Penetrating and blunt diaphragmatic injuries

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ABSTRACT

Objective: The purpose of this study is to analyze the ruptured diaphragm retrospectively in regard to mechanism of injury, diagnosis and treatment; and to discuss the difficulties in their diagnosis.

Methods: Thirty patients were included in the study and the study was carried out at Al-Yarmouk Teaching Hospital, Baghdad, Iraq, over a 9 year period (1992-2001). Their demographic data, diagnosis and treatment were recorded.

Results: Twenty-one patient had civilian penetrating injuries, while 9 suffered blunt trauma. Young males were the predominant victims. Three cases of the blunt trauma group had a delayed diagnosis, (2 after repeated chest radiography and one after Ba meal).

Conclusion: The preoperative diagnosis of diaphragmatic injuries is difficult. Most cases are diagnosed during exploration for associated injuries. The case is more difficult after blunt trauma. Repeated chest radiography and gastrointestinal contrast studies can be used for the diagnosis.

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Diaphragmatic injuries are uncommon and can occur from penetrating or blunt trauma. Rarely, it follows disruption of acute inflammatory process such as subphrenic abscess or empyema. The so-called spontaneous ruptures have occurred after heavy lifting, twisting and coughing.[1] Penetrating injuries to the diaphragm may result from gunshots, shells or stabbing injuries. In these circumstances, patients quite often had both intra-thoracic and intra-abdominal organ injuries.[2] In blunt trauma, it results from sudden increase in the pleuroperitoneal pressure gradient as with thoracic or abdominal compressive injuries. In our study, we will review cases in regard to their prevalence, diagnosis and management.

Methods. A retrospective review was conducted in patients with diaphragmatic trauma managed by the author. The study was carried out at Al-Yarmouk Teaching Hospital, Baghdad, Iraq, over a 9 year period 1992-2001. Patients with iatrogenic diaphragmatic injuries were excluded. Informations were evaluated, including: age, sex of patients, mechanism of injury, anatomic location, associated injuries, and their management.

Results. A total of 30 patients had diaphragmatic injuries, 21 were due to civilian penetrating injuries and 9 had blunt trauma **(Table 1)**. In the penetrating group, 15 patients had gunshot wounds and 6 had stab wounds. Male to female ratio was 6:1. The age range was 16-60 years (mean = 25.5 years). Ten patients were presented with signs of hypovolemic shock. After examination, all patients had plain x-rays of the chest and abdomen. Nine had associated chest injury evident on plain x-ray (pneumothorax, hemothorax, or both) and a chest tube was inserted. Preoperative diagnosis of diaphragmatic injury was suspected in those with positive radiological findings in the chest but there was no visceral herniation and all were explored depending on clinical judgment

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and x-rays finding. All had an associated abdominal organs injury apart from 4. Surgical treatment was according to the finding. Diaphragmatic injury was looked for and treated during the operation. A separate thoracotomy incision was necessary in 2 patients for severe pulmonary laceration. Three patients had extensive laceration in the diaphragm and they were repaired by 2 layers of continues silk sutures. Postoperative complications (**Table 2**) occurred in 10 patients (47.6%) and only 2 needed re-exploration for bile leakage and subphrenic abscess. Two patients died in this group, first case was a 60-year-old male who had thoraco-abdominal injury by bullet causing severe liver laceration and injury to the spleen, small and large bowel. The 2nd case was a 40-year-old male who had multiple shells with injury to small and large bowel. In the blunt trauma group (9 patients); 6 were males and 3 were females. Their age range was 7-35 years (mean age = 18.2). All were due to road traffic accidents. Three patients presented with hypotension. All patients had chest x-ray and 3 had associated chest injury who needed a thoracostomy tube during their resuscitation. Six patients had positive abdominal signs and were explored and the injured diaphragm was dealt with. The left hemidiaphragm was injured in 7 cases and the right hemidiaphragm was injured in 2 cases (**Figure 3**). Extensive laceration was present in 3 patients. Associated abdominal organs injury were dealt with **(Table 4)**. One patient needed thoracotomy for severely lacerated lung. Three patients had associated head injury and 3 had limb injury. Postoperative complications **(Table 2)** occurred in 4 patients (44.4%). All were managed conservatively apart from one with subphrenic abscess who needed re-intervention. One patient died in this group. He was 25-year-old male who was unconscious due to head injury in addition to thoracoabdominal injury. Three patients had delayed diagnosis for isolated injury to the left diaphragm. Two were diagnosed after repeated chest x-rays (**Figures 1a & 1b**) and one after barrium-meal (**Figure 2**).

