

# TRAUMATIC DIAPHRAGMATIC RUPTURE: A CASE REPORT

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## ABSTRACT

Traumatic diaphragmatic rupture is a rare but serious condition, often linked to high-velocity injuries, predominantly located on the left side. Traumatic ruptured diaphragm is a surgical emergency with a high mortality rate, and diagnosing it can be challenging. This report discusses a 48-year-old male who initially presented to the Emergency Department (ED) with complaints of chest pain and shortness of breath after a fall. Initial chest X-ray showed elevated right diaphragm and basal atelectasis, while computed tomography (CT) scan showed right sided diaphragmatic rupture with intra thoracic liver herniation and multiple bone fractures. Diaphragmatic rupture was later confirmed during surgery and underwent closure of the defect. This particular case underscores the importance of early detection and immediate treatment for traumatic ruptured diaphragm. This case report delves into an instance of right sided traumatic diaphragmatic rupture in a polytrauma patient. Radiological imaging not only plays a crucial role in confirming the diagnosis but also guides treatment planning, including the consideration of other associated injuries

## KEYWORDS

Computed tomography, diaphragmatic rupture, FAST, imaging, polytrauma

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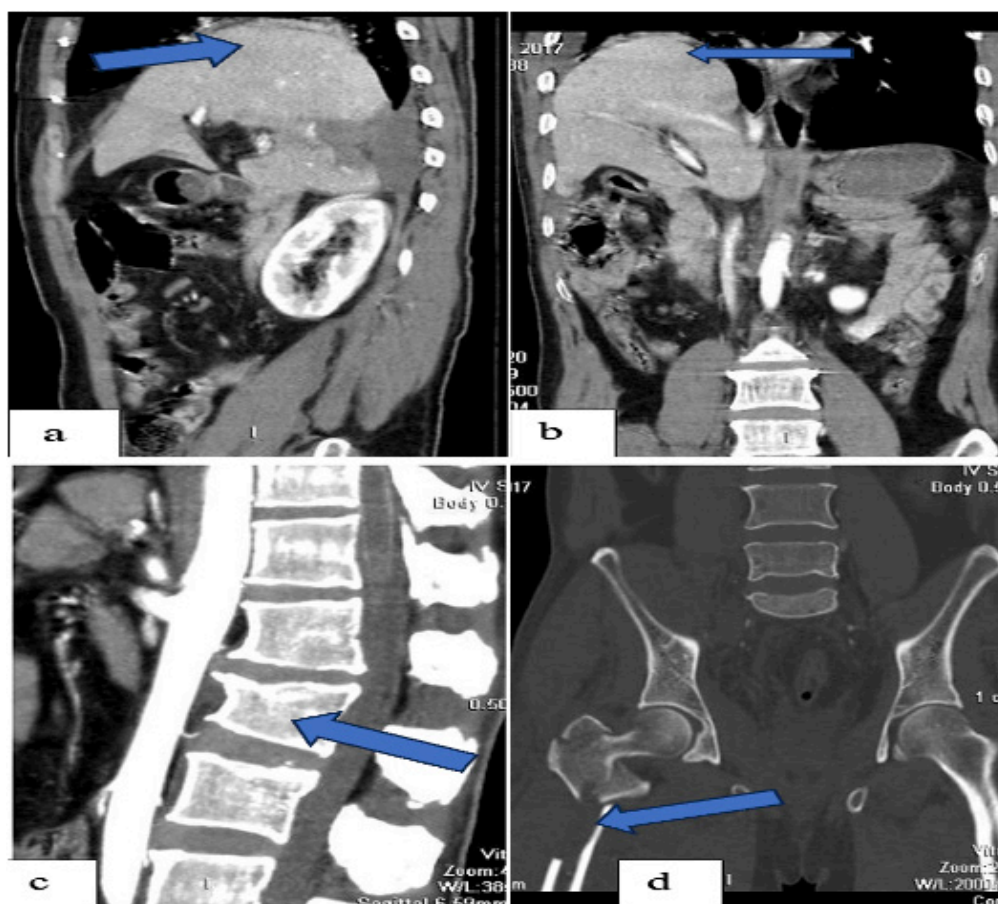
## INTRODUCTION

