

Missed Traumatic Rupture of the Diaphragm

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A 48-year-old man came to the emergency department with altered consciousness and hemoperitoneum following a pedestrian traffic accident. He underwent immediate emergency laparotomy, and on the second day, he required craniectomy because of increase of intracranial hemorrhage. A chest radiograph taken 7 days after admission, showed elevation of the right hemi-diaphragm, and follow-up chest CT showed a right-sided rupture of the diaphragm, which was surgically repaired. Rupture of the diaphragm can be easily overlooked and the diagnosis delayed, especially in unstable patients with multiple trauma or altered level of consciousness, as in the case reported here. [J Trauma Inj 2017; 30: 16-20]

Key Words: Thoracic trauma, Traumatic diaphragm rupture

I. Introduction

Rupture of the diaphragm occurs rarely in multiple trauma patients and is reported in 0.8 to 7% of cases.(1) Ruptured diaphragm can increase morbidity and mortality of trauma patients owing to herniation, incarceration, or strangulation of the abdominal organs, and respiratory insufficiency. Traumatic rupture of diaphragm should be repaired promptly, but immediate diagnosis of traumatic rupture of the diaphragm is difficult and rupture of the diaphragm is often overlooked particularly in patients with accompanying injuries.(2) Rupture of the right hemi-diaphragm is less common than left diaphragmatic rupture because of the anatomical features of the diaphragm.(3) And it is also more difficult to diagnose, therefore the diagnosis of a ruptured right diaphragm is more likely to be delayed.

The following is a report of a patient with rupture of the right diaphragm that was overlooked in the presence of severe accompanying trauma.

II. Case

A 48-year-old man was brought to the emergency department after he was hit by a car. He was unconscious, apneic, and in shock. His blood pressure could not be measured, pulse was 132 beats per min, and his body temperature was 36°C. After cardiopulmonary resuscitation (CPR), the systolic blood pressure rose to 60 mm/Hg and the oxygen saturation reached 99% on pulse oximetry. The patient was sufficiently stabilized with blood transfusion and fluid resuscitation, and emergency computer tomography (CT) scans were performed.

The brain CT showed an acute traumatic subdural

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hemorrhage in the right hemisphere and a linear fracture of the left temporal bone. The 3D chest CT

showed right hemothorax in association with a contusion of the lower lobe of the right lung and a

