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Original Article

Traumatic diaphragma rupture: an experience of 13 cases

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Abstract. Diaphragmatic injury is a rare condition, but late diagnosis may be associated with increased mortality and morbidity. The aim of this study was to present our experience with the management of this injury. Between 2004 to 2007, 13 patients with traumatic diaphragmatic rupture or diaphragmatic hernia were treated. We described the findings in patients, who had operated urgent or had complaints due to intestinal obstruction months to years after an injury. All patients were male and mean age was 23.1 years. Diaphragmatic rupture was left-sided in all patients. Six of these patients had blunt and the remaining 7 had penetrating trauma. Diagnosis of diaphragmatic rupture was established in less than 24 hours in 4 patients. In the remaining 9 patients, who developed intra-throracic herniation of abdominal organs, diagnostic delay ranged from 12 to 48 months. The most frequent herniated organ was transverse colon. Non-absorbable sutures were used for closure of the defect. Complication rate was 30% and no death was observed. After blunt or penetrating trauma in upper abdomen and distal chest, a high index of suspicion is important to diagnose diaphragmatic rupture. Late presentations are associated with increased morbidity.

Key words: Blunt/penetrating trauma, diaphragmatic rupture, diaphragmatic hernia, complication

1. Introduction

Traumatic diaphragmatic hernia (TDH) was first described by Sennertus in 1541 (1). Diaphragmatic hernia is a herniation of abdominal organs to the thoracic cavity through the diaphragmatic defect (2). Traumatic diaphragma defect usually occurs due to a blunt or penetrating injury. Acute diaphragmatic rupture (ADR) arises in 1 - 7% of blunt trauma and in 10 - 15% with penetrating trauma to the lower chest (3). Penetrating trauma, such as gunshot or stab wounds of the upper abdomen and lower thorax, more commonly affects the left hemidiaphragm. In penetrating traumas, the possibility of diaphragmatic injury should be kept in mind. The diaphragmatic injury can be diagnosed at laparotomy, but the preoperative diagnosis is difficult in the absence of simultaneous organ injury (4). It has been reported that missed diaphragmatic injuries in conservatively-managed patients range from 12% to 66% (5,6). Undetected injuries may remain clinically silent for hours to years (7) and are often associated with late complications such as herniation and strangulation of intraabdominal organs. This situation is usually in correlation with increased morbidity and mortality. The aim of this study was to review the experience of our service with the management of TDH.

2. Materials and methods

The data were collected over the period from 2004 to 2007. Patients with blunt or penetrating trauma were included in the study. We reviewed and analyzed all the records of the patients. The side of rupture, mechanism of injury, diagnostic methods, mortality and morbidity, herniated organs and management of organ injuries were evaluated. Acute diaphragmatic rupture defined as rupture of diaphragm in the acute phase, extends from the time of original trauma to the apparent recovery from the primary injuries (14 days). Traumatic diaphragma hernia is defined as intraabdominal viscera occupy the defect and variably herniate into the thoracic cavity and then begins with the signs of visceral obstruction or ischemia as in other hernias.

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Table 1. Characteristics of injury in 13 patients

Mechanism of injury	ADR group	TDH group
Penetrating trauma		
Stab wounds	2	5
Blunt Trauma		
Traffic accident	2	3
Fall from height	-	1

ADR= Acute diaphragmatic rupture, TDH= Traumatic diaphragmatic hernia

3. Results

The study identified 13 male patients ranging in age from 20 to 37 years (mean 23.1 years). The most common cause of diaphragmatic injury was penetrating trauma (7 patients, 53%). All penetrating injuries were due to stab wounds. Blunt injuries had a prevalance of 47% (6 patients). While 83% of blunt traumas were from traffic accidents, the remaining 17% (one patient) occurred in falling from a height. We divided the patients into two groups. While the ADR group included 4 patients, the TDH group had 9 patients. Table-1 shows the characteristics of injuries in both of the groups.

Patients diagnosed with ADR were admitted to our hospital within 24 hours after the trauma. Nine patients with a history of trauma more than one year presented with intestinal obstruction as a late complication of traumatic rupture of the diaphragm.

The patients, who were managed due to mechanical obstruction in our center, were initially followed-up in another health center after the injury and diagnostic delay ranged from 12 to 48 months. All the patients had rupture on the left hemidiaphragm. The patients in the ADR group had associated injuries which include hemothorax in one, pneumothorax in one, clavicle fracture in one and extremity fracture in one patient.

