Delayed diagnosis of a right-sided traumatic diaphragmatic rupture

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Abstract

Right-sided traumatic diaphragmatic rupture in childhood is a very rare injury. Diaphragmatic rupture often manifests itself later, after an organ progressively herniates into the pleural cavity. When the patient is tubed, the ventilation pressure does not allow herniation of an organ, which occurs when the patient is ex-tubed. We present a patient with a delayed diagnose of right sided diaphragmatic rupture with a complicated post-operation state.

Introduction

Diaphragmatic rupture is a very rare injury, which occurs in less than 2% of all blunt injuries to the abdominal area.[1] Injury to the diaphragm is most commonly caused by a sudden change in intra-abdominal pressure, most commonly by a blunt blow to the abdominal area. Another cause of diaphragmatic rupture is sudden decelaration, when abdominal organs continue movement due to inertia, and tear through the diaphragm. Diaphragmatic rupture often manifests itself later than other injuries, after an organ progressively herniates into the pleural cavity. We present a patient with a delayed diagnose of right sided diaphragmatic rupture with a complicated post-operation state.

Case Report

A 11-year-old boy, 35 kg, was involved in a car crash, as the nearside passanger. He was admitted to the Intensive care unit, where he was intubated and ventilated. The patient was hemodynamically stable. Computed tompgraphy (CT) of the chest and abdomen showed a subcapsular liver hematom, right lung contusion and a minor hemothorax. The patient also had a right femur diaphysis fracture, which was resolved by external fixation, and a right acetabulum fracture without dislocation. On the second post-traumatic day, 1 hour after transfering to spontaneous ventilation, the patient underwent a breathing distress. A X-ray and CT of the chest was carried out (Figure 1), with the find of thoracicaly herniated liver. A operational revision was indicated. A right sided, subcostal laparotomy was carried out, where the liver was found to be completely herniated intrathoracicaly. The liver was herniated into the chest through a 15 cm diaphragm rupture, like a button through a buttonhole (Figure 2). A suture of the defect was carried out by seperate matress sutures (3-0 Ethibond). The patient was extubated after 24 hours. Due to dyspnoea, and a fluidothorax in the right pleuric cavity, the patient was tubed again, a pleuric drain was also applied. At the 7th post-traumatic day, the drain was removed. Atelectasis of the bottom right lobe was prevelant. 9th post-traumatic day, a CT was carried out and a thoracoscopic surgery, with the goal of aspirating the fluidothorax and placement of a right side thoracic drain, indicated. After this, the ventilation improved and the patient was extubated on the 14th post-traumatic day. The thoracic drain was removed on the 18th post-traumatic day. The following development was without complication. The patient was released on the 23rd post-traumatic day. No complications were found during the following check ups.

Discussion

The diaphragm is a flat muscle. The edges of the muscle are fuller than the middle area, which is made up from a thin aponeurosis called centrum tendineum. Diaphragmatic ruptures occur mostly in the dorsolateral part. Left-sided ruptures of the diaphragm are described in up to 70% of all cases. Left-sided ruptures can result in a herniated stomach, small intestine, colon, spleen and omentum. Right-sided diaphragm ruptures, occuring in 30% of all cases, result in the herniation of the liver. The reason for this in-equality is that the right side of the diaphragm is, in a way, protected by the liver. However, if a rupture to the right side does occur, it often results in serious or even fatal injury. A right sided diaphragm rupture is often complicated by damage to blood vessels, most commonly vena cava inferion, the hepatic veins can also be damaged. Both-sided injury to diaphragm occurs in only 2% of all diaphragm injuries.[2]

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Diaphragmatic injury has a high morbidity and mortality rate. Diaphragm injuries are most commonly accompanied by fractures of the pelvis, damage to the spleen, rib fracture, damage of the liver, contusion or rippage of a lung.[3] Our patient, in adition to a ruptured diaphragm, had a brain comotion, right lung contusion, subcapsular liver hematom, dislocated right femur fracture and a right acetabulum fracture, without dislocation. With comparison to adult patients, we find a larger number of isolated diaphragm ruptures amongst children. In larger scales of patients, isolated injury occurs in roughly 50% of all cases of injured children,[4] and in 20% off all cases of injured adults.[5] The difference is caused by higher elasticity in childrens tissue. The injury is diagnosed more in boys than girls, largely due to the fact, that boys have a higher incident rate than girls.

