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Laparoscopic repair of posttraumatic diaphragmatic rupture. Report of three cases

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ABSTRACT

INTRODUCTION: Posttraumatic diaphragmatic rupture (PTDR) is a rare complication of thoracoabdominal injuries. In the emergency phase, it is generally treated via wide laparotomy. The laparoscopic approach is controversial and it is reserved for the chronic type of PTDR. Herein we present three cases of laparoscopic treatment of PTDR, one of which was conducted early after the injury.

PRESENTATION OF CASE: The patients' age was 42, 66 and 53 years and the time from the injury until the operation 1 week, 2 months and 4 years, respectively. Hernia involved the left hemidiaphragm in two patients and the right hemidiaphragm in the second patient. Prolapsing viscera were the omentum/stomach/spleen, the small intestine and the omentum/large bowel, respectively. The PTDR was diagnosed right after the injury of the first patient but its treatment was postponed until the fourth day of hospitalization because of severe respiratory distress due to bilateral pneumothorax, flail chest and extended bilateral lung contusions. All patients underwent laparoscopic operation and correction of the hernia with the use of non-absorbable sutures or endoclips in two patients. There were no serious intra- or postoperative complications and the patients were discharged 30, 5, 6 days after the operation. After a period of 1, 8 and 9 years, respectively the patients remain without clinical evidence of recurrence.

DISCUSSION: Trauma is the major cause of acquired diaphragmatic hernias.

CONCLUSION: Laparoscopy is an attractive approach for the management of chronic PTDR. Moreover, it may offer the benefits of minimally invasive surgery during the acute phase of injury in highly selected patients.

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1. Introduction

Post-traumatic diaphragmatic rupture (PTDR) has been well described after blunt (25%) or penetrating (75%) thoracoabdominal injuries. Traffic accidents that lead to non-penetrating traumas in lower chest or upper abdomen represent the main cause of diaphragmatic blunt injuries while injuries from knives, firearm or fractured ribs are mainly responsible for penetrating traumas. It has been reported that 1–7% of patients after major blunt thoracoabdominal trauma and 10–15% of patients with penetrating trauma will sustain diaphragmatic rupture.¹ It represents a finding in 8% of injured patients undergoing surgical exploration.² The rupture may

not be diagnosed during the initial hospitalization of the patient. Approximately 40–62% of the traumatic patients arrive delayed to the emergency department suffering from chronic diaphragmatic hernia. These patients usually present with obstructive symptoms, pain, nausea or pulmonary dysfunction.^{1,3}

Laparoscopy has been proposed as a rational alternative to open surgery for chronic PTDR. Regarding its role in the acute setting of blunt trauma there are controversial data. Herein, we present three patients who underwent laparoscopic treatment of PTDR, one of which was conducted early after the injury.

1.1. Case report #1

A 42 year old man presented to the ER with multiple injuries due to a car accident. He complained of chest pain, dyspnea and he was tachypnoic (35 breaths per minute) and febrile (38 °C). The physical examination and chest X-ray revealed bilateral pneumothoraces. Bilateral chest tubes were inserted. Due to worsening respiratory distress the patient was intubated. FAST (Focused Abdominal Sonography for Trauma) was negative and the patient underwent whole body CT scan which revealed extensive

Abbreviations: DH, diaphragmatic hernia; PTDR, posttraumatic diaphragmatic rupture; ICU, intensive care unit; CT, computed tomography; FAST, Focused Abdominal Sonography for Trauma.

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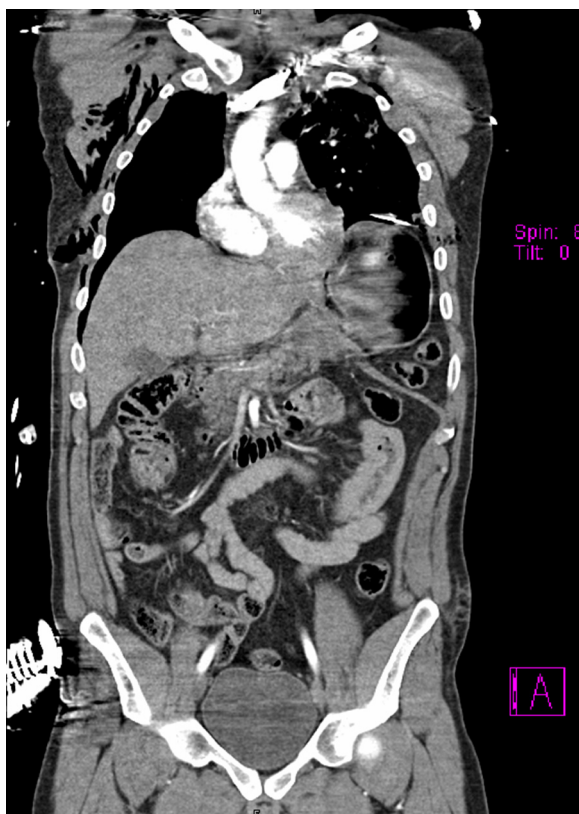


