

A Diaphragmatic Hernia and Pericardial Rupture Caused by Blunt Injury of the Chest: A Case Review

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ABSTRACT

Blunt traumatic diaphragmatic hernias are most commonly seen in combination with other injuries. Right diaphragmatic ruptures with serious pericardium ruptures are relatively rare. The diagnosis of diaphragmatic hernias is not difficult; however, prior to surgery, it is difficult to judge whether pericardium damage has occurred, particularly on the right side. This injury may occur in a critical pathological state in which cardiac tissue is outside the pericardium due to the pericardial defect. Severe hemodynamic disorders or even death may occur if the patient's condition is not diagnosed and treated in a timely manner. The transportation of patients with severe trauma must be performed with extreme caution. It is necessary to weigh a wide range of differential diagnoses in a serious and thorough initial investigation.

Key Words

Blunt chest trauma, Diaphragm rupture, Pericardial rupture

Blunt traumatic diaphragmatic hernias are most commonly seen in combination with other injuries and usually occur on the left side of the body. Right diaphragmatic ruptures with serious pericardium ruptures are relatively rare. Diagnosis of diaphragmatic hernia is not difficult; however, prior to surgery, it is difficult to judge whether pericardium damage has occurred, particularly on the right side. This case review aimed to describe a hospitalized patient with multiple injuries associated with right diaphragmatic hernia, accompanied by

a rare and difficult diagnosis of pericardial injury, and the literature related to diaphragmatic hernia.

CASE REVIEW

A 44-year-old man presented to our hospital 5 hr after falling from a height of 3 m at work. Radiographs and computed tomographic (CT) scans showed a fifth lumbar vertebral burst fracture, left iliac fracture, left sacroiliac joint rupture, and left hemopneumothorax, with pulmonary contusions. Following admission to the hospital, blood transfusion and fluid infusion were initiated, and thoracic closed drainage was conducted on the left side. Four days after hospitalization, the patient suddenly complained of dyspnea, which was associated with a decrease in blood pressure. He was therefore moved to the intensive care unit (ICU). While being transported to the ICU, the patient went into cardiac arrest. We immediately started cardiac compressions, performed tracheal intubation, and initiated ventilator-assisted breathing. After 20 min of cardiopulmonary resuscitation with active resistance to shock and ventilator therapy, heart function recovered. The patient regained consciousness and his vital signs stabilized. Two days later, a review of his chest radiographs revealed right diaphragm elevation and a visibly improved left hemopneumothorax. A review chest CT scan and a magnetic resonance image showed that the right lung was compressed significantly and the transverse colon appeared in the right chest cavity (Figures 1 and 2). Three weeks later, we performed right exploratory thoracotomy under general anesthesia, with the patient placed in the left lateral decubitus position. The right thorax was entered via lateral thoracotomy in the seventh intercostal space. We found that the transverse colon and liver had herniated into the thoracic cavity but were undamaged. We repositioned the organs and found a tear of approximately 18 cm in the right diaphragm (Figure 3), and there were greater omentum and diaphragmatic adhesions, with consolidation in the right lower portion of the lung. The surgeons found a tear in the left pericardium of approximately 12 cm long; thus, the heart was exposed in the chest cavity (Figure 4). The adhesions were separated and the transverse colon drawn into the abdominal cavity. The diaphragm was then repaired, followed by suture of the pericardium

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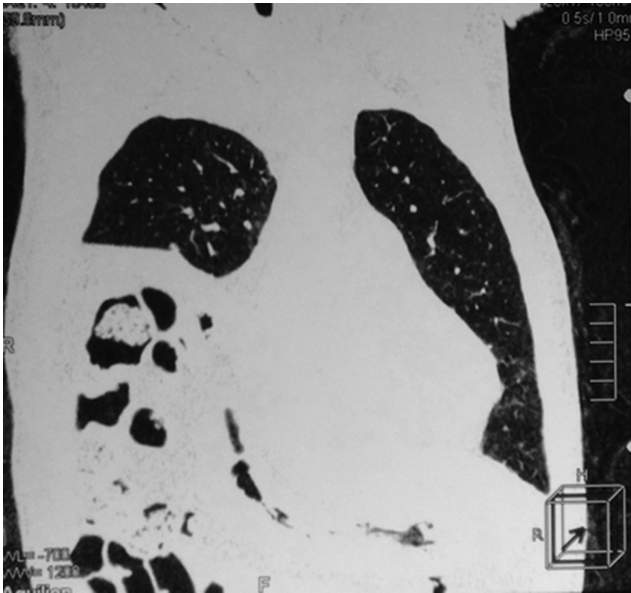


Figure 1. Computed tomography shows that the right lung is significantly compressed and that the transverse colon appears in the right chest cavity.

