Case Report

Posttraumatic Diaphragmatic Hernia Managed by Laparoscopic Repair: Case Report and Review of the Literature

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ABSTRACT: Posttraumatic diaphragmatic hernia (PTDH) is an uncommon but potentially life-threatening consequence of blunt or penetrating thoracoabdominal trauma, occurring in an estimated 1-7% of such injuries. Because clinical and radiological signs are frequently subtle or masked by associated injuries, PTDH is missed at initial presentation in up to 30% of cases and may become apparent only months or years later, when herniated abdominal viscera cause obstruction, incarceration or strangulation. We report a 62-year-old woman who, approximately three months after a blunt (crush/rollover) thoracoabdominal trauma, presented with pain at the base of the left hemithorax and dyspnoea; chest imaging demonstrated a left-sided diaphragmatic hernia with intrathoracic herniation of the stomach. The patient underwent laparoscopic repair, with reduction of the herniated stomach and reinforcement of the diaphragmatic defect using a composite mesh (Ventralight). The postoperative course was favourable. We correlate this case with a review of the literature covering the pathophysiology and morphology of diaphragmatic injury, the diagnostic accuracy of available imaging and endoscopic modalities, the American Association for the Surgery of Trauma (AAST) diaphragm injury grading, and current evidence-based operative strategies, including the indications for primary suture versus mesh reinforcement and the technical principles of laparoscopic repair. This case underscores the importance of maintaining a high index of suspicion for diaphragmatic injury based on trauma mechanism alone, and supports laparoscopy as a safe and increasingly preferred approach for both acute and delayed PTDH repair in haemodynamically stable patients.

KEYWORDS: *Diaphragmatic hernia, thoracoabdominal trauma, laparoscopic repair, delayed diagnosis, case report.*

Introduction

The diaphragm is the principal muscle of respiration and a critical anatomical partition between the thoracic and abdominal cavities.

Traumatic rupture of the diaphragm, first described in the mid-sixteenth century, became surgically treatable only after the advent of thoracotomy in the late nineteenth century; chest radiography and later computed tomography (CT) reduced missed injuries, and the minimally invasive era of the 1980s-1990s added prosthetic mesh reinforcement and, subsequently, laparoscopic and thoracoscopic repair [1].

Posttraumatic diaphragmatic hernia (PTDH) is reported in approximately 1-7% of patients sustaining severe thoracoabdominal trauma, with a substantially higher incidence after penetrating injury (10-15%) than after blunt trauma [2,3].

The left hemidiaphragm is affected in roughly 75% of blunt injuries, reflecting a congenital area of relative weakness at the costo-lumbar fusion and the protective effect of the liver on the right side; when the right hemidiaphragm is torn, this generally implies a higher-energy mechanism and a worse overall injury profile [1,2].

PTDH carries an associated mortality of 30-45%, driven largely by concomitant injuries rather than by the diaphragmatic defect itself [4].

Diagnosis is frequently delayed: up to 30% of cases are recognized only weeks to years after the index trauma, once herniated abdominal viscera cause obstructive or strangulating complications, because small defects are often clinically silent and can be obscured by positive-pressure ventilation or distracting injuries [1,5].

Because the diagnosis is easily missed and the condition does not resolve spontaneously, every confirmed diaphragmatic defect requires surgical repair once identified [3,6].

We report a case of PTDH managed by laparoscopic repair, correlated with a review of the current literature on the epidemiology, diagnosis, and operative management of this injury, with particular emphasis on the indications for and technique of laparoscopic repair.

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Material and Methods

This is a case report combined with a narrative review of the literature.

Clinical, imaging and operative data were extracted from the medical records of a patient treated at the 1st Surgical Clinic and the Thoracic Surgery Clinic of the Emergency Clinical County Hospital of Craiova, Romania.

Written informed consent for the use of clinical data and images for publication was obtained from the patient, and the report was prepared in accordance with the CARE (CAse REport) guidelines and the ethical requirements of the journal.

A literature search was performed in PubMed/MEDLINE, Scopus and Web of Science; the last search was run on 15 October 2026.

The following terms were combined using Boolean operators: "posttraumatic diaphragmatic hernia", "traumatic diaphragmatic injury", "diaphragm rupture", "diaphragmatic hernia repair" and "laparoscopic diaphragm repair".