The diaphragm is a dome-shaped fibromuscular structure that separates the thoracic cavity from the abdominal cavity and is a part of the respiratory musculature. It is estimated that 0.8% to 5% of cases involving closed blunt or penetrating trauma are linked to diaphragmatic rupture.<sup>1</sup> Typically, such ruptures are found in the posterolateral region of the left dome of diaphragm, as the liver absorbs significant impact and offers protection to the right dome of diaphragm. Diagnosing a diaphragmatic rupture poses significant challenges and is frequently overlooked, with approximately 70.0% of cases initially missed.<sup>1</sup> Patients often present with signs of hemodynamic instability or respiratory failure in acute situations; however, some may exhibit delayed symptoms indicative of intestinal obstruction due to the strangulation of herniated intestines.<sup>2,3</sup> This type of injury is commonly associated with both vascular and visceral damage, resulting in considerably higher morbidity rates.

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.

## CASE PRESENTATION

A 48-year-old male arrived at the Emergency Department of Nepal Medical College Teaching Hospital (NMCTH) following a fall from a four-storey building, resulting in blunt trauma to the thorax and abdomen. He exhibited symptoms of shortness of breath and intense chest pain. Upon examination, there was decreased air entry on the right side. The Glasgow Coma Scale (GCS) score was 11/15, accompanied by hypotension with a blood pressure of 70/60 mmHg. Focused assessment with sonography for trauma (FAST) scan indicated areas of hypoechogenicity in the right lobe of the liver, along with right sided pleural effusion which was confirmed as



**Fig. 1:** (a) Sagittal CT image(a) of abdomen and pelvis showing waist like diaphragmatic defect (arrow) with herniation of liver into the thoracic cavity. Coronal CT image (b) of abdomen and pelvis showing the herniation of liver into the thoracic cavity (b). Sagittal CT image (c) of vertebra showing compression fracture of L2 vertebra. Coronal CT image (d) of pelvis showing right intertrochanteric fracture extending into the shaft of femur (d).

