Laparoscopic Repair of Diaphragmatic Hernias: Experience of Six Cases

Atul Wadhwa, Jasti B.K. Surendra, Anil Sharma, Rajesh Khullar, Vandana Soni, Manish Baijal and Pradeep K. Chowbey, Department of Minimal Access Surgery, Sir Ganga Ram Hospital, New Delhi, India.

OBJECTIVE: Laparoscopic diaphragmatic hernia repair is increasingly performed in adults for congenital diaphragmatic hernias and chronic traumatic diaphragmatic hernias. This study reviewed our experience with laparoscopic diaphragmatic hernia repair to evaluate its safety, efficacy and outcomes.

METHODS: Between January 1999 and December 2002, four male and two female patients presented to us with diaphragmatic hernias, three with traumatic and three with congenital hernias. The mean age of patients was 58.6 years (range, 42–83 years). Five patients presented with main complaints of postprandial retrosternal/chest discomfort and one patient had an acute gastric outlet obstruction. Dissection was performed laparoscopically to reduce the contents of the sac and the hernial defect was repaired using prolene sutures and a polypropylene mesh.

RESULTS: Laparoscopic repair of diaphragmatic hernias was completed successfully in all patients. The mean size of the defect was 6.8 cm (range, 3–12 cm) and the mean operative time was 100 minutes (range, 60–150 minutes). There were no major intraoperative complications. One patient required placement of a chest tube due to inadvertent opening of the pleura with the hernial sac and one patient had prolonged postoperative gastric ileus. The mean hospital stay was 2.3 days (range, 1–4 days) and the mean pain score was 4 (range, 2–6). All patients remained asymptomatic over a mean follow-up of 2.9 years.

CONCLUSION: Adult congenital and chronic traumatic diaphragmatic hernias are amenable to laparoscopic repair. Laparoscopic repair is safe and feasible and confers all the advantages of minimal access surgery. [Asian J Surg 2005;28(2):145–50]

Key Words: congenital, diaphragmatic hernia, laparoscopy, trauma

Introduction

Over the last decade, laparoscopic and endoscopic procedures have revolutionized many aspects of surgical care. Laparoscopic diaphragmatic hernia repair is increasingly reported to be an acceptable and safe alternative to open surgical repair. The procedure can be performed in times comparable to those required for open repair, with minimal morbidity and postoperative pain for patients. Surgical repair of diaphragmatic hernias is indicated even in asymptomatic patients because of the danger of intestinal incarceration/strangulation or respiratory compromise.

The diaphragm is a dome-shaped musculotendinous structure separating the thoracic and abdominal cavities. Its embryology is complicated and not fully elucidated. It is formed from four embryological entities: the septum transversum, pleuroperitoneal membranes, mediastinum (dorsal mesentery of the oesophagus) and body wall muscles. Traumatic and congenital diaphragmatic hernias are rare entities. We encountered six patients with diaphragmatic hernias over a...
Trendelenberg tilt. Operating theatre layout and port placements are shown in Figures 3 and 4.

Patients and methods

A retrospective analysis was carried out to review records of patients who presented to our department over a period of 4 years from January 1999 to December 2002. All patients with diaphragmatic hernias, excluding hiatus hernias, were included in the study. Patient demographics were obtained, including age, gender, clinical symptoms and investigations (Table 1). Preoperative diagnosis of diaphragmatic hernia was based on history, symptoms, radiological investigations (chest X-ray, barium meal and computed tomography, CT) (Figures 1 and 2) and endoscopic examination (upper gastrointestinal endoscopy). Five patients presented with the main complaints of postprandial retrosternal/chest discomfort and one patient had an acute gastric outlet obstruction.

Routine haematological and biochemical investigations included blood counts, blood sugar, urea nitrogen and creatinine levels. Radiological investigations included chest X-ray/CT. Three patients underwent upper gastrointestinal endoscopy.

All patients were treated laparoscopically. Details of operative procedures such as type of hernia, size and contents of defect, approximations of defect margins and mesh insertion were noted, as were postoperative complications and follow-up.

