

Misdiagnosis of diaphragmatic rupture in a trauma setting

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Distinguishing diaphragmatic eventration from rupture in the trauma setting can be a considerable challenge. We present a case involving a man suffering from chest pain and with a raised left hemidiaphragm on the chest radiograph after a motor vehicle injury. A review of the literature discusses the use of imaging modalities and subsequent surgical diagnostic procedures in the face of uncertainty.

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Case report

A 40-year-old man was the driver of a vehicle that skidded and rolled into a ditch at speed. All passengers including the driver were able to exit the car unaided, but as a precaution the driver was taken to the casualty department at our hospital, a level 2 centre that provides regional and tertiary services. On arrival he started to complain of moderate left-sided chest pain on inspiration.

He had a history of mild untreated asthma and a body mass index of 35. Observations revealed a resting tachycardia (110 beats/min) with a normal blood pressure and oxygen saturation of 94% on air. He was not in any respiratory distress. Breath sounds were reduced in the left basal hemithorax, and there was a slight inspiratory wheeze throughout. The abdomen was soft and very mildly tender in the left upper quadrant. An erect chest radiograph (Fig. 1) revealed an elevated left hemidiaphragm with bowel loops overlapping the diaphragmatic markings. Owing to suspicion of diaphragmatic rupture and the patient's relatively stable condition, a computed tomography (CT) scan of the chest (Fig. 2) was performed immediately in order to confirm clinical suspicions. At the hospital all radiology images are interpreted by the relevant discipline after hours, as there is no on-call consultant radiology service. The chest scan was reviewed by the surgeon on call, who interpreted it as demonstrating that the intra-abdominal viscera were situated within the thorax. An urgent laparotomy was subsequently performed.

The laparotomy was negative for free fluid and any identifiable diaphragmatic injury; however, it was noted that the median lobe of the left hemidiaphragm was quite elevated and appeared relatively thin and mobile. A diagnosis of diaphragmatic eventration (DE) was made.

Discussion

DE refers to thinning of all or part of the hemidiaphragm while maintaining continuity with the costal margins, resulting in elevation and cranial displacement of intra-abdominal viscera on the affected side. It can be a congenital or an acquired anomaly,

usually asymptomatic and often an incidental finding when imaging is performed for other reasons. Severe eventration can result in acute respiratory compromise in neonates owing to related lung hypoplasia, or present as worsening dyspnoea in adults.¹ In congenital eventration there is a defect in the muscular portion of the diaphragm, whereas progressive muscular atrophy secondary to several causes, for example a phrenic nerve palsy or previous trauma, is usually the cause of the acquired condition.^{1,2}

In the event of trauma, one should have a high index of clinical suspicion for diaphragmatic rupture (DR), a notoriously difficult diagnosis to make clinically and potentially fatal if missed. DR can result from penetrating or blunt trauma, the latter usually resulting from abdominal impact causing a sudden increase in intra-abdominal pressure and forcing abdominal contents towards the thoracic cavity. Fifty to eighty per cent of ruptures occur in the left hemidiaphragm, probably because of the protective cushioning effect of the liver on the right side.³ One of the principal diagnostic difficulties is the presence of a relatively small hole after penetrating trauma with a reduced chance of visceral herniation, in comparison with blunt trauma, where there will be a large defect that may appear similar to an eventration. Associated injuries can include gastrointestinal hernias leading to volvulus

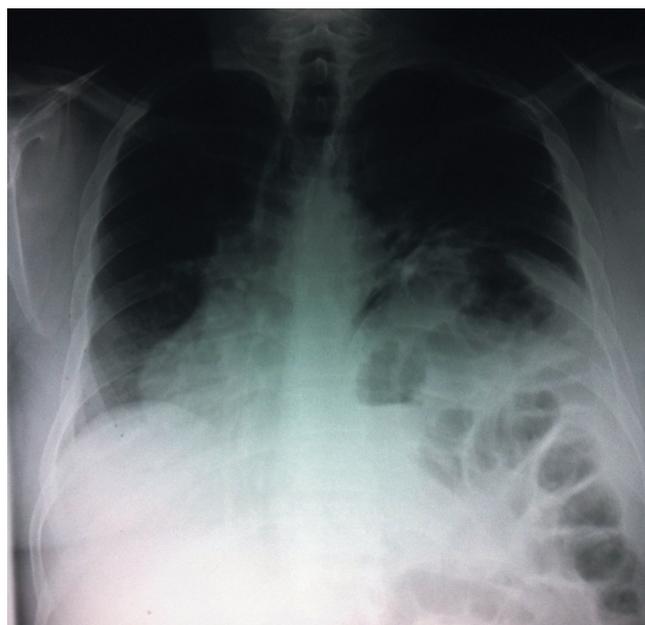


Fig. 1. Erect chest radiograph, displaying an elevated left hemidiaphragm over which bowel loops appear to be crossing its border into the left hemithorax. The heart and trachea are displaced to the right, demonstrating mediastinal shift.

