

Review of 9 Cases of Diaphragmatic Injury Following Blunt Trauma Chest; 3 Years Experience

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Received: 21 February 2012 / Accepted: 5 June 2012 / Published online: 20 July 2012
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Abstract Diaphragmatic injuries can occur with both blunt and penetrating trauma which can be associated with herniation of abdominal viscera into the thoracic cavity. Diaphragmatic injuries can occur with blunt trauma chest in 1–7 % of patients. Retrospectively for last 3 years all cases blunt trauma chest admitted to surgery were reviewed and a study of cases of diaphragmatic rupture was done. We analysed 496 patients of blunt trauma chest retrospectively for period of three years. Nine patients have diaphragmatic injuries, all were males, six presented acutely three were chronic. In six patients laparotomy was done, four subcostal and two midline incisions were preferred. In chronic cases thoracotomy was done. Left sided injury predominates and rib fractures are most common associated finding. Diagnosis in majority of cases is made by Computerised tomography scan. Subcostal incision may be used in patients with isolated diaphragmatic injury in acute presentation while thoracotomy is preferred in late cases. Most common morbidity is pulmonary complications

Keywords Blunt trauma chest · Diaphragmatic injuries · Subcostal incision

Introduction

Diaphragmatic injuries can occur with both blunt and penetrating traumas which can be associated with herniation of abdominal viscera into the thoracic cavity. Their presentation can be immediate or delayed and they are often in combination with other more severe injuries. The diagnosis is missed among those admissions in up to two thirds of cases. Various modalities of imaging studies such as X-ray, multislice computerized tomography scan, and fluoroscopy are available for diagnosing diaphragmatic injury. They often result in herniation of abdominal viscera into the thoracic cavity. Delay in presentation can lead to complications and increased mortality.

Material and Methods

Over the past of 3 years, all cases of blunt trauma chest admitted to surgery were reviewed and a study of diaphragmatic rupture cases was done regarding their presentation, investigations done, and the line of management.

Results

We had analyzed 496 patients retrospectively in which most of patients had fracture ribs with pneumothorax/hemothorax. There were 9 cases of diaphragmatic injury, and all of these were males. All these patients had

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been involved in a motor vehicle accident. Patients belonged to the age group of 30–40 years; 3 had delayed presentation and the rest of 6 were diagnosed immediately following trauma. All injuries were sustained to the left side of diaphragm.

Associated Injuries

Rib fractures	9
Splenic injury	2
Liver lacerations	2
Lung contusions	7
Head injury	4
Gut injury	1
Fracture extremities	3
Empyema	2
Spine injury	1

Chest X-ray was the first modality of investigation. Two patients in whom stomach was seen herniating into the chest were diagnosed on basis of chest X-ray (Fig. 1). One patient had doubtful X-ray findings in which we had suspicion of diaphragm injury which were diagnosed with help of fluoroscopy. One patient who had multiple rib fractures with grade 3 splenic injury (Fig. 2) was diagnosed due continuous drainage of over 1 l in 2 days in the chest tube. The rest of the cases were diagnosed with computerized tomography scan which was done due to clinical suspicion along with significant findings on X-ray (Fig. 3).

Of 9 cases, 6 cases with immediate presentation were explored through extended left subcostal incision and 3 cases with delayed presentation were explored through left posterolateral thoracotomy.



Fig. 1 Chest X-ray showing herniated stomach in chest



Fig. 2 CT scan showing herniating stomach

Herniated Viscera

Stomach	2
Left lobe of liver	3
Small bowel	2
Transverse colon	1

Contents were reduced and thorough lavage was done, and exploration for any other associated injury was done. The rent in the diaphragm was posterior in location in all cases, with length of 5–8 cm on average. Repair was done with No. 1 Prolene in interrupted fashion with figure of 8 stitch. Splenorrhaphy was done in one case of grade 3 splenic injury and splenectomy in the other. Liver lacerations were small and superficial and were managed with packing and compression. One patient had herniation of the transverse colon which was perforated (Fig. 4). Two drains, one in the chest through separate stab incision and the other in the abdominal cavity, were placed in all cases explored



Fig. 3 CT scan (axial section) showing compressed lung and herniating stomach

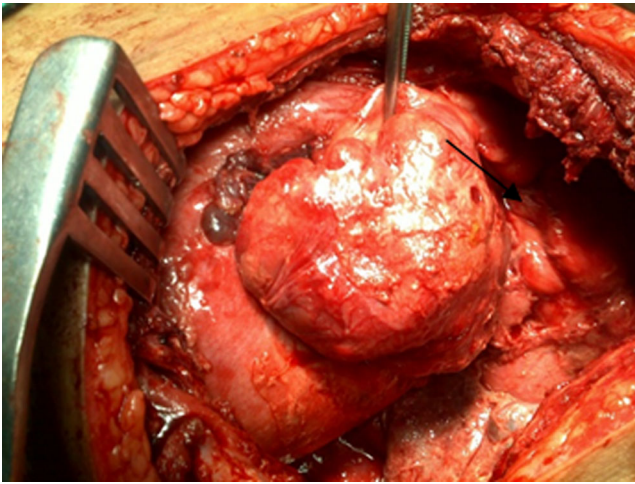


Fig. 4 Perforation of transverse colon

through abdominal route. We had used left subcostal incision in 4 patients, midline incision in 2 patients, and left thoracotomy in 3 patients. We had 6 cases of acute injury to the diaphragm which were operated by laparotomy, and 3 cases of chronic injury to diaphragm which were operated by thoracotomy. Postoperatively in patients with subcostal incisions the recovery was better.