Surgical technique

After obtaining informed consent, procedures were performed under general anaesthesia with endotracheal intubation. Patients were placed in the Lloyd Davis position with reversed Trendelenberg tilt. Operating theatre layout and port placements are shown in Figures 3 and 4.

Table 1. Patient demographics and preoperative investigations

<table>
<thead>
<tr>
<th>Age/Gender</th>
<th>Symptoms</th>
<th>Investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>73/M</td>
<td>Postprandial chest discomfort, acute gastric outlet obstruction</td>
<td>Chest X-ray PA view, UGI endoscopy, barium meal</td>
</tr>
<tr>
<td>43/M</td>
<td>Postprandial chest discomfort</td>
<td>Chest X-ray, CT scan</td>
</tr>
<tr>
<td>83/M</td>
<td>Acute gastric outlet obstruction</td>
<td>Chest X-ray, UGI endoscopy</td>
</tr>
<tr>
<td>66/F</td>
<td>Postprandial dyspnoea, epigastric pain</td>
<td>Chest X-ray, CT scan, USG abdomen</td>
</tr>
<tr>
<td>45/M</td>
<td>Postprandial fullness, vomiting</td>
<td>Chest X-ray, UGI endoscopy, barium meal</td>
</tr>
<tr>
<td>42/F</td>
<td>Upper abdominal pain, postprandial retrosternal discomfort</td>
<td>Chest X-ray, CT scan, USG abdomen</td>
</tr>
</tbody>
</table>

M = male; PA = posteroanterior; UGI = upper gastrointestinal; CT = computed tomography; F = female; USG = ultrasonography.

Figure 1. Chest X-ray showing bowel loops inside the chest cavity.

Figure 2. Barium meal films showing bowel loops inside the chest cavity.
A 30° 10-mm telescope was used through a port placed between the xiphisternum and umbilicus slightly to the left of the midline. Quick diagnostic laparoscopy was performed to view the hernial defect and any associated pathology (Figure 5). The contents of the sac, if any, were reduced using atraumatic bowel graspers (Figures 6 and 7). In one patient with a small hernial defect, a lateral incision on the neck of the hernial sac...
was required to facilitate reduction of contents and avoid bowel injury. Adhesions with the sac were lysed using sharp dissection. No attempt was made to reduce the sac into the abdomen except in one patient with dense vascular adhesions in whom the entire sac was reduced. Once the edge of the defect was defined, it was closed using intracorporeal knotting with non-absorbable polypropylene sutures. In one patient with a very large defect, approximation was not possible. In another patient with evagination of the diaphragm, approximation was not attempted. A suitable-sized polypropylene mesh (margin of mesh at least 3–4 cm beyond the edge of the defect) was fixed with spiral tacks (Protack, Autosuture, US Surgicals, Norwalk, CT, USA) and non-absorbable polypropylene endosutures.

In the immediate postoperative period, patients were thoroughly monitored and any signs/symptoms of chest trauma were sought. All patients underwent a postoperative chest X-ray. They also received injectable analgesics for the first 24 hours after surgery, except the patient with gastric ileus who had continuous ryles tube aspiration for 2 days, and then received oral analgesics for 5 days.

The operative time was defined as the time from initial skin incision to completion of skin closure. The length of stay was defined as the number of days in hospital after the operative procedure. Postoperative pain was evaluated using a visual analogue scale.

Patients were allowed oral sips on recovery from anaesthesia and made ambulatory. A soft diet was allowed on the first postoperative day. Patients were followed-up after 1 week, 3 months and then annually up to 4 years after surgery. On follow-up, patients were subjected to a clinical examination and a chest X-ray.

Results

Laparoscopic repair of diaphragmatic hernia was performed in six patients (4 male, 2 female). The mean age was 58.6 years (range, 42–83 years). Diagnostic laparoscopy was performed initially in all patients. The operative findings and procedure are summarized in Table 2. The mean size of the defect in the diaphragm was 6.8 cm (range, 3–12 cm). In two patients, reduction of hernial sac contents (stomach and transverse colon) was extremely tedious due to thick and vascular adhesions between the contents and the hernial sac. The edges of the hernial defect were approximated in all except two patients, one with a large defect and the other with evagination of the diaphragm, in whom the approximation of edges was not attempted.

