CASE REPORT JSLS

Laparoscopic Repair of a Traumatic Intrapericardial Diaphragmatic Hernia

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ABSTRACT

Introduction: Intrapericardial diaphragmatic hernia is a rare injury. We present a case of an intrapericardial diaphragmatic hernia from blunt trauma. In this report we will review the current literature and also describe the first report of a primary laparoscopic repair of the defect.

Case Description: A 38-year-old unrestrained male passenger had blunt chest and abdominal trauma from a motor vehicle collision. Two months later, on a computed tomography scan, he was found to have an intrapericardial diaphragmatic hernia. The defect was repaired primarily through a laparoscopic approach.

Discussion: Symptoms of intrapericardial diaphragmatic hernia are chest pain, upper abdominal pain, dysphagia, and dyspnea. Chest computed tomography is the most useful diagnostic test to define the defect. Even when the injury is diagnosed late, laparoscopy can be used for primary and patch repair.

Key Words: Hernia, Diaphragmatic, Traumatic, Pericardium.

INTRODUCTION

The diaphragm is a dome-shaped septum, composed of muscular portions surrounding the central tendon, which is a clover leaf–shaped fascial aponeurosis with one anterior leaf and two lateral leaves.[1] The 3 components of the muscular portions of the diaphragm (costal, sternal, and lumbar components) attach to the circumference of the thoracic inlet (lower 6 ribs, sternum and xiphoid process, and upper 3 lumbar vertebrae) and attach to the central tendon.[2] The central tendon is attached to the pericardial sac and lies anterior to the esophageal hiatus. In an animal model, the central tendon is subject to higher tension than the other muscles of the diaphragm.[3]

Intrapericardial diaphragmatic hernias occur when this central tendon of the diaphragm ruptures with herniation of abdominal viscera into the pericardium from blunt trauma. This is opposed to a tear of the pericardium into the thorax, which has also been described. The literature on this rare injury was last reviewed in 2001 by Reina et al.[4] We present an additional case of an intrapericardial diaphragmatic injury along with an updated review of the published English-language literature focusing on diagnosis, treatment, and outcome.

CASE REPORT

A 38-year-old male unrestrained passenger was involved in a motor vehicle collision and had blunt chest and abdominal trauma. His initial imaging included radiographs of the chest and pelvis and computed tomography (CT) imaging of the head, cervical spine, abdomen, and pelvis. He was found to have a left grade 4 renal laceration, multiple bilateral rib fractures, bilateral pulmonary contusions, and 2 tiny foci of pneumoperitoneum that were not attributable to any hollow viscous injury (**Figure 1**). He was initially resuscitated in the surgical intensive care unit and then underwent selective renal angioembolization on hospital day 1. On hospital day 4, the patient had a CT urogram that showed a urine leak and subsequently underwent placement of a left ureteral stent. On hospital day 6, he was discharged home with a Foley catheter. He was then seen in the trauma surgery clinic on postinjury day 19 for follow-up and was having regular bowel move-

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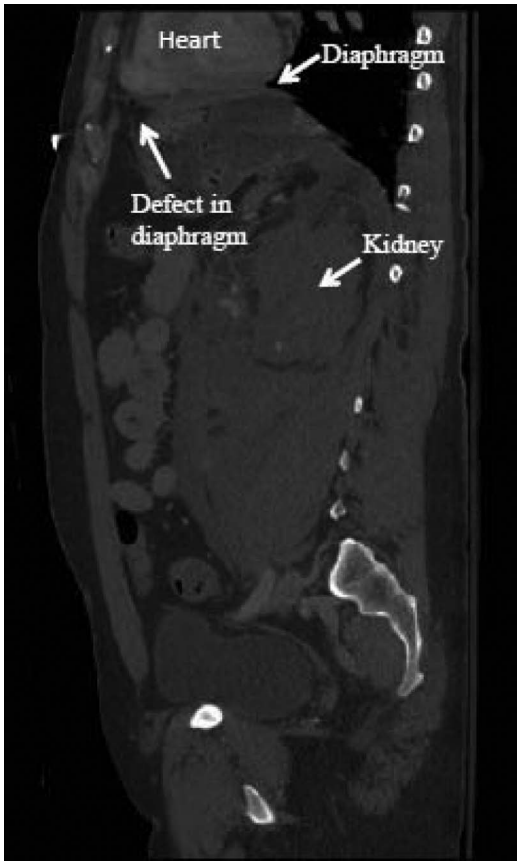

