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**CASE REPORT**

# A PROPOSED NEW NOMENCLATURE IN CLINICAL DIAGNOSIS FROM AN OLD CULPRIT: EMPYEMA THORACISABDOMINIS

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## ABSTRACT

### Introduction

We report a unique case of blunt torso trauma resulting from repeated punches during a fight, which caused right hemidiaphragmatic rupture complicated by empyema involving both the thoracic and abdominal cavities. To describe this unusual pathological communication, we propose the term **empyema thoracisabdominis**.

### Case Report

A patient who sustained blunt abdominal trauma from repeated punches during a fight resulting in right diaphragmatic rupture is presented. Clinical findings, laboratory investigations, imaging studies, operative findings, and postoperative observations were reviewed from the patient's case records. The diagnosis of empyema communicating between the thoracic and abdominal cavities was established from the combined clinical and intraoperative findings.

An unusual abdominal asymmetry was observed, characterised by distension of the upper abdomen above the umbilicus while the lower abdomen remained relatively flat. Operative findings demonstrated empyema extending between the thoracic and abdominal cavities through a traumatic rupture of the right hemidiaphragm.

### Conclusion

This case demonstrates an unusual communication of empyema between the thoracic and abdominal cavities through a traumatic diaphragmatic rupture. Based on the Greek derivation of the word *empyema* and the anatomical distribution observed in this patient, the descriptive term **empyema thoracisabdominis** is proposed.

**Keywords:** Empyema; thoracis; thoracisabdominis; diaphragm; diaphragmatic rupture; case report.

## INTRODUCTION

Empyema thoracis (ET) has been described by Treasure as the "end stage of pleural infection for any reason." [1] Diagnostic challenges may arise, particularly following trauma, where the condition may masquerade as traumatic diaphragmatic rupture sustained during interpersonal violence. The term *empyema* is derived from the Greek words *en* ("in" or "within") and *pyema* ("accumulation of pus"), and may occur in various anatomical sites, including the thorax, urinary bladder, uterus, ear, and other body cavities.[2]

Penetrating chest injuries and haemothorax are recognised risk factors for post-traumatic ET. Approximately 35–40% of cases result from direct inoculation of microorganisms

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into the pleural space, while other causes include invasive diagnostic procedures and postoperative infections.[3,4]

Empyema thoracis (ET) is defined as the presence of purulent fluid within the pleural cavity or non-purulent pleural fluid with bacteriological or biochemical evidence of microbial invasion.[5] The term is commonly translated from Greek as "pus within the chest".[6,7]

The word *empyema* is derived from the Greek words *en*, meaning "in" or "within," and *pyema*, meaning "accumulation of pus."[2] Although the condition is classically described within the pleural cavity, empyema may occur in other anatomical sites, including the urinary bladder, uterus, ear, and other body cavities.[2] In the present case, the pathological process involved both the thoracic and abdominal cavities through a traumatic diaphragmatic rupture. We therefore propose the descriptive compound term **empyema thoracisabdominis** for this unusual presentation.

ET may arise from intrapulmonary causes, including pneumonia, lung abscess, and bronchiectasis, or from extrapulmonary causes such as thoracic trauma, post-pneumonectomy complications, and thoracentesis.[8]

Thoracic trauma may result from either blunt or penetrating injuries,[2,9,10] including iatrogenic trauma.[10] The severity of diaphragmatic injury depends on the magnitude, direction, and mechanism of the applied force.[11] Blunt diaphragmatic rupture has an estimated incidence of 1–3%, while severe blunt thoracoabdominal trauma is associated with diaphragmatic injury in approximately 1–7% of patients. Radial tears involving the central tendon are characteristic of burst-type injuries. Most diaphragmatic ruptures occur on the left side (80–90%), whereas right-sided injuries are less common because the liver provides partial protection against transmitted forces.[2] Penetrating trauma is associated with an incidence of 10–15%, although the reported frequency varies geographically because of missed injuries and delayed diagnosis.[10]

Prompt diagnosis of ET requires a high index of clinical suspicion and remains essential for reducing morbidity and mortality, with reported mortality rates ranging from 15% to 20%.[9] Similarly, early recognition of traumatic diaphragmatic rupture is crucial to prevent delayed complications such as visceral herniation, intrathoracic bowel strangulation, haematoma formation, and secondary pleural infection. Delayed diagnosis has been reported even 15 years after the initial injury.[10] As noted by Bosanquet *et al.*,[10] timely diagnosis of diaphragmatic injury remains challenging because associated life-threatening injuries and haemodynamic instability often divert clinical attention during the acute phase of trauma.

We report an unusual case of blunt thoracoabdominal trauma sustained during a fight that resulted in right diaphragmatic rupture complicated by empyema involving both the thoracic and abdominal cavities. To the best of our knowledge, this entity has not previously been described in the literature.