Studies were eligible if they were written in English and addressed the diagnosis or surgical management of traumatic diaphragmatic injury; priority was given to articles published between 2023 and 2026, while foundational sources (historical descriptions, the AAST organ injury scale and major society guidelines) were included irrespective of publication date where they remain the primary reference.

The search identified 35 records, from which case reports, case series, narrative and systematic reviews, and clinical practice guidelines were retained; the reference lists of retrieved reviews and guidelines were hand-searched for additional relevant articles.

Results

Case presentation

A 62-year-old woman sustained a blunt (crush/rollover) thoracoabdominal trauma in November 2025.

On admission she was in a severe general condition, with intense thoracic pain, dyspnoea and acute respiratory failure (peripheral oxygen saturation 80-85%, restored to normal values with 6L/min of supplemental oxygen); she was haemodynamically stable.

Laboratory tests showed moderate anaemia (haemoglobin 9 g/dL) and only mildly elevated hepatic transaminases (below 150U/L).

Imaging demonstrated multiple left rib fractures (ribs 1-10) and right rib fractures (ribs 1-6), a left clavicle fracture, a comminuted fracture of the left scapula (Figure 1a), a hepatic contusion and bilateral pulmonary contusions (Figure 1b); the rib and scapular fractures, together with paravertebral muscle contracture, produced an 11° right lateral rotation of the thoracic spine (Figure 1c).

Her course was complicated by a left haemopneumothorax and a right haemothorax that required bilateral pleural drainage (Figure 1d).

She improved progressively and was subsequently transferred to the Plastic Surgery department for treatment of a degloving wound of the right leg.

Chest radiographs obtained before discharge showed no sign of diaphragmatic injury (Figure 1e,f).

The diaphragmatic injury was not recognized during this initial admission.

The patient underwent multiple radiographs and serial CT examinations, none of which raised the suspicion of a diaphragmatic lesion.

On retrospective review, a contrast-enhanced thoraco-abdominal CT performed seven days after the trauma showed a displaced bony spicule of the seventh rib lying in a position from which it could have injured the diaphragm (Figure 2); however, the adjacent pulmonary contusion and haemothorax masked any diaphragmatic lesion, and the patient's condition at that time did not permit thoracoscopic or laparoscopic exploration.

Approximately three months later, in February 2026, after an uneventful interval, she was readmitted-to the thoracic surgery service-with pain at the base of the left hemithorax and dyspnoea. Physical examination revealed reduced breath sounds over the left hemithorax.

Chest radiography (Figure 3a) raised the suspicion of a posttraumatic diaphragmatic hernia, showing elevation of the left hemidiaphragm with a gas-filled gastric shadow within the left hemithorax; contrast-enhanced thoraco-abdominal CT with oral contrast (Figure 3b) confirmed a left diaphragmatic defect with intrathoracic herniation of the gastric fundus.