Figure 1. CT scan of abdomen and pelvis on day of injury.

ments without nausea or vomiting, but he was noted to be eating small meals because of abdominal bloating. He was seen by his primary care provider 1 month later with complaints of worsening epigastric pain, lower chest discomfort, and abdominal cramps but was again noted to be having regular bowel movements. An abdominal radiograph was obtained at the time and showed a moderate stool burden but no other apparent abnormalities. The patient subsequently started taking a proton pump inhibitor for presumed reflux. His next visit was to our urology clinic 2 months after injury for removal of his ureteral stents. His CT urogram showed no evidence of urinary extravasation, but we visualized an intrapericardial diaphragmatic defect with herniation of the abdominal viscera into the pericardial sac (**Figure 2**). A retrospective review of the CT scan from the patient's initial presentation showed an intrapericardial defect in the anterior diaphragm (**Figure 1**).

We elected to repair the intrapericardial diaphragmatic hernia through a laparoscopic abdominal approach. The patient was positioned in the supine reverse Trendelenburg position. A total of 3 trocars were used (a camera port above the umbilicus and 2 working ports at the epigastrium and left subcostal margin). Pneumoperitoneum was maintained at 10 to 12 cm H_2O to avoid any potential tamponade effect on the heart. The transverse colon and omentum were reduced from the pericardial sac through the diaphragmatic defect, with adhesiolysis of attachments of the omentum at the rim of the pericardium and diaphragm (**Figures 3** and **4**). The intrapericardial diaphragm defect measured 8 cm long × 4.5 cm wide. The heart was directly visualized through the intrapericardial diaphragmatic defect. The defect was closed primarily with horizontal mattress stitches with No. 0 Prolene suture (Ethicon, Somerville, New Jersey) (**Figure 5**). The patient had an uneventful postoperative course and was discharged home on postoperative day 2.

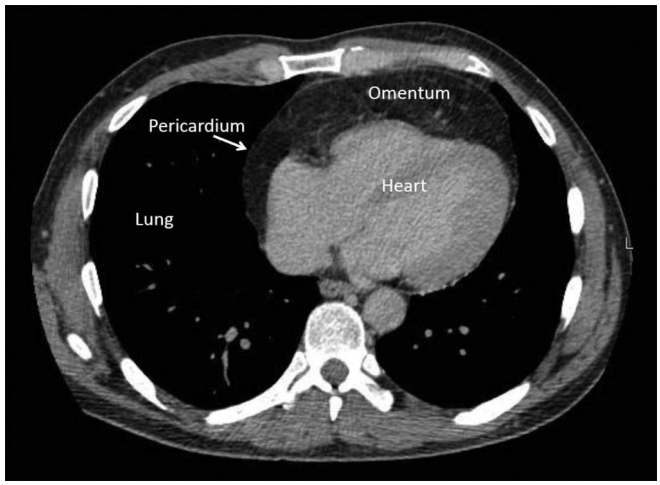

Figure 2. CT scan of chest 2 months after injury.

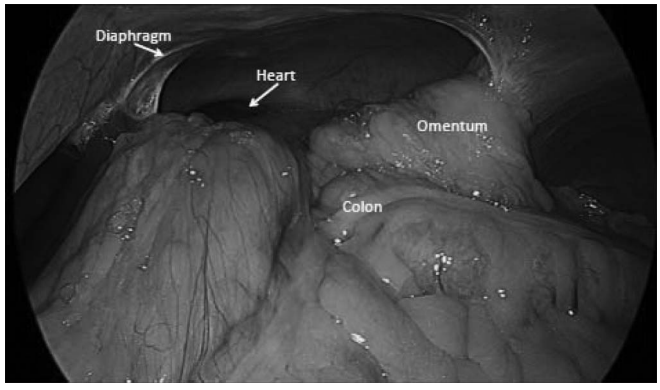

Figure 3. Intraoperative image of intrapericardial diaphragmatic hernia.