Fig. 1. CT scan of the abdomen showing herniation of stomach, spleen and bowel into the left hemithorax.

injuries of the spinal cord and persistent right pneumothorax along with atelectasis of the ipsilateral lung, subtle left pneumothorax, bilateral lung contusions and subtle bilateral pleural effusion. CT scan of the abdomen showed intrathoracic herniation of the gastric fundus the gastric body and the splenic flexure, spleen and part of the pancreatic tail through a 10 cm long discontinuity (Fig. 1) of the left hemidiaphragm displaced fracture of the manubrium of the sternum followed by rear displacement, cracked fractures of T1, T2, T3 vertebral bodies, fractures of the 1st, 2nd, 3rd and 4th thoracic rib ambilaterally and of the 5th, 6th and 7th rib on the left side and parenchymal contusion of about 3 cm diameter in VII liver segment. The patient was immobilized with a thoracic–cervical brace and he was transferred to the Intensive Care Unit (ICU). Due to severe bilateral lung injury the operation to treat the diaphragmatic rupture was initially postponed in order to obtain adequate and stable ventilation. His respiratory function was improved during the next 5 days and for its further improvement treatment of diaphragmatic rupture was considered necessary. The patient was guided to the operating theater the 6th day after the injury.

During laparoscopy, a sizeable rupture of the left hemidiaphragm with prolapse of the gastric body, fundus, part of the spleen, the left colonic flexure and part of the pancreatic tail was found (Fig. 2). The prolapsed organs were reduced to the abdominal cavity and the diaphragmatic lesion was repaired with the use of non-absorbable sutures (Fig. 3). The respiratory function of the patient was significantly improved during the following days and the patient underwent an open reduction and posterior fixation of the C5–C7 as well as osteosynthesis of the right knee fracture, the 14th day after the injury. The patient had a long postoperative recovery due to the orthopedic condition and was discharged 30 days after the injury. Eight months after the operation the patient is asymptomatic without clinical evidence of recurrence.



Fig. 2. Intraoperative view of the diaphragmatic defect. Spleen prolapsed into the left hemithorax in the middle of the figure, omentum in the bottom and forceps on the ruptured hemidiaphragm.

1.2. Case report #2

A 66 year old male presented with continuous epigastric pain after a 2-month hospitalization following a serious injury in a traffic accident. Immediately after the injury the patient had been diagnosed with right acetabular fracture, subluxation of the hip joint and a CT scan of thorax had revealed fracture of the 8th–10th rib with limited ambilateral pleural effusion without evidence of diaphragmatic rupture. At physical examination intestinal sounds were noticeable upon auscultation of the right lower hemithorax. A new CT scan of the chest and the abdomen revealed the presence of small intestine's loops inside the right hemithorax. The patient was guided to the operating room and he underwent laparoscopy during which a sizeable rupture of the right hemidiaphragm was evident with prolapse of the small intestine. The prolapsed intestine was reduced to the peritoneal cavity, pleural effusion was aspirated and the diaphragmatic lesion was repaired with clips and inabsorbable sutures. The patient had a normal postoperative course and he was discharged the 5th postoperative day. Nine years after the operation the patient remains asymptomatic without clinical evidence of recurrence.

1.3. Case report #3

A 53 year old female with a history of car accident 4 years ago, presented with a diaphragmatic rupture. She appeared with left upper quadrant pain and intermittent abdominal pain. The clinical imaging results revealed rupture of the left hemidiaphragm with prolapse of the omentum and part of the large intestine. The patient underwent a laparoscopic repair of the diaphragmatic rupture during which prolapse of the omentum and part of the transverse colon through a 5 cm × 5 cm lesion of the right diaphragm was evident.

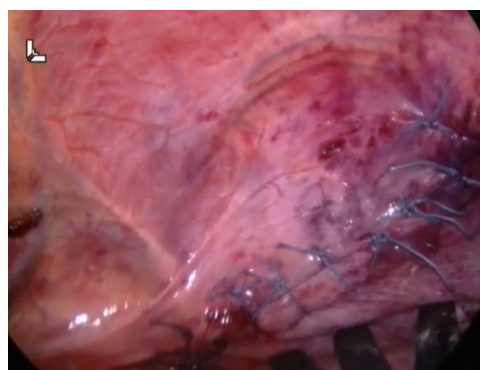


Fig. 3. Intraoperative view of the diaphragmatic repair.

Abdominal organs were reduced to the peritoneal cavity after lysis of the adhesions with the diaphragm and pleura. The diaphragmatic rupture was repaired with the use of endoclips. During repair minimal bleeding from the spleen was caused which was controlled with hemostatic pad (Surgicell). The patient had an uneventful recovery and discharged from the hospital on the 6th postoperative day. After a follow up of 8 years she has no clinical evidence of recurrence.