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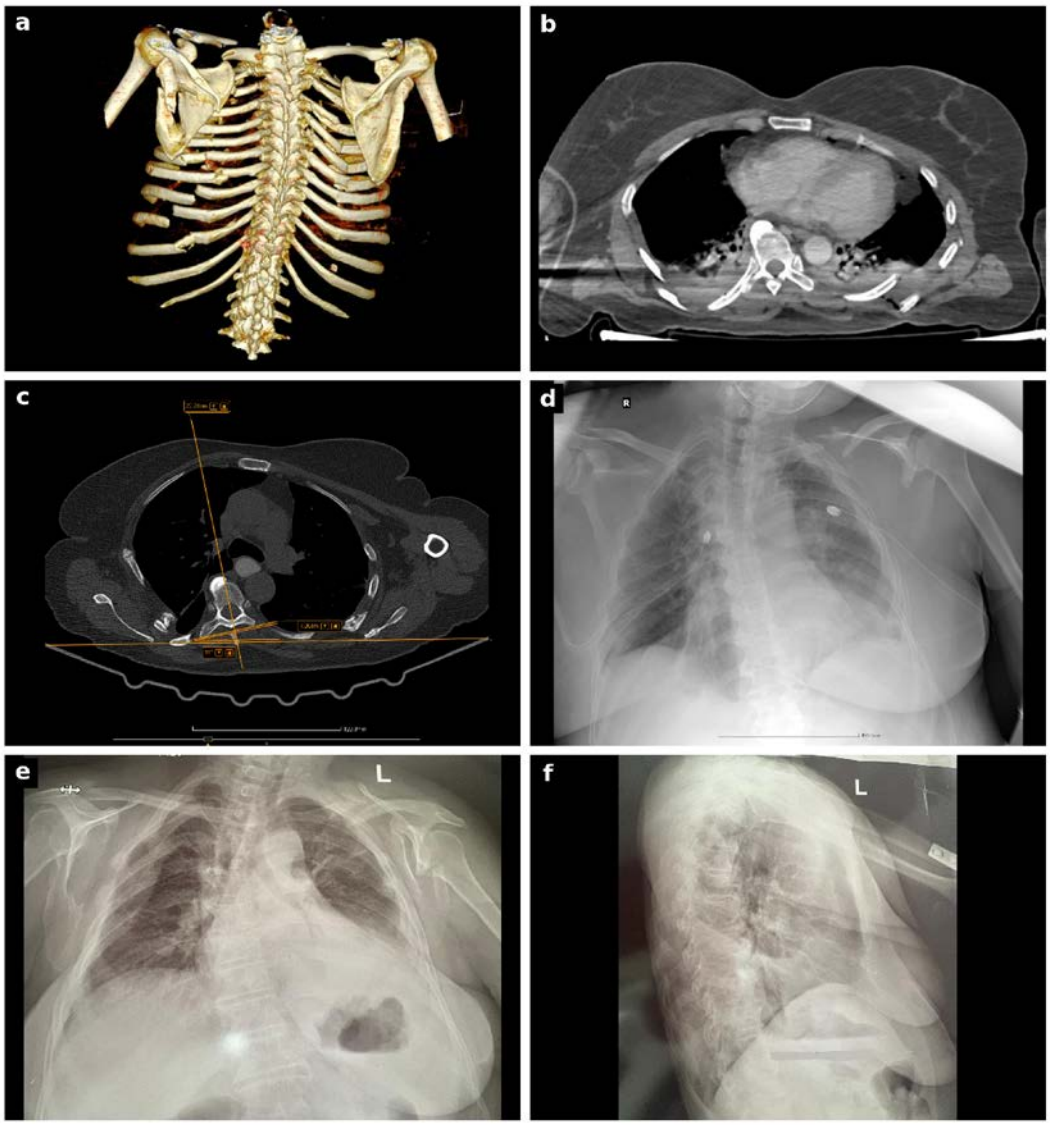


Figure 1. Initial thoracoabdominal polytrauma (November 2025): (a) volume-rendered 3D CT of the thoracic cage showing comminuted fractures of the left scapula and clavicle and multiple bilateral rib fractures; (b) axial CT showing bilateral pulmonary contusions; (c) axial CT with angle measurement showing an 11° right lateral rotation of the thoracic spine; (d) anteroposterior chest radiograph with bilateral pleural drains for left haemopneumothorax and right haemothorax; (e, f) pre-discharge chest radiographs showing no sign of diaphragmatic injury.