## CASE REPORT

A 20-year-old man was referred with a one-week history of abdominal pain, which was occasionally colicky, associated with progressive difficulty in breathing and a non-productive cough. He also had fever and progressive abdominal distension but no vomiting. There was a history of involvement in a physical fight with a friend three weeks before the onset of symptoms.


**Figure 1A and 1B:** (A) Purulent right pleural effluent; (B) Asymmetrical abdominal distension above the umbilicus (preoperative).


**Figure 2A and 2B:** (A) Purulent intraperitoneal effluent encountered during laparotomy. (B) Fibrinopurulent adhesions following suction of the peritoneal cavity.


**Figure 3A–C:** (A) Improvised urine bag containing pus mixed with blood. (B) Standard underwater seal thoracostomy drainage system following surgery. (C) Magnified view of the thoracostomy drainage.

On examination, he appeared acutely ill, pale, and tachypnoeic, with a respiratory rate of 44 cycles/min. Air entry was reduced over the upper zone of the right lung, while breath sounds were absent at the right lung base, which was stony dull to percussion. He was tachycardic with a pulse rate of 130 beats/min, while the blood pressure was 111/65 mmHg.

A remarkable finding was the unusual asymmetry of the abdomen. The upper abdomen, particularly above the umbilicus, was markedly distended, whereas the lower abdomen remained relatively flat. Abdominal tenderness was present, and diminished breath sounds were noted over the right hemithorax.

An initial diagnosis of right pleural effusion with peritonitis following blunt thoracoabdominal trauma was made. Laboratory investigations showed a packed cell volume (PCV) of 41%. The white blood cell count was elevated at 18.0 × $10^9$/L with neutrophilia (86%), hypersegmented neutrophils, and toxic granulations. Platelet count was 382 × $10^9$/L, which was within the normal range. Serum biochemistry was essentially normal, with a urea concentration of 5.0 mmol/L (reference range: 2.1–6.9 mmol/L). Serum creatinine was also within normal limits.

Chest radiography demonstrated homogeneous opacification of the right hemithorax, consistent with pleural fluid collection. Abdominal ultrasonography showed hypoperistaltic bowel loops with increased echogenicity of the surrounding mesentery, suggestive of inflammatory changes. No para-aortic lymphadenopathy was identified. Low-level echoes were present within the urinary bladder, raising the possibility of cystitis. The radiological impression was right-sided pleural effusion with a subdiaphragmatic collection, probably a haematoma, in addition to hepatosplenomegaly.

Diagnostic thoracentesis yielded purulent fluid, following which an improvised chest drainage system using a urine collection bag was inserted. Intravenous ceftriaxone (1 g every 12 hours) and intravenous metronidazole were commenced. Fluid resuscitation with intravenous normal saline was continued while preparations were made for exploratory laparotomy.

A urinary catheter was inserted for fluid balance monitoring. The patient declined insertion of a nasogastric tube for gastric decompression.

Following induction of general anaesthesia with endotracheal intubation, exploratory laparotomy was performed. Operative findings included extensive intraperitoneal pus, multiple loculations, and fibrinopurulent adhesions involving the small bowel. The greater omentum was adherent to the liver and right hypochondrium. A large collection of pus was identified beneath the right hemidiaphragm, where a traumatic diaphragmatic rupture measuring approximately 11 cm in length was demonstrated.

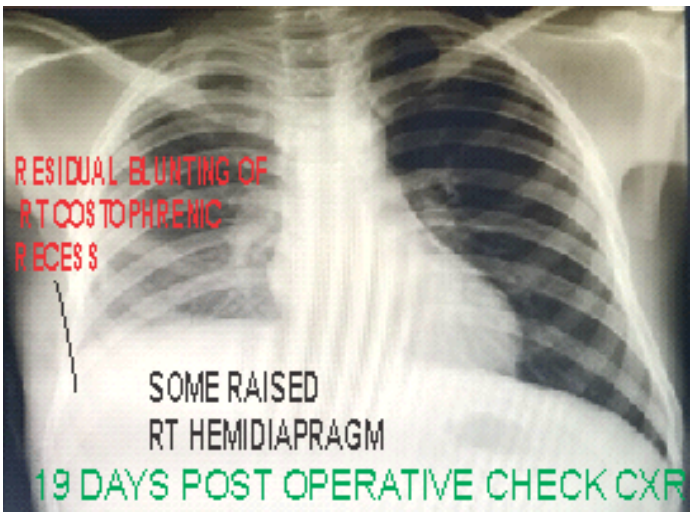


**Figure 4:** Postoperative chest radiograph obtained on postoperative day 19 showing satisfactory right lung expansion with residual blunting of the right costophrenic angle and mild elevation of the right hemidiaphragm.

