Rupture of the diaphragm and pericardium with cardiac herniation after blunt chest trauma

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Abstract A 61-year-old man was transferred to our institution because of blunt chest trauma after accidentally falling. A chest roentgenogram (CXR) and computed tomography (CT) revealed bilateral hemopneumothorax and fractures of multiple left ribs, the pelvis, and the left femur. On the second day in hospital, the patient suddenly complained of dyspnea. Emergency CXR and CT revealed elevation of the left diaphragm, suggestive of a traumatic diaphragmatic hernia; emergency surgery was performed. We confirmed rupture of the diaphragm and pericardium with cardiac herniation: the pleural pericardium and diaphragm were torn individually, and the heart and abdominal organs had herniated into the pleural cavity. They were repaired, and there were no cardiopulmonary complications during or after the operation. Pericardiodiaphragmatic rupture with cardiac herniation after multiple blunt traumas is rare. We describe the successful treatment of a diaphragmatic and pericardial rupture with cardiac herniation, with special reference to pericardial injuries.

Key words Blunt chest trauma · Cardiac herniation · Diaphragm rupture · Pericardial rupture

Introduction

Pericardiodiaphragmatic rupture with cardiac herniation after multiple blunt trauma is rare.1 We have researched the term “pericardiodiaphragmatic rupture” in the literature and found that it is often confused. Strictly, this injury is divided into two patterns. First, the pleural pericardium and diaphragm are torn individually, and the heart and abdominal organs herniate into the pleural cavity. Second, the diaphragmatic pericardium is torn, and the abdominal organs herniate directly into the pericardial sac. The patient described here exhibited the first pattern. Only one similar case has been reported in the English-language literature.2 Here, we describe the successful treatment of a diaphragmatic and pericardial rupture with cardiac herniation, with special reference to pericardial injuries.

Case

A previously healthy 61-year-old man suffered blunt chest trauma after accidentally falling 5 m in the workplace. The next day, the patient was transferred to our institution after initial resuscitation at another hospital. Upon arrival, the patient was conscious, was hemodynamically stable, and had a normal Glasgow Coma Score. His heart rate was 123 beats/min, and his blood pressure was 113/78 mmHg. His respiratory rate was 20 breaths/min, and his oxygen saturation was 99% percent under 10 l of oxygen delivered by a face mask. Laboratory data were as follows: white blood cell (WBC) count 8400/μl; hemoglobin 12.3 g/dl; C-reactive protein (CRP) 21.9 mg/dl.

Electrocardiography demonstrated a nonspecific ST-T elevation in the total chest lead but no ischemic symptoms. Echocardiography showed no sign of cardiac injury or tamponade. A chest roentgenogram (CXR) and computed tomography (CT) revealed bilateral...
hemopneumothorax and fractures of multiple left ribs (Fig. 1A,B), the pelvis, and left femur. Subsequently, we performed chest tube drainage to the bilateral thorax and direct traction of the femur. After hospitalization, the patient’s vital signs were stable. However, on the second day in hospital, the patient suddenly complained of dyspnea. Emergency CXR and CT revealed elevation of the left diaphragm (Fig. 1C,D), suggestive of a traumatic diaphragmatic hernia. Emergency surgery was planned.

The patient was placed in the right lateral decubitus position. The left thorax was entered through a lateral thoracotomy in the fifth intercostal space. Abdominal organs had herniated into the thoracic cavity (Fig. 2A) but were undamaged. We repositioned the organs and found that the left hemi-diaphragm had developed a C-shaped tear in its attachment region to the lateral thoracic wall (Fig. 2B,C). The heart was prolapsed into the left pleural cavity (Fig. 2D), but there was no strangulation of the heart. We confirmed that the pericardium was torn longitudinally, extending the entire length of the left pleural pericardium (Fig. 2E). However, the left phrenic nerve, heart, and lung were intact. The heart was repositioned, and the pericardial rupture was repaired with interrupted sutures (3-0 nonabsorbable filament) and a surgical fabric (Bard Sauvage Filamentous Fabric; Bard Peripheral Vascular, Tempe, AZ, USA) because the pericardium was shriveled and its edges could not be connected (Fig. 2F). Next, the diaphragmatic rupture was repaired with mattress sutures using 1-0 non-absorbable filament. The sixth and seventh fractured ribs were fixed with titanium steel plates (Reconstruction Plate; Bestmedical, Saitama, Japan) and a poly-L-lactide rod (Super Fixsorb; Takiron, Osaka, Japan). The total operating time was 6 h 45 min, and blood loss was 419 g. Four units of red blood cells were transfused because anemia had preoperatively progressed to a hemoglobin level of 9.9 g/dl.

The Head and Neck Abbreviated Injury Scale score was 0 (face 0; chest 5; abdomen 0; extremities 3; skin 1). The Injury Severity Score was 26. The endotracheal and chest tubes were removed on postoperative days (PODs) 1 and 3, respectively. No cardiopulmonary complication occurred during or after the operation. Minor pleural and pericardial effusions were observed a few days later but did not require drainage. The patient was transferred to the orthopedic department on POD 22.

Discussion

A pericardial and diaphragmatic rupture following blunt chest trauma is caused by direct contusion of the trunk, sometimes by deceleration. More specifically, rupture

![Fig. 1 A, B Upon arrival, a chest roentgenogram (A) and computed tomography (CT) (B) revealed bilateral hemopneumothorax and fractures of multiple left ribs (the first to the tenth). Two chest tubes were placed in the bilateral thorax, and the left lower lobe is clearly collapsed. C, D On the second day in hospital, a roentgenographic image (C) shows abnormal air patterns in the left thoracic cavity and elevation of the left diaphragm without cardiac tamponade. D CT image. The heart shows some rotation and displacement to the right side.](image-url)