2. Discussion

It is estimated that trauma is the major cause of acquired diaphragmatic hernias (DH). The rupture is mostly left-sided (80%) vs right-sided (15%) vs bilateral (5%).⁴ The major challenge for successful management of a PTDR is the early diagnosis which can often be excessively delayed, in cases where the existence of diaphragm damage has not been established in the acute period of a trauma. It is quite common for the missed DH to present months or even years after the injury with a high risk of life-threatening complications such as visceral perforation or strangulation as well as cardiovascular and respiratory compromise.⁵ For the timely diagnosis of PTDR high index of suspicion is needed along with deliberate use of computerized tomography in patients with moderated to severe thoracoabdominal trauma.

Despite the technological evolution and the great advances in imaging, CT scan may miss 30–50% of the diaphragmatic rupture during the initial assessment.⁶ On the contrary, both thoroscopic and laparoscopic approaches have been found to have both excellent diagnostic and promising therapeutic benefits. The sensitivity and the specificity almost climb up to 100% and they offer the benefit of simultaneous treatment if a diaphragmatic rupture is diagnosed. Whether laparoscopy or thoracoscopy is more appropriate in the acute phase of PTDR is a matter of debate and could be also influence by the expertise of the treating surgeon.⁷ A significant limitation of thoracoscopy in the acute trauma is that it cannot exclude intraperitoneal injury which is a significant concern in these patients. Moreover, it allows the surgeon to see only the one hemidiaphragm.

Laparoscopy gives the opportunity for an integrated exploration of the whole diaphragm and the peritoneal cavity. The left hemidiaphragm can be completely evaluated by positioning the patient in a steep reverse Trendelenburg position while using a 45-degree laparoscope with a right lateral tilt. The right hemidiaphragm is slightly more difficult to visualize completely, thus an additional port may be required to retract the right lobe of the liver. In case of PTDR with laparoscopy it is possible to check the viability of the prolapsed organs and control directly any bleeding. We generally perform primary repair of diaphragmatic hernias without the use of mesh unless the risk of subsequent recurrence is high i.e. in large defects where the diaphragmatic parts cannot be approximated, when there is significant tension after primary closure or when the approximated tissue appears weak. In these patients the use of a prosthetic mesh the benefit of the mesh outweighs the risk of infection and erosion or adjacent organs.

The indications of laparoscopy in acute blunt abdominal trauma have been controversial in the literature. Laparoscopy may play a role in patients with blunt abdominal trauma, who are not bleeding, but have unclear findings on CT and the patient's clinical status is only suspicious or not assessable (comatose patients) because these patients may have unrecognized injuries that prompt surgical intervention. On the other hand, the Society of American Gastrointestinal and Endoscopic Surgeons, states that diagnostic laparoscopy is contraindicated when there is obvious intra-abdominal injury.¹⁰ This has been challenged by many authors that described successful laparoscopical repairs of injuries to

virtually every organ¹¹; however everyone agrees that if laparoscopy is to be employed in the acutely injured patient, high degree of expertise and skills are necessary along with careful patient selection.¹⁰ The reported benefits of laparoscopy in trauma is avoiding unnecessary (non-therapeutic) laparotomy, improve operative visualization of diaphragm, reduced the incidence of systemic inflammatory response syndrome often seen in multiple injured patients, decrease postoperative pain, respiratory complications and rates of incisional hernia or postoperative ileus and allow faster recovery.^{8–10}

In our first case, the multidisciplinary team of the surgeon, thoracic surgeon, anesthetist, intensive care physician and radiologist decided that the patient was at higher risk due to his respiratory instability than due to a potential organ ischemia. Therefore surgery was postponed until the 6th day after the injury and by that time his respiratory function was significantly improved and pneumothoraces had been resolved. If there was continuing air leak from lung parenchyma the patient would be at risk for tension pneumothorax with the clamping of the chest tube but this was not the case in our patient. If there was difficulty to ventilate the patient hemodynamic instability indicating tension pneumothorax we would unclamp the chest tube and convert the operation immediately. We believe that the effective communication between surgeons, the intensive care unit physicians and the anesthetist was critical in order to select the optimal time point for surgical intervention, involve the surgeons with the necessary laparoscopic expertise to the management of the patient and offer him the benefits of minimally invasive surgery.

3. Conclusion

In conclusion, laparoscopy is an attractive approach for the management of chronic PTDR. Moreover, it may offer the benefits of minimally invasive surgery during the acute phase of injury in highly selected patients.

Conflict of interest

The author(s) declare that they have no competing interests.

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Ethical approval

Written informed consent was obtained from the patients for publication of these Case reports and any accompanying images/videos. A copy of the written consents is available for review by the Editor of this journal.

Author contributions

S.X. contributed in the design of the manuscript, K.L. contributed in the collection of the data, creation and narration of the videos and

design of the manuscript, A.A. contributed in the video section, E.C. participated in the design and coordination and helped to draft the

manuscript, G.C. reviewed the manuscript and was the operating surgeon. All authors read and approved the final manuscript.

Key learning points

- Laparoscopy can be successfully used in the treatment of chronic post-traumatic diaphragmatic hernia.
- Laparoscopy can be used in the acute or subacute phase of diaphragmatic injury in carefully selected patients by experienced surgeons.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ijscr.2014.07.007>.

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