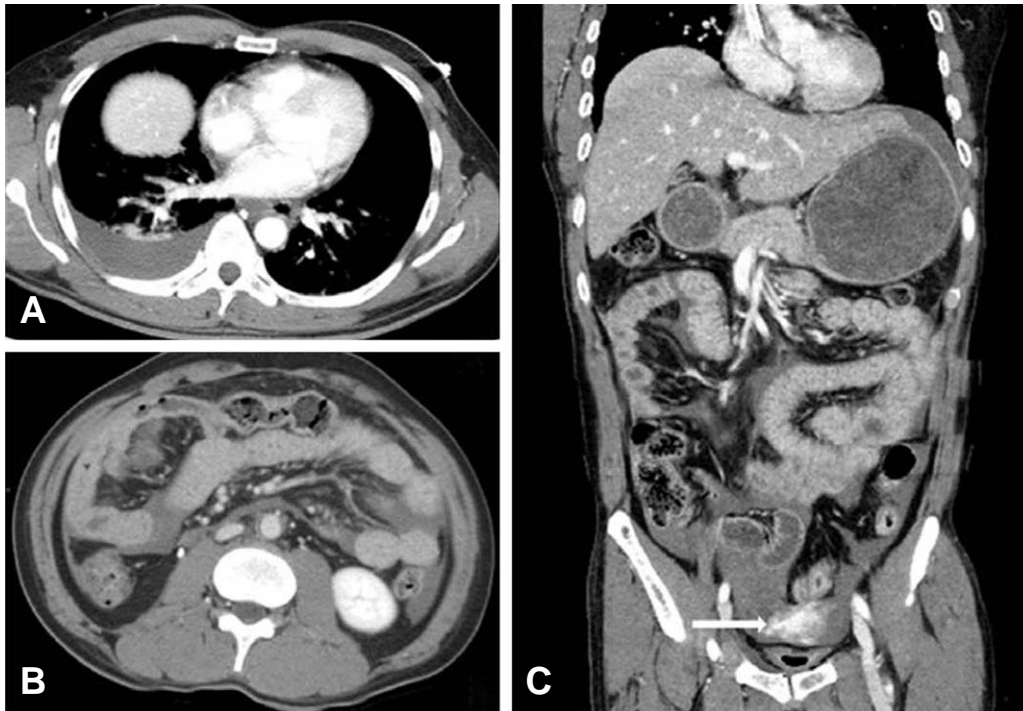


Fig. 1. Preoperative CT showing right hemothorax (A), hemoperitoneum (B), the arrow is extravasation of the contrast (C).

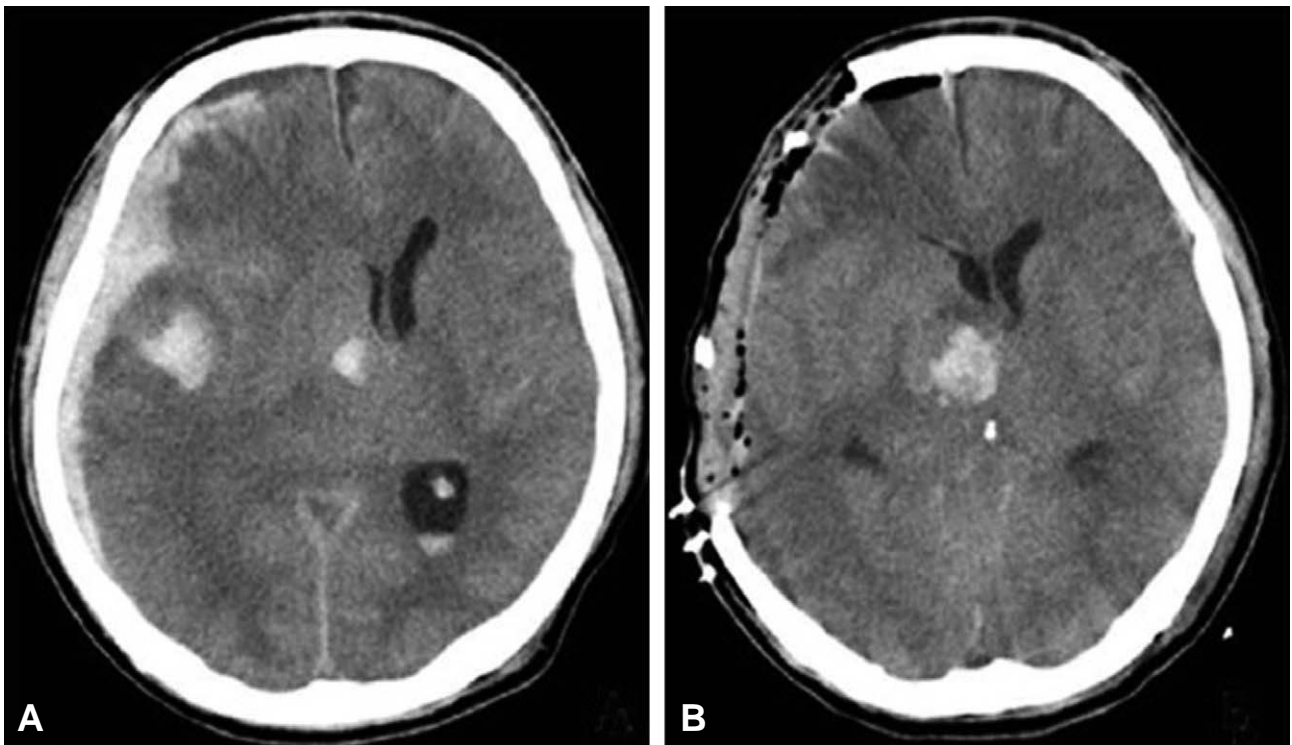


Fig. 2. Brain CT showing increased subdural hemorrhage, aggravated mid line shifting (A), after craniectomy, midline shift is decreased and subdural and intracranial hemorrhage is reduced (B).

