Endoscopically Assisted “Components Separation” for Closure of Abdominal Wall Defects

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Learning Objectives: After studying this article, the participant should be able to: 1. Discuss the complexities related to repair of midline ventral hernias. 2. Describe the anatomic structures of the anterior abdominal wall. 3. Discuss the four objectives for successful anterior herniorrhaphy. 4. Discuss the potential advantages of endoscopically assisted components separation.

The repair of ventral hernia defects of the abdominal wall challenges both general and plastic surgeons. Ventral herniation is a postoperative complication in 10 percent of abdominal surgeries; the repair of such defects has a recurrence rate as high as 50 percent. The “components separation” technique has successfully decreased the recurrence rates of ventral abdominal hernias. However, this technique has been associated with midline dehiscence and a prolonged postoperative stay at the authors’ institutions.

The purpose of this study was to determine whether endoscopically assisted components separation could minimize operative damage to the vasculature of the abdominal wall and decrease postoperative wound dehiscence. The study group consisted of seven patients who underwent endoscopically assisted components separation; the control group consisted of 30 patients who underwent open components separation. The two groups were similar regarding demographic data and defect size.

The endoscopic group had a higher initial success rate than the open group (100 versus 77 percent). Recurrence rates were not significantly different between the two groups. However, the endoscopically assisted components separation patients had fewer postoperative and long-term complications. In the authors’ experience, endoscopically assisted components separation has proved to be a safe and effective method for the repair of complicated and recurrent midline ventral hernias. (Plast. Reconstr. Surg. 105: 720, 2000.)

Ventral herniation is a postoperative complication in 10 percent of abdominal surgeries (Fig. 1).1,2 Predisposing factors to herniation include obesity, pulmonary disease, wound infection, sepsis, malnutrition, anemia, and corticosteroid dependency.3 If untreated, herniation may result in intestinal incarceration, strangulation, and obstruction. Because of the complexity of this problem and the high recurrence rate, no standardized and universally applicable surgical technique has been identified for treatment.

The abdominal wall is composed of multiple overlapping layers of musculature (Fig. 2). The internal and external oblique and the transversus abdominis muscles together form the musculature of the anterolateral abdominal wall. These muscle groups overlap one another, with contrasting orientation of their muscle fibers.

Both a superficial and a deep vascular system form the blood supply to the abdominal wall. The skin and subcutaneous tissues of the abdominal wall are supplied by direct cutaneous vessels, such as the superficial circumflex iliac and the superficial inferior epigastric arteries, and by musculocutaneous vessels, such as the deep inferior and superior epigastric arteries. The perforators of the deep epigastric arcade...
supply the rectus muscle and the overlying skin in the midline. Inadvertent interruption of these vessels can lead to ischemic changes in the abdominal wall, including midline skin necrosis and wound dehiscence.

The intercostal, subcostal, iliohypogastric, and ilioinguinal nerves, which provide motor and sensory innervation to the abdomen, are derived from the roots of nerves T7 through L4. These nerves course circumferentially through the abdominal wall, terminating at the midline. The rectus abdominis muscle is innervated by the five lower intercostal nerves and by the subcostal nerve. The external oblique muscle is innervated by the intercostal (branches 7 to 11), subcostal, and iliohypogastric nerves. The internal oblique and transversus abdominis muscles are supplied by the intercostal (branches 8 to 11), subcostal, iliohypogastric, and ilioinguinal nerves. Nerves should be preserved for sensation and to maintain motor function.

The closure of abdominal wall defects using “components separation” was first reported by Ramirez et al. in 1990. Using this method, DiBello and Moore reported a recurrence rate of 8.5 percent. This technique is unique in that the functional transfer of the abdominal musculature provides stable and dynamic support to the abdominal wall, without the need for musculofascial flaps.

Using components separation, the posterior rectus sheath and external oblique are sequentially incised and released, allowing midline advancement of the abdominal wall. The linea alba is thus recreated, and dynamic support is provided. Relaxing incision to the external oblique allows 2, 4, and 2 cm of advancement in the upper, middle, and lower thirds of the abdomen, respectively. Release of the posterior rectus sheath allows the anterior sheath of the rectus muscle to be advanced 3, 5, and 3 cm, respectively. The combined release of the posterior rectus sheath and the external oblique maintains fascial continuity and allows an advancement of 5, 10, and 3 cm, respectively. In sum, bilateral partition and sequential relaxing incisions provide 10, 20, and 6 cm of advancement in the upper, middle, and lower thirds of the abdomen, respectively.

The advent of endoscopy has expanded the surgical horizon. The use of endoscopy provides multiple surgical advantages, including decreased scarring, preservation of anatomic...
structures, and decreased morbidity. Endoscopy eliminates the trauma inherent in large surgical incisions, including vascular interruption. Finally, endoscopy is associated with less postoperative pain, a more rapid recovery and, consequentially, a diminished length of hospital stay and reduced overall cost of repair.8–12

Concerns exist regarding the use of endoscopy. One drawback is the initial high cost of purchasing endoscopic equipment. Additionally, a short learning curve is involved in becoming comfortable with the endoscopic approach. Initially, technical difficulty in the use of the endoscope will result in longer operative times. However, once the surgeon is proficient with the endoscope, operative time will rapidly decrease. Additionally, the use of balloon dissection quickly develops a fascial plane and helps to decrease operative time.13 This report describes our experience with endoscopically assisted components separation.

SUBJECTS AND METHODS

A total of 37 patients with midline ventral hernias who were treated at the University Health System between October of 1994 and June of 1997 form the basis of this study. The control group consisted of 30 patients undergoing open components separation. A retrospective chart review was used to evaluate the control group. The study group consisted of seven patients who underwent endoscopically assisted components separation. This group was composed of the first seven patients evaluated for standard components separation after the development of the endoscopically assisted components separation concept.

Coexisting medical diagnoses were recorded for both groups, as were body mass index, the size of defect, and social history. Operative data, postoperative recovery data, and compli-
cations associated with the procedure, including infection and dehiscence, were evaluated. A follow-up of the study group 1 year postoperatively was undertaken to determine the definitive results of the repair and long-term complications.

A standard endoscopic setup, including a light source, video camera, and monitor, is used for the dissection. A high-flow insulator, using carbon dioxide gas, is used during the procedure. Endoscopic instruments include one 10-mm port, two 5-mm ports, blunt and sharp forceps, electrocautery, and scissors. The endoscope is a 10-mm, 30-degree, angled laparoscope. The SpaceMaker balloon, manufactured by Snowden Pencer and fillable to 1000 cc, is used to assist with dissection (Fig. 3).

Operative Technique

After a preoperative mechanical and antibiotic bowel preparation, parenteral antibiotic administration, and placement of pneumatic compression devices, the patient is placed in the supine position. General anesthesia by means of endotracheal intubation is used, and the skin is sterilized from the nipples to the upper thighs using a standard povidone-iodine solution. A Foley catheter is inserted.

The involved scar tissue or skin graft is excised, the hernia is reduced, and the hernia sac and scar tissue are removed. A limited lysis of adhesions is performed to free the posterior abdominal wall. The fascial edges are freed with a 1-cm margin to avoid the interruption of the perforators from the anterior surface of the rectus.

A sequential approach is then undertaken. If the fascial edges of the wound approximate without tension using two Adson forceps, successful fascial closure can be obtained. If tension