A particularly striking intraoperative observation was the bidirectional movement of pus between the right pleural cavity and the peritoneal cavity through the diaphragmatic defect. This movement occurred synchronously with positive-pressure ventilation delivered by manual anaesthetic bagging, clearly demonstrating free communication between the thoracic and abdominal cavities.

The volume of pleural drainage increased remarkably during surgery, from approximately 300 mL at the commencement of the procedure to about 2,000 mL by its completion. The drained fluid consisted of pus mixed with blood, consistent with pyohaemothorax (Figure 3). Simultaneously, the abdominal distension subsided significantly.

Following repair of the diaphragmatic rupture using continuous polyglactin (Vicryl®) sutures reinforced with interrupted sutures, no further movement of purulent material between the thoracic and abdominal cavities was observed during positive-pressure ventilation. Intraoperative examination showed no evidence of hepatosplenomegaly, and the remaining abdominal viscera appeared normal.

The abdominal cavity was thoroughly irrigated with warm normal saline followed by dilute povidone-iodine solution. Closure was performed in layers with placement of an abdominal drain. The improvised chest drain was replaced with a size 28 Fr Avium polyvinyl chloride thoracostomy tube connected to an underwater seal drainage system. Approximately 800 mL of fluid was subsequently drained through the abdominal drain.

The patient received two units of whole blood intraoperatively. The postoperative recovery was generally satisfactory. Oral feeding was commenced on the third postoperative day, and early ambulation was encouraged.

The postoperative course was complicated by infection at the chest tube insertion site and superficial surgical site infection of the abdominal wound. Both responded to daily wound dressing. However, the patient absconded on the twentieth postoperative day before completion of treatment.

Unfortunately, no microbiological culture results were available despite routine submission of specimens for laboratory analysis. The absence of culture reports was most likely related to financial constraints associated with out-of-pocket healthcare payments, as most patients in the region are uninsured. Following surgery, many patients and their relatives tend to decline further investigations once the principal operative problem has been addressed. This situation may also reflect the socioeconomic challenges in a region recovering from prolonged insurgency.

Although an immediate postoperative chest radiograph is routinely performed to confirm chest tube position and assess lung re-expansion, this was not obtained in the present case. The only postoperative chest radiograph was performed on the nineteenth postoperative day after repeated persuasion of the patient before discharge. It demonstrated satisfactory expansion of the right lung with residual blunting of the right costophrenic angle, indistinct diaphragmatic outline, and mild elevation of the right hemidiaphragm (Figure 4).

## DISCUSSION

Treasure succinctly described empyema thoracis (ET) as "the end stage of pleural infection for any reason,"[1] a definition that remains widely accepted. Several factors have

been associated with poor outcomes in ET, including advanced age (≥60 years),[3,7] poor dental hygiene,[7,12] intravenous drug abuse,[14] diabetes mellitus,[7,8,12] cardiovascular disease,[8,12] liver disease, traumatic brain injury, seizures,[7,12] chronic lung disease,[7] gastro-oesophageal reflux disease,[7] neoplasms,[8] and immunosuppression.[8,13] Although these are predominantly medical risk factors, traumatic injuries may further increase susceptibility to pleural infection because haematomas can serve as an excellent culture medium for bacterial proliferation.

In the present case, blunt thoracoabdominal trauma resulting in right diaphragmatic rupture was the principal predisposing factor for empyema. The patient was a young male, consistent with previous reports demonstrating a marked male predominance in both empyema thoracis[13,15–17] and traumatic diaphragmatic rupture.[18–21]

Diaphragmatic injuries result from either blunt or penetrating trauma to the thoracoabdominal region.[18,20] Blunt diaphragmatic rupture (BDR) is associated with considerable morbidity and mortality[19] and accounts for approximately one-third of all diaphragmatic injuries. Crush injuries and falls account for about 10% of blunt injuries, whereas road traffic crashes remain the commonest cause worldwide.[21]

Blunt diaphragmatic ruptures are generally larger than penetrating injuries, typically measuring 5–15 cm, and may involve both hemidiaphragms in approximately one-third of patients.[21] The left hemidiaphragm is affected in approximately 75% of cases because it represents the structurally weaker side, whereas the liver affords partial protection to the right hemidiaphragm by dissipating transmitted forces.[19] Nevertheless, the present patient sustained a large right-sided diaphragmatic rupture.

Traumatic diaphragmatic rupture establishes an abnormal communication between the thoracic and abdominal cavities and predisposes to pleural contamination and infection.[20] This mechanism explains the pathological process observed in the present patient, in whom empyema extended freely between both cavities through the diaphragmatic defect. The patient therefore fulfilled the criteria for multiple-system trauma involving more than one body cavity.

