

Penetrating Diaphragmatic Injury: A Lesson Learnt After Laparotomy

S Singla, S Bhoariwal, T S Chauhan, R Kaswan, S Sharma., M Chebi

Citation

S Singla, S Bhoariwal, T S Chauhan, R Kaswan, S Sharma., M Chebi. *Penetrating Diaphragmatic Injury: A Lesson Learnt After Laparotomy*. The Internet Journal of Surgery. 2013 Volume 30 Number 1.

Abstract

Traumatic diaphragmatic injuries still are difficult to diagnose; it needs a high index of suspicion in patients having severe thoracoabdominal blunt or penetrating trauma. To diagnose them accurately, poses a challenge to trauma surgeons, especially in cases of small injuries, which later may be diagnosed as diaphragmatic hernias, and their complications. An emergency laparotomy followed by repair of the defect is gold standard in the management of these patients. Herein, we report a case of penetrating diaphragmatic injury in a young female having multiple stab wounds on the left side of the chest and the abdomen with a chest x-ray showing air under the right dome of the diaphragm.

INTRODUCTION

Diaphragmatic injuries remain a diagnostic challenge due to variable clinical presentation, frequent presence of other multi-system injuries, like hemo-pneumothorax and multiple rib fractures, pelvic fractures, blunt abdominal trauma with hepatic and splenic injuries and head injuries, which draw attention away from the diaphragm, and lack of a single reliable diagnostic modality. These injuries are associated with a mortality rate of about 5.5-51% and are missed in up to 30% of cases on initial evaluation.^{1,2} Owing to its high mobility, injuries in the diaphragm do not heal spontaneously and can lead to catastrophic outcomes like visceral herniation and strangulation in the later period and pulmonary morbidity, raising the mortality up to 30-80%.³

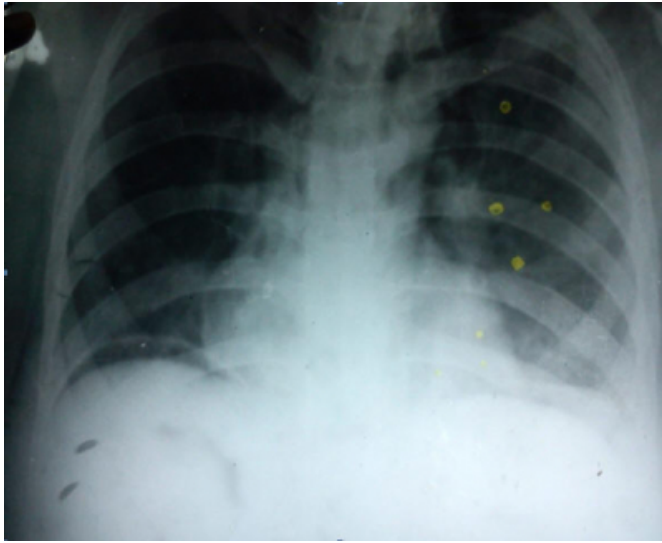
CASE REPORT

A young female of 24 years with 13-week pregnancy was brought to our accident and emergency department within 6 hours after multiple stab injuries. On examination, she was conscious, the airway was patent and secured, breathing was spontaneous and the chest was moving equally on both sides, but there were diminished breath sounds on auscultation in left side of the chest. An intercostal chest tube was put in immediately and a gush of air came out, followed by approximately 300ml of blood. Her vitals were: pulse rate, 84 per minute; blood pressure 124/80mmHg. There were three stab injuries, the first in the left fourth intercostal space 5cm lateral to the sternum, the second in the eighth left intercostal space 4cm lateral to the sternum

and the third in the left lumbar region of the abdomen. FAST (focused assessment with sonography for trauma) was negative. Chest x-ray showed air under the right dome of the diaphragm and an expanded left lung. A provisional diagnosis of penetrating injury of the chest and abdomen with hemo-pneumothorax and traumatic gut perforation was made and the patient was immediately shifted to the emergency operation room. An exploratory laparotomy was done. There was no free fluid in the peritoneal cavity and all hollow and solid viscera were normal. On meticulous examination, finally a rent of 2x1cm was found in the left dome of the diaphragm, which was repaired using polypropylene 2-0 in interrupted manner. The intercostal tube on the left side was removed after three days. The patient was discharged on the 6th post operative day and there was no postoperative complication on a regular follow-up of 6 months.

