

# Traumatic Diaphragmatic Hernia Associated with Pelvic Ring Fracture

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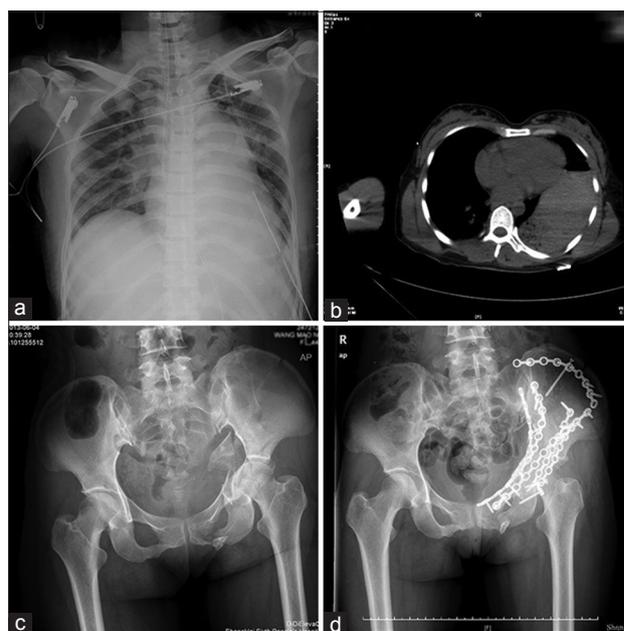
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**Key words:** Emergency Injury Control; Pelvic Ring Fracture; Pelvic Straps; Traumatic Diaphragmatic

Traumatic diaphragmatic hernia (TDH) is an uncommon injury and a marker of severe trauma. This injury is rarely associated with pelvic ring fracture, although TDH is one of the most dangerous comorbidities of such fractures. Since this condition is easily misdiagnosed in emergency cases, we reported two cases and analyzed the clinical symptoms, diagnosis, treatment, and outcome of this comorbidity. Based on these results, we recommended an appropriate method for diagnosis and treatment and proposed a contraindication in treating TDH associated with pelvic fracture.

A 44-year-old woman (case 1), who was injured in a suicide jump, was admitted into the emergency room in Shanghai Sixth People's Hospital. The patient had a closed wound and stable blood pressure (BP). The chief complaint was pain in the left hip and shoulder. A series of X-ray photographs was taken immediately. The chest radiograph showed there were no obvious abnormalities, but an increase in the area of the heart shadow was observed [Figure 1]. The pelvic ring had a type-B fracture according to Tile and AO classification and an acetabulum C1 fracture according to Judet and Letournel classification. Initially, attention was focused on the fracture site. Because of continuous left chest pain, a chest computerized tomography (CT) was performed and showed a very obvious diaphragmatic hernia, in which the stomach was pushed into the thoracic cavity, close to the pericardium. This explained why the heart shadow was larger in the chest radiograph. Then an emergency thoracic surgery was conducted to repair the hernia. Two weeks later, open reduction internal fixation (ORIF) surgery was performed successfully. The pelvic ring fracture was fixed in surgery. This patient began to walk 3 months after surgery and had no visible sign of leg length inequality or neurological symptoms.

A 65-year-old female patient (case 2) who was injured in a car accident was transferred to Shanghai Sixth People's Hospital 10 days after the event. The patient's pelvic ring had a type-B fracture according to Tile and AO classification and an acetabulum B1 fracture according to Judet and Letournel classification [Figure 2]. No abdominal or pectoral injury history had been observed by the physicians in the previous hospital, and only slight dyspnea was shown. The chief complaint was pain in the right hip and shoulder. After 2 days of preoperational preparation, the night before surgery, the patient developed severe respiratory failure that turned into



**Figure 1:** (a) The plain chest radiograph of Case 1 showed an increase in heart shadow; (b) The chest computed tomography radiograph of Case 1 showed the diaphragmatic hernia; (c) The plain pelvic radiograph before open reduction internal fixation (ORIF) surgery and (d) after ORIF surgery.

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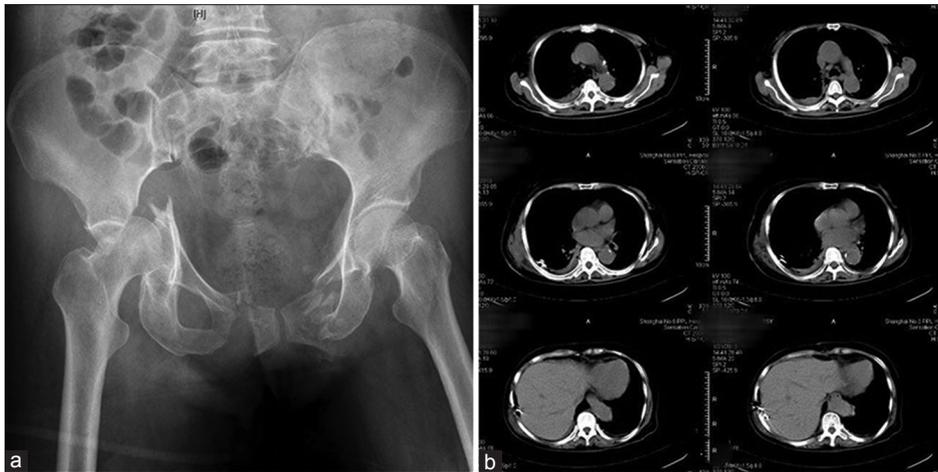