A polypropylene mesh was placed in all patients except one where the defect was small (3 cm). The mean operative time was 100 minutes (range, 60–150 minutes). One patient required placement of a chest tube due to inadvertent opening of the pleura with the sac during dissection. The chest tube was removed on the second postoperative day after full lung expansion was achieved, as confirmed by a chest X-ray in the postoperative period. There were no other major intraoperative complications.

The mean hospital stay was 2.3 days (range, 1–4 days). The mean score for pain was 4 (range, 2–6). One patient had prolonged gastric ileus after surgery and had nasogastric tube drainage for 2 days postoperatively. This patient had the longest hospital stay in our series (4 days). There were no other major postoperative complications. Follow-up ranged from 2 months to 4 years (mean, 2.9 years). All patients remained asymptomatic over the follow-up period.

Table 2. Intraoperative findings and postoperative complications

<table>
<thead>
<tr>
<th>Type of hernia</th>
<th>Sac contents</th>
<th>Size of defect (cm)</th>
<th>Edge approximation</th>
<th>Size of mesh (cm)</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic traumatic</td>
<td>Stomach + omentum</td>
<td>3 x 3</td>
<td>Possible</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Chronic traumatic</td>
<td>Transverse colon + omentum</td>
<td>6 x 5</td>
<td>Possible</td>
<td>10 x 15</td>
<td>None</td>
</tr>
<tr>
<td>Chronic traumatic</td>
<td>Stomach + omentum</td>
<td>3 x 3</td>
<td>Possible</td>
<td>6 x 6</td>
<td>Prolonged gastric ileus</td>
</tr>
<tr>
<td>Congenital</td>
<td>Stomach + transverse colon + omentum</td>
<td>8 x 10</td>
<td>Not possible</td>
<td>15 x 15</td>
<td>None</td>
</tr>
<tr>
<td>Left eventration</td>
<td>Small bowel + transverse colon + stomach + spleen</td>
<td>12 x 8</td>
<td>Not attempted</td>
<td>15 x 15</td>
<td>None</td>
</tr>
<tr>
<td>Morgagni’s</td>
<td>Transverse colon + omentum</td>
<td>6 x 8</td>
<td>Possible</td>
<td>15 x 15</td>
<td>None</td>
</tr>
</tbody>
</table>
Discussion

Diaphragmatic hernias can be classified as congenital hernias, which include eventration of the diaphragm, posterolateral hernia of Bochdalek, parastrernal hernia of Morgagni-Larrey and peritoneo-pericardial hernias, or traumatic diaphragmatic hernias, including those following penetrating trauma (> 90%), blunt trauma and unrecognized diaphragmatic rupture. These usually occur after polytrauma. Spontaneous closure of the rupture does not occur, but omental interposition may seal off the tear temporarily.1

Blunt trauma of the lower chest and upper abdomen is the major cause of diaphragmatic rupture and hernia.4 Traumatic diaphragmatic hernia is incorrectly diagnosed in up to 33% of cases during the immediate post-traumatic period.4 Mortality as high as 25–60% has been reported in patients with strangulation of incarcerated viscera if left untreated.4,5 Therefore, the identification of a diaphragmatic defect is an indication for repair. Ruptures tend to occur at the central tendon or at the boundary between the tendinous and muscular parts of the diaphragm.1 In blunt trauma, the rupture occurs on the left in 65–85% of patients, on the right in 15–35% and bilaterally in 1–12%.6,7 This is due to the protection offered by the liver on the right, under-diagnosis on the right, and weakness of the left hemidiaphragm at points of embryonic fusion of pleuroperitoneal canals. In our series, we encountered only post-traumatic hernias in the left hemidiaphragm. Unlike acute rupture, chronic rupture develops dense adhesions and fibrosis between the abdominal organs, sac and pleura and is more likely to be associated with injury to the visceral contents during reduction.8 In one patient in our series, there was inadvertent opening of the pleura with the sac during reduction of contents that needed a chest tube that was kept in situ until the second postoperative day. In another patient, due to the small hernial opening and adhesions between the sac and contents, a lateral transverse incision in the neck of the hernial sac was required for safe reduction of contents without injuring the viscera. Although there are few case reports of laparoscopic diaphragmatic hernia repairs, thoracoscopy has recently been used successfully.9 This has a sensitivity and specificity approaching 100%.10 Unfortunately, only one hemidiaphragm can be inspected at a time.

The term congenital hernia usually refers to the most common posterolateral type of hernia first described by Bochdalek in 1884. Repair of Bochdalek’s hernia is usually performed in the postnatal period. Laparoscopic repair is generally not feasible in these infants because of the risk of pneumoperitoneum. However, 5% of patients with Bochdalek hernias have small defects that present in adulthood.11 These hernias have been mistaken for pleural effusions, empyema, lung cysts and pneumothorax.12 Our 66-year-old patient had a huge hernial defect of 10 × 8 cm that contained stomach, transverse colon and omentum. The defect was covered with prolene mesh and no attempt was made to approximate the edges of the hernial defect.

Morgagni’s hernia is rare, comprising less than 3% of all diaphragmatic hernias.13 Diagnosis of hernia of the foramen of Morgani has historically been difficult. Frequently, patients undergo an extensive battery of tests that often fails to yield a diagnosis.14 Surgical repair is recommended to avoid strangulation, although its frequency may be low.15 The standard surgical procedure requires thoracotomy or laparotomy, with the subsequent morbidity and long postoperative recovery. Several reports are now available supporting successful laparoscopic repair of this form of hernia.2,13,16 There are also a few reports of patients with Morgagni’s hernia treated thoracoscopically.17,18 Our patient with Morgagni’s hernia underwent abdominal ultrasonography and thoracic and abdominal CT scan prior to diagnosis followed by successful laparoscopic closure of the hernial defect reinforced with prolene mesh.

The questions of whether to excise the hernial sac or leave it in place, and of how to close the defect laparoscopically remain controversial. Some authors advise excision of the sac,16 while others believe that the sac should be left because of the risk of pneumomediastinum and other cardiovascular complications that may arise because of dissection of the mediastinum.19 Many authors have now advocated leaving the sac in place, particularly in large hernias.2 In our series, the sac was left in place in all patients except one, for whom the sac was fully reduced. The method of hernial defect closure is also an area of controversy. Smaller defects (< 3 cm) can generally be sutured laparoscopically (without tension). However, larger defects should be closed with a prosthesis.1 In our series, we successfully closed hernial defects measuring up to 6 × 10 cm reinforced with prolene mesh. For defects larger than this, no attempt was made to approximate the edges of the hernial defect and a mesh was used to suitably cover the hernial defect. Primary closure was used in defects that could be closed primarily without tension and a prosthetic overlay was used to reinforce the closure. No attempt was made to approximate the edges of the defects in which tension on the suture line was expected.

The use of a chest tube in the repair of diaphragmatic...
hernia is not mandatory. Re-expansion of the lung at the time of surgery by passing a tube into the chest through the diaphragm and then aspirating the chest at the completion of the procedure may eliminate postoperative pneumothorax. Any remaining CO₂ is reabsorbed after surgery. However, in our series, we inserted a chest tube in one patient in whom the pleura was inadvertently opened.

Polypropylene mesh has been widely used for repair of abdominal wall hernias in different locations for several decades. Some authors have reported occasional complications with intraperitoneal use of polypropylene mesh. These include bowel fistula, erosion into intra-abdominal organs and wound sepsis. On the other hand, several authors have also reported successful application of intraperitoneal polypropylene mesh without complications. Vrijland et al reported a series of 136 patients followed-up over 36 months showing no enterocutaneous fistula after the application of polypropylene mesh. We have previously reported 202 ventral abdominal hernia repairs performed laparoscopically using intraperitoneal polypropylene mesh without complications. In our series, we preferred polypropylene mesh because it is cost-effective and provides a transparent surface, which is a great advantage in optimal placement and fixation of the mesh.

Conclusion

Congenital diaphragmatic hernias in adults and chronic diaphragmatic hernias are uncommon surgical entities that are amenable to a minimal access approach, provided safe handling of the bowel and meticulous technique is adopted.

References