(Figure 5). Postoperative gastrointestinal decompression and rehydration therapy were performed. Postoperative chest radiographs showed a normal diaphragm position and right lower lung atelectasis. After 15 days of postoperative rehabilitation, the patient was discharged from the hospital.

Pathophysiology

Because of the movement of the diaphragm and its unique function and anatomical features, diaphragmatic injuries tend not to occur in isolation. Meyers and McCabe (1993) reported that 40% of patients with blunt diaphragmatic injuries present with a pelvic fracture, 25%



Figure 2. Computed tomographic scan shows the liver has herniated into the thoracic cavity.



Figure 3. Surgical exploration of the thoracic cavity shows that the liver has visibly herniated into the chest.

with liver and spleen injuries, and 5% with thoracic aortic injuries. Most blunt traumatic diaphragmatic hernias are caused by strong indirect violence. On the right side, the diaphragm can be temporarily closed because of the presence of the liver. Often, this is mistaken for right diaphragm elevation, lung contusion or consolidation, and pleural effusion. Blunt trauma diaphragmatic hernias are often associated with complex injuries and are easy to misdiagnose. A diagnosis of pericardial laceration should not be made prior to surgery.

Radiography

Right blunt traumatic diaphragmatic hernias have no characteristic appearance, and various laboratory examinations are required to make a diagnosis. Spiral CT three-dimensional reconstruction imaging and magnetic resonance imaging are helpful to display the diaphragm to determine its continuity. In addition, they can determine

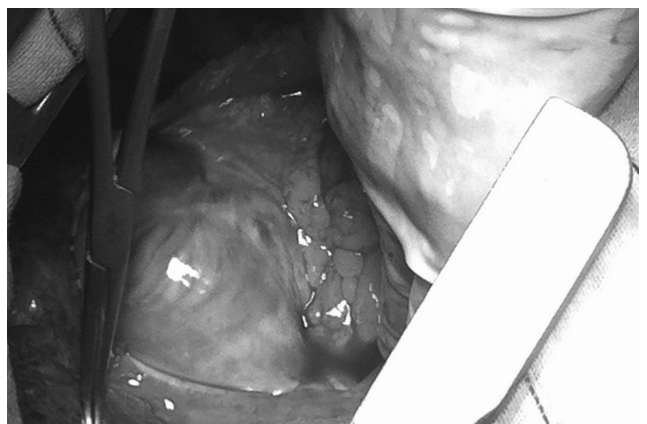


Figure 4. Pericardium tear of approximately 15 cm. The heart is exposed in the chest cavity.



Figure 5. Pericardium and diaphragm after completion of the repair.

the change of the position of the abdominal viscera. However, following considerable research, Perry (1970) found that the spiral CT has no sufficient effect on the diagnosis of acute diaphragmatic injury. With the development of minimally invasive techniques, laparoscopy and thoracoscopy are being increasingly used for the diagnosis and treatment of diaphragmatic hernias.

Treatment

Ivatury, Simon, Weksler, Bayard, and Stahl (1992) studied 40 patients with chest and upper abdominal sharp injuries; using laparoscopic techniques, the investigators suggested that the accuracy of thoracic and laparoscopic diagnoses of diaphragmatic ruptures was very high. If such technology is available and the patient's situation allows, early application of thoracoscopy is recommended. The thoracoscope can not only remove the pleural effusion but can also observe whether the abdominal viscera have entered the thoracic cavity. Laparoscopic techniques allow for clear diagnosis and treatment; they can also be used for the repairs of lung tears, diaphragmatic injuries, and other injuries.