fracture of the left scapula (Fig. 1). The abdomino-pelvic CT showed hemoperitoneum and right pelvic fracture (Young-Burgess vertical shear type). The hemoperitoneum prompted an immediate emergency laparotomy, during which a large volume of intraperitoneal blood was evacuated and bleeding from a lacerated mesenteric vessel 20 cm above the ileocecal valve was identified. The vessel was repaired and a partial bowel resection with end-to-end anastomosis was performed due to ischemia near the injured

vessel. The patient was moved to the intensive care unit postoperatively. His vital signs stabilized but he remained comatose, and on the following day, he required decompression by craniectomy and evacuation of intracranial hematoma due to spreading cerebral contusion and aggravated midline shift on follow-up brain CT (Fig. 2). The signs of increased intracranial pressure were improved on the postoperative follow-up CT (Fig. 2). But the patient remained comatose and required continued ventilator support

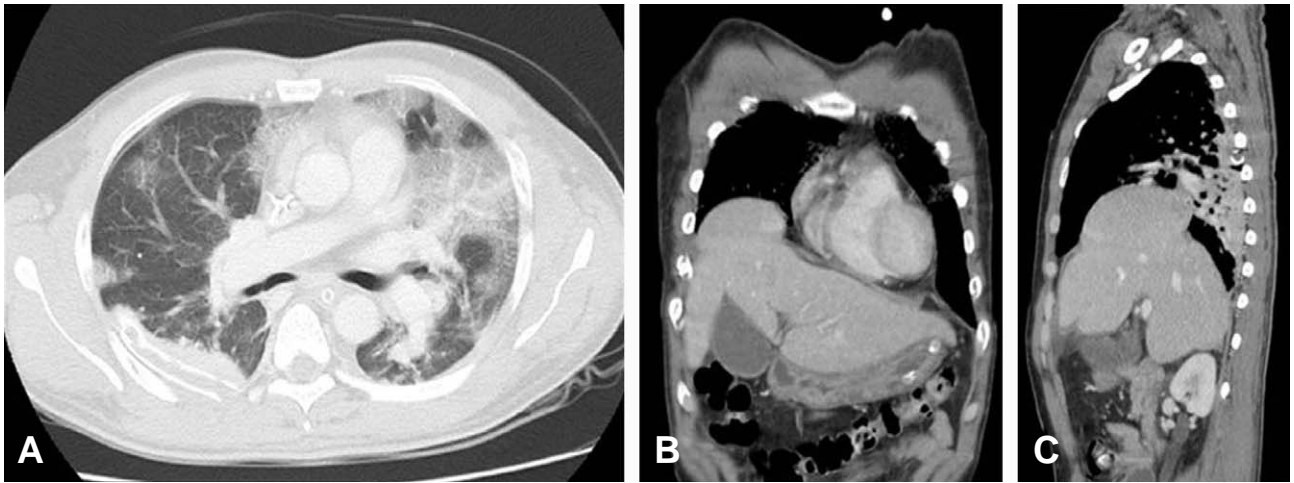


Fig. 3. Chest CT showing aggravation of bilateral pneumonia (A), on coronal (B) and sagittal (C) views, the chest CT shows rupture of the right hemi-diaphragm.