Website:  
www.cmj.org

DOI:  
10.4103/0366-6999.156149

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**Figure 2:** (a) The plain pelvic radiograph of Case 2; (b) The chest computed tomography radiograph of Case 2 showed the diaphragmatic hernia in the right side.

shock. Oxygen pressure of the patient's arterial blood fell to a level of 89.1 mmHg. Body temperature reached 41°C at one point, accompanied by slight peritoneal irritation. An upper abdominal CT scan showed a diaphragmatic hernia on the right side. This type of TDH might be more difficult to diagnose during the early period of trauma, potentially leading to progressive herniation of intra-abdominal contents into the thorax.<sup>[1]</sup> A part of the patient's liver was incarcerated in the hernia, which led to ischemia and delayed rupture. The thoracic and general surgeons conducted an emergency surgery immediately. After surgery, the patient remained in critical condition in an intensive care unit and was then transferred to Department of Thoracic Surgery for an extended period. Considering the unstable vital signs, internal fixation of multiple fracture (pelvic, acetabulum, proximal humerus, and scapula) was supposed to be very dangerous. When the patient physically recovered, the fracture was already partly united with deformity. We lost the best opportunity for ORIF surgery. The patient was discharged 4 weeks after thoracic surgery. Many sequelae remained, and the patient could barely to walk, nor could work. The range of motion in her shoulder was also poor.

When facing TDH, misdiagnosis frequently occurs. Reports from thoracic surgeons revealed that in polytraumatized patients, only 64%<sup>[2]</sup> of diaphragmatic ruptures were diagnosed in a timely fashion. Therefore, it is very important to understand this special comorbidity. An average of just one report per year was found regarding TDH associated with pelvic fracture. Blunt trauma was the primary injury mechanism. All reported cases were shown to occur with Type-B or Type-C fractures (rotational unstable, with or without vertical unstable). We speculated that the mechanism was violent squeezing that caused the intra-abdominal pressure to jump sharply and caused the diaphragm to rupture. This may hold true especially when the patient holds his/her breath and contracts the abdominal wall at the time of impact. Direct force is also a factor in this type of injury. Direct force from an impact against the side of the ribcage can cause a tear in the diaphragm rib attachments and rupture the diaphragm.

To diagnose this comorbidity correctly, both physical and imaging examinations are necessary.<sup>[3]</sup> A barium study, fluoroscopy, laparoscopy, ultrasound, and magnetic resonance imaging (MRI) can also be utilized for this purpose. The barium study is sensitive to gastrointestinal hernia while MRI has greater sensitivity to simple diaphragm injury with reducible hernia or even without hernia. Fluoroscopy can be used for evaluation of diaphragmatic motion with integrity. Examination and repair can be performed at same time under a laparoscope. In addition, the ultrasound test was designed for pregnant patients. Some authors have reported that the CT scan has the best sensitivity and specificity.<sup>[4]</sup> In the emergency room, a total-body CT scan is sometimes used to assess more severe patients. Once the TDH is correctly diagnosed, immediate control of hemorrhage by surgical or minimally invasive techniques, stabilization of pelvic ring, and inter-disciplinary cooperation are important for management and successful treatment. First, an emergency laparotomy for the diaphragmatic rupture and diaphragmatic hernia must be performed. Second, debridement and suturing of the open wound should be performed immediately. Third, selective open reduction and internal fixation of the fracture should be performed when vital signs are stable. Case 1 followed this diagnostic and therapeutic principle and achieved favorable outcomes.

Military antishock trousers (MAST), pelvic straps, patching, and packing have been widely used in pelvic fracture patients to control bleeding. These measures should be strictly forbidden in patients with TDH. Hemostatic effect was achieved through increasing intra-abdominal pressure.<sup>[5]</sup> With a rupture in the diaphragm, not only would the pressure increase in the pelvic cavity but also part of the abdominal organs might extrude into the thoracic cavity and cause pulmonary atelectasis. A number of studies have already proven this. When the pressure is released, the low abdominal pressure would extract the herniated organs back, which may cause incarceration. Therefore, these patients with pelvic fracture might be the only individuals

who cannot use the aforementioned measures to achieve stable BP. Furthermore, performing MRI in emergent cases is unrealistic, while fluoroscopy and CT scans have been shown to be insensitive to reducible diaphragmatic hernias. If dyspnea or chest pain occurs after compression on the pelvic ring, diaphragm injury should be suspected.

In conclusion, traumatic diaphragmatic hernia associated with pelvic fracture is dangerous and easily misdiagnosed. Delayed diagnosis and inappropriate treatments can cause serious consequences. Excluding TDH before using MAST, pelvic straps, and pelvic patching in a pelvic fracture patient, especially when the patient exhibits symptoms of chest pain and dyspnea, is always necessary. With early diagnosis, in time for surgical intervention and awareness of contraindications, the harm caused by TDH in pelvic fracture can be minimized to a very low level.

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**Received:** 24-09-2014 **Edited by:** Xin Chen

**How to cite this article:** Zhang Y, Cheng T, Gao H, Zhang XL. Traumatic Diaphragmatic Hernia Associated with Pelvic Ring Fracture. *Chin Med J* 2015;128:1272-4.

**Source of Support:** Nil. **Conflict of Interest:** None declared.