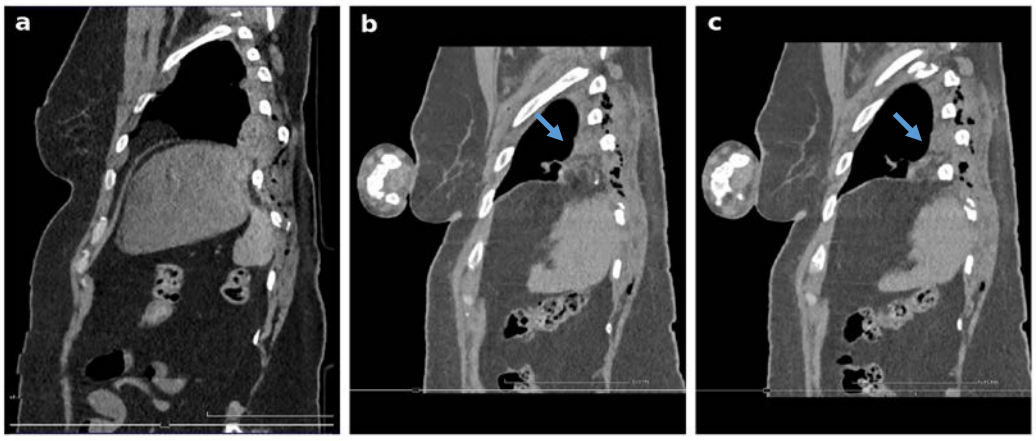


Figure 2. Retrospective review of the contrast-enhanced thoraco-abdominal CT obtained seven days after the trauma: (a-c) sagittal reconstructions showing a displaced spicule of the seventh rib adjacent to the diaphragm, with surrounding pulmonary contusion and haemothorax masking the diaphragmatic injury.

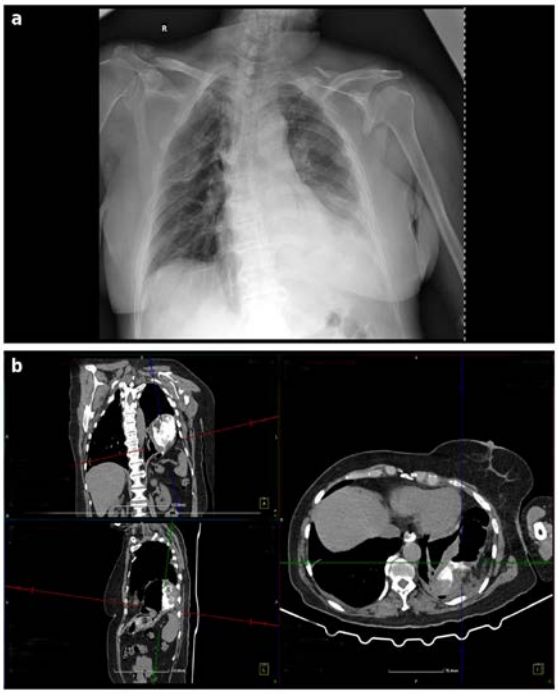


Figure 3. Imaging at delayed presentation (February 2026): (a) anteroposterior chest radiograph showing elevation of the left hemidiaphragm with a gas-filled gastric shadow within the left hemithorax; (b) contrast-enhanced thoraco-abdominal CT with oral contrast showing intrathoracic herniation of the stomach.

A diagnosis of posttraumatic diaphragmatic hernia was established and surgical repair was indicated.

Because the comminuted fractures of the left clavicle and scapula had left the patient with marked shoulder stiffness and an inability to abduct the left arm, a transthoracic approach was impractical; an abdominal, laparoscopic approach was therefore chosen.

Pneumoperitoneum was established with CO_2 insufflation at a pressure of 11mmHg, using a Palmer's point Veress approach.

The optical trocar was placed on the midline above the umbilicus, at one third of the distance between the umbilicus and the xiphoid.

A 5mm and a 10mm working trocar were inserted on the right and left midclavicular lines, 2-3 fingerbreadths below the costal margin; a 10mm port was placed in the subxiphoid position for a Cuschieri-type liver retractor, and a supplementary 5mm trocar on the left anterior axillary line.

This trocar layout is the one routinely used by the surgical team for hiatal hernia repair.

The laparoscopic tower was positioned cranially, at the patient's left shoulder.

Exploration of the upper abdomen revealed transdiaphragmatic herniation of the gastric fundus (Figure 4a,b), which was reduced gently and progressively into the abdominal cavity, taking care to avoid injury to the gastric wall (Figure 4c,d).

Adhesions between the gastric wall and the gastrosplenic ligament were carefully divided to completely free the viscera (Figure 4e).

The defect in the posterolateral left diaphragm was oval, measuring 7-8cm along its antero-posterior axis and 5-6cm in width; as the laceration measured between 2 and 10cm, the injury corresponded to AAST diaphragm injury grade III (Table 1).

There was no gastric ischaemia or perforation. The defect was closed with a single-layer running barbed suture (2/0 V-Loc), placed in a postero-anterior direction under minimal tension (Figure 4f), and reinforced with a Ventralight composite mesh (15×15cm) fixed to the diaphragm with intracorporeal polypropylene stitches (Figure 4g).