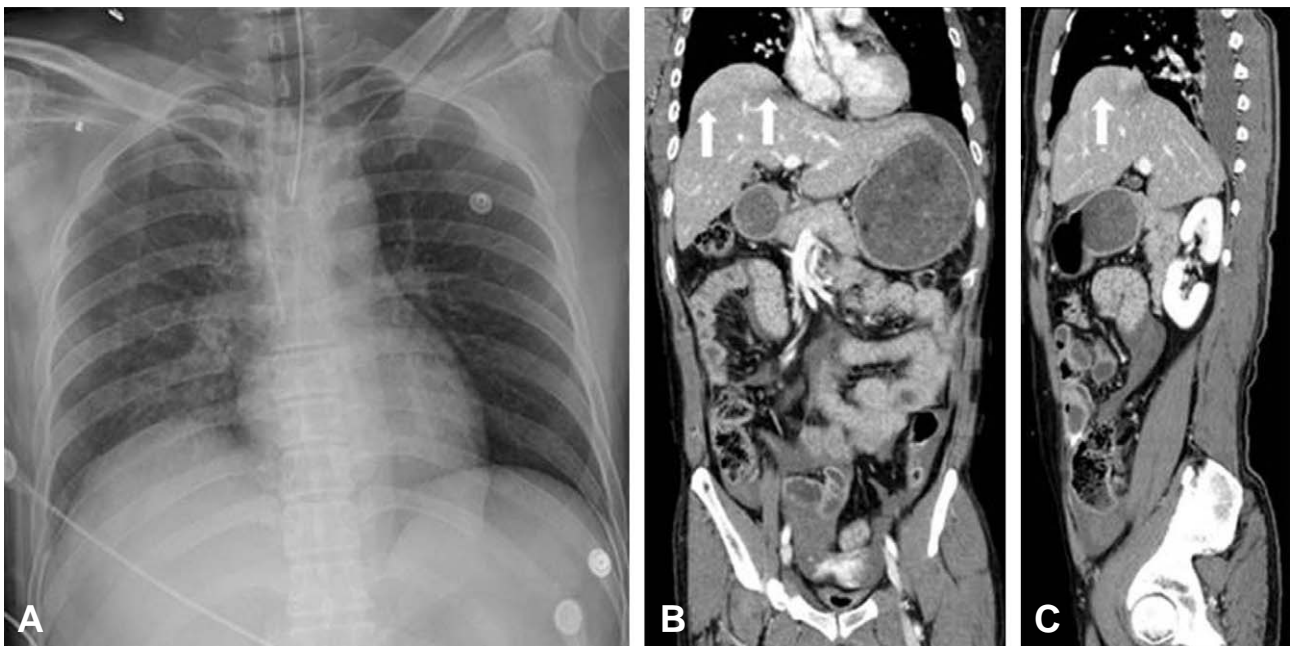


Fig. 4. Anterolateral chest x-ray at admission (A), abdominal CT showing suspected rupture (arrows) of the right hemi-diaphragm on sagittal (B) and coronal (C) views.

and symptomatic treatment in the intensive care unit. Imaging studies on the sixth hospital day were indicative of severe herniation of abdominal viscera through the right hemi-diaphragm and the patient had progressively worsening hypoxia. A chest CT on the seventh day of admission showed progressive bilateral pneumonia and was also highly suggestive of rupture of the diaphragm (Fig. 3). There was some doubt when compared with chest radiograph and CT from admission (Fig. 4), but it could be assumed that some slight herniation may have been overlooked, particularly in light of the patient's initial condition and the severity of his other injuries.

Rupture of the diaphragm was confirmed by diagnostic thoracoscopy. An oblique tear of the diaphragm approximately 11cm was seen extending from the vicinity of the inferior vena cava to the anterolateral thoracic wall. We chose to perform open thoracotomy because thoracoscopic repair of the diaphragm is difficult, and we were concerned about the risk of injury to the patient's heart. The liver was reduced into the abdominal cavity through the defect in the diaphragm without difficulty and the rupture was then repaired using interrupted 1-0 polypropylene sutures. Suturing was completed under bilateral lung ventilation because the patient was not maintaining adequate oxygen saturation. After surgery, the patient returned to the intensive care unit, and intensive ventilator therapy and pneumonia treatments were given along with symptom management. Elevation of the right hemi-diaphragm was resolved after the operation, and the patient's respiration improved. He remained in a coma and continued to require mechanical ventilation, and a tracheostomy was performed on hospital day 10, after which the patient's pneumonia began to improve, and mechanical ventilation was discontinued on hospital day 20.