Discussion. Traumatic rupture of the diaphragm with herniation of abdominal organs into the chest and apparent strangulation has been observed since at least the time of Ambroise Pare over 450 years ago.[3] In this study, males were the usual victims especially in the penetrating type of trauma. Carter[4] in his study in Canada concluded that males predominate in all types of injury. Diaphragmatic rupture was the only pathology in 3 patients (10%), others had associated injuries of abdominal and thoracic structures. These associated injuries often dominate the early course and determine the outcome of diaphragmatic trauma.[3] Unilateral injury was the case in all patients in this collection, and the left side was the predominant injured part in both types of injury, but more evident in the blunt type. In many clinical reports, blunt diaphragmatic injury has been observed more common on the left side than the right by a factor of as much as 2. Autopsy series, however, suggest that the incidence of right and left sided injuries is nearly equal.[3] In spite of such observations, it is generally thought that the right hemidiaphragm is somewhat protected by the underlying liver and its ligamentous attachments. In the penetrating injury group, the presence of penetrating wounds and associated signs make surgical intervention necessary in most cases. The diagnosis of diaphragmatic injuries can be made and dealt with during laparotomy. Extensive laceration of the diaphragm and herniation was rare. In the blunt trauma group the condition is more difficult. Diagnosis and treatment of diaphragmatic injury can be accomplished during laparotomy in those who had positive indication for that. Preoperative diagnosis is often difficult due to presence of concurrent injuries both intra or extra abdominal.[5-7] Herniation of the viscera may not occur immediately after trauma. These together with the non-specific symptoms and signs due to diaphragmatic rupture may lead to delayed diagnosis for an indefinite period. Chest radiographs are the initial and most valuable investigation. Serial chest x-rays in suspected patients may lead to preoperative diagnosis. In this series, 2 patients were diagnosed by serial chest x-rays. Another patient was diagnosed by upper gastro-intestinal contrast study. Other methods of diagnosis include radioactive scan.[8] Recent studies confirm the benefit of ultrasound, computerized tomography and magnetic resonance imaging in the diagnosis of ruptured diaphragm.[9-12] Thoracoscopy had been used recently in the diagnosis and treatment of ruptured diaphragm.[13,14] Laparoscopy was reported to have a role in the diagnosis and treatment of diaphragmatic rupture by such minimal access

Table 1 - Patients information in penetrating and blunt trauma group.

Information	Penetrating N=21	Blunt N=9
Male	18	6
Female	3	3
M:F	6:1	2:1
Age range (years)	16 - 60	7 - 35
Mean age (%)	25.5	18.2
Mechanism of injury		
Bullet	12	-
Shells	3	-
Stabbing	6	-
Road traffic accident	-	9
Mortality	2	1

M:F - male to female ratio

Table 2 - Postoperative complications.

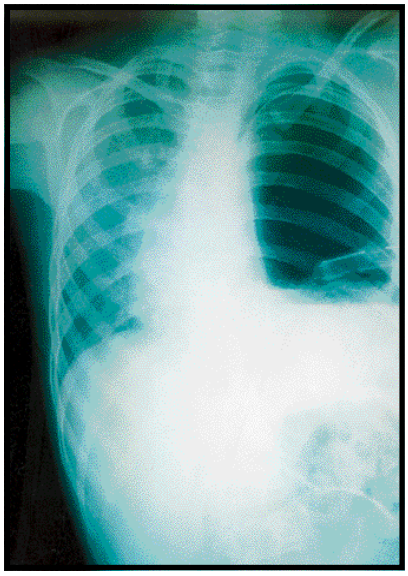
Complications	Penetrating	Blunt
Pneumonia	2	1
Emphysema	1	-
Bile leakage	3	1
Subphrenic abscess	1	1
Major wound infection	3	1

Table 3 - Anatomic location of injury.

Anatomical side	Penetrating	Blunt
Left hemidiaphragm	13	7
Right hemidiaphragm	8	2
Total	**21**	**9**

Table 4 - Associated injuries in both groups.

Associated injuries	Penetrating	Blunt
Spleen	6	3
Liver	7	2
Stomach	6	-
Duodenum	1	-
Small intestine	3	-
Large bowel	3	-
Renal injury	1	-
Spine	1	-
Abdominal great vessel	1	-
Chest injury	9	3
Head injury	-	3
Extremities	2	3



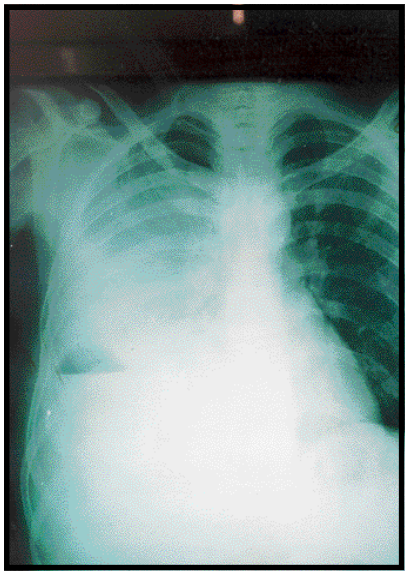


Figure 1 - Plain x-ray of the chest showing the **a)** stomach in the chest and **b)** subphrenic abscess complicating ruptured right hemidiaphragm.

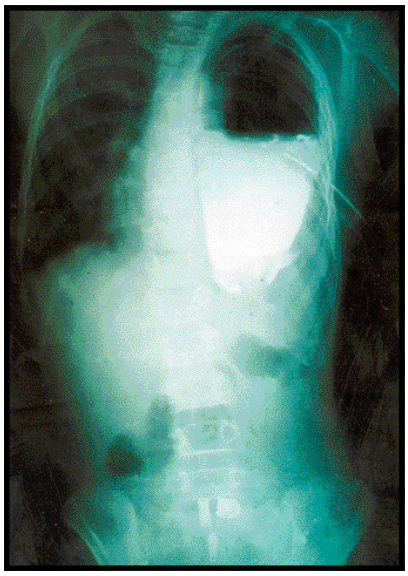


Figure 2 - Plain x-ray of the chest showing the barrium meal of the patient.

surgery.[15-17] The unavailability of these diagnostic images, make chest radiographs and gastrointestinal contrast studies valuable in detecting those cases with isolated diaphragmatic injuries. The abdominal approach was used in most cases, but thoracic approach may be added in those with severe thoracoabdominal injuries. Mortality was related to the serious abdominal or extraabdominal injuries.

In conclusion, preoperative diagnosis of diaphragmatic injury is difficult. Good laparotomy for associated injuries will lead to intraoperative diagnosis of most cases. Chest x-rays and gastrointestinal contrast studies are valuable in diagnosis of isolated injuries. New diagnostic techniques if available, may give encouraging results.

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