Care was taken to protect the spleen and to position the mesh so as to ensure adequate overlap of the defect in all directions.

The procedure was performed under standard general anaesthesia with two-lung ventilation.

Intraoperatively, adhesions were found between the left lower pulmonary lobe and the margins of the diaphragmatic defect; because these adhesions had effectively sealed the pleural space, no intrathoracic communication or significant pneumothorax developed during pneumoperitoneum.

The chest drains inserted at the initial trauma admission had been removed before that discharge and were not in place at the time of repair.

Before the final stitch of the barbed suture was tied, the anaesthetist performed a Valsalva manoeuvre to re-expand the left lung and evacuate any residual intrapleural air, and the left subphrenic space was aspirated; adequate lung re-expansion was confirmed intraoperatively.

Given the sealed pleural space and the absence of significant pneumothorax, no thoracic drain was placed.

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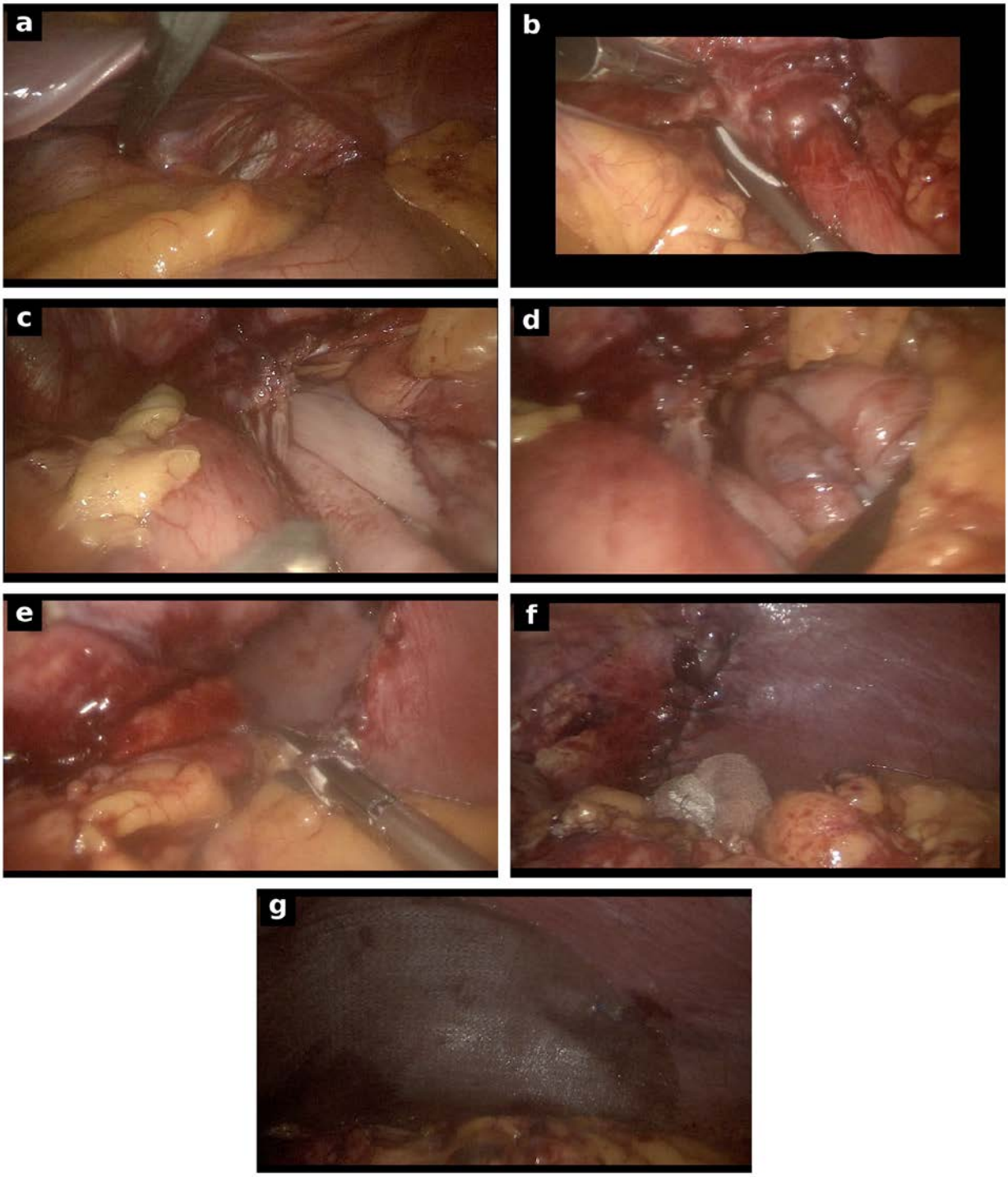


