Recurrence of Diaphragmatic Hernia After Thoracoscopic Repair With Strattice Patch

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ABSTRACT

Introduction: Thoracoscopic repair of congenital diaphragmatic hernia has increased with the use of prosthetic material. When the defect cannot be repaired primarily, a variety of materials have been used. The ideal prosthetic material has not been identified yet. The use of biologic tissue matrix prosthesis is appealing because this material may serve as a framework to support the patient's own tissue regeneration. We report on 2 newborns with congenital diaphragmatic hernia repaired by thoracoscopy with placement of a Strattice patch (LifeCell, Branchburg, New Jersey). The hernia recurred in both cases.

Case Description: Two neonates born at term, weighing 3.5 kg and 4.0 kg, had left-sided congenital diaphragmatic hernias repaired by thoracoscopy with a Strattice patch. The repairs were performed at 1 and 4 days of age after a period of stabilization. There were no other congenital anomalies. There were no operative complications. The neonates recovered uneventfully and were discharged in good condition. Recurrence of the diaphragmatic hernia was identified by chest radiographs at routine follow-up visits 16 and 22 months postoperatively. One patient had mild abdominal pain and increasing shortness of breath, whereas the other patient was asymptomatic. One patient had an abdominal open primary repair of the recurrent diaphragmatic hernia, whereas the other patient had a laparoscopy-assisted repair with AlloDerm patch (LifeCell). They both recovered uneventfully.

Discussion: Postoperative follow-up at regular intervals is extremely important after repair of diaphragmatic hernia, especially when prosthetic material is used, because of the high incidence of recurrence. We do not recommend the repair of diaphragmatic hernia with the Strattice patch at this time.

Key Words: Congenital diaphragmatic hernia repair, Thoracoscopy, Strattice mesh

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INTRODUCTION

Congenital diaphragmatic hernia (CDH) is a congenital anomaly in which there is incomplete development of the diaphragm, with varying severity of associated pulmonary hypoplasia.[1] CDH has been surgically treated since the early 1900s,[2] but the treatment paradigm of emergent surgical repair has shifted in the past 2 decades after it was shown that respiratory compliance often deteriorates after surgical repair of CDH.[3] Although there is no definitive evidence currently to support either cardiopulmonary stabilization and delayed repair or immediate repair,[4] most centers now use the non-emergent approach to surgical repair.[5] Thoracoscopic repair of CDH has increased with

the advances in minimally invasive surgery,[5] and the use of different prosthetic materials has also expanded as patch options have increased.[6] When the defect cannot be repaired primarily, a variety of materials have been used. The ideal prosthetic material has not been identified yet, although several biologic and nonbiologic options have been investigated for use in CDH repair.[6] The use of biologic tissue matrix prosthesis is appealing because this material may serve as a framework to support the patient's own tissue regeneration.

We report on 2 newborns with CDH repaired by thoracoscopy with placement of a Strattice patch (LifeCell, Branchburg, New Jersey). Strattice mesh (LifeCell) is a biologic prosthetic of processed sterilized porcine dermal matrix that provides strength, biocompatibility, and incorporation into the patient's tissue with associated cell and microvascular ingrowth, as noted in the product description provided by the manufacturer.

The hernia recurred in both cases. These case descriptions add to the literature on the use of, and success of, various synthetic prosthetics in CDH repair because the use of the Strattice patch for thoracoscopic CDH has not previously been described, and well-designed clinical trials regarding the various patch options have not been carried out, resulting in a lack of specific guidelines for patch repair of CDH.[6] These cases also suggest that clinicians should be cautious in using the Strattice patch in CDH repair.

CASE 1

This baby was born at term, weighing 3.5 kg. He had respiratory distress at birth, and a chest radiograph confirmed the diagnosis of left-sided CDH **(Figure 1)**. The patient was ventilated and stabilized overnight and underwent thoracoscopic repair of the diaphragmatic hernia on day-of-life 1. Intraoperatively, it was noted that the small intestine, spleen, stomach, left kidney, and part of the colon were in the left thorax. These were reduced, and the diaphragmatic defect was noted to be too large for a primary tension-free repair **(Figure 2)**. We used an appropriately sized Strattice patch to close the defect **(Figure 3)**, securing it to the diaphragm using a combination of pledgeted and nonpledgeted No. 3–0 silk and No. 3–0 Prolene sutures (Ethicon, Somerville, New Jersey), tying the knots extracorporeally with a knot pusher. On the left side of the chest, there was no diaphragm to which to secure the patch, and it was secured to the rib in this region **(Figure 4)**. There were no complications during the procedure, and the postoperative recovery was uneventful. A postoperative chest radiograph showed complete repair of the hernia **(Figure 5)**. The patient was discharged in stable condition and followed up routinely as an outpatient.

