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# Massive left hemothorax following left diaphragmatic and splenic rupture with visceral herniation: A case report

Esubalew Taddese Mindaye<sup>a,\*</sup>, Abraham Zegeye<sup>b</sup>

<sup>a</sup> Department of Surgery, Saint Paul's Hospital Millennium Medical College, Swaziland Street, 1271 Addis Ababa, Ethiopia

<sup>b</sup> Department of Surgery, Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

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## ABSTRACT

**BACKGROUND:** Massive left hemothorax following left diaphragmatic and splenic rupture with visceral herniation is quite an uncommon life-threatening condition usually associated with blunt thoracoabdominal trauma. Mortality is generally associated with coexistent vascular and visceral injuries that could be rapidly fatal. Timely, and proper diagnosis is mandatory as survival depends on prompt diagnosis and treatment.

**PRESENTATION OF CASE:** We describe a case of massive left hemothorax secondary to blunt thoracoabdominal injury with left diaphragmatic and splenic rupture, gastric, greater omentum and splenic herniation into the left thoracic cavity in a 32 years old male car driver after sustaining a road traffic accident and presented with shortness of breath of 4 h' duration. He also had zone 3 retroperitoneal hematoma and left acetabular fracture. He was treated surgically and discharged home improved.

**DISCUSSION:** Diaphragmatic ruptures following blunt injuries are larger leading to herniation of visceral organs into the thoracic cavity and the most common organ to herniate on the left side is the stomach followed by omentum and small intestine. Splenic rupture is a very rare cause of hemothorax and is often missed in the differential diagnosis.

**CONCLUSION:** Massive hemothorax following splenic and diaphragmatic rupture with visceral herniation following either blunt or penetrating trauma is rare. Delayed or missed diagnosis is associated with higher morbidity and mortality. A high index of suspicion and proper use of diagnostic studies are crucial for early and correct diagnosis.

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## 1. Introduction

Diaphragmatic injuries can occur following blunt or penetrating trauma and iatrogenic causes often resulting in herniation of abdominal viscera into the thoracic cavity [1]. Diaphragmatic rupture is invariably a marker of serious trauma and isolated injury is rare. Associated injuries include intra-abdominal injuries, thoracic injuries, fractures of the ribs, pelvis and long bones, and head injuries [2]. The spleen is the most commonly injured organ, due to its fragile nature and fixation by various ligaments, or the pulling effect of the stomach in blunt trauma [3–5].

Clinically, diaphragmatic injuries are divided into three phases as the initial or acute phase, latent phase, and obstructive

phase [5,6]. A timely diagnosis in acute phase can be difficult since patients invariably have other distracting and possibly life-threatening injuries, and present with shock in 50–60% of the time [7].

A plain chest radiograph is accessible, highly useful imaging modality in patients suspected with diaphragmatic injury, to show a nasogastric tube within the chest, hepatic displacement into the right hemithorax, or herniated bowel loops within the chest, with or without focal constriction of the viscus at the herniation site known as a “collar sign”. Other suggestive signs include irregularity of the diaphragmatic outline and mediastinal shift [1,5]. Chest X-ray can be normal or non-specific in 20–50% of patients with diaphragmatic injuries [8].

Management is primarily according to ATLS (Advanced Trauma Life Support) guidelines and, most morbidity and mortality is due to associated injuries [1]. Once the patient is stabilized thorough evaluation for further obvious and occult injuries should be done during a secondary survey. *The case report has been reported in line with the SCARE 2020 criteria [9].*

**Abbreviations:** ATLS, Advanced Trauma Life Support; Cm H2O, centimeter of water; CT, computerized tomography; FAST, focused abdominal ultrasound for trauma; MAP, mean arterial pressure; RTA, road traffic accident; SPHMMC, Saint Paul's Hospital Millennium Medical College.

\* Corresponding author.

E-mail addresses: [esubetad24@yahoo.com](mailto:esubetad24@yahoo.com) (E.T. Mindaye), [Zcardiothoracic@gmail.com](mailto:Zcardiothoracic@gmail.com) (A. Zegeye).