Preoperative chest x-rays were obtained for all patients in the ADR group, and one of those was considered as hemothorax and the other as pneumothorax. Chest tubes were inserted in these patients. Chest x-rays and thoracoabdominal computerized tomography (CT) were performed on the other two patients, who were hemodynamically stable, during the initial evaluation, but the radiological findings were not diagnostic in these patients. Laparoscopic evaluations were made with the suspicion of diaphragmatic rupture (DR), and diaphragmatic injuries were detected by laparoscopy.

In the TDH group, all patients presented with mechanical obstruction. Preoperative diagnoses of intrathoracic herniation were accurately made in all of the patients based on physical examination, chest x-rays and CT. Chest x-rays suggested diaphragmatic hernia in only three patients (33%), and intrathoracic bowel gas was determined. Computerized tomography scan of the chest and upper abdomen was performed in all hemodynamically stable patients. It was diagnosed in all of them and indicative of abdominal organ herniation into the chest.

4. Management

In the ADR group, one patient presented with massive haemorrhage via the chest tube and was suspected of having an intrathoracic injury. We preferred an emergency left thoracotomy as an initial approach and determined that no intrathoracic injury was present. The reason for the massive haemorrhage was herniation of the spleen into the thoracic cavity and iatrojenic splenic laceration due to chest tube insertion. A splenectomy was performed through the thoracotomy incision. The other patient, who presented with drainage of colonic contents via the chest tube, underwent laparotomy. It was seen that the transverse colon was also injured because of the chest tube which had been accidentally placed into the herniated colon. These two patients were referred from other hospital with chest tubes inserted. The other two patients had undergone laparoscopy and the defects were repaired laparoscopically with interrupted nonabsorbable sutures. Chest tubes were routinely placed in all patients.

All patients in the TDH group were treated surgically. Reduction of the herniated organs and repair of the diaphragm were done through laparotomy in all patients (Fig. 1).

Interrupted non-absorbable sutures were used for closure of the diaphragmatic defect through a thoracotomy in one patient and through a laparotomy in the others in the ADR group. No mesh was required to repair the defect.

Intrathoracic herniation was seen in two patients in the ADR group (50%), which included spleen (n=1) and transverse colon (n=1). The herniated organs in the TDH group respectively were, transverse colon (n=3), small bowel (n=3), stomach (n=1), omentum-small bowel (n=1) (Fig. 2) and stomach-colon (n=1). In one patient transverse colon resection was necessary because of the herniated and strangulated colon part.