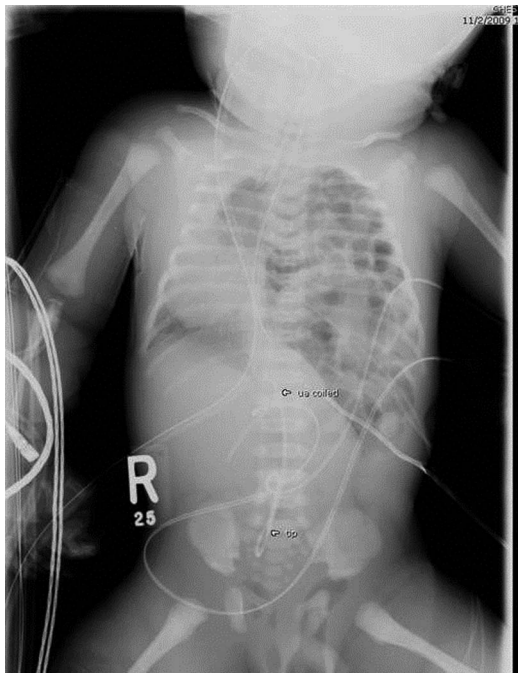

Figure 1. Preoperative chest radiograph at birth indicating left-sided CDH in case 1.

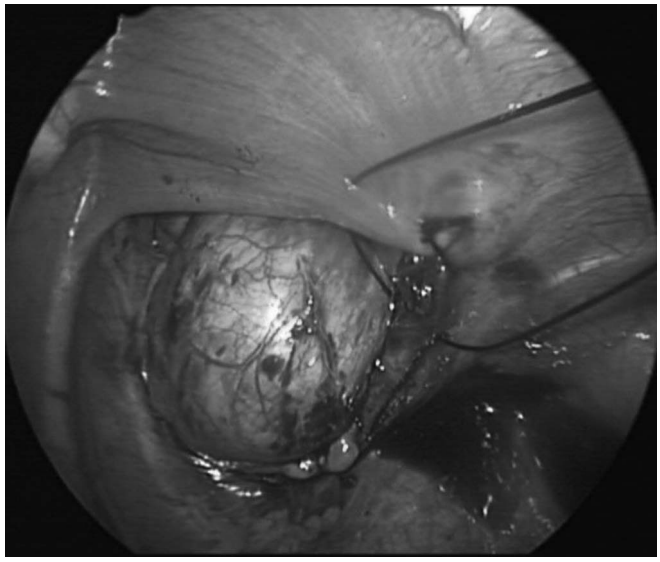

Figure 2. Large residual diaphragmatic defect, too large for tension-free repair, in case 1.

At nearly 22 months of age, the patient was seen for routine follow-up and a routine chest radiograph showed recurrence of the diaphragmatic hernia. The patient was

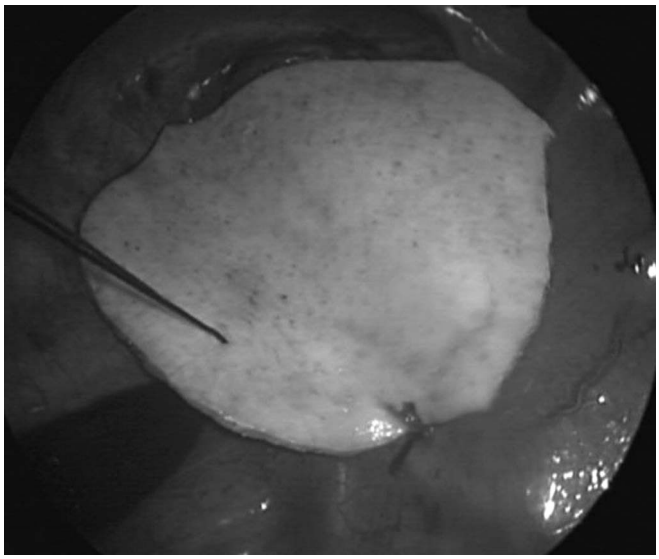

Figure 3. An appropriately sized Strattice patch was used to close the diaphragmatic defect in case 1.