The diaphragm muscle moves continuously with breathing. Thus, an initially small diaphragm injury will progress to a larger gap if not promptly treated, resulting in a complete or incomplete hernia of the abdominal contents, which can affect heart and lung function. Therefore, diaphragm muscle injuries, regardless of size, are unable to self-heal. Early surgical repair is relatively simple; as

time progresses, diaphragmatic retraction or atrophy occurs in combination with adhesion formation, making delayed repair relatively difficult. Surgery must therefore be carried out as soon as a diaphragmatic hernia is diagnosed. However, such patients often have serious associated injuries. First, treatment of these life-threatening injuries is commonly required; thereafter, surgery can be performed when the patient's condition has stabilized. The main aim of the operation is to return the abdominal organs to the correct position and to repair the lacerations to the diaphragm. This is achieved by using absorbable, horizontal, or discontinuous overlapping full layer sutures, and sufficient time is required to complete the repair. After the separation of adhesions, repairs generally do not require artificial materials. However, if pericardium contracture occurs, the use of mesh repair is inevitable.

For traumatic diaphragmatic hernias with pericardial ruptures, preoperative radiographs, CT scans, ultrasound scans, and other tests are not sufficiently specific and diagnosis can only be made intraoperatively. After completion of the pericardial patch, a cardiophrenic angle retention gap of 2 cm should be retained for adequate postoperative pericardial drainage to prevent cardiac tamponade.

In 2008, Hanna, Ferri, Fata, Razek, and Mulder reviewed 105 cases of diaphragmatic injury and found an overall mortality rate of 18%. With an increase in natural disasters and accidents, blunt traumatic diaphragmatic hernia incidence will continue to increase and those managing trauma injuries must be alert to the possibility of pericardial injury. Careful exploration and early surgical repair will improve the cure rate and sequentially reduce mortality.

NURSING CONSIDERATIONS

For multiple injuries, rapid assessment and intervention should be made. As a result of the force required to generate a heart injury, the patient might have other significant life-threatening injuries. A timely primary survey can help identify these injuries and guide interventions.

It is essential to fully prepare before the operation; the nurse should be prepared to obtain large-bore intravenous access, initiate controlled fluid resuscitation, and facilitate diagnostic imaging. Continuous monitoring of cardiac rhythm, vital signs, mentation, and urine output should also be done so that the nurse can evaluate the patient's response to the interventions and identify changes in his or her clinical conditions. The nurse should also be prepared to rapidly transfer the patient to surgery or, if necessary, a facility that can provide a higher level of care. Gastrointestinal decompression tubes should be prepared along with other tools, and the gastric contents should be sucked out and decompressed as much as possible before operation, to avoid vomiting or aspiration during anesthesia.

Most of the patients with traumatic diaphragmatic injuries and diaphragmatic hernias suffer from ill conditions, multiple injuries, and progressive dyspnea. Most patients have tension, fear, and some experience suffocation; it is possible to increase the patient's tension and fear with the preoperative preparation. Therefore, nurses should be accurate and gentle in their preparatory actions. In addition, necessary psychological counseling will be beneficial for the early recovery of the patients.

Following the operation, the nurse should closely monitor the output of the heart. Effective blood pressure management can improve the patient's prognosis. Because this injury is accompanied by lung contusion, acute lung injury and acute respiratory distress syndrome are common.

Patients with injuries of the diaphragm and with diaphragmatic hernias generally have various catheters; strengthened nursing services will assist in maintaining catheter patency and ensuring accurate observation and proper fluid drainage. This is particularly the case for the strict aseptic technique for the catheter, which is used to reduce the frequency of complications and improve the cure rate. A thoracic closed drainage tube with a flow rate of more than 100 ml/hr suggests that there may be active bleeding in the chest and should be promptly reported to the doctor for treatment.

Nurses should also be prepared for significant patient and family education needs. Patients with multiple injuries tend to be young, so long-term surgical durability is a concern. Routine, timely follow-up is necessary to ensure the injury does not progress (Weigang et al., 2008).

Patients impacted by these conditions have significant alterations in their daily life. Those suffering from multiple injuries are twice as likely to experience significant functional disability (feeding, locomotion, and expression) as those with head or abdominal trauma. They are also less likely to be fully independent. One study showed that only 19% of patients were fully independent in all three functional categories (Arthurs et al., 2009). Therefore, the

patient and his or her family may need significant support and resources to prepare for life after discharge.

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KEY POINTS

- Pericardial rupture attributable to blunt injury is not common.
- This injury may occur in a critical pathological state in which cardiac tissue is outside the pericardium due to the pericardial defect. Severe hemodynamic disorders or even death may occur if the patient's condition is not diagnosed and treated in a timely manner.
- Patients with severe trauma must be transported with great caution. It is therefore necessary to weigh a wide range of differential diagnoses as part of a serious and thorough initial investigation.

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