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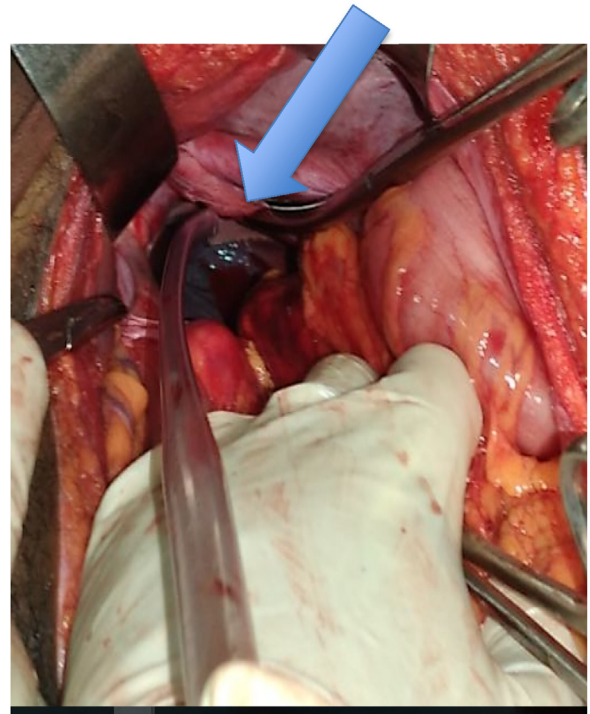


**Fig. 1.** Supine CXR showing irregular left diaphragmatic outline, collapsed left lung, marked mediastinal shift to the right and soft tissue opacity containing visceral gas in the thorax.

## 2. Case presentation

A 32 years old male car driver presented with shortness of breath and easy fatigability of 4 h' duration associated with left side abdominal & hip pain after being involved in front collision of two automobile cars. He was hit by the front door of his car to his left side of the chest, abdomen and pelvic area. He has no history of drug allergy, self or family history of relevant medical or surgical illness. For these complaints, he was taken to a nearby primary hospital within 1 h of the trauma where a chest tube was inserted to his left chest, and upon insertion about 1500cc of frank blood was drained for which he was referred to our tertiary center, Saint Paul's Hospital Millennium Medical College (SPHMMC), with an impression of massive left hemothorax. After 2 h of travel upon arrival to our Emergency surgical department his chest tube has drained extra 1200cc blood and he was acutely sick looking with difficulty of breathing and deranged vital signs (PR = 130beats/min, feeble, RR = 36breath/min, BP = 70/40mmhg). He was assessed according to ATLS protocol and resuscitation continued. With 15 l of face mask oxygen, his saturation of oxygen was 85% and he had paper white pale conjunctiva, absent air entry on the left posterior lower 2/3 lung field but no evidence of rib fracture. His abdomen was full with active bowel sound and there was slight tenderness on the left upper quadrant and pelvic area. He also had marked tenderness upon moving his left hip joint with limited range of motion. Upon catheterization, his urine was clear but only 20cc. Other organ system examination was unremarkable.

Focus abdominal ultrasound for trauma (FAST) was unremarkable and his hemoglobin (Hg) was 7 gm/dl, and with continued resuscitation with crystalloids and whole blood till achieving targeted systolic blood pressure of 90mmhg. Supine Chest X-ray was taken (Fig. 1) showing irregular left diaphragmatic outline, collapsed left lung, marked mediastinal shift to the right and soft tissue



**Fig. 2.** Intraoperative picture showing herniated spleen, stomach & greater omentum through the left diaphragmatic defect.

opacity containing visceral gas in the thorax with no evidence of rib fracture.

