

Right Diaphragmatic Injury Accompanied by Herniation of the Liver: A Case Report

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Traumatic diaphragmatic injury (TDI) occurs in 1% of patients of blunt abdominal trauma. Most TDIs involve the left diaphragm, however the authors experienced TDI accompanied by a liver laceration of the right diaphragm. When detected early, TDI can be easily treated, however serious complications can occur if not. When diaphragmatic injury is suspected due to clinical manifestation, comprehensive analysis of the patient data including radiologic findings is important. [J Trauma Inj 2016; 29: 43-46]

Key Words: Diaphragmatic injury, Blunt abdominal trauma, Liver laceration

I. Introduction

Traumatic diaphragm injury (TDI) is a relatively rare injury, occurring in 0.5–1.6% of blunt abdominal trauma patients.(1) However the real incidence of TDI is thought to be higher because TDI patients without obvious symptoms or radiologic findings may not be diagnosed.(2)

When detected early, treatment of TDI is not difficult, however serious complications such as herniation or strangulation can occur if not.(2)

Blunt TDI is reported to involve mainly the left diaphragm (56–86%) and rarely the right diaphragm.(2) The authors experienced and report on a case of right diaphragmatic injury accompanied by herniation of the liver.

II. Case

A 57-year-old female patient was transported to the emergency room by ambulance after a pedestrian traffic accident. The patient's level of consciousness on arrival was semicomatose with spontaneous respiration. Vital signs were as follows: systolic blood pressure 50 mmHg, pulse rate 76, respiratory rate 16, and body temperature 36.2°C. No specific findings were detected on physical examination, except for abrasion of the right leg. Plain radiography of the chest showed that the right diaphragm was elevated (Fig. 1). Blood analysis (serum hemoglobin 7.6 g/dL, hematocrit 22.7%, serum platelet 209,000/mm³, prothrombin time 10.7 sec, and activated partial prothrombin time 28.4 sec) and arterial blood gas analysis (pH 7.32, pCO₂ 35 mmHg, PO₂ 89 mmHg, base excess -7.4 mmol/L, lactate 4.6 mmol/L, and oxygen saturation 96%) were checked.

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Blood chemistry test was within normal range except for elevated serum aspartate aminotransferase (300 U/L, AST) and serum alanine aminotransferase (234 U/L, ALT).

Hydration and blood transfusion was performed immediately and whole body computed tomography (CT) scanning was performed after establishment of hemodynamic stability. Traumatic subarachnoid hemorrhage of the brain, multiple right rib fractures with right lung concussion, and hemothorax was diagnosed after CT scan. Pelvic bone fracture and laceration of liver and spleen were observed on abdominal CT. Active bleeding was observed at the

left lateral sacral artery and left iliolumbar artery and no bleeding focus at liver or spleen was observed on angiography of the abdomen. The bleeding focuses were controlled by endovascular embolization. The patient showed stable vital signs and was observed in the intensive care unit. Serum AST and ALT were elevated to 566 U/L and 510 U/L immediately after embolization therapy, but soon became gradually normalized. CT scan performed on the sixth hospital day showed that the right diaphragmatic herniation had become more remarkable (Fig. 2). The patient was still intubated and mechanical ventilation with pressure controlled mode was ongoing. Oxygen saturation and partial pressure were measured at 90% and 60 mmHg under 80% fraction of inspired oxygen (FiO₂). Although surgery for diaphragmatic herniation had been planned, the patient was transferred to another hospital in her hometown.



Fig. 1. The initial chest radiograph shows an elevated Rt. Hemidiaphragm.

III. Discussion

TDI can occur by both penetrative and blunt trauma. Particularly in blunt trauma, strong external force may cause increased abdominal pressure and sequential excessive tension of the diaphragm, which can result in TDI.(3)

According to the National Trauma Data Bank (NTDB) of the United States, prevalence of TDI in 2012 was 0.46% (3,873 patients in 883,309 popula-



Fig. 2. Follow-up CT shows a more prominent hepatic herniation (White star), and a "Band sign" in the axial section (White arrow).

tion).(4) In a study on TDI, 42% of TDI caused by blunt trauma was diagnosed after laparotomy surgery and many cases of TDI may be undiagnosed.(5)