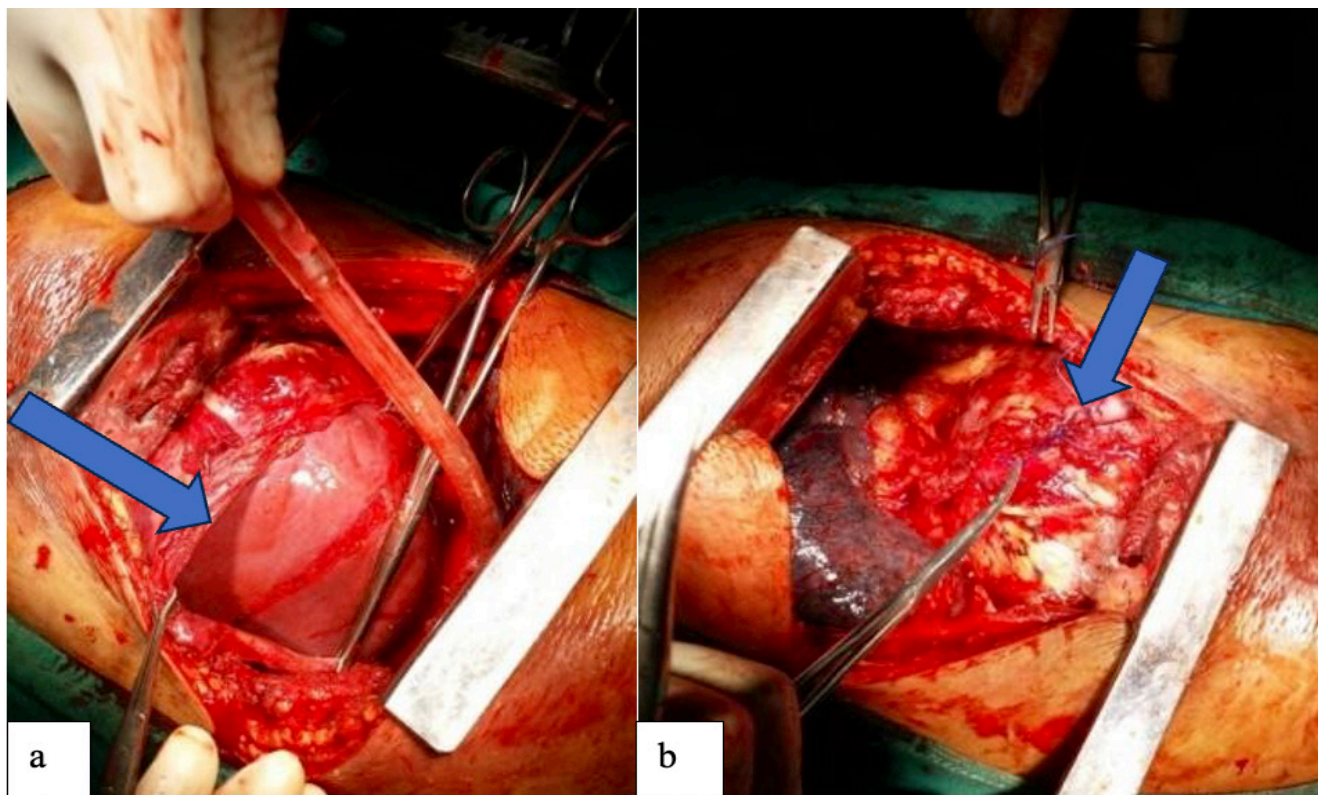


Fig. 2: (a) Intraoperative findings showing a diaphragmatic defect (arrow) through which liver is herniating. Intraoperative findings (b) showing closure of the diaphragmatic defect (arrow) with prolene mesh

hemothorax on diagnostic aspiration; however, no free fluid was detected in the intra-abdominal cavity. Plain X-ray of chest revealed an elevated right hemidiaphragm, patchy air opacity in the right middle zone, and obliteration of the right costophrenic angle.

The patient was stabilized in the ER and subsequently transferred for a contrast enhanced CT scan of the head, thorax, abdomen, and pelvis. CECT showed a discontinuity in the right hemidiaphragm, accompanied by herniation of the right lobe of the liver into the thorax. A constriction resembling a waist was observed as the herniated liver moved from the abdomen into the chest at the location of the diaphragmatic defect, indicating a diaphragmatic rupture. Additionally, moderate blood attenuating fluid density was noted in the right pleural cavity, consistent with hemothorax. A well-defined, non-enhancing, ill-defined hypodense area measuring approximately 7.1 x 4.0 x 3.4 cm was observed in segments VI and VII of liver, suggestive of contusion. Furthermore, linear and irregular non-enhancing hypodense lesions are present in the periphery of segment VII, with the largest measuring approximately 45 mm, indicative of lacerations. A minimal perihepatic fluid collection was noted, consistent with Grade III liver injury according to the American

Association for the Surgery of Trauma (AAST) classification. No intraperitoneal free fluid was observed (Fig. 1). Additionally, linear undisplaced fractures of the right 4th and 5th ribs, along with comminuted intertrochanteric fracture on the right, fractures of bilateral superior and inferior rami, and compression fracture of the L2 vertebra were seen. Linear undisplaced fractures in the right sacrum were also observed. Patchy opacities in the air spaces accompanied by air bronchogram were seen in the superior and posterobasal segments of the right lower lobe of lung, indicative of pulmonary contusion.

Emergency management for hypovolemic shock that included fluid resuscitation, multiple blood transfusion was initiated. Chest tube was placed in the right side to address the hemothorax. Following a two-day stabilization period in the intensive care unit, the patient was transferred to the operating theater with a high-risk consent. An exploratory thoracotomy revealed a diaphragmatic tear accompanied by the herniation of the liver into the thoracic cavity (Fig. 2). The liver was repositioned, and the defect was repaired using prolene mesh. Post-surgery, the patient remained hemodynamically stable in the ICU. Subsequently, the patient was shifted from the surgical unit to the orthopedics department for



further management of fractures. Patient made an uneventful recovery and was discharged after three weeks and was kept on regular followup under surgery and orthopedics department. The patient was followed up for 3 years and currently patient is asymptomatic and returned to normal work 2 years back.