The historical evolution of diaphragmatic injury is noteworthy. Bowditch made the first ante-mortem diagnosis in 1853, while Riolfi performed the first successful surgical repair in 1886. Walker subsequently reported the first successful diagnosis and repair of acute blunt diaphragmatic rupture in 1900 following a tree-crush injury.[10]

Blunt diaphragmatic rupture is generally considered a marker of severe trauma because more than half of affected patients have associated life-threatening injuries.[19,21] The injury usually results from a sudden increase in intra-abdominal pressure that exceeds the tensile strength of the diaphragm or from shearing forces acting at muscular insertion sites.[19,21] Lateral impact injuries frequently produce avulsion and shearing mechanisms.[10]

Under physiological conditions, intra-abdominal pressure ranges from approximately +2 to +10 cm $H_2O$, creating a trans-diaphragmatic pressure gradient of 7–20 cm $H_2O$.[10,22] During severe trauma or forceful respiratory effort, this gradient may increase to nearly 100 cm $H_2O$, resulting in rupture of the diaphragm and subsequent herniation of abdominal viscera.[10,22]

Radiological diagnosis of diaphragmatic injury remains challenging, with as many as 50% of cases diagnosed only during laparotomy.[10] The American Association for the Surgery of Trauma (AAST) classifies

diaphragmatic injuries into five grades according to laceration size and tissue loss.[23] Based on the operative findings, the present patient had a Grade IV diaphragmatic injury.

Grimes further described diaphragmatic injuries as progressing through acute, latent, and obstructive phases.[22] The present patient was managed during the acute phase before visceral herniation or bowel obstruction had developed.

The epidemiological findings in this report agree with previous studies. Özgüç *et al*.[18] reviewed 12,577 trauma patients and reported diaphragmatic injury in 0.4% of cases, with blunt trauma accounting for 51% and right-sided injuries for 19%. Males represented 94% of affected patients.

Similarly, Lim *et al.*[19] reported a male predominance of 84.2%, with right-sided injuries occurring in 15.8% of patients. Garcia *et al.*[20] also reported male predominance (88%) among patients with traumatic diaphragmatic injuries and observed post-traumatic empyema in 5.7%.

More recently, Kruger *et al*.[23] reviewed 425 patients with traumatic diaphragmatic injury and found blunt trauma to be the commonest mechanism (67%). Most patients were young males, and Grade IV injuries were among the most frequent lesions requiring laparotomy. The operative findings in the present case closely resemble those reported in that series.

However, none of these studies identified interpersonal assault involving repeated punches as the mechanism of injury. This feature distinguishes the present case and represents its principal clinical novelty.

Chest radiography remains an important initial investigation. Characteristic findings include intrathoracic herniation of abdominal viscera, elevation of the hemidiaphragm, the collar sign, or visualization of a nasogastric tube within the thoracic cavity when gastric herniation is present.[10,19,25] None of these classical radiographic features were demonstrated in the present patient because extensive empyema produced diffuse homogeneous opacification of the right hemithorax.

Computed tomography provides substantially greater diagnostic accuracy than plain radiography, with reported sensitivities of approximately 74% and specificities approaching 100% for selected injuries.[10,19] Although CT scanning was not performed in this patient because of resource limitations, the clinical findings, chest radiograph, ultrasonography, and operative findings were sufficient to establish the diagnosis.

The mechanism of injury deserves particular consideration. Since the patient sustained repeated punches during a fight, evidence from boxing biomechanics provides useful insight. Pierce *et al.*[24] demonstrated punch forces ranging from approximately 867 N to 1,149 N in professional boxers. Interestingly, punch force correlated more closely with technique than body weight. These findings suggest that, under appropriate circumstances, blunt force generated by repeated punches may be sufficient to produce significant internal injury, including diaphragmatic rupture. Further biomechanical and clinical studies are required to investigate this hypothesis.

Because empyema is frequently polymicrobial, broad-spectrum antimicrobial therapy with anaerobic cover remains recommended even when culture results are negative.[12,26] Unfortunately, microbiological culture results were unavailable in the present case, representing an important limitation.

## CONCLUSION

This case describes an unusual presentation of post-traumatic empyema involving both the thoracic and abdominal cavities through a traumatic right diaphragmatic rupture. The intraoperative demonstration of free communication of purulent material between the two cavities represents the principal clinical finding.

The authors propose the descriptive term **empyema thoracisabdominis** for this uncommon pathological entity. Although additional reports are required before widespread adoption of the terminology, the present case broadens the spectrum of traumatic empyema and highlights the importance of maintaining a high index of suspicion for diaphragmatic rupture following blunt thoracoabdominal trauma, including injuries sustained during interpersonal violence.

Early recognition and prompt surgical intervention remain essential for reducing morbidity associated with delayed diagnosis.

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