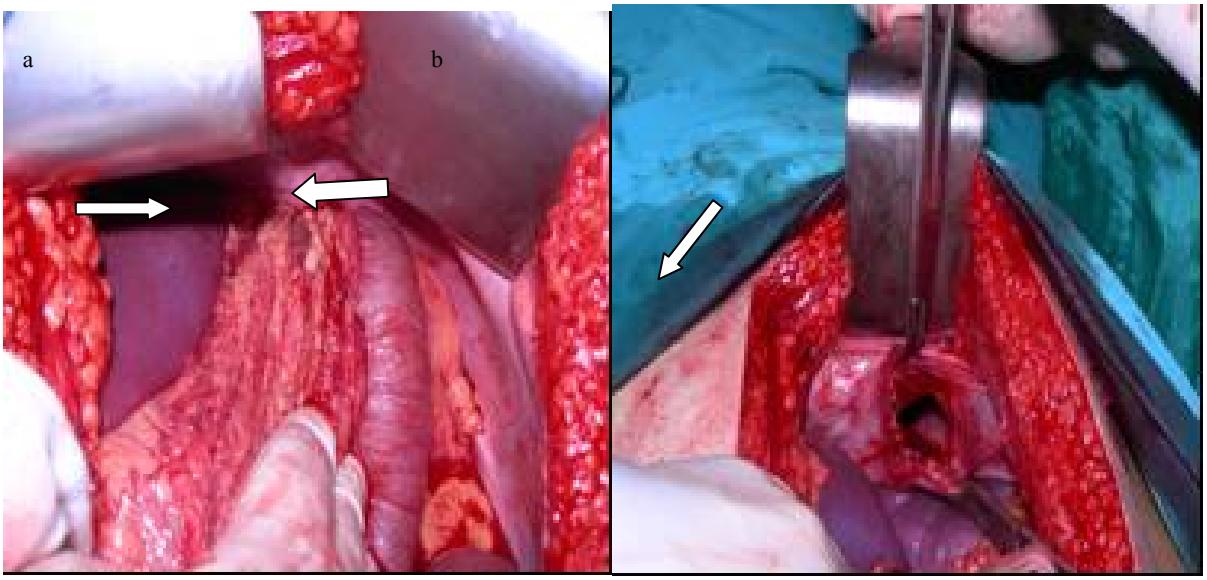

Fig. 1. a) Herniated organs through the defect. Omentum (thin arrow), small bowel (thick arrow) b) Diaphragmatic defect (arrow)

5. Outcome

Four patients developed postoperative complications releated to surgery (30%). These included thoracic empyema in one patient, mechanical bowel obstruction in one, pneumonia in two. They were all treated succesfully either surgically or conservatively. No patients died in our study groups. The mean hospital stay was 14 days (range 2 – 36 days). Follow-up ranged from 2 to 36 months. Four patients (30%) were lost to follow-up because they failed to follow-up. The remaining 9 patients had no further problems.

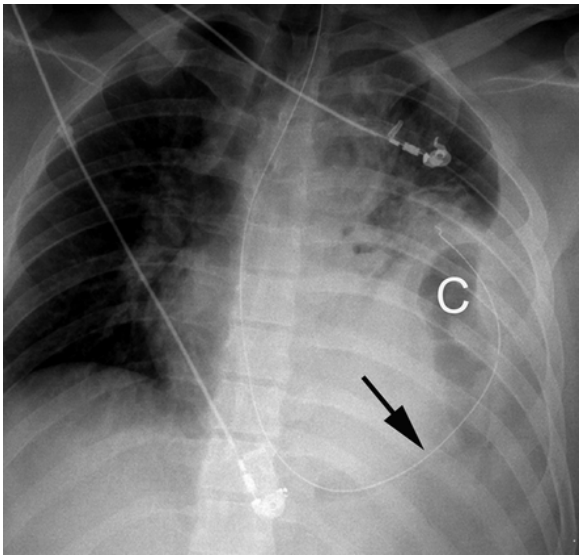

Fig. 2. Chest radiograph shows a gas-filled viscus above the left hemidiaphragm that corresponds to the colon (C). A nasogastric tube is clearly seen in the thoracic cavity (arrow).

6. Discussion

Traumatic diaphragmatic hernia can be divided into three phases: the acute phase where a patient's diagnosis is established immediately up to 14 days after injury; the second phase where patients are diagnosed in the period after acute injury, but before intestinal obstruction or strangulation; and the third phase because the patients were in that phases.

Diaphragmatic rupture (DR) is an uncommon, but severe problem which can occur from penetrating or blunt thoracoabdominal injuries. The reported incidence of DR is between 0.8% and 7% of patients admitted to the emergency unit when associated with blunt trauma and between 10% and 15% when associated with penetrating trauma. Penetrating traumas are the most common cause of DR, with a ratio to blunt injury of 2:1 (11). In this study, the most common cause of DR was penetrating injuries (53%).

The preoperative diagnosis of traumatic DR is difficult and therefore the actual incidence of DR is unknown. It remains silent for hours to years after injury unless a complication develops. One reported study has stated that the potential diagnosis rates of DR were only 25% to 50% of the cases after trauma (12). Early diagnosis of DR has been advocated but is not easy due to absence of characteristic symptoms, such as pain, dyspnea, cyanosis, cardiac arrhythmia, and hypotension. There is usually no clinical symptom to diagnose isolated blunt diaphragmatic injury (4), and it is usually diagnosed during examination for other injuries. Diaphragmatic rupture must first be suspected

and then a method be chosen to determine an early and correct diagnosis. However, location of a penetrating trauma such as a stab wound might be helpful to display a diaphragmatic defect (4). Missed diaphragmatic injuries result inevitably in intrathoracic herniation due to the intraabdominal to intrathoracic pressure gradient reaching up to 100 mmHg during Valsalva manoeuvre (normal: 2 – 10 mmHg) (13). Although difficult to detect, trauma surgeons must pay much more attention to find its existence because a delay in diagnosis can be associated with a significant increase in mortality from 3% - 7% to 25% - 30% if the DR is not detected during the initial admission (7, 14).