Figure 4. Intraoperative images: (a, b) transdiaphragmatic herniation of the gastric fundus, with adhesions accounting for the incarceration; (c, d) progressive gentle reduction of the stomach into the abdominal cavity; (e) division of the last adhesions to complete liberation of the gastric fundus; (f) final aspect of the single-layer running barbed suture (2/0 V-Loc); (g) composite mesh in place, fixed with polypropylene stitches, ensuring adequate overlap in all directions.

Postoperative recovery was favourable and uneventful, with no residual pneumothorax, no pleural effusion or other pleural complication, and no need for additional intervention.

A pre-discharge chest radiograph showed the gastric fundus reduced within the abdomen, with no herniation.

The patient was discharged on postoperative day 4 and remained asymptomatic at 1, 3 and 6 months of follow-up.

At 6 months, chest radiography and CT (Figure 5) confirmed an intact diaphragm with no recurrence.



Figure 5. Postoperative CT at 6 months showing the intact left diaphragm (arrow), with the stomach reduced within the abdomen and no recurrence.

Literature review

Historical evolution. First described anatomically in 1541, traumatic diaphragmatic rupture became surgically treatable only after the advent of thoracotomy in the late nineteenth century, the first successful repairs being reported in 1886.

Chest radiography and, later, CT reduced missed injuries, while laparotomy became the standard approach for acute trauma because it allowed simultaneous treatment of associated intra-abdominal injuries; from the 1980s-1990s onward, prosthetic mesh and minimally invasive techniques were progressively adopted [1].

The conceptual framework still draws on Carter's 1951 staging into an acute, a latent, and an obstructive or strangulating phase; whatever the phase, every confirmed rupture requires repair, with mesh reserved for large defects [1,7].

Mechanism and morphology. Blunt trauma causes diaphragmatic rupture through a sudden rise in intra-abdominal pressure (reportedly up to ~200 cmH_2O), typically producing large, radial, posterolateral tears that are more common on the left.

Penetrating trauma, in contrast, produces direct lacerations that are often small and easily occult; any wound between the nipple line and the costal margin should raise suspicion, particularly on the left, where concomitant visceral injury is common [2,8].

Loss of the normal 7-20 cmH_2O pleuroperitoneal pressure gradient allows progressive herniation of abdominal viscera into the chest, impairing both ventilation and venous return [2,8].

Clinical presentation. Presentation ranges from silent to catastrophic, depending on defect size, herniated content, and the presence of distracting injuries; a high index of suspicion based on the mechanism of injury alone is essential [2,9].

In the acute phase, small defects are frequently asymptomatic, while larger herniations may cause epigastric or referred shoulder pain, bowel sounds in the chest, or cardiorespiratory compromise; symptoms are often masked by distracting injuries, and positive-pressure ventilation can conceal herniation on imaging. In the delayed phase-up to 30% of injuries, occurring weeks to years later-patients typically present with bowel obstruction or, in the worst case, incarceration and strangulation with peritonitis, a surgical emergency for which an abdominal approach is preferred [2,9].

Diagnosis. Contrast-enhanced CT of the chest and abdomen with multiplanar reconstruction is the non-invasive gold standard, with reported sensitivity of 56-83% and high specificity (78-100%), but a negative scan does not exclude injury when clinical suspicion is high [5,6].

Plain chest radiography is a useful first-line test but has limited sensitivity (27-68% left-sided, 17-33% right-sided) and is frequently normal in the absence of herniation.

Ultrasound and MRI have adjunctive roles only. Diagnostic laparoscopy remains the invasive gold standard, both diagnosing and treating the injury in a single anaesthetic (sensitivity 88-100%); video-assisted thoracoscopy suits posterior or right-sided tears but cannot address abdominal viscera [5,6].