Discussion

Bowditch in 1853 published the first account of traumatic diaphragmatic hernia diagnosed antemortem [1]. He established the following five criteria for the physical diagnosis of the lesion:

1. Prominence and immobility of the left thorax
2. Displacement to the right of the area of cardiac dullness
3. Absent breath sounds over the left thorax
4. Bowel sounds audible in the chest
5. Tympany to percussion over the left chest

The surgical history began with the first successful repair, by Riolfi in 1886, of a laceration of the diaphragm produced by a penetrating injury. In 1899, Walker successfully reduced a diaphragmatic hernia and repaired the diaphragm in a patient who had been crushed beneath a falling tree [2]. The incidence of diaphragmatic injuries has been reported as ranging from 1 to 7 % of all patients with significant blunt trauma, and 10 to 15 % with penetrating wounds. Of those undergoing laparotomy for trauma, 4–6 % patients have diaphragmatic injuries [3]. More injuries occur on the left (66 %) than on the right (32 %), with rare bilateral presentation in only 1.5 % [3]. Although the most common etiology is trauma, others include iatrogenic and spontaneous events that occur during pregnancy [4, 5]. A diaphragmatic injury is invariably a marker of serious trauma [6]. The diaphragm is rarely injured alone, with an

associated injury rate approaching 100 %. It is commonly associated with intra-abdominal injuries, thoracic injuries, fractures of the ribs, pelvis and long bones, head injuries, and rarely aortic injuries. Death is commonly caused by a concomitant injury, rather than the diaphragmatic injury alone [1]. The two mechanisms of injuries produce a variety of different diaphragmatic injuries. For example in blunt trauma, it is the abrupt change in intra-abdominal pressure that is thought to cause the majority of injuries, although shearing and/or avulsion can occur, especially following lateral trauma. Normal intra-abdominal pressure varies from ≈ 2 to ≈ 10 cm H₂O during inspiration [3]. A pressure gradient of 100 cm H₂O can be achieved across the diaphragm during the Valsalva maneuver, and it is these pressure gradients that are thought to exist at the moment of injury, thus contributing to it. This pressure gradient contributes to the initial injury, and can lead to the herniation of abdominal contents through a diaphragmatic injury if presentation is delayed [7]. Numerous studies have shown a greater incidence of left-sided diaphragmatic injuries following blunt trauma. Furthermore, studies on bursting pressures in cadavers have shown consistent weaknesses on the left side. This is due to the protective effect of the liver on the right, and the location of the lumbocostal trigone on the left. It has also been suggested that the location of the esophageal hiatus contributes to the left-sided weakness. The pathophysiological sequelae of a ruptured diaphragm affect both the circulation and respiratory systems due to the reduced function of the diaphragm, lung compression, mediastinal shift, and therefore impaired venous return to the heart. Physical findings can be either thoracic or abdominal. Thoracic signs include decreased breath sounds, fractured ribs, flail chest, and signs of hemothorax or pneumothorax. Auscultation of bowel sounds in the chest is pathognomonic of diaphragmatic rupture, occurring due to herniation of bowel contents. Abdominal signs include abdominal pain, guarding, absence of bowel sounds, and abdominal swelling, depending on the extent of injuries. Occasionally physical examination can be relatively normal [8]. Pathognomonic signs that should raise serious suspicions of a diaphragmatic rupture include abdominal gas patterns in the chest, nasogastric tube in the chest, blurring of the diaphragmatic margin, elevation of the affected side, mediastinal shift without a pulmonary cause, and compression atelectasis of the lower lobe [3]. If diagnosis is delayed to months or years after the injury, symptoms are generally less severe, and are due to size reduction in the chest cavity (dyspnea, orthopnea, respiratory distress), and partial or complete obstruction of herniated abdominal contents (nausea, vomiting, abdominal, and chest pain). Physical signs often present in a diaphragmatic hernia include diminished expansion of the chest, impairment of resonance, adventitious sounds, cardiac displacement, circulatory collapse, cyanosis, dyspnea, and asymmetry of the hypo-chondrium. Many centers use chest radiography to support the diagnosis of diaphragmatic hernia by looking for an elevated

diaphragm, acute gastric dilatation, loculated pneumohemothorax, or subpulmonary hematoma. CT scan can support diagnosis by showing diaphragmatic discontinuity, intrathoracic herniation, and strangulation of abdominal viscera, the so called “collar” sign [7]. Avulsed hemi-diaphragm and isolated omentum are also easily detectable with CT; magnetic resonance imaging (MRI) scan can be used to visualize the anterior and posterior parts of the diaphragm and its hernial orifices with T1-weighted images. Management principles are based on the repair of the defect by either an abdominal approach if presentation is early or thoracotomy. Nonabsorbable sutures are used for the repair. Delayed presentations frequently lead to intrathoracic adhesions due to the herniated abdominal viscera, which require a thoracotomy approach.

Conclusion

Most cases are due to roadside traffic accident. Majority are males. Left-sided injury predominates and rib fractures are most common associated findings. Diagnosis in majority of cases is made by computerized tomography scan. Subcostal incision may be used in patients with isolated diaphragmatic

injury in acute presentation, while thoracotomy is preferred in late cases. Most common cause of morbidity is pulmonary complications.

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