## DISCUSSION

Diaphragmatic injuries occur in approximately 0.8 to 1.6% of blunt abdominal trauma cases, of which 4.0 to 6.0% requiring surgery.<sup>3</sup> Traumatic diaphragmatic hernias are often associated with other injuries, such as splenic and liver injuries, rib fractures, and pelvic fractures. Common causes include blunt trauma, penetrating injuries (e.g. gunshot wounds), falls, and high-velocity accidents. Lateral chest impacts can cause diaphragm avulsion, while frontal impacts may lead to rupture from increased abdominal pressure.<sup>4,5</sup> In this case, the injury resulted from a fall from a four-storey building, causing direct impact to the right side of thorax and abdomen.

Isolated diaphragmatic injuries are rare, and associated other injuries may go unnoticed due to subtle symptoms.<sup>6</sup> A high index of suspicion and thorough clinical examination are crucial in blunt abdominal trauma cases, as patients may initially be asymptomatic or may present with minimal/varied symptoms, depending on the involved organs and duration of trauma. Stomach is the most commonly herniated organ, followed by the colon, omentum, small intestine, spleen, and liver.<sup>7</sup> Stomach herniation often causes retching and regurgitation, while bowel herniation can lead to intestinal obstruction, symptoms like pain, nausea, and distension. Bilateral injuries are uncommon. Injuries on the left side are more prevalent than on the right, probably because the liver provides protection on the right and there are inherent congenital vulnerabilities on the left, particularly in the posterolateral region.<sup>7</sup>

Dahal *et al.*<sup>8</sup> documented blunt abdominal trauma case with herniation of both the spleen and stomach into the left hemithorax. Similarly, Konstantino *et al.*<sup>9</sup> reported a case of left kidney and spleen herniating into the left thoracic cavity, completely severed from their vascular structures due to blunt trauma. Undiagnosed diaphragmatic hernias treated as tension pneumothorax may lead to complications like iatrogenic colonic perforation from chest tube insertion.<sup>10</sup>

Conventional imaging modalities like X-ray are the initial modality of choice for imaging, but studies show it is inconclusive in 50.0% of diaphragmatic injury cases.<sup>11</sup> Signs include non-visualization of diaphragmatic contour, abnormally elevated hemidiaphragm, contralateral mediastinal shift, focal constricted gas-filled bowel loop (collar sign), visualization of curved nasogastric tube above left hemidiaphragm.<sup>4</sup> However, pleural effusion, contusion, atelectasis and phrenic nerve palsy can mask diaphragmatic injury.<sup>12,13</sup> Notably, only 46.0% of left-sided and 17.0% of right-sided ruptures are visible on x-ray, making right-sided ruptures particularly easy to miss.<sup>14</sup>

Ultrasonography is an initial tool for assessing diaphragmatic function, but multidetector computed tomography (MDCT) is preferred for diagnosing diaphragmatic rupture, with specificity of 61.0 to 87.0% and sensitivity of 72.0 to 100.0%.<sup>15</sup> MDCT shows discontinuity in the hemidiaphragm and intrathoracic herniation of abdominal contents. Key signs include the “Collar” sign (waist-like constriction of the stomach or colon), the “Fallen” viscus sign (herniated viscera against the ribs), and the “Dangling diaphragm” sign (torn diaphragm curling inward).<sup>6,13</sup> Active contrast extravasation may also be visible, and in penetrating injuries, the trajectory of the injury can be seen.<sup>6</sup> MRI can show diaphragmatic disruption and herniation of abdominal fat or viscera, and is generally better for visualizing the diaphragm in stable patients rather than those with acute trauma.<sup>16</sup> Notably, in our case both FAST and CT scans showed no hemoperitoneum, which was due to the herniation of the lacerated liver lobe into the thoracic cavity, causing hemothorax instead.

Minimally invasive procedures, like diagnostic laparoscopy, are essential for diagnosing ruptured diaphragms when other methods fail.<sup>17</sup> While laparotomy has been the traditional approach, modern laparoscopic techniques are effective for treating diaphragmatic ruptures and hernias, offering better results.<sup>17</sup>

Traumatic right sided diaphragmatic rupture can be challenging in emergencies, often presenting with acute abdomen symptoms. It is important to consider ruptured diaphragm as the primary diagnosis in cases of elevated diaphragm in high velocity polytrauma cases. Treatment requires multidisciplinary approach between emergency physicians, radiologists, and surgeons for management.

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