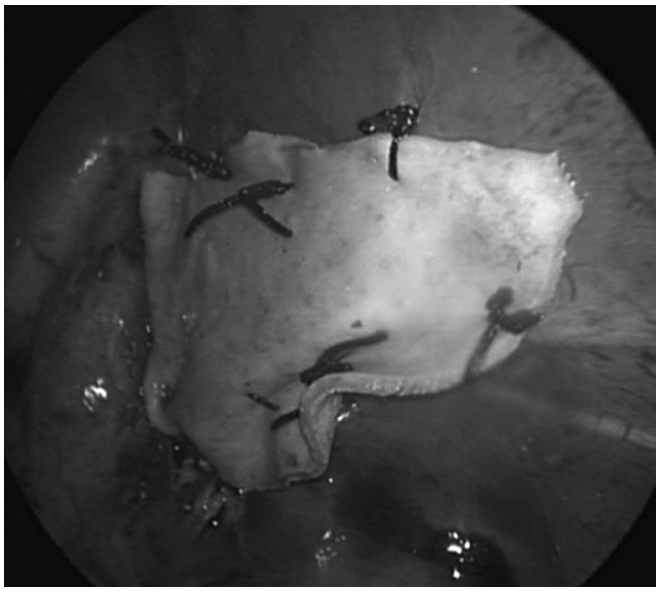

Figure 4. Strattice patch sutured to diaphragmatic edge and to ribs laterally in case 1.

clinically asymptomatic. He subsequently underwent repair for the recurrence with an initial laparoscopic abdominal approach, converted to an open approach, with placement of an AlloDerm patch (LifeCell). Intraoperatively, it was noted that the previously applied mesh was moderately attenuated with very poor adherence, especially at the posterior leaflet. Histologic examination of the mesh showed fibrous tissue with acute and chronic inflammation. The spleen, left kidney, small bowel, left adrenal gland, part of the colon, and pancreas were noted to be in the thoracic cavity. These were reduced laparoscopically except for the kidney, which could not be reduced in a safe manner. The procedure was converted to an open procedure, and the left kidney was then successfully reduced into the abdominal cavity. The remnant of the previously used patch was excised, and posteriorly, no residual diaphragmatic rim was noted. No. 2–0 silk sutures were placed in the medial and posterior aspects of the defect incorporating the ribs. An AlloDerm patch was cut, fit, and secured to the posterior rim of the defect. A satisfactory tension-free repair of the diaphragmatic defect was accomplished. The kidney, spleen, stomach, and left lobe of the liver were placed in an anatomically correct position.

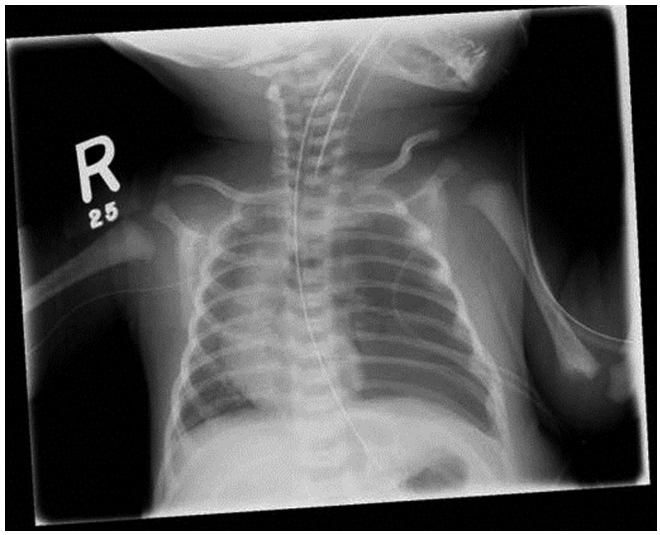

Figure 5. Chest radiograph immediately postoperatively indicating reduction of intra-abdominal organs and re-expansion of lung in case 1.

