated with increased morbidity (30%) and mortality (10%) [14]. Patients with missed injuries often present with delayed complications, such as obstruction due to herniated viscera. This highlights the critical importance of maintaining a high index of suspicion and employing comprehensive diagnostic strategies to ensure timely identification and management, thereby reducing long-term morbidity and preventing mortality associated with delayed treatment.

CONCLUSION

In conclusion, while the diagnosis and management of diaphragmatic ruptures pose substantial challenges, a thorough clinical evaluation, high suspicion for associated injuries, and an appropriate surgical approach are essential to improving patient outcomes. Future research, particularly randomized controlled trials, may offer more definitive guidance on optimal repair techniques and suture materials to further reduce morbidity and mortality in these complex cases.

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