



ORIGINAL RESEARCH PAPER

General Surgery

A CASE REPORT OF DIAPHRAGMATIC INJURY DUE TO STAB WOUND

KEY WORDS:

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ABSTRACT

INTRODUCTION: Traumatic diaphragmatic injuries are rare complications resulting from a thoracic/abdominal blunt or penetrating trauma. Left-sided diaphragmatic injuries are more commonly reported in literature. Bilateral injuries are extremely rare, occurring in about 3% of the patients and just few cases reported in literature. Traumatic diaphragmatic hernias are definitely a marker of a severe trauma, in fact diaphragmatic injuries are often related to thoracic and abdominal organs injuries. Sometimes the classic clinical signs and symptoms of diaphragmatic injuries may initially not be present so that definitive evaluation is delayed or even missed.

CASE REPORT A 20 year old male presented to emergency department with multiple stab wound over left side of chest back and forearm. All routine investigations X RAY USG ABDOMEN AND HRCT THORAX was advised. Diagnostic laparotomy was done under GA. Primary repair of left dome of diaphragm with silk 2-0 in horizontal mattress manner. ICD insertion was done on left side.

INTRODUCTION

Traumatic diaphragmatic injuries are rare complications resulting from a thoracic-abdominal blunt or penetrating trauma. Since diaphragmatic injuries are quite uncommon in trauma, with a reported incidence in literature between 0.8% and 8% [1], the true incidence of abdominal organ herniation is unknown, also because many cases remain undiagnosed. The blunt vs. penetrating trauma ratio is widely variable geographically [1-3]. Male people, especially aging from 30 to 45 y.o. are most frequently involved [1,3,5]. According to AAST (American Association for the Surgery of Trauma) Classification (Table 1), diaphragmatic injuries are clustered into 5 grades: I (Contusion); II (Laceration <2 cm); III (Laceration 2-10 cm); IV (Laceration >10 cm with tissue loss <25 cm²); V (Laceration with tissue loss >25 cm²) [4]. Left-sided diaphragmatic injuries are more commonly reported in literature (60-70%) [3,5], probably due to the protective effect of the liver on the right side or a left-side embryologic weakness [1,3,5], and mostly get complicated involving stomach, colon and spleen [5]. On the other hand, right-sided wounds, accounting about 30-40% [3,5], requires higher energy (i.e. high speed collisions) and involve liver or colon. Bilateral injuries are extremely rare, occurring in about 3% of the patients and just a few cases reported in literature [1]. Blunt trauma typically produces large radial tears (5-15 cm), most often located in the left postero-lateral region of the diaphragm [5]. On the other hand, penetrating trauma usually generates small linear incisions or holes (<2 cm in size) [5]. An abrupt change in intraabdominal pressure (i.e. motor vehicle crashes; falls from height), shearing and avulsion are the main mechanisms of diaphragmatic injuries in blunt trauma [1,5]. Furthermore the higher pressure gradient across diaphragm contributes to the initial injury and to the herniation of abdominal organs as well. Hence, because of their own pathophysiology, traumatic diaphragmatic hernias can be considered definitely a marker of a severe trauma. In fact diaphragmatic injuries are often related to thoracic and abdominal organs injuries (aorta, kidney, hollow viscera, liver, lung, spleen, pelvic and rib fractures) and severe complications (DVT/PE, hemo-pneumothorax, pneumonia, respiratory distress, sepsis), with a high mortality rate reported in literature (20%) [1]. Nevertheless sometimes the classic clinical signs and symptoms of diaphragmatic injuries may initially not be present or associated damages may be so severe that definitive evaluation is delayed or even missed [1,3,5]. Thus the diaphragmatic wound will become larger and herniation of abdominal organs more likely, producing respiratory distress or bowel obstruction or strangulation [3,5]. Radiological imaging plays a central role in diagnosis. Plain chest X-ray and FAST ultrasound, although represent the most accessible and first line imaging modality in the trauma patients, have a poor accuracy (nonspecific

alterations in only 20%-50% of the patients - i.e. interruption of diaphragm silhouette, hemidiaphragm elevation, costophrenic sulcus obliteration or distorted diaphragmatic profile) [5,6]. The only direct sign is represented by the visualization of herniated bowels or the nasogastric tube into the thoracic cavity [5,6]. For this reason, whole-body contrast CT scan with multiplanar reconstructions is nowadays the imaging modality of choice. Thanks to its high accuracy (60%-90% sensitivity and 70%-100% specificity) [5,6], it is able to directly detect diaphragmatic lesions, herniated bowels or indirect signs (i.e. "dangling diaphragm sign", "collar sign" and "hump and band" sign) [6]. When equivocal findings on imaging studies are present and conservative management (NOM) is not suitable, exploratory laparoscopy achieve 90-100% sensibility and specificity in detecting diaphragmatic injuries [1,5,7]. Furthermore in selected patients, laparoscopic repair of diaphragmatic injuries is safe and feasible when performed by highly skilled surgeons [5,7-10].