Figure 1

Chest x-ray (erect) of the patient showing free air under diaphragm



DISCUSSION

Gastrointestinal tract perforation causes pneumoperitoneum in up to 90% of cases.⁴ Other causes include penetrating/blunt abdominal and chest trauma leading to diaphragmatic injuries, pneumothorax and bronchoperitoneal fistula, emphysematous cholecystitis, spontaneous bacterial peritonitis, ruptured hepatic abscess and perforated pyometra. The diaphragm is a dome-shaped muscular structure that separates the thoracic cavity from the abdominal cavity and is the primary muscle for respiration. Traumatic injuries of the diaphragm remain uncommon but having been recognised early in the history of surgery. Diaphragmatic injuries present only in 0.8-1.6% of blunt trauma and in up to 10-15% in penetrating trauma.⁵ In a study of traumatic rupture of diaphragm in 65 patients, blunt trauma accounted for the injuries of 52 patients. Rupture of the diaphragm was left-sided in 43 patients (66%), right-sided in 21 (32%), and bilateral in one patient (1.5%).¹ Diaphragmatic injuries due to penetrating trauma are slightly more common on the left side due to predominance of right-handed attackers. Penetrating wounds result in more diaphragmatic injuries as compared with blunt trauma, but penetrating wounds are usually small and may go unrecognised.

Clinical features of diaphragmatic injuries are highly non-specific and may vary from pleuritic discomfort in small uncomplicated injuries to dyspnea, chest pain in case of herniation or even obstructive or ischemic symptoms in strangulated hernias. Grimes described the distinct phases of presentation of traumatic diaphragmatic injuries which

include acute phase (at the time of the injury to the diaphragm), latent phase (generally occurs few weeks after injury due to herniation of abdominal organs into the thoracic cavity and leads to decreased functional capacity of the thorax), and obstructive phase (usually months to years after the injury when herniated viscera get strangulated).⁶ There is no gold standard diagnostic modality for diaphragmatic injuries. Chest x-ray is the first investigation to be done, but its sensitivity is 62% for left-sided injuries and 17% for right-sided injuries.¹ Features of diaphragmatic injuries include irregular diaphragmatic outline, mediastinal shift and nasogastric tube in the thorax, etc. Computed tomography is the second-line study to be done but poor in detecting the diaphragm due to its movement artefacts.⁷ But the advent of fast multi-slice spiral CT scanning with image acquisition in a single breath hold coupled with the availability of multiplanar reformatting of images has markedly improved its diagnostic ability for diagnosis of diaphragmatic injuries.⁸ Minimally invasive procedures like laparoscopy and thoracoscopy are now the diagnostic and therapeutic choices in selected stable patients with penetrating injuries to the upper abdomen and lower chest. M-mode ultrasonography combined with FAST is a new diagnostic tool for penetrating injuries, because M-mode evaluates diaphragmatic movement which is decreased in penetrating injuries.⁹

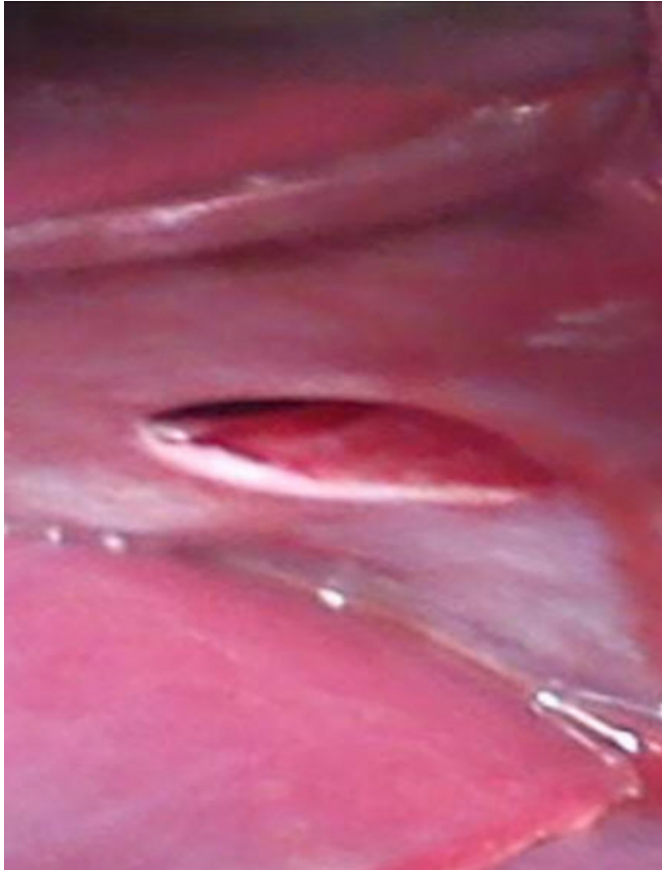
Figure 2

Intra-operative image taken during laparotomy.