After adequate resuscitation and getting informed written consent, with diagnostic impression of hemorrhagic shock secondary to massive left hemothorax secondary to blunt thoracoabdominal injury with left diaphragmatic rupture and suspected left hip bone fracture he was operated through midline laparotomy. The intraoperative finding was about 12 cm × 10 cm left diaphragmatic rupture through which the stomach, greater omentum and spleen has herniated into the left thoracic cavity (Fig. 2). There was 150cc hemoperitoneum in the general peritoneal cavity and 1000 cc clotted blood in the left thoracic cavity. The tight diaphragmatic defect was released and herniated viscera was relocated into the peritoneal cavity. Up on replacement of the spleen in to the peritoneal cavity, grade four splenic injury was identified on the diaphragmatic surface extending to the hilum (Fig. 3) with active bleeding for which splenectomy was done. There was non-pulsatile, non-expanding zone three retroperitoneal hematoma but other visceral organs looked normal. The hemoperitoneum and clotted hemothorax was sucked out, the left diaphragmatic defect closed using interrupted horizontal mattress with silk, peritoneal cavity lavaged with warm saline and abdominal wound closed in layers. Post-operatively he was transferred to intensive care unit (ICU) where resuscitation continued while being on mechanical ventilator support. He was transfused with a total of 6 units of whole blood and both adrenalin drip and crystalloid resuscitation continued until the mean arterial pressure (MAP) raises to 70 mmhg. On the second operative day, he was able to gain consciousness and weaned from the mechanical ventilator. On the 4th post-operative day, pelvic CT scan was done (Fig. 4) and showed left acetabular anterior and posterior column fracture for which skeletal traction was applied until he recovers for operative fixation. On his 10th postoperative day he was taken to the operating theater and, Open reduction and internal fixation was done (Fig. 5). Subsequently, he improved well and discharged home on his 10th postoperative day (Figs. 5 and 6).



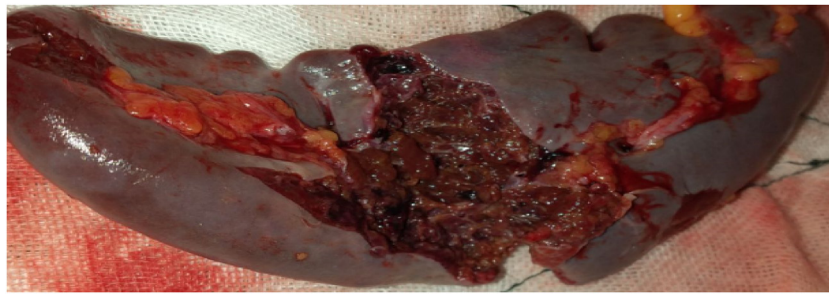


Fig. 3. Splenectomy specimen showing Grade 4 splenic injury extending to the hilum.



Fig. 4. Pelvic CT scan showing left acetabular anterior and posterior column fracture.



Fig. 5. Post ORIF pelvic x-ray showing reduced acetabular fracture.

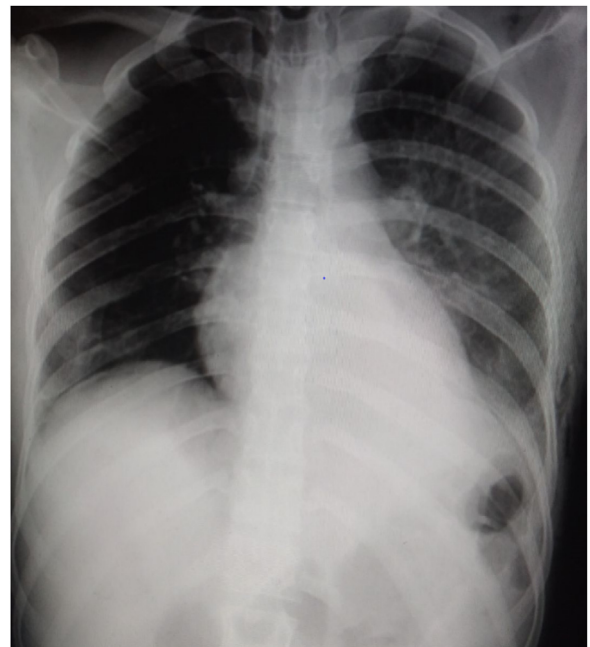


Fig. 6. Postoperative chest x ray showing well expanded lung with defined diaphragmatic outline.

### 3. Discussion

Although the true incidence of diaphragmatic injury is difficult to ascertain due to missed and delayed diagnosis, it ranges from 1 to 7% of all patients with significant blunt trauma, and 10–15% with penetrating wounds, and this number is expected to increase due to the rise in the number of road traffic accidents annually [10]. The commonest causes for blunt injury are high velocity road traffic

accidents (RTAs) and for penetrating injuries are knife attacks and gunshot wounds [1].