CASE REPORT

Table 1 Diaphragm Injury Scale (from Moore EE et al. Organ injury scaling. IV: Thoracic vascular, lung, cardiac, and diaphragm. J Trauma. 1994 Mar;36(3):299-300).

Diaphragm Injury Scale

Grade* Description of injury

- I. Contusion
- II. Laceration <2 cm
- III Laceration 2-10 cm
- IV Laceration >10 cm with tissue loss (<25 cm²)
- V Laceration with tissue loss >25 cm²

* Advance one grade for bilateral injuries up to grade III.

Table 2 Abbreviated Injury Scale - AIS (from Copes WS et al. Progress in Characterising Anatomic Injury, In Proceedings of the 33rd Annual Meeting of the Association for the Advancement of Automotive Medicine, Baltimore, MA, USA 205-218).

Abbreviated Injury Scale (AIS)

- | | |
|------------|--------------|
| AIS Score. | Grade |
| 1 | Minor |
| 2 | Moderate |
| 3. | Serious |
| 5. | Critical |
| 6. | Unsurvivable |

Table 3 ISS Score: A2 + B2 + C2 (from Baker SP et al. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma. 1974 Mar;

14(3): 187–96).

Injury Severity Scale (ISS)

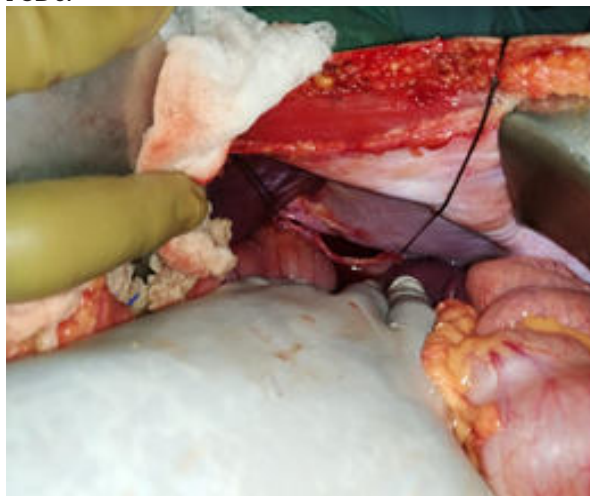
Region.	AIS Score
Head and neck	1-2-3-4-5-6
Face	1-2-3-4-5-6
Chest.	1-2-3-4-5-6
Abdomen.	1-2-3-4-5-6
Extremity (including pelvis)	1-2-3-4-5-6
External	1-2-3-4-5-6

CASE REPORT

A 20 year old male patient presented to emergency department with alleged history of penetrating injury by sharp object. On clinical examination multiple stab wound over left forearm , stab wound over left midaxillary line at level of 9-10 rib. Stab wound on left side of upper back(paraspinal region) at level of 10-11th rib multiple abrasions over right mid thigh. After resuscitation and supportive management she underwent blood routine investigation and chest and abdomen x ray. Suspicious lesion noted near left dome of diaphragm. USG abdomen was normal. HRCT thorax was advised which suggestive of loculated hydro pneumothorax seen in left lower lobe of lung paranchymal opacity seen in left lower lobe of lung suggest lung contusion. Pneumomediastinum was noted. Subtle linear defect with air foci are seen posterior inferior chest wall. Patient was vitally stable and no any clinical sign of respiratory distress or bowel obstruction. ICD insertion was done on 5th intercostal space at midaxillari line and fixed with silk 2-0 at 10.