Diagnostic methods are useful in the evaluation of DR. Chest X-rays and CT are the most commonly used modalities and are diagnostic in 30% to 50% of the cases (1). Chest radiography is the first technique preferred in all DR cases, but the diagnostic accuracy is relatively low and can even be normal in most of the cases (15, 16). While Murray et al. (16) reported that the majority of patients (62%) with occult diaphragmatic injuries have a normal radiograph of the chest, Miller et al (17) and Demetriades et al (14) reported this to be 43% and 11% respectively. The specific findings of chest graphies are intrathoracic herniation of abdominal viscera, the 'collar sign' and elevation of the hemidiaphragm (18). The hernia sac is visualized as a soft tissue opacity, containing visceral gas in the thorax, which is pathognomonic of diaphragmatic hernia (2). Chest graphy also exposes associated rib fractures, haemopneumothorax and intrathoracic air-fluid levels, which reveal the strangulated bowel (2). If the strangulated bowel perforates, pneumothorax presents on the chest graphy. On the other hand, a herniation on the costophrenic angle may be misdiagnosed as pleural effusion or haemothorax on the initial chest radiograph, and a chest tube could accidentally be placed into the herniated organs (19). In this study, chest graphies showed haemothorax and pneumothorax in two patients in the ADR group. The other two patients with DR in the ADR group had a normal chest graphy (50%). Because of the low accuracy of clinical and radiological findings, some authors have advocated additional diagnostic methods in detecting the defect in the early period to avoid the complications due to visceral herniation into the chest (16). These methods include CT, upper gastrointestinal contrast study, diagnostic peritoneal lavage, fluoroscopic evaluation of diaphragmatic motion, ultrasound, magnetic resonance imaging, intraperitoneal radioisotope injection, laparoscopy and thoracoscopy (1).

In this study, the clinical examination and chest graphy were not adequate to establish the correct diagnosis in either group. Further investigation was necessary and we choose the CT scan. Thoracoabdominal CT is a very useful and appropriate tool in the evaluation of DR of a hemodynamically stable patient (20). Computerized tomography identified not only the diaphragmatic injury but also the other abdominal and thoracic injuries. Sensitivity and specifity of conventional CT ranges between 14% to 82% and 76% to 100%, respectively. Helical CT has a greater diagnostic potential and has a sensivity of 71% to 100% and specifity of 75% to 100%. Multisection CT allows more detailed images which is important for emergency cases. It presents the diaphragm integrity, herniated organs and intrathoracic structure more clearly (2,5). Our findings demonstrate that conventional CT evaluation was not useful in determining a diagnosis in the ADR group. However, it was a helpful method in detecting the diaphragmatic hernia in the TDH group. All patients were correctly diagnosed using conventional CT in this group.

Occult DR has been found in penetrating thoracoabdominal trauma with a rate of 7% to 26% (21). Occult injuries may be present with significant morbidity and mortality as we mentioned above. If the detection methods are not reliable for DR, efforts must be made to evaluate the diaphragm visually. Some authors have reported that laparotomy should be performed in all trauma patients with suspected DR (16, 17). On the other hand, negative laparotomies might be bothersome due to surgery-related or other complications. Therefore, multiple studies have been carried out to clarify the safety and feasibility of laparoscopy, especially in penetrating trauma to reduce the negative laparotomy rates (22). It has been found that laparoscopy has a sensitivity and specifity of 100% and 87.5%, respectively (21). Other authors have also confirmed the utility of laparoscopy for occult DR (21). This method is also advantageous in the repair of DR, which is identified by laparoscopy. In the present study, two patients were not correctly diagnosed by clinical examination, chest graphy and CT in the ADR group. We identified the occult diaphragmatic injury (50%) in those patients by laparoscopy. Some studies have shown the successful results of laparoscopic repair with sutures or prostheses in DR (23). We preferred to

repair the deffect with interrupted non-absorbable sutures.

In conclusion, early diagnosis of diaphragmatic rupture is difficult despite the available diagnostic modalities. Anyone admitted to emergency services with blunt or penetrating trauma, particularly on the left diaphragma, should arouse suspicion of a diaphragmatic injury. Diaphragmatic injury after penetrating or blunt thoracoabdominal trauma can be clinically silent. However, the results of a missed injury can be catastrophic. Laparoscopy should be considered whenever diaphragmatic injury is suspected.

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