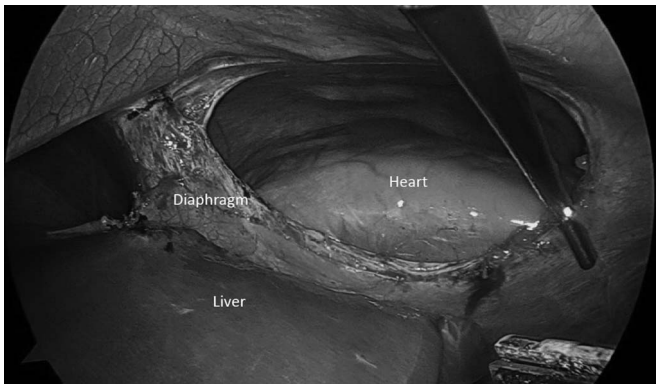

Figure 4. Intraoperative image of intrapericardial diaphragmatic hernia reduced.

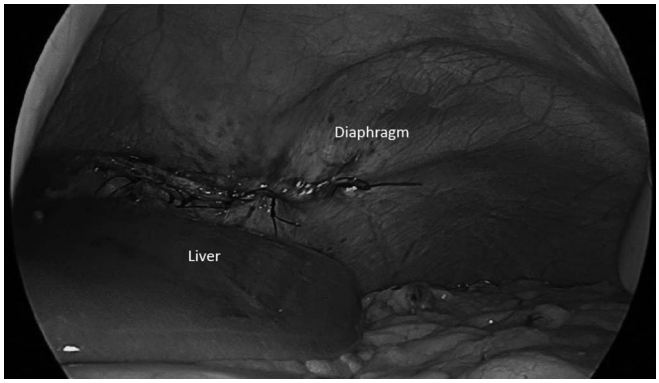

Figure 5. Intraoperative image of intrapericardial diaphragmatic hernia repaired.

LITERATURE REVIEW

van Loenhout et al[5] were the first authors to review the literature on traumatic intrapericardial diaphragmatic hernia. They found 58 cases in addition to reporting a case. Reina et al[4] reviewed the literature from 1986 through 1999 and found 22 cases in addition to the case they reported. Rodriguez-Morales et al[6] described an additional two cases in 1986 that were not described by Reina et al. Since 1999, there have been 11 additional cases of traumatic intrapericardial diaphragmatic hernias reported in the English-language literature.[7–14] Including our case, there are 96 published occurrences of traumatic intrapericardial diaphragmatic hernias. **Table 1** summarizes the 12 recent cases from 1999 through 2012. A blunt mechanism is most common, including car crashes, pedestrians being struck by cars, or falls, with one case in which the exact mechanism was unknown. There are a variety of associated injuries that are common in blunt trauma without any one being specifically associated with intrapericardial diaphragmatic hernia. Four of the patients were immediately taken to the operating room on presentation. The longest time interval to presentation was 38 years, and the defect length ranged from 6 to 16 cm. Reina et al reported an average interval between injury and diagnosis of 4.8 years and average defect length of 10.3 cm.

DISCUSSION

Half of the cases of blunt traumatic intrapericardial diaphragmatic hernias (6 of 12) were diagnosed remotely (>30 days) from the initial trauma injury. The most common presenting complaint is chest and upper abdomen symptoms. Diaphragmatic hernia in general should be maintained in the differential of a patient with blunt trauma who does not progress appropriately and in whom dysphagia, dyspnea, new-onset gastroesophageal reflux disease symptoms, or abdominal or chest discomfort persists without an adequate explanation from another abdominal or thoracic process. Chest radiography was a common initial imaging study followed by CT to confirm the diagnosis. The initial trauma imaging workup missed the diagnosis of intrapericardial diaphragmatic injury in all cases described in the past decade, including our case. Interestingly, our patient had a chest CT scan on initial presentation that was read as normal, but in retrospect, there was a small defect present. As the quality of CT imaging improves, there is potential that these rare injuries will be more commonly diagnosed on initial imaging.

The principles of the operation are to reduce the herniated organs (most commonly the transverse colon, omentum, and stomach), define the edges of the diaphragm, and close the diaphragmatic defect either primarily or with a patch. A variety of surgical approaches are described for repair of intrapericardial hernias, including thoracotomy with either primary or patch repair, laparotomy with primary or patch repair, and abdominal laparoscopy with patch repair. One theoretical concern associated with laparoscopic repair is cardiac tamponade due to gas insufflation.[7] The laparoscopic approach using a patch was described by McCutcheon et al[11] as a safe and feasible repair method. We describe the first case of an intrapericardial diaphragmatic hernia successfully repaired primarily through an abdominal laparoscopic approach.