SURGICAL INTERVENTION

We decided to perform diagnostic laparotomy under GA WITH 10-12 CM midline incision. Abdominal cavity examined. Bowel walk was done. Bowels were normal under vision. 8 CM defect was seen in muscular part of left dome of diaphragm. Triangular ligament of liver was cut and left lobe of liver mobilised. Spleen was mobilised downwards with splenic flexure of colon. 2 stay sutures was taken beyond defect of diaphragm with silk 2-0. Primary closure of diaphragm was done by ethilon 2-0 in horizontal mattress manner. ADK no. 32 was placed in pelvic cavity and fixed with silk 2-0. Hemostasis achieved. Abdomen closed layer by layer. Closure of stab wound over chest back and forearm closed layer by layer. Patient shifted to ICU for intensive care and supportive management. On post operative day 3 patient was shifted to ward. ADK drain and RT was removed on post operative day 3. Patient was shifted to sips orally to liquids on post operative day 3. Follow up x ray weredone daily. ICD was removed on post operative day 5. Patient was discharged on POD 5.



DISCUSSION

The diaphragm is the principle muscle of respiration. With the contraction of striated muscle fibers it carries more than 70%

of the work creating a negative intrathoracic pressure which is necessary for the proper performance of respiratory mechanics, as well as encouraging proper venous return to the heart. The integrity of the diaphragm separates the chest cavity from abdominal positive pressure, which ensures proper maintenance of the different pressure regimes of the two chambers, and prevents the migration of the abdominal organs into the chest. A laceration of the diaphragm produces an alteration of these physiological mechanisms with possible migration of the abdominal viscera into the thorax and the disappearance of the thoraco-abdominal pressure gradient which causes alteration of respiratory mechanics, compression of the vena cava with reduced venous return to the heart, and consequential respiratory failure and cardiovascular collapse [17]. Diaphragmatic rupture is a potentially lethal clinical condition for the patient and a delayed or missed diagnosis causes high mortality with this type of trauma [11]. In literature, the first description of diaphragmatic trauma dates back to the sixteenth century when in 1853 Bowditch described a diaphragmatic injury, in a dead victim of a gunshot penetrating trauma, during the autopsy[14]. The first repair with favorable outcomes of a penetrating diaphragmatic injury was described by Riolfi in 1886, while in 1900 Walker published the first repair of traumatic diaphragmatic gunshot lesion with favorable outcomes [18]. It is difficult to accurately estimate the real incidence of diaphragmatic injuries due to delayed or missed diagnosis and pre-hospital deaths [11].

Approximately 5% of patients with abdominal trauma at the time of thoracotomy or laparotomy have a diaphragmatic injury [12]. They are mainly caused by blunt trauma of the chest and abdomen (75%) and more rarely by stabbing (25%) [13]. Diaphragmatic injuries mainly affect the male sex (M/F ratio 3:1) generally occur following closed thoracoabdominal trauma and more rarely penetrating trauma [19]. Mortality rate ranges from 1% to 28%; this high percentage depends upon frequency of associated injuries but also on the delay between diagnosis and the traumatic event [13]. Diaphragmatic injuries frequently occur during automobile accidents; frontal impact causes an increase of intra-abdominal pressure resulting in a lesion in the radial wall posterolateral to the diaphragm [13]. Side impacts also may be associated with lesions of the liver or spleen in 96% of cases [19]. Diaphragmatic injuries during penetrating trauma of the abdomen are extremely rare, making up 25%, of which 20% from gunshot and 5% from weapon [13]. In the course of penetrating trauma to the abdomen small sized diaphragmatic lesions are often created, which may initially remain undetected and determinate the onset of a diaphragmatic hernia. Right hemidiaphragm trauma is less frequent than left trauma (with a ratio of 1:3) and also is diagnosed with greater delay. This is due to the protective function of the liver which lies on the right abdominal surface preventing herniation of the abdominal viscera into the thorax [17]. Furthermore, many studies performed on cadavers show that during closed trauma the pressure required to determine a lesion of the left hemidiaphragm is less than that required for the right side. [20]. Any discontinuity of the diaphragm leads to alterations of mechanical respiration and circulatory collapse until cardio circulatory system [21]. In severe multiple trauma with patient in a state of shock, respiratory failure and/or coma, diaphragmatic injuries can be misunderstood, as often the attention of the medical team is on damage to other organs which often occur in the course of this type of trauma. In acute phases, diaphragmatic rupture usually occurs with thoracoabdominal pain, hypotension, hemodynamic instability, dyspnea, and cyanosis. Hemodynamic instability and shock are often the result of associated injuries and bleeding of the diaphragmatic muscle injury [22]. When the diaphragmatic lesion is small, it may go unrecognized for several hours, weeks or even months and manifest late and progressively as a diaphragmatic hernia with the appearance of typical symptoms of intestinal obstruction, tachycardia, dyspnea [23]. Small injury of the right hemidiaphragm may

