



Laparoscopic patch repair of diaphragmatic hernias with Surgisis

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Abstract

Background: Laparoscopic repair of congenital diaphragmatic hernias has been sparsely reported. Moreover, each report has primarily been a single operative case. In most of the reports, prosthetic mesh has not been used, and when used, it has been nonabsorbable in nature. Most of these case reports have documented only a few months of clinical follow-up.

Methods: After institutional review board approval (No. 01-12-115X), the clinical course and outcome of 3 patients undergoing laparoscopic repair of foramen of Morgagni and Bochdalek hernias using 4-ply Surgisis soft tissue graft (Cook Inc, Bloomington, Ind) were reviewed to determine if this approach is appropriate.

Results: In 2001, 2 patients, ages 9 months and 14 years, underwent laparoscopic foramen of Morgagni repair and one 5-day-old underwent laparoscopic foramen of Bochdalek repair using Surgisis soft tissue graft as a patch to close the diaphragmatic defects because there was too much tension with primary repair. In each case, the prosthesis was secured to the rim of the defect using interrupted silk sutures tied intracorporally. The mean operative time for repair of the Morgagni defects was 230 minutes with a postoperative discharge of 1 and 2 days. For the foramen of Bochdalek repair, the operative time was 204 minutes, and the patient was discharged at 3 weeks. No complications have occurred during or after any of the procedures, but the oldest patient underwent diagnostic laparoscopy 3 months postoperatively for a radiographic finding of suspected recurrence. At laparoscopy, the patch was intact, and no diaphragmatic hernia was noted.

Conclusions: Laparoscopic repair of congenital diaphragmatic defects using prosthetic material is possible although the operative time required is around 3.5 hours. Because of the brief postoperative course, the laparoscopic approach appears justified in the nonneonatal patients. Whether this approach is appropriate for repair of neonatal Bochdalek hernias remains unclear.

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With the increasing use of laparoscopy by pediatric surgeons, a number of more difficult problems are being approached with this modality. Included in this group are repairs of congenital diaphragmatic hernias (CDHs) origi-

nating from either the foramen of Bochdalek or foramen of Morgagni. A number of pediatric surgeons have reported their experiences with laparoscopic repairs of foramen of Morgagni hernias [1-8]. For the most part, these isolated case reports have been in asymptomatic children older than 2 years [1-5,8]. Also, most have not involved the placement of a prosthetic mesh [1-7]. When mesh has been used, it has been nonabsorbable in nature [8]. In these reports, the

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longest follow-up has been 1 year with most case reports reporting only a few months of follow-up.

Two reports have described the laparoscopic approach for a CDH through the foramen of Bochdalek, one in a 9-day old neonate [9] and another in a 2-year-old [10]. The primary reasons for the lack of use of laparoscopy for the repair of a Bochdalek hernia in a newborn center on the small operative volume of the neonatal abdominal cavity and the fragile nature of CDH pathophysiology. For this reason, there is, understandably, a reluctance to perform a prolonged procedure in an infant whose stable physiology might become critical at any moment. Furthermore, for those patients requiring mesh for closure of a large diaphragmatic defect, the length of time to perform this operation laparoscopically further heightens the concerns about the instability of the underlying pathophysiology.

1. Materials and methods

In 2001, we performed laparoscopic repair of foramen of Morgagni hernias in 1 infant and 1 adolescent and a 5-day-old newborn with a congenital Bochdalek hernia. In all 3 instances, 4-ply Surgisis soft tissue graft (SIS) (Cook Inc, Bloomington, Ind) was used to close the large diaphragmatic defect. Surgisis soft tissue graft was chosen because of its ability to allow native tissue ingrowth, which

hopefully will reduce the rate of recurrence. These patients are now retrospectively reported more than 4 years later because each has recovered uneventfully and has not developed a recurrence. Institutional review board approval has been obtained for this review (CMH 01-12-115X).

