Repair of recurrent ventral hernias using tissue expansion and porcine acellular dermal matrix

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Abstract

Background Recurrent ventral hernias are often large and associated with loss of abdominal domain, hindering primary closure. One established intervention for patients with large ventral hernias is the component separation procedure that advances muscle from the lateral abdomen. This technique allows closure without creating tension; however, the relaxing incisions weaken the lateral abdominal wall by altering its natural architecture. We propose an approach to primary midline closure that does not compromise lateral abdominal wall stability and restores the architecture of the abdominal wall while allowing tension-free midline closure.

Methods In three patients with recurrent ventral hernias who had failed two or more repair attempts, we used a two-stage reconstruction. Bilateral rectangular tissue expanders placed between the external and internal oblique muscles via subcostal incisions were expanded for 6–8 weeks. Second-stage surgery consisted of expander removal and primary closure of the abdominal defect reinforced by an underlay and overlay of noncross-linked intact porcine-derived acellular dermal matrix (PADM; Strattice™ Reconstructive Tissue Matrix, LifeCell, Branchburg, NJ, USA).

Results Primary closure of ventral hernias measuring 8×8, 12×8, and 8×6 cm was achieved with no need for component separation. At follow-up ranging from 10 to 17 months, all patients had structurally intact abdomens with no hernia recurrence and no abdominal wall weakness. All patients have resumed normal daily activities, including returning to work.

Conclusions Expansion of the external and internal oblique muscles combined with an underlay and overlay of noncross-linked intact PADM allows strong and reliable primary closure of recurrent ventral hernias without the need for component separation.

Level of evidence: Level V, therapeutic study

Keywords Hernia • Abdominal • Ventral hernia • Reoperation • Surgical mesh • Recurrence • Tissue expansion

Introduction

Reconstructive plastic surgeons are often consulted to repair complex ventral hernias. Patients with recurrent hernias or those who have a history of multiple surgeries and infection present particularly vexing reconstructive challenges. Achieving a primary midline tension-free closure, the primary goal of ventral herniorrhaphy is particularly difficult in the setting of loss of abdominal domain. In such patients, a closure that is too tight can lead to numerous complications, including hernia recurrence and pulmonary function compromise [1].

The component separation procedure is an established intervention that allows surgical closure of the abdomen without excessive tension [2]. This procedure can be used successfully to close massive ventral hernias associated with loss of abdominal domain [3, 4]. Component separation mobilizes abdominal wall tissue in high-risk patients with these large defects, but the procedure...
involves suturing the external oblique muscles in an effort to advance the rectus abdominis, internal oblique, and transversus abdominis muscles from the lateral abdomen to the midline. This anatomic attention weakens the lateral abdominal wall while attempting to tension free midline closure and strengthen the midline abdomen. Recurrence is a well-documented problem, however, with approximately 20% of patients suffering a failure of the repair and experiencing recurrence of their midline hernia with fewer surgical options (5, 6).

Given the challenges associated with component separation, we explored alternative ventral herniorrhaphy options, such as tissue expansion, to treat the patient with mass of abdominal domain. The pedicles and adult surgical literature describes the use of tissue expanders to address abdominal wall defects by increasing the amount of tissue available to fill the defect (7–9). Rodrigo et al. [10] reported a case of a 47-year-old woman who underwent staged abdominal wall reconstruction to treat a motor vehicle accident-related abdominal compartment syndrome. Tissue expanders were placed adjacent to the abdominal hernia and following a component separation procedure, five sheets of a human acellular dermal matrix (ADM; Alloderm® Regenerative Tissue Matrix, LifeCell, Branchburg, NJ, USA) were secured to the fascia to reduce tension on the closure. One year postoperatively, the closure was well healed and no hernia recurrence was observed.

Regardless of the means of obtaining midline closure, the use of internal herniotomy provides additional reinforcement. Synthetic mesh repair has been shown to be superior to native repair, particularly in patients with ventral incised hernias (11). Synthetic mesh may be added to each expander. The limit for each week's expansion was determined by the patient's comfort level. The goal of expansion at each session was 100 ml; however, additional fluid was placed in the expander until the patient noticed some discomfort when reported as pressure in the area of the expander at which point filling was stopped. Most patients reported that this discomfort disappeared in about 24 h. On a case-by-case basis, patients were given analgesics before each expansion to help alleviate discomfort. The expansion process was repeated for 8 to 8 weeks or until obtaining the required expansion as determined by physical examination and computed tomography (CT) imaging measurements. The amount of expansion was determined by the size of the hernia. Each expander was filled to a diameter equal to the widest diameter of the hernia defect. In our experience, because the old mesh had shifted, the final hernia size after deflation is very similar to the defect visible on the preoperative CT images (Fig. 3). Once the expansion was complete, each rectus abdominis muscle would then be advanced toward the midline by a distance equal to the radius of each expander to provide muscle tissue to cover half of the area. Those expanded muscle surfaces allowed the rectus abdominis muscles to inset at the midline without tension in an anatomically correct manner. The second-stage surgeries were scheduled at least 2 weeks after the final expansion session. Immediately prior to PADM placement while the patient was under general anesthesia, surgeons from the Colorectal Service first resected the hernia, performed a lysis of adhesions procedure, and removed previously placed meshes. The bowel was then centered and fixed from the abdominal wall to allow for placement of the PADM undersurface. The Plastic Surgery Service injected an additional 200 ml into each tissue expander to provide a small amount of extra stretch to the abdominal wall. They then accessed the expanders through the previous subcostal incisions, drained them, and removed them. Old scar tissue was excised and the subcostal incisions were closed in a layered fashion, with one or more placed in each pocket to reduce the risk of seroma formation.