The 2018 Eastern Association for the Surgery of Trauma (EAST) guideline conditionally recommends diagnostic laparoscopy for haemodynamically stable patients with left-sided penetrating thoracoabdominal wounds rather than reliance on CT alone, given its modest sensitivity for occult tears [6].

Injury grading. Once diagnosed, the diaphragmatic injury should be graded using the

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AAST Diaphragm Injury Scale (Table 1), which informs repair complexity and standardizes severity reporting; bilateral injuries are upgraded by one grade, to a maximum of Grade III [7].

Increasing grade correlates with larger defects, greater tissue loss, and a higher likelihood of requiring mesh reinforcement and of associated visceral injury [1,7].

Table 1. AAST Diaphragm Injury Scale [7].

Grade	Lesion
I	Contusion
II	Laceration < 2cm
III	Laceration 2-10cm
IV	Laceration > 10cm, with tissue loss < 25cm²
V	Laceration with tissue loss > 25cm²

Note: bilateral injuries are advanced one grade, to a maximum of Grade III.

Operative strategy and technique. EAST, the World Society of Emergency Surgery (WSES) and the Western Trauma Association all favour an abdominal approach in the acute setting, since it allows simultaneous management of the associated intra-abdominal injuries present in the majority of cases [3,6].

In unstable patients, damage-control laparotomy is performed, with repair deferred until life-threatening injuries are controlled; in stable patients, laparoscopic or robotic repair is increasingly preferred for its shorter stay and reduced morbidity, while thoracoscopy or thoracotomy remain indicated for posterior or right-sided tears [3,6].

Principles of repair. The principles of repair are: reduction of herniated viscera and debridement of devitalized muscle to healthy edges; copious irrigation of the ipsilateral pleural cavity, essential after hollow-viscus perforation; tension-free primary closure with heavy (No. 0-1) non-absorbable suture, with pledgets to reduce tearing through fragile muscle; mesh reinforcement for large defects that cannot be closed without tension (avoided with synthetic material in contaminated fields); and thoracostomy drainage, ideally placed before pneumoperitoneum, although it may be omitted if one-lung ventilation is used and the thorax suctioned before the final stitch [3,10].

Suture material and technique. No. 0 polypropylene is the first-choice suture: monofilament, non-absorbable, with minimal tissue reaction and durable tensile strength suited to a muscle under continuous respiratory motion, and it is the standard for both open and minimally invasive repair.

No. 0 silk is an acceptable alternative.

No. 0 barbed suture (e.g., V-Loc) is increasingly used in laparoscopic and robotic repairs, where its knotless design simplifies intracorporeal suturing, with no proven inferiority to conventional sutures [10-12].

Rapidly absorbable sutures should be avoided, as they lose tensile strength before the diaphragm has healed [10].

Full-thickness bites spaced 1-1.5 cm apart are required, with tension-free apposition the single most important determinant of durable repair; running sutures are faster than interrupted ones in minimally invasive surgery, with no outcome difference [10,13].

Mesh reinforcement. Mesh is indicated for defects greater than 3cm that cannot be closed primarily without tension, for chronic or delayed hernias with scarred, retracted edges, or for recurrence after prior repair.

Polypropylene mesh should be restricted to clean fields; biologic or composite mesh is preferred when the field is contaminated.

Mesh is fixed circumferentially with at least 3-5 cm of overlap beyond the defect margins. WSES issues only a weak recommendation for routine mesh use and cautions against synthetic mesh in contaminated fields [3,11,14].

Chronic and delayed hernia. Missed diaphragmatic injuries may present incidentally on later imaging or emergently with incarceration; the 2018 EAST guideline could offer no firm recommendation on the optimal surgical route for chronic PTDH [6].

Elective presentations allow planned repair tailored to comorbidities, adhesion pattern and surgeon expertise, with laparoscopy increasingly preferred; incarceration or strangulation is a surgical emergency for which an abdominal approach is preferred, since herniated viscera can be assessed and resected more readily than via the chest.

Dense adhesions must be released carefully to avoid enterotomy or pulmonary laceration, and fibrotic, retracted edges more often require mesh than acute tears [9,15].