There were no complications during the procedure or postoperatively, and a chest radiograph showed complete repair of the hernia. The patient was discharged home in stable condition on postoperative day 6. At 4 years of age, he continues to undergo routine follow-up and is doing well, without recurrence of the diaphragmatic hernia.

CASE 2

A 4.1-kg male baby, born at term with severe respiratory distress, was unstable at birth and required intubation, ventilation, and nitric oxide. He was diagnosed with a left-sided diaphragmatic hernia. He was transferred to our hospital from an outside institution and stabilized over the

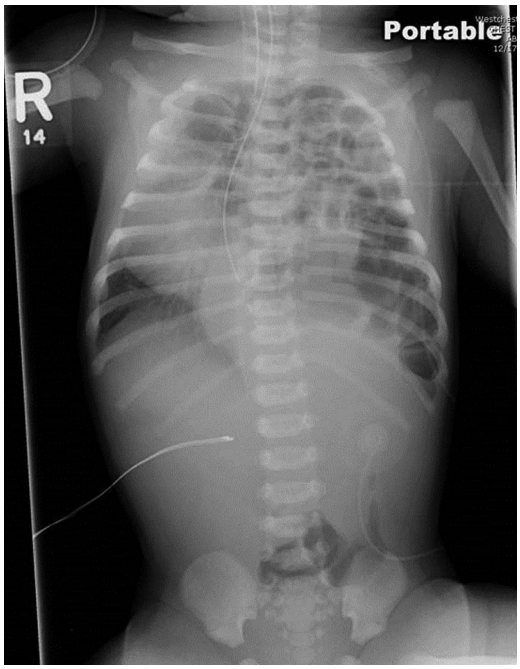

Figure 6. Preoperative chest radiograph at birth indicating left-sided CDH in case 2.

first few days of his life. On day-of-life 4, the patient underwent thoracoscopic repair of the diaphragmatic hernia with a Strattice patch. A preoperative chest radiograph showed that the intra-abdominal organs were in the left chest cavity **(Figure 6)**. The organs found in the left chest intraoperatively included the small intestine, spleen, stomach, left kidney, and part of the colon. These were successfully reduced into the abdominal cavity, and the diaphragmatic defect was found to be too large to allow for primary repair **(Figures 7 and 8)**. An appropriately sized Strattice patch was used to close the defect, which was secured medially with interrupted No. 2–0 silk sutures and laterally with interrupted No. 2–0 nylon sutures placed through the chest wall, around the diaphragmatic rim, and buried subcutaneously **(Figure 9)**. A postoperative chest radiograph showed resolution of the hernia **(Figure 10)**. The patient recovered uneventfully and was discharged home in stable condition.

The baby was followed up routinely as an outpatient and found to have right-sided hemihypertrophy. He was doing well until he presented at 16 months of age with dysphagia. The workup included a modified barium swallow study that showed recurrence of the diaphragmatic hernia with loops of bowel in the left chest. The patient was scheduled for elective repair of the recurrence; however, on the day before the planned repair, he presented with

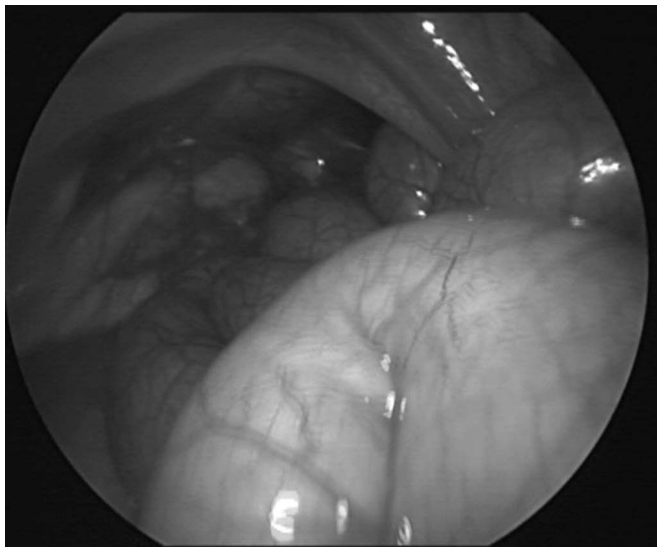

Figure 7. The diaphragmatic defect was too large for a tension-free repair in case 2.