Figure 3

Rent in the left dome of the diaphragm



Repair of the diaphragmatic ruptures can be performed by the classical open method or with minimally invasive methods. In case of acute injuries, the patient must be resuscitated first, followed by the insertion of a nasogastric tube and an intercostal tube if needed. At laparotomy, examination of the diaphragm may require transsection of the falciform ligament and downward traction of the liver for the right hemi-diaphragm and downward retraction of the spleen and greater curvature of the stomach for the left hemi-diaphragm. If a small rent is detected, a primary repair is done using polypropylene sutures in interrupted manner, as we did in our case. In large defects, prosthetic non-absorbable mesh material is used to reconstruct the diaphragm.

Blunt abdominal trauma severe enough to cause injuries to abdominal organs also causes increased intra-abdominal pressure and disruption of diaphragmatic attachments leading to diaphragmatic injury.¹⁰ We highlight the importance of a high degree of suspicion for diaphragmatic injury in every case of blunt or penetrating trauma to

abdomen or chest. We explored our patient, keeping in mind the possibility of traumatic gut injury. If we had found the same, we would have performed primary closure of gut perforation and would have closed the abdomen after examining other solid and hollow viscera. There is very little probability that we would have examined the diaphragm in that case. Thus hereby we emphasize the role of examining the diaphragm in all cases of trauma undergoing laparotomy.

CONCLUSION

Traumatic diaphragmatic injuries require a high index of suspicion for early diagnosis. Missed diagnosis presents as catastrophic outcome even after years. No imaging modality is ideal for diagnosis; chest x-ray is the first investigation to be done, but it may be normal initially. CT scan requires high-quality reconstruction for diagnostic accuracy. Thoracoscopy and diagnostic laparoscopy is a good option in stable patients. Exploratory laparotomy remains a good choice for diagnosis and management of diaphragmatic injuries. Thus, in all polytrauma patients undergoing exploratory laparotomy, it is mandatory to examine both domes of the diaphragm for injury so that, if present, it can be managed timely and delayed catastrophic complications can be avoided.

References

1. Mihos P, Potaris K, Gakidis J, Paraskevopoulos J, Varvatsoulis P, Gougoutas B, et al.: Traumatic rupture of the diaphragm: experience with 65 patients. *Injury*; 2003; 34: 169-72.
2. Abdel Hadi MS, Al-Mulhim AA, Al-Awad NI, Zakaria HM, Al-Awami MS: Diaphragmatic injury. A clinical review. *Saudi Med J*; 2001; 22: 890-4.
3. Sliker CW: Imaging of diaphragm injuries. *Radiol Clin N Am*; 2006; 44: 199-211.
4. Mularski RA, Ciccolo ML, Rappaport WD: Nonsurgical causes of pneumoperitoneum. *West J Med*; 1999; 170: 41-6.
5. Mansour KA: Trauma to the diaphragm. *Chest Surg Clin N Am*; 1997; 7: 373-83.
6. Grimes O: Traumatic injuries of the diaphragm. *Am J Surg*; 1974; 128: 175-81.
7. Shapiro MJ, Heiber E, Durham RM, Luchtefel W, Mazuski JE: The unreliability of CT scans and initial chest radiographs in evaluating blunt trauma induced diaphragmatic rupture. *Clin Radiol*; 1996; 51: 27-30.
8. Hoy JF, Shortsleeve MJ: Diagnosis of diaphragmatic rupture utilizing spiral computed tomographic reconstruction. *Emerg Radiol*; 1997; 4: 127-8.
9. Urvoas E, Pariente D, Fausser C, Lipsich J, Taleb R, Devictor D: Diaphragmatic paralysis in children: diagnosis with TM-mode US. *Pediatr Radiol*; 1994; 24: 564-8.
10. Kearney PA, Rouhana SW, Burney RE: Blunt rupture of the diaphragm: mechanism, diagnosis, and treatment. *Ann Emerg Med*; 1989; 18: 1326-30.

Author Information

Sham Singla, M.S., F.I.C.A.

Department of General Surgery, Pt. B.D.Sharma University of Health Science
Rohtak, Haryana. India

Sandeep Bhorawal, M.S.

Department of General Surgery, Pt. B.D.Sharma University of Health Science
Rohtak, Haryana. India
drsandeepkbhorawal@gmail.com

Tapan Singh Chauhan, M.S.,

Department of General Surgery, Pt. B.D.Sharma University of Health Science
Rohtak, Haryana. India

Ramesh Kaswan, M.B.B.S.

Department of General Surgery, Pt. B.D.Sharma University of Health Science
Rohtak, Haryana. India

Saurabh Sharma, M.B.B.S.

Department of General Surgery, Pt. B.D.Sharma University of Health Science
Rohtak, Haryana. India

Madiwalesh Chebi, M.B.B.S.

Department of General Surgery, Pt. B.D.Sharma University of Health Science
Rohtak, Haryana. India