Normal intra-abdominal pressure varies from +2 to +10 cm H<sub>2</sub>O during inspiration and the pressure gradient across the diaphragm reaches 100 cm H<sub>2</sub>O during the Valsalva's maneuver, and this pressure gradient is thought to exist at the moment of injury, thus contributing to both the initial injury, and can lead to the herniation of abdominal contents through a diaphragmatic injury [1,11]. The most commonly herniated organs on the left side are the stomach (80%), omentum, small intestine, colon, and spleen [12,13]. Diaphragmatic ruptures following blunt injuries are generally more extensive than those caused by penetrating trauma, measuring 5–15 cm, and are typically radial [1]. These look to be the mechanism of injury to our patient and the herniated organs were stomach, greater omentum and spleen. Although spleen is the most commonly involved organ in such trauma massive hemothorax leading to circulatory collapse are rarely reported in literature. Since splenic rupture is a very rare cause of hemothorax, it isn't usually considered in the differential diagnosis which delays early proper surgical intervention, making proper information about the mechanism of injury vital. Clinical findings can be either thoracic including, decreased breath sounds, fractured ribs, flail chest, and signs of haemothorax or pneumothorax, or abdominal including

guarding, absence of bowel sounds, and abdominal swelling, depending on the extent of injuries [1].

In hemodynamically stable patients conventional CT (sensitivity of 14%–61% and specificity of 76%–99%) or Helical CT (sensitivity of 71% and specificity of 100%) can be used to diagnose diaphragmatic injury [14]. Diagnostic laparoscopy remains an excellent tool for the detection of haemoperitoneum, solid organ damage and diaphragmatic lacerations [15] and thoracoscopy has diagnostic accuracy 98%–100% to diaphragmatic injuries [7]. The diagnosis may be even unsuspected and found only on laparotomy in up to 50% of blunt ruptures [16]. In our case the chest x-ray with clinical evaluation findings were the main determinant factors to decide operative exploration.

At laparotomy, regardless as to whether the diagnosis is suspected or confirmed pre-operatively, full evaluation of both diaphragms should be undertaken. All herniated viscera must be carefully reduced and relocated to its original position, and the pleural cavity should be drained [1]. Devitalized diaphragmatic tissue needs to be carefully debrided and closed using a horizontal mattress with preferably nonabsorbable sutures [1,17]. Diaphragmatic repair can be done through thoracotomy alone, however, relocation of abdominal viscera can be quite challenging [7], and laparoscopic repair is the other alternative [1].

In polytrauma patients with diaphragmatic rupture like ours' patient survival depends on the severity of associated injuries, timely correct diagnosis and early intervention. In this regard our patient has suffered from ongoing bleeding during transportation till getting definitive surgical intervention which has increased his morbidity during recovery.

Upon subsequent post-operative follow-up for the last 8 months, he has marked Clinical improvement with physiotherapy and is happy with his treatment.

#### 4. Conclusion

Although diaphragmatic rupture is rare it signifies underlying serious injuries which are highly fatal with delayed intervention. A high index of suspicion with detailed information about the mechanism of injury and proper use of diagnostic studies are the most important factors in early and correct diagnosis. Although massive hemothorax following splenic rupture is extremely rare condition delayed or missed diagnosis is associated with higher morbidity and mortality making its consideration into the differential diagnosis crucial.

#### Declaration of Competing Interest

The authors report no declarations of interest.

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#### Ethical approval

Ethical Clearance was obtained from the Institutional Research and Ethics Review Committee (IRB) of SPHMMC for the publication of the case report and accompanying images.

#### Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

#### Author's contribution

##### 1. Esubalew Taddese Mindaye, MD

Conceived and conducted the study, did literature search and Critical revision of the manuscript, involved in the management of the case

##### 2. Abraham Zegeye, MD

Involved in the management of the case, conducted over all supervision and critical revision of the manuscript.

#### Registration of research studies

Not applicable.

#### Guarantor

##### Esubalew Taddese Mindaye, MD

Department of Surgery, Saint Paul's Hospital Millennium Medical College, Swaziland Street, P. O. Box 1271, Addis Ababa, Ethiopia.

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