Misdiagnosis or delayed diagnosis of TDI is more frequent in TDI induced by blunt trauma than by penetration injury, because physicians suspect TDI when there is a penetration injury and a higher proportion of patients with penetration injury undergo laparotomy surgery compared with blunt trauma patients. Blunt TDI generally occurs by high energy impaction, thus diagnosis of TDI may be missed because of other severe injuries accompanying TDI in blunt trauma patients. However the most significant factors making diagnosis of TDI difficult are non-specific and ambiguous symptoms and radiologic findings, and many patients with TDI are unconscious.(2)

TDI occurs mainly on the left side, probably because the left diaphragm has weaker anatomical structure than the right side and the location of the liver near the right abdomen prevents injury of the diaphragm.(2) Incidence of right TDI is lower than that for the left, with a high rate of missing the diagnosis in up to 40%.(6) Because the location of the liver just below diaphragm prevents bowel herniation the image diagnosis is difficult. And massive effusion, hemothorax may conceal the TDI.(7)

Patients with right TDI had lower Glasgow Coma Scale scores, and were more likely to be initially in hypovolemic shock.(8) Thus in many cases the initial symptoms are unknown. In physical examinations, silence or bowel sound can be auscultated from the chest.(2,4) Diaphragmatic herniation should also be suspected in patients with hypoxia which is not easily corrected by mechanical ventilation.(9)

Imaging study confirmed the diagnosis of TDI. Simple chest radiography is usually used for initial examination for trauma patients, but 20–50% of TDI patients have normal chest radiography initially.(10,11) In particular, the diagnosis rate for right TDI is lower with simple x-ray. Left and right TDI were diagnosed from chest x-ray in 37% and 0% of cases.(8) Using simple x-ray, non-specific abnormal findings such as blurring or irregularity of diaphragmatic shadow, elevation of unilateral

diaphragm, hydrothorax, and atelectasis may be observed in TDI patients.

Multi-detector computed tomography (MDCT) is important for diagnosis of TDI, because simple radiography shows many of the non-specific findings mentioned above.(9) MDCT shows accuracy of 95%, particularly when there is accompanying diaphragmatic herniation.(2) According to a recent study, accuracy of MDCT in diagnosis of TDI was 97% in blunt injury and 65.7% in penetrative injury.(12) Relatively low accuracy of MDCT in penetrative injury suggests that the size of the diaphragmatic defect is small and frequency of visceral herniation is low in penetrative injury. Findings suggesting TDI in MDCT are as follows.(9)

Discontinuity of diaphragmatic profile/Segmental non-recognition of the diaphragm

Intrathoracic visceral herniation

Collar sign (entanglement of a herniated organ at a diaphragmatic defect which looks like neck strangulation)

Hump sign (finding that part of the liver looks like a hump when part of the liver is herniated)

Band sign (finding that the diaphragm looks like a relatively radiolucent band at the herniated region)

Dependent viscera sign (absence of costophrenic sulcus that normally appears as the visceral organs are herniated above the diaphragm)

Thickening of the diaphragm (finding looks like diaphragmatic thickening, caused by traction of the diaphragm to the lateral side)

Dangling sign (finding of appearance of a comma-shape after entanglement of a torn diaphragm)

Diagnosis rate of TDI without diaphragmatic herniation is significantly lower compared with that of TDI with diaphragmatic herniation.(2,9,13) In right TDI, after chest tube drainage due to pleural effusion or hemothorax, the resultant negative intrathoracic pressure gradient would have caused hepatothorax and it was detected on repeat CT scan.(7)

The goal of treatment of TDI is reduction of herniated organs and repair of diaphragmatic injury.(2, 9,13) In general, laparotomy through midline incision is advantageous in blunt TDI because accompanying abdominal injury should be verified and reduction of herniated organs is easy with laparotomy.

my. For right TDI, the liver was more likely to be injured and adhesions may form between margins of ruptured diaphragm and liver. Repair of a right side defect is technically difficult by laparotomy, which requires mobilization of friable liver. Therefore open thoracotomy is considered a convenient approach for repair if there is no associated injury of bowel.(7)

The prognosis of TDI patients depends on accompanying injuries rather than TDI itself.(2) Mortality of TDI patients is variously reported as 18–40%.

Diagnosis of right diaphragmatic rupture is difficult in trauma patients, however a high index of suspicion with appropriate use of serial radiological modalities is helpful in reaching an accurate diagnosis.

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