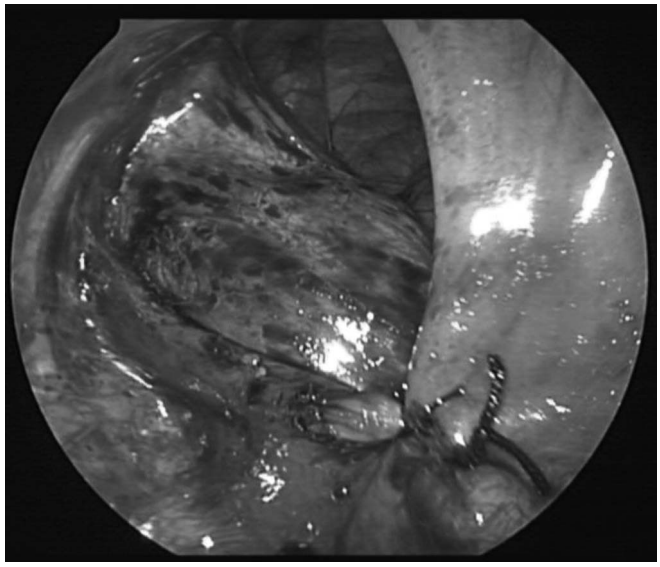

Figure 8. Large diaphragmatic defect partially closed with interrupted sutures in case 2.

abdominal pain, restlessness, decreased oral intake, irritability, and a palpable mass in the right lower quadrant of the abdomen. He was taken emergently to the operating room to undergo exploration of the abdomen and repair of the recurrent hernia. Intraoperatively, the patient was found to have torsion of a wandering spleen in the right lower quadrant. The spleen was untwisted. The small intestine and the left kidney were in the left thoracic cavity with associated intestinal malrotation. The previously

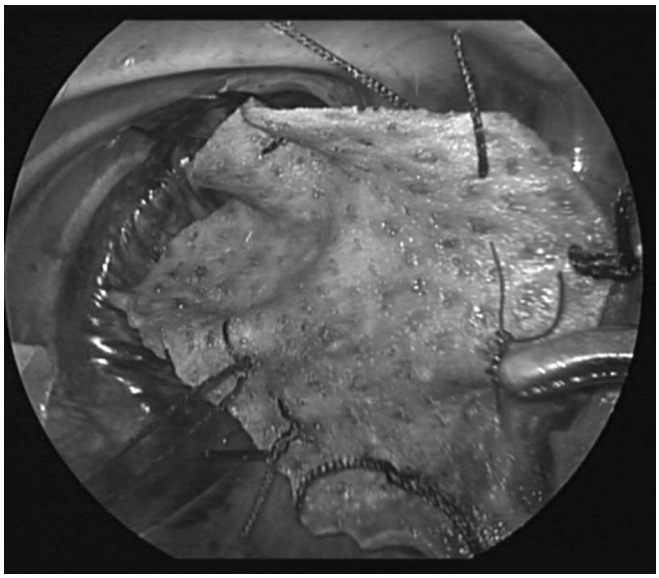

Figure 9. An appropriately sized Strattice patch was used to close the defect in case 2.

used Strattice mesh was resected and the diaphragmatic rim dissected free of adhesions. The posterolateral aspect of the diaphragm had no remaining rim; primary repair was accomplished with interrupted No. 2–0 braided nylon sutures around the ribs in the posterolateral aspect. After repair of the diaphragmatic defect, a splenopexy, Ladd procedure, and appendectomy were also performed. The Strattice mesh was found to be very attenuated and practically nonexistent. A postoperative chest radiograph showed complete repair of the diaphragmatic hernia. The patient, now aged 45 months, recovered uneventfully and continues to do well after routine follow-up.