After expansion removal, redundant skin overlying the hernia was debulked, and the skin and fascial edges were reapproximated. The abdominal wall flaps were advanced to the midline to ensure a tension-free closure. The skin surrounding the hernia was then undermined in a subcutaneous plane bilaterally, but only as far as needed to ensure a secure fascial flange (attachment of the PADM overlay (tympanically a distance of 2 cm from the incision line). A sheet of PADM was placed into the abdominal cavity using a punch technique to serve as an underlay. The goal is to have the underlay as tight as feasible such that when the abdominal wall is closed, the underlay is as close to the abdominal wall as possible. The underlay was secured with interrupted 3/0 Prolene sutures with monotonous tension to avoid folding. The abdominal wall was then closed primarily using running locked 0 PDS sutures (Ethicon). A single layer of adhesive (Nestor® M, St. Paul, MN, USA) was applied. The abdominal binder was applied and the drapes were retracted to mechanical suction overnight. The patients were advised for postoperative management and diet advancement. At discharge, drains were switched to bulb suction and patients were given instructions to limit their activity and wear their abdominal binder at all times. Initial follow-up examination was at 1 week. Drains were maintained for at least 2 weeks to encourage adherence of the PADM and removed based on visual output, usually by 3 weeks. By 1 month after the second-stage surgery, patients were allowed to resume full activity. The abdominal binder is continued for the first month and highly recommended for the first 6 months post-operation.

Table 1 Background information on the patient with hernia

<table>
<thead>
<tr>
<th>Patient Age</th>
<th>BMI</th>
<th>Hernia defect size (cm²)</th>
<th>Male/Female</th>
<th>ADM overlay size (cm²)</th>
<th>ADM overlay number</th>
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ADM = acellular dermal matrix, BMI = body mass index

due to problematics in patients with a risk of infection, however, and is contraindicated in the setting of an actively contaminated surgical field. In such patients, biologic ADM is an effective alternative to synthetic mesh (12). Midline ventral defect closures achieved with or without component separation have been shown to have lower recurrence rates when reinforced with ADM than when nonreinforced with ADM or nonreinforced with ADM and a mesh (13, 14).

Neurotized intercostal pedicle-derived ADM (PADM; Strattice® Regenerative Tissue Matrix, LifeCell) is a biologic mesh used in ventral herniorrhaphy. Histologic data in primates show ideal cellular repopulation and rematuration with a PADM matrix (15). Clinical research has documented the safety of neurotized PADM expanders as an effective component of a muscle repair in parastomal hernias (16), chest wall resection (17), and ventral hernia repair (18).

No studies have reported the combined use of tissue expanders and PADM epidural in patients with abdominal wall defects. Our objective in this case study series is to achieve stable primary midline closure using tissue expanders combined with an underlay and overlay of neurotized-intercostal pedicle PADM. This approach creates a stable abdominal wall by restoring its natural anatomic structure without compromising the integrity of the lateral musculature.
of the abdominal wall (Fig. 16). At the 10-month follow-up visit, the patient complained of lateral abdominal wall pain that subsequently resolved without intervention. This pain is not unusual even months post-operatively and is related to the pulling on the permanent Prolene sutures holding the lower edge of the APD. Patient usually experience this weeks to months after the surgery when they really become more active.

Case 2

The second patient is a 35-year-old man who underwent laparoscopic cholecystectomy in 2006 (Table 1). He subsequently developed an abdominal incisional hernia that was repaired on an outpatient basis using meshes by the Colorectal Surgery Service in 2009. The herniography site became infected and he underwent a second hernioplasty with patching in November 2010. Resolution of the surgical site was noted in December 2010, and despite antibiotic treatment and local wound care, the patient’s hernia continued to increase in size. A ventral hernia measuring 12-× 8 cm was shown on CT imaging (Fig. 17).

![Fig. 17] CT scan of the hernia.

PADD. This third repair attempt also failed. At consultation with AP following referral to the Plastic Surgery Clinic, the CT scan showed an 8-× 6 cm ventral hernia (Fig. 20) and the patient was scheduled for repair using the tissue expander method and PADD overlay and overlay.

In October 2011, the patient underwent insertion of tissue expanders, which were incrementally expanded to 750 ml postoperatively (Fig. 21). He underwent repair using expanded tissue and PADD overlay and overlay and is doing well 17 months postoperatively (Figs. 22 and 23). Follow-up CT scans done for right upper quadrant pain incidentally shows stable repair at 2 months (Fig. 24).

Discussion

Recent hernias are a particularly challenging problem for surgeons, especially when patients present with a history of multiple surgeries, infections, and loss of domains. Massive hernias may also be associated with discomfort and disability. Patients with obesity, diabetes, wound contamination, or other comorbidities are at an increased risk for developing complex hernias.

A history of smoking, abdominal surgery, infection, or other underlying conditions may contribute to the development of hernias. The use of mesh in hernia repair is well established, and its use has significantly reduced the recurrence rate in the short term. However, the long-term outcomes and complications associated with mesh repair are still a topic of debate.

References