Most common cause of diaphragm injury is a blunt injury in the abdominal area, often caused by traffic accidents, or falls from heights. In our country, we do not encounter penetrating wounds to the abdomen or chest in children. In north america, the number of stab and shot wounds is larger. At the Johns Hopkins Hospital in Baltimore, the number of patients with diaphragm injury was 14 over the span of 15 years, with 11 of these being a penetrating wound.[6] In Europe, the rate of diaphragm injury caused by a blunt blow is 80-100%.[7] In blunt injuries to the diaphragm, the laceration is of larger scale, in our case, the laceration was 15 cm long. This makes herniation of internal organs easier. In injuries caused by stabbing, the defect in the diaphragm ranges up to 2 cm, in this case, the most common herniation is that of the omentum, not of an internal organ. The danger of

herniation into smaller defects in the diaphragm is that of strangulation followed by the perforation of an organ. This danger, which occurs during herniation through smaller defects, is caused by pressure differences between thoracic and abdominal cavities, which is normally 2-10 mm Hg and during the Valsalvov manouver increases up to 100 mm Hg .

A diaphragmatic rupture can present itself immediately after injury, but more commonly, complications occur proggressively. When the patient is tubed, the ventilation pressure does not allow herniation of an organ, which occurs when the patient is extubated. Deterioration is typical after the patient is extubated. In our case, the rupture of the diaphragma was right sided, and the liver herniation occured after extubation of the patient.

Symptoms, found in patients with diaphragma injury are pain in the epigastrium, shoulder pain, respiratory problems, intestinal obstructions. During an examination of a patient with a small intestine herniation, we can hear peristaltic movement sound in the thorax. Only a very small number of patients manifest symptoms of a ruptured diaphragm relatively longer after the primary injury. These patients have only minor symptoms, which can, nevertheless, result in a herniation of an organ. In the case of chronic herniation with a late diagnose, the first symptom can be a partial intestinal obstruction.

Figure 1. Liver herniation intrathoracicaly (contrast enhanced computed tomography, coronal multi-planar reformatting).

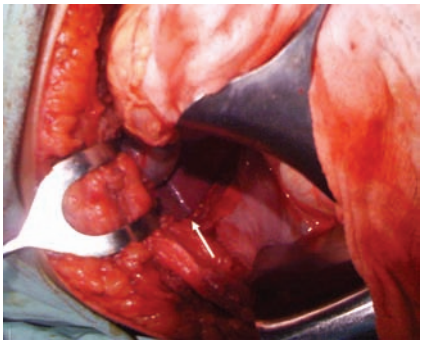

Figure 2. Defect in the diaphragma and herniated liver into the thoracic cavity.

Diagnostical methods, used to diagnose diaphragm ruptures are X-ray, ultrasound and CT. The basic method is X-ray, which shows elevation or decrease in sharpness of the diapghragm conture, occluded hemithorax caused by abdominal organs in the thoracic cavity, hemopneumothorax. Sometimes a X-ray of a stomach or colon herniation can be confused with a pneumothorax. When in doubt a passage through the digestive tract can help. Another used examination method is ultrasound, the advantages being non-invasivity and easy accesability. Another method is CT scanning, which shows organs herniated into the thoracic cavity. Hard to diagnose is a diaphragm rupture, that is not accompanied by herniated organs. In this case, a spiral CT is of use.

The treatment of diaphragmatic rupture is surgical. There are still multiple views on how to acces the diaphragmatic rupture. The most common access is through laparotomy (in 74%), thoracotomy (18%) and from thoracoabdominal access (8%).[8,9] Which access we choose, depends also on the accompanying injuries. The abdominal access is encouraged, because other organs in the abdominal cavity are often damaged too. In our case, we opted for the abdominal access. Suture of the diaphragma was without complications. However, it was difficult to repone the liver back into the abdominal cavity. The liver was herniated into the thoracical cavity through the diaphragma like a button through a buttonhole. Post-operational progress was complicated by atelectasis of the bottom right lobe and a fluidothorax, thoracoscopic revision was needed on the 9th post-operational day. In the University department in Mansoura, Egypt, where 44 patients with diaphragma rupture are placed, the thoracotomy access is prefered in 84%.[8] Thoracotomy acces is also encouraged at most departments in cases of older date, due to the possibility of adhesion in the thorax area. Now, laparoscopic or thoracoscopic access is gaining popularity and is being encouraged.[10] In our case, during laparoscopic revision, where the access was wide and the defect in the diaphragma well accessible, the reponation was difficult, because of the large difference between the size of the diaphragmatic defect and herniated liver. In this case, laparoscopic treatment would have been very difficult.

Other complications that can occur during diaphragmatic injury are pneumonia, empyem, subphrenical or intraabdominal absces, especially if a herniated organ is damaged. After injury to the diaphragm, good drainage of the thoracic and abdominal cavity is recommended.[9] During the injury, branches of the phrenical nerv can be damaged, causing partial denervation of the diaphragm, and lung complications. Therefore, after diaphragmatic injury, it is recommended that long-term follow up is established.

Conclusions

Traumatic rupture of the diaphragm is rare and diagnosis can be late in some cases. Diaphragmatic injury is masked by artificial lung ventilation. It is important to remember the possibility of this injury and always check the diaphragm for any signs of damage, when dealing with abdomenal injuries.

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