Case reports

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Magnetic resonance imaging of blunt traumatic rupture of the right hemidiaphragm

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Abstract. A patient suffering from blunt traumatic rupture of the right hemidiaphragm is presented. Chest radiography and computed tomography (CT) suggested the type of injury, but magnetic resonance imaging (MRI) established unequivocally the correct preoperative diagnosis. [Eur J Cardio-thorac Surg (1993) 7:553–554]

Key words: Diaphragm – Rupture – Trauma – Magnetic resonance imaging

Blunt traumatic rupture of the right hemidiaphragm is a relatively rare injury whose diagnosis is frequently overlooked. A patient suffering from this injury is presented. The correct diagnosis was established with the aid of magnetic resonance imaging (MRI).

Case report

A 28-year-old white man had a high speed automobile accident on August 9, 1992 and was admitted to a local hospital, where a right hemothorax due to blunt thoracoabdominal trauma and a fracture of the left humerus were diagnosed. Peritoneal lavage was performed, yielding 2,000 red cells/ml and 70 white cells/ml. These findings were considered nondiagnostic of intraperitoneal bleeding. A closed drainage of the right hemithorax was established and the left arm put in plaster, and the patient was transferred to our hospital 3 days after the injury.

Upon arrival the patient complained of dyspnea and pain at the base of the right hemithorax. His blood pressure was 105/75 mm Hg, pulse rate 116/min and regular, respiration 28/min and temperature 36.9 °C. The breathing sounds were absent at the base of the right hemithorax. The abdomen was soft and tender, mainly in the right upper quadrant.

On investigation the following values were established: hematocrit 37.3%, SGOT 72 U/l, SGPT 219 U/l, alc. phosphatase 116 (normal limits 38–117) U/l, bilirubin total 0.43 mg/dl (direct 0.14 mg/dl, indirect 0.29 mg/dl). While the patient was breathing room air, his p_aO_2 was 60 mm Hg and p_aCO_2 48 mm Hg. The remaining routine laboratory investigations were unremarkable.

Chest X-ray showed elevation of the right hemidiaphragmatic contour accompanied by elevation of the inferior margin of the liver (Fig. 1). Computed tomography (CT) confirmed elevation of the liver, which occupied the lower part of the right hemithorax. In addition, there was a liver contusion in the posterior segment of the right lobe. Thoracic findings included right hemothorax and compressive atelectasis of the right lower lobe. The integrity of the right diaphragm could not be assessed (Fig. 2). Immediately afterwards the patient underwent MRI with a 0.5 T system (Gyroscan TS). [1] Respiratory gating was employed in all sequences. The coronal and sagittal T_1 weighted images demonstrated a large central rupture of the right hemidiaphragm. Through this rupture there was herniation of the liver into the pleural cavity, resulting in significant deviation of the heart to the left (Fig. 3). The supplementary axial PD/T_2 weighted images did not provide additional information compared to the CT study.

The patient was operated on through a right thoracotomy. A 10 cm tear of the dome of the right hemidiaphragm was found. The entire right lobe of the liver including the gall bladder was herniated through the diaphragmatic tear into the right pleural cavity displacing the heart to the left. The liver was repositioned into the peritoneal cavity and the diaphragmatic tear was closed. The postoperative course was uneventful.

Discussion

Traumatic rupture of the right hemidiaphragm constitutes 20%–35% of all the diaphragmatic injuries [1, 3, 9, 12]. Early diagnosis of this injury is overlooked more frequently than that of the left hemidiaphragm [4, 8].

Plain chest radiography remains the screening examination for evaluating blunt trauma of the chest [5]. It is sensitive in detecting left hemidiaphragmatic injuries, however the findings for right hemidiaphragmatic tears are often nonspecific [4, 5]. Suspicious findings include elevation or distortion of the diaphragmatic silhouette and unusual lucencies or opacities in the lower chest due to herniated bowel or solid viscera. In the differential diagnosis several other conditions have to be excluded, such as diaphragmatic eventration or paresis due to phrenic nerve injury. Additional findings in the lung parenchyma (consolidation, cysts), pleural space (fluid collections) or abdomen (ileus, Chilaiditi's syndrome) may obscure or mimic diaphragmatic injury.

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Fig. 1. Anteroposterior chest X-ray showing elevation of the right diaphragmatic contour as well as elevation of the liver (*inferior margin noted by arrows*)

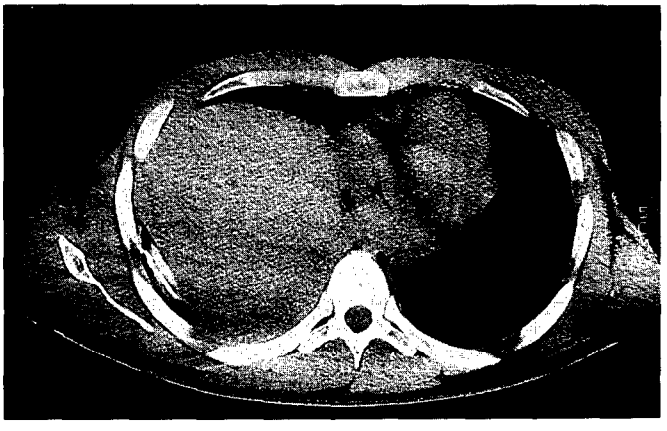

Fig. 2. CT section confirms the hepatic elevation to the lower level of the hila. The right diaphragm cannot be visualized

Fig. 3. MR study: (**a**) Coronal image shows nearly complete displacement of the liver upward with bulbous appearance of its right lobe suggesting constriction. Note the small slip of diaphragm attached to the chest wall (*arrow*). The heart is displaced to the left. (**b**) Sagittal image demonstrates a large diaphragmatic defect (*between arrows*) allowing herniation of the liver into the thoracic cavity

Further evaluation of possible diaphragmatic rupture may be performed with sonography and CT. True positive and false negative results have been reported with both of these imaging modalities [2, 5, 7, 11]. Sonography is a highly operator-dependent examination and can be limited by subcutaneous emphysema, bowel gas, pain, or wound bandages [5]. Computed tomography usually relies on indirect findings such as the identification of omental fat or abdominal viscera outside the diaphragmatic confines [6]. Direct visualization of diaphragmatic discontinuity is very difficult because the diaphragm is oriented in the axial plane, which is the plane of the CT sections.

The multiplanar capability of MRI permits direct imaging of the diaphragm, which is best evaluated in the coronal and sagittal planes. Due to this capability, MRI has been used successfully to detect left-sided diaphragmatic tears at least twice [5, 10]. However, diagnosis of blunt rupture of the right hemidiaphragm based on MRI findings has not been previously reported. In our patient the chest X-ray and CT findings only suggested the presence of a right hemidiaphragmatic tear without providing evidence for definitive diagnosis. On the other hand MRI clearly demonstrated the rupture of the right hemidiaphragm allowing us to establish the correct diagnosis preoperatively.

It is concluded that MRI may provide information which is unavailable from any other imaging technique, and establish the diagnosis of rupture of the right hemidiaphragm.

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