In each case, the patient was brought to the operating room and underwent satisfactory general endotracheal anesthesia. In the 2 infants, the babies were placed at the end of the operating table. The teenager was placed in lithotomy stirrups. The surgeon stood at the end of the table and the assistant to his right. Automated endoscope system for optimal positioning (AESOP) was used to hold the camera. In each patient, a 5-mm 45°-angled telescope was placed through a 5-mm cannula that was placed in the umbilicus in the 2 patients undergoing Morgagni repair and cephalad to the umbilicus in the baby undergoing the Bochdalek hernia repair. There were 3 working sites, 2 for the surgeon and 1 for the assistant. Three-millimeter instruments were used in the infants and 5-mm instruments were used in the adolescent.

In each patient, a 4-ply SIS patch (0.2-mm thickness) was rolled into a tubular shape and inserted into the abdominal cavity through the telescope site after removal of the cannula. The cannula was then reintroduced and the SIS material delivered to the region of the diaphragmatic defect. Interrupted 2-0 silk sutures were used to secure the SIS patch to the edges of the defect. There was a 2- to 3-mm overlap between the SIS patch and rim of the diaphragmatic

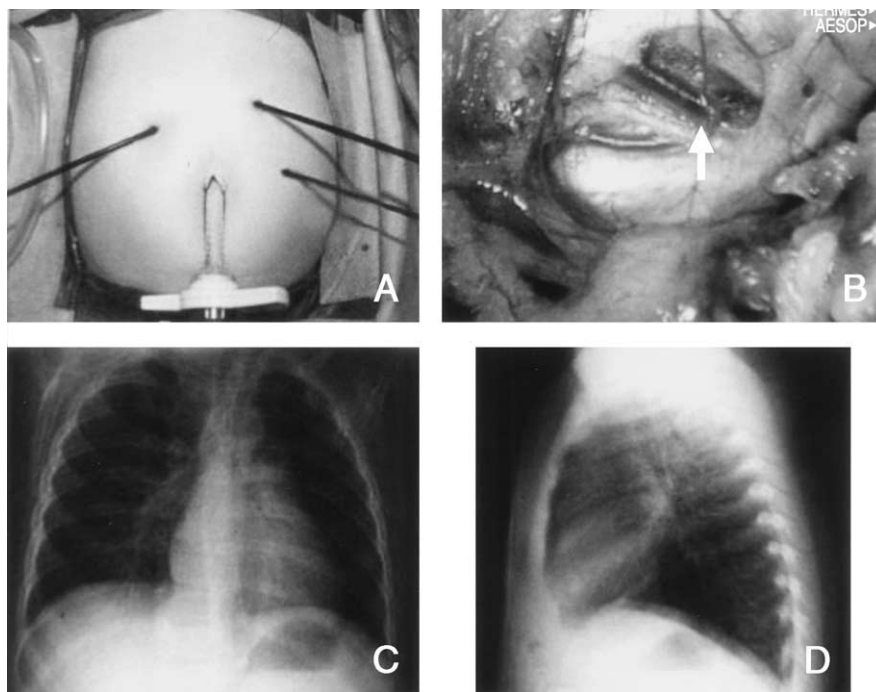


Fig. 1 This 9-month-old presented with an asymptomatic foramen of Morgagni hernia. The location of the 3 ports used for repair of the Morgagni hernia is shown (A). One year later, at the time of laparoscopic fundoplication, the area of the SIS patch was visualized. Note the neovascularity (arrow) seen in the center of the patch (B). It was not possible to distinguish between native diaphragm and the patch at the time of this operation. More than 3 years later, a posterior-anterior and lateral chest radiograph (C and D) did not show any evidence of recurrence of the foramen of Morgagni hernia.

defect. All sutures were tied intracorporally. Suturing the patch to the rim of the defect was straightforward, except for the anterior closure of the Morgagni defect and the lateral closure of the Bochdalek defect. In the cases involving Morgagni hernias, the patch was secured anteriorly to the posterior periosteum of the sternum. Lateral closure of the Bochdalek hernia was obtained by suturing the SIS patch around the ribs.

2. Results

2.1. Case 1

In January 2001, this 9-month-old presented with an asymptomatic foramen of Morgagni hernia. At the time of laparoscopic evaluation, despite reducing the intraabdominal pressure to less than 5 mm Hg, it was not possible to close the defect primarily, which measured 3×7 cm. An SIS patch (4-ply) was fashioned and used to close the hernia. The operative time was 210 minutes and he was discharged the next day. Interestingly, he required laparoscopic

fundoplication for refractory symptoms of gastroesophageal reflux 1 year later. At the time of this second laparoscopic operation, there was no evidence of recurrence of the Morgagni hernia nor was there evidence of a differentiation between the normal diaphragm and the SIS material. Now, 48 months later, he remains asymptomatic and his chest radiograph is normal (Fig. 1).