The patient's scapular and pelvic fractures were treated conservatively and a fractured right fibula was treated by splint fixation. The patient's condition stabilized, although he remained in a coma, and he was moved to the ward on hospital day 30, and transferred to a hospital closer to his hometown for rehabilitation on day 241.

III. Discussion

Traumatic rupture of the diaphragm can be caused by blunt or penetrating thoracoabdominal trauma. Penetrating injury can cause direct damage to the diaphragm and blunt trauma can cause an abrupt increase in abdominal pressure, that is transferred to the diaphragm and causes diaphragmatic injury. The abdominal viscera herniate into the thorax through the injured diaphragm because the pressure in the chest cavity is lower than the normal abdominal pressure. The diaphragm is an important muscle of respiration, rupture of the diaphragm itself can cause breathing difficulties, which will be exacerbated by herniation of the abdominal viscera into the thoracic cavity and subsequent compression of the lung. Herniation of the abdominal viscera may also cause bowel obstruction and incarceration, or strangulation of the bowel. Thus a patient with a ruptured diaphragm may have a variety of signs and symptoms. Imaging findings and other signs and symptoms of ruptured diaphragm may not be apparent during initial examination, leading to delayed diagnosis and treatment.(4) If the rupture is small or a herniated viscus blocks the area, the rupture may be overlooked. If the herniation progresses, the diaphragmatic rupture may be discovered on subsequent imaging evaluation. Rupture of the diaphragm caused by blunt trauma usually occurs in association with multiple injuries, including thoracic injuries (>60%), intraabdominal injuries (64.1%), and head and pelvic injuries (50%).(5) Patients with rupture of the diaphragm after blunt trauma with multiple accompanying injuries have an estimated 14-30% mortality rate,(6,7) and ruptured diaphragm is initially overlooked in up to 12-15% of trauma patients because of the difficulty of early diagnosis and the presence of multiple accompanying injuries.(8,9) Rupture of the left hemi-diaphragm is reported 3 times more frequently than rupture of the right hemi-diaphragm because there is a known weak area on the left side of the diaphragm and because the liver absorbs a significant impact for the right diaphragm.(10)

In the present case the patient exhibited shock and required cardiopulmonary resuscitation followed by emergency laparotomy for hemoperitoneum. The

patient's condition was poor and repair of a hemorrhaging mesenteric vessel that was seen near the pelvic bone on abdominal CT was the top priority in the operating room (Fig. 1). It is regretful that the focus on hemostasis may have precluded immediate detection of the injury to the diaphragm.

Moreover, the patient had a cerebral hemorrhage that required decompressive craniectomy on the second hospital day after which he remained comatose. By the time surgery was performed to repair the diaphragm, the patient had bilateral pneumonia and significant respiratory compromise. It was not easy to distinguish the signs and symptoms of diaphragmatic rupture in the setting of the patient's overall condition.

From 2013 to 2015, 5 patients have undergone surgical repair of ruptured diaphragm due to blunt trauma at our hospital. With the exception of this case, all of the diaphragmatic ruptures were found on admission. The 5 patients had various accompanying injuries, but all of them had Young-Burgess vertical shear (VS) type pelvic fractures. (11) Vertical shear type pelvic fracture is characterized by severe instability of the pelvis and indicates that the patient has suffered an enormous impact. It is also thought to be associated with diaphragm rupture as a function of the direction of the force of impact that is delivered to the patient. Although it is hard to judge based on the small number of patients, it might be inferred that the mechanism of diaphragm rupture is associated with a direct rise in abdominal pressure associated with the impact of the pelvic fracture. The putative association between vertical shear pelvic fractures and rupture of the diaphragm will be further investigated in the future.

IV. Conclusion

Rupture of the right diaphragm can be easily overlooked and the diagnosis delayed, especially in unstable patients with multiple trauma or altered level of consciousness. The physician's suspicion is the most important diagnostic clue of the right hemi-diaphragm injury. One more search the diaphragm in patients with multiple trauma, particularly with pelvis fracture, even without thorax injuries.

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