DISCUSSION

CDH is a life-threatening anomaly, and even in patients who survive the perinatal period, it can have long-term associated complications and sequelae.[7] In patients who have undergone successful surgical repair, the incidence of recurrence has ranged from 14% to 22% in most published patient series.[8,9] The rate of recurrence in patch repairs has been noted to be higher, 41% and 42% in two studies;[8,10] however, it is difficult to identify the etiologic factors associated with the recurrences in these cases because patches are used mainly in patients with very large diaphragmatic defects. Postoperative follow-up at regular intervals is critical after repair of diaphragmatic hernia, especially when prosthetic material is used, because of the high incidence of recurrence.

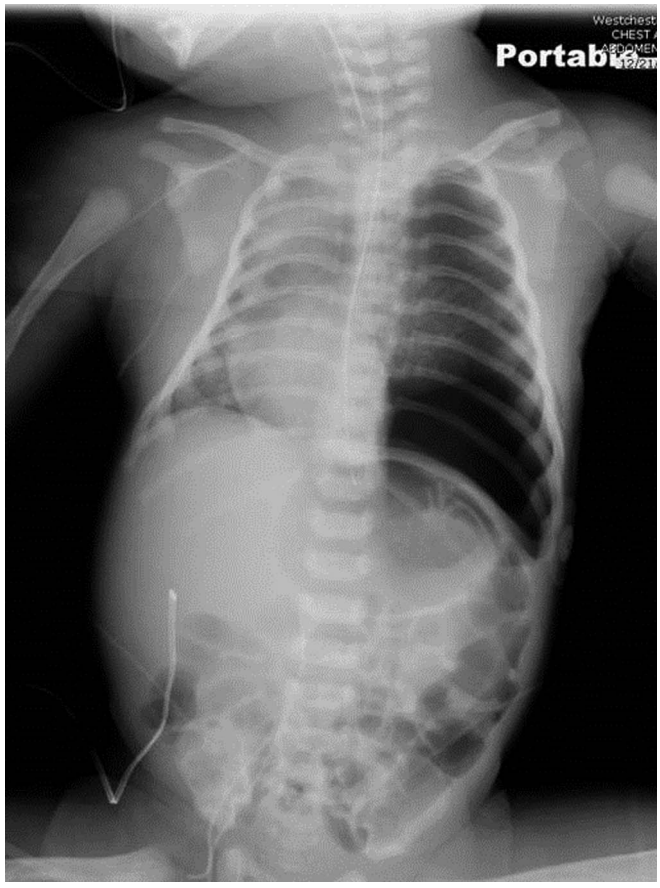

Figure 10. Chest radiograph immediately postoperatively indicating reduction of intra-abdominal organs and re-expansion of lung in case 2.

With advances in minimally invasive surgery, both laparoscopic and thoracoscopic approaches are used for repair of CDH.[5] A review of 15 cases indicated that laparoscopy was the preferred approach for Morgagni defects whereas thoracoscopy is preferred for Bochdalek defects despite a failure rate of 14%.[5] Another study identified the presence of some preoperative factors that could contribute to a safe thoracoscopic approach. These factors included the presence of an intra-abdominal stomach, minimal ventilator support, and no evidence of pulmonary hypertension.[5] Our 2 cases conformed to these preoperative criteria except for the presence of intrathoracic stomachs found at the time of repair.

A recent review of patch options in the repair of CDH noted that the ideal prosthesis would have strength, flexibility, and inertness to avoid inflammatory reactions and adhesions and should be replaced or reinforced by native tissue rapidly enough to avoid chest wall deformation

and/or recurrence as the child ages.[6] This ideal patch has yet to be designed, and the current patch options all have advantages and disadvantages. Clinical randomized trials should be performed to compare the different options before determining which option is superior.[6] In addition, there is no evaluation in the literature of the Strattice mesh in the context of CDH. Given our experience with Strattice patch repair of CDH and recurrence of the diaphragmatic hernia in both patients presented, we do not recommend its use in repair of CDH at this time. Further studies to evaluate the performance of the Strattice mesh in comparison with other biologic mesh options for use in CDH repair are necessary to guide clinical decision making in these cases. Additional studies are also needed to identify factors that increase the risk of recurrence. The use of algorithms in terms of preferred approaches, repair techniques, and maximization of clinical patient factors preoperatively will lead to better-informed decision making.

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