Although the central tendon portion of the diaphragm may seem to be less compliant than the dome of the diaphragm, our case—along with most of the literature—suggests that primary repair can be performed.

Table 1.
Intrapericardial Diaphragmatic Hernia Case Reports, 1999–2012

Author	Mechanism	Time to Diagnosis	Presenting Symptoms	Imaging	Defect Size	Associated Injuries	Treatment
Sharma,[7] 1999	Head-on collision, air bag	Day 0	Chest pain	Chest CT, CXR	6 × 2 cm	None	Laparotomy, primary repair
Sharma,[7] 1999	Head-on collision	Day 0	Acute abdomen	CXR	Not described	None	Laparotomy (repair not described)
Sharma,[7] 1999	Head-on collision	Day 0	Acute abdomen	CXR	Not described	None	Laparotomy (repair not described)
Sharma,[7] 1999	Car crash, unrestrained	Day 0	Hypotension	None	2 cm	Spleen, liver, left diaphragm	Laparotomy, primary repair
Wenzel and Hamilton,[8] 2001	Exact mechanism unknown	38 y	Dyspnea	CXR, chest CT	Not described	Rib fractures	Hospice for metastatic malignancy
Wright et al.,[9] 2005	Pedestrian struck by car	7 y	Dyspnea, chest pain	CXR, chest CT	16 × 10 cm	TBI, orthopaedic injuries	Laparotomy, primary closure + ePTFE patch for reinforcement
Barrett and Satz,[10] 2006	Pedestrian struck by car	Day 2	Dyspnea, abdominal, chest and back pain, pericarditis	CXR, chest CT	Not described	Pubic ramus fracture	Not described
McCutcheon et al.,[11] 2010	Car crash	4 mo or 2 y	Chest pain	Chest CT	6 × 5 cm	Pubic ramus fracture	Laparoscopy, ePTFE patch
Bini et al.,[12] 2010	Car crash	15 y	Discovered incidentally when operating for adhesive small bowel obstruction	Barium study	Not described	Rib fractures	Laparotomy, primary repair
Scheepers et al.,[13] 2011	Car crash	10 y	Dyspepsia, chest pain	CXR, chest CT	Not described	None	Laparotomy, primary repair
Joyeux et al.,[14] 2011	Fall	3 wk	Dysphagia, weight loss	Chest CT	10 cm	Left diaphragm hernia	Left thoracotomy, PTFE patch
Current case, 2012	Car crash, unrestrained	2 mo	Chest discomfort	Abdomen CT	8 × 4.5 cm	Grade 4 renal injury, rib fractures	Laparoscopy, primary repair

CXR = Chest X-ray.

ePTFE = expanded polytetraflouroethylene.

PTFE = polytetraflouroethylene.

TBI = Traumatic Brain Injury.

Just as in the repair of diaphragmatic hernias, both absorbable and nonabsorbable sutures have been described, as has a running versus interrupted suture technique.[5,7] We advocate that a blunt traumatic intrapericardial diaphragmatic defect can be fixed primarily, similar to most other blunt diaphragmatic injuries. If primary repair is not feasible, use of an expanded Polytetraflouroethylene patch as a bridge seems appropriate because it presents a smooth surface for both the cardiac and intra-abdominal sides. A biologic patch may also have a role in repairing this injury but has not yet been described. A laparoscopic approach should be considered because avoiding an upper abdominal incision may translate into a significantly shorter hospital stay as has been shown with laparoscopic cholecystectomy.[15]

Although successful reports of primary and patch repair are present in the literature, long-term outcomes are lacking. Only 3 reports have any follow-up, which ranged from 6 to 48 months. Recurrence rates within these reports were 0%. Our patient has been followed up for 8 months postoperatively and has no signs of recurrence either clinically or on chest and abdominal radiographs.

In conclusion, half of the cases of blunt traumatic intrapericardial diaphragmatic hernias present remote from the initial traumatic injury, with the most common symptoms being chest pain, upper abdominal pain, dysphagia, and dyspnea. Chest CT is the most useful diagnostic test to define the defect. Even when the injury is diagnosed late, laparoscopy can be used for primary and patch repair and should be attempted first before an immediate open approach.

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