Complications and outcomes. Outcome is dictated more by associated injuries than by the diaphragmatic repair itself.

The number and severity of concomitant organ injuries (solid-organ laceration, rib fractures, pulmonary contusion) dominate prognosis.

Delayed presentation carries a specific risk of incarceration, strangulation and sepsis, with mortality reported as high as 30% in some series, underscoring the importance of early diagnosis [4,9].

Common postoperative complications include surgical-site infection, empyema, pneumonia, atelectasis, and hernia recurrence, the last more frequent with large or chronic defects [4].

Discussion

This case illustrates several principles that emerge consistently from the contemporary literature on PTDH.

First, the diagnosis of diaphragmatic injury depends primarily on a high index of suspicion driven by the trauma mechanism, since clinical and even radiological signs can be subtle or entirely absent, particularly in the acute setting or when distracting injuries dominate the clinical picture [2,5,9].

In the present case, the diaphragmatic component of a blunt crush/rollover trauma was masked by extensive distracting injuries and recognized only about three months later, when intrathoracic gastric herniation produced left basal thoracic pain and dyspnoea, consistent with recently published series, in which delayed recognition-occurring weeks to years after trauma in up to 30% of cases-remains one of the most persistent diagnostic challenges [1,9,16,17].

Second, the choice of a laparoscopic approach in this patient is supported by current guideline recommendations for haemodynamically stable patients, in whom minimally invasive surgery offers both diagnostic confirmation and definitive treatment in a single anaesthetic, with shorter hospital stay and reduced morbidity compared with open surgery [3,6,11,18].

Recent case series and reports-including laparoscopic repairs of both acute and markedly delayed PTDH, in some instances diagnosed more than a decade after the inciting trauma-confirm the feasibility and safety of this approach even in chronic hernias, provided that adhesiolysis is meticulous and standard conversion criteria are respected [11,12,16,19].

Third, the technical principles applied in this case-reduction of the herniated stomach and reinforcement of a 7-8cm (AAST grade III) left diaphragmatic defect with a composite mesh, using a running barbed suture-mirror the current standard of care: tension-free closure with heavy non-absorbable or barbed suture as first-line treatment, with mesh reserved for large, chronic or recurrent defects, and avoided in contaminated fields in favour of biologic alternatives [10,11,14].

Absorbable sutures, historically used in some early series, are now recognized to compromise durability and should be abandoned [10].

This report has the inherent limitations of a single-case description: the findings cannot be generalized, and long-term follow-up beyond the interval reported here is required to confirm durable freedom from recurrence.

Nonetheless, taken together with the reviewed literature, this case reinforces two clinically actionable messages: diaphragmatic rupture must be actively excluded whenever the trauma mechanism is compatible, irrespective of the initial imaging result, and once confirmed, every defect requires repair, since it will not close spontaneously and a missed injury will eventually return as incarceration [1,2,6,9].

Conclusions

Posttraumatic diaphragmatic hernia is an uncommon injury that is frequently missed at initial evaluation and can present, sometimes years later, with life-threatening obstructive or strangulating complications.

Diagnosis should be actively pursued whenever the trauma mechanism is compatible, using contrast-enhanced CT as the non-invasive gold standard and diagnostic laparoscopy when suspicion persists despite negative imaging, particularly for left-sided penetrating thoracoabdominal wounds.

Once confirmed, every diaphragmatic defect requires repair. In haemodynamically stable patients, laparoscopic repair-using tension-free non-absorbable or barbed suture, with mesh reserved for large or chronic defects-is a safe and effective approach, as illustrated by the present case, and is increasingly favoured over open surgery for both acute and delayed presentations.

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Author contributions

Conceptualization, V.M.Ş. and A.D.; surgical management, T.B., A.D. and V.M.Ş.; intensive-care management, M.E.; data collection and imaging, A.M. and B.M.; writing-original draft, T.B. and A.D.; writing-review and editing, V.M.Ş.; supervision, V.M.Ş.

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Conflicts of interest

The authors declare no conflict of interest.

Institutional Review Board

Not applicable.

Consent statement

Written informed consent was obtained from the patient for the publication of clinical data and images.

Data availability

All data presented in the manuscript are available, anonymized, from the authors upon request.

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