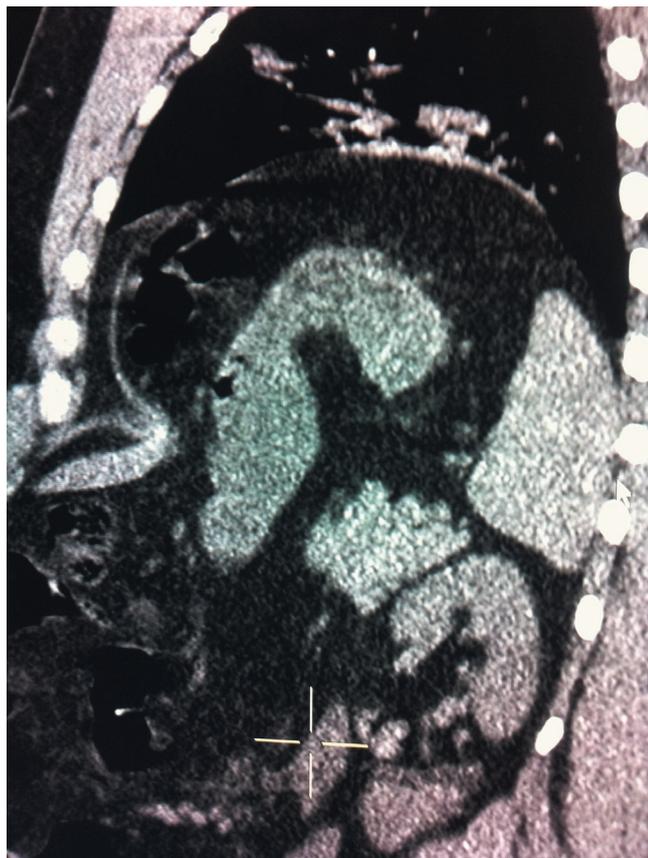


Fig. 2. Plain sagittal CT scan, illustrating a significantly raised left hemidiaphragm. The crus of the left diaphragm can be traced in continuity with no evidence of disruption. There is no free fluid in the abdomen or thorax.

and/or strangulation, liver, pancreatic and splenic injuries, and lung contusions causing respiratory compromise; early diagnosis is therefore key to management.

DR can be identified in the stable patient using a variety of clinical and imaging modalities. Plain chest radiographs have been found to be notoriously unreliable for diagnosis;⁴ a significantly elevated hemidiaphragm and mediastinal shift can be found in both DR and DE. The use of oral contrast or the presence of a nasogastric tube may help for diagnostic purposes, as it is likely that the stomach will appear in the chest cavity if there is a significant rupture. The presence of pleural effusions and lung contusions on a chest radiograph should also raise clinical suspicion; however, all cases should proceed to CT scans of the chest and abdomen with intravenous contrast if available. Sagittal, coronal and axial multihelical slice CTs should be interpreted carefully for signs of a rupture. The diaphragmatic crus should be followed in continuity, as this

is where abrupt breaks can be identified. Haemoperitoneum, pneumoperitoneum and a waist-like collar sign indicative of herniated viscera or fat should raise suspicion.^{2,4} Combining these imaging modalities with oral or enema contrast studies can also aid in the diagnosis of DR. Video fluoroscopy and ultrasound for paradoxical movement of the diaphragm have also been shown to be useful where available.^{1,4} Studies have shown magnetic resonance imaging to be the most reliable modality for excluding diaphragmatic ruptures,^{1,4} but its use is limited by lack of availability in the trauma situation.

Diagnostic laparoscopy has an increasingly important role in clinically stable patients who have suffered traumatic thoraco-abdominal injuries,⁵⁻⁷ and has been found to reduce the negative laparotomy rate while also identifying clinically unsuspected injuries.^{6,7} Thoracoscopy should only be performed in cases where no need for laparotomy is predicted, but there is evidence to suggest that the decision to perform laparoscopy or thoracoscopy in the first instance depends on the surgical specialty and centre expertise.⁷

If DE is diagnosed, no further surgical intervention is required if there are no other symptoms.⁸ Plication of the diaphragm may be performed if the patient has given a premonitory symptomatic history, but this procedure is best performed electively.⁸ There is no clinical evidence to prove that patients with known DE have an increased risk of rupture in trauma, yet a high clinical suspicion should be maintained in this situation.

Conclusion

DE can be very difficult to distinguish from DR in a trauma setting. Selection of appropriate imaging, dependent on centre capabilities and availability of subsequent interpretation by a radiologist, should be key to non-invasive management if the patient is stable. If any clinical doubt remains, it would be justifiable to perform a diagnostic laparoscopy, thoracoscopy or laparotomy, as when missed these injuries are associated with significant morbidity and mortality.

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