even remain undetected due to the protective function offered by the liver, which prevents bowel herniation into the thorax cavity. There is rarely herniation of the liver [24]. Preoperative diagnosis of diaphragmatic injury still represents a diagnostic challenge for the radiologist. The high mortality of this trauma is also linked to the difficulty of studying this anatomical site in emergency conditions [11]. In a chest x-ray, a diaphragmatic injury should be suspected when the hemidiaphragm is not correctly placed. The specific signs of a diaphragmatic lesion on chest x-rays are represented by the presence of air-fluid levels in the chest and the salience of a hemidiaphragm compared to the contralateral side. Chest x-ray has a diagnostic accuracy of less than 40% and can only detect indirect signs described, the absence of which does not rule out a diaphragmatic lesion [25]. Diagnostic accuracy is four times greater for lesions of the left hemidiaphragm (42%) compared to the right (17%) [16]. Chest x-ray has been replaced by computed tomography (CT) which has a diagnostic sensitivity of 50% for right hemidiaphragm lesions and of 70% for the left side ones. It allows the physician to see any discontinuity of the diaphragmatic profile and the presence of loops or omentum in the thoracic cavity, as well as the presence of hemoperitoneum and hemothorax [25].

Historically, CT showed poor visualization of the diaphragm due to motion of the muscle itself, but the advent of multiphase spiral CT has led to a sensitivity of 80% and a specificity of 90% [26]. CT is a valuable diagnostic tool, readily available in trauma centers and executable in hemodynamically stable patients with multiple trauma. In hemodynamically unstable patients, ultrasound (US), and in particular FAST in real time can demonstrate the absence or reduced motility of the diaphragm suggestive of lesions of the muscle itself, with an accuracy of 30%. In addition, the US can identify the presence of indirect signs such as hemothorax and hemoperitoneum [27]. Magnetic resonance imaging (MRI) has a sensitivity and specificity of 95% in identifying a diaphragmatic lesion, it is not always available in emergency rooms, but extremely helpful in the diagnosis of post-traumatic diaphragmatic hernias [28]. Thus, in the absence of a bowel herniation through the lesion, it is very difficult to diagnose a diaphragmatic lesion with the conventional images that are readily available in emergency conditions [29]. This observation is even more valid when penetrating injuries affect the right upper quadrant of the abdomen. In these cases, the liver, due to its particular anatomical position, stands between the lesion and the viscera preventing diaphragmatic herniation of the latter into the chest through the opening in the diaphragm, accounting for the delay in diagnosis of this type of diaphragmatic injury [30]. In this case, there are indirect signs such as effusion into the thorax and abdomen, principally if there is a lacerated liver (98% of cases) and the presence of subdiaphragmatic air in the abdomen. In hemodynamically stable patients with penetrating injury of the abdomen in which there is a strong clinical suspicion of diaphragmatic hernia, laparoscopy is indicated as, in addition to having a diagnostic role [15,31] in identifying the presence of associated lesions, when possible, it also allows repair of the torn diaphragm with a non-absorbable suture sutures [15]. In hemodynamically unstable patients a midline laparotomy is the recommended approach as it allows exploration of the entire abdominal cavity. The diaphragmatic lesion is repaired with non-absorbable suture after placement of chest tube. In countries with a low incidence of inter-personal violence, stab wound diaphragmatic injury is particularly rare, in particular involving the right hemidiaphragm. Diaphragmatic injury may be underestimated due to the presence of concomitant lesions of other organs, to a state of shock and respiratory failure, and to the difficulty of identifying diaphragmatic injuries in the absence of high sensitivity and specific diagnostic instruments. Diagnostic delay causes high mortality with these traumas with insidious symptoms. A diaphragmatic injury should be suspected in the presence of a clinical picture which includes hemothorax,

hemoperitoneum, anemia and the presence of sub diaphragmatic air in the abdomen.

Disclaimer

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Ethical approval

Ethical approval exemption was given for this study.

Consent

Written consent was obtained by the patient for publishing this case report.

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