2.2. Case 2

This newborn was transferred to our hospital with a left CDH in July 2001 (Fig. 2). Postnatally, the baby remained stable on conventional ventilation without evidence for reactive pulmonary hypertension. On day of life 5, he underwent laparoscopic evaluation of the left diaphragmatic defect. A large posterolateral defect was found with herniation of the transverse and descending colon, stomach, spleen, and most of the small intestine into the left hemithorax. These organs were reduced into the abdominal cavity, but it was not possible to close the diaphragmatic defect primarily, despite reduction of the intraabdominal pressure to 5 mm Hg. Therefore, SIS was used to patch the

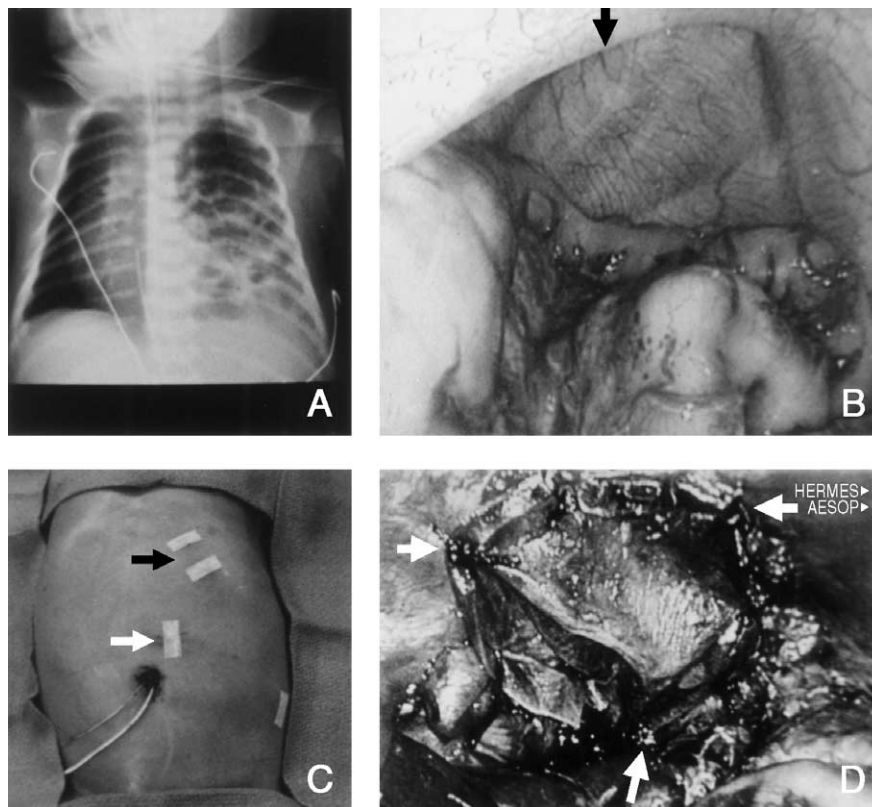


Fig. 2 This newborn presented with a left CDH (A). Note the large defect and the anterior rim of the left diaphragmatic defect (arrow) (B). The site of placement of the cannulas and instruments is seen in the lower left photograph (C). The umbilicus was not used in this patient because of the umbilical venous and umbilical arterial catheters that were felt to be important for monitoring during the procedure. The 5-mm cannula and telescope were placed through the incision just cephalad and to the right of the umbilicus (white arrow). The 2 subcostal incisions (black arrow) were the primary working sites. The far left subcostal incision was used for retraction of the viscera. The Surgisis patch is seen in D. Note the interrupted silk sutures (white arrows) that were tied intracorporally. This patient remains well and without evidence of recurrence 4 years later.

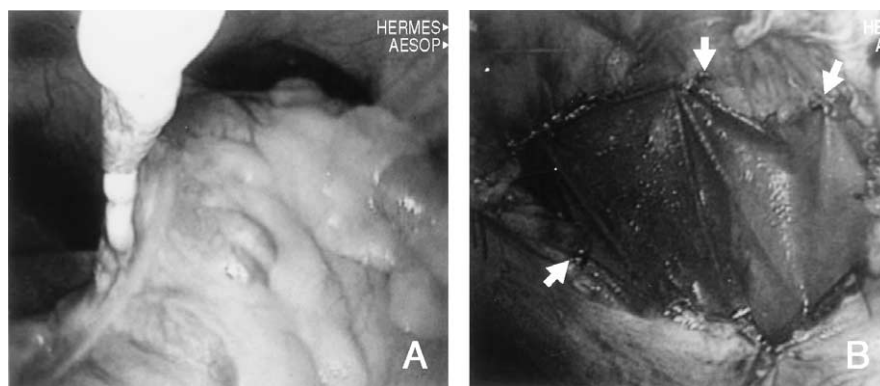


Fig. 3 This 13-year-old was found to have his transverse colon herniated through a foramen of Morgagni defect (left). The defect could not be closed primarily and a Surgisis patch was placed (right). The Surgisis was secured with interrupted silk sutures (arrows).

defect. The operative time was 180 minutes. The baby recovered uneventfully and was discharged on his 20th day of life. His postoperative course has been uneventful and his chest radiograph appears normal 4 years later.

2.3. Case 3

In August 2001, a 13-year-old mildly obese boy presented to the emergency department with symptoms of abdominal pain. The lateral abdominal radiograph revealed intestinal herniation through an anterior diaphragmatic foramen of Morgagni hernia. At laparoscopy, the diaphragmatic defect was estimated at 7×10 cm and could not be closed primarily despite reduction of the abdominal pressure to 5 mm Hg. The hernia was so large that the entire SIS patch was required to obtain closure (Fig. 3). The operative time was 240 minutes and he was discharged on the second postoperative day. Three months later, he returned with recurring abdominal pain. A chest radiograph showed a possible recurrence of the diaphragmatic hernia. However, at laparoscopy, there was no evidence for recurrence. He has remained asymptomatic since that time and his chest radiograph is also normal 4 years later.

3. Discussion

Laparoscopic closure of congenital diaphragmatic defects has been reported in both the pediatric and adult literature [1-13]. However, there have been very few reports using prosthetic materials and none have mentioned the use of SIS for closure. Small intestinal submucosa is a natural biomaterial harvested from porcine small intestine and is made into a biocompatible medical product. This extracellular matrix is comprised of collagen, noncollagenous proteins, and other biomolecules including glycosaminoglycans, proteoglycans, and glycoproteins. It is available in 2 thicknesses. The 8-ply variant is 0.4 mm thick whereas the 4-ply is 0.2 mm thick. The primary advantage of SIS in the growing pediatric patient is its ability to biologically act as a scaffold, allowing for host connective and epithelial

tissue ingrowth such that the patch is generally overtaken with native tissue. This is an extremely attractive material in this patient population [14].

Although SIS is biomedically attractive, clinical reports have not been universally favorable. Albanese and colleagues found that 3 of 16 infants undergoing open Bochdalek hernia repairs using SIS developed hernia recurrence at a mean of 6 months after the original operation [15]. In that experience, absorbable sutures were used to secure the SIS patch to the rim of the defect. We feel that the use of silk sutures may have played a beneficial role in our success in this small number of patients. Also, the placement of interrupted sutures may have been advantageous as well. Silk sutures, as opposed to absorbable sutures, may be important because there may be a greater inflammatory response that promotes the neovascularity and tissue ingrowth into the patch. Moreover, these sutures remain permanently as opposed to resorbing around 3 months. It is possible that the recurrences develop once the sutures resorb.

Although this is a small experience, we are able to report that SIS can be readily used for diaphragmatic coverage with the laparoscopic approach. The operations are technically difficult with regard to suturing the SIS in the small volume of the neonate, but suturing is much easier in the older patient. In addition, manipulation of SIS during laparoscopy is easier than a stiffer material such as polytetrafluoroethylene or Dacron polyester fabric. In this small series, there has been no evidence of recurrence to date with a follow-up of greater than 4 years for each patient. This portends well for these patients' future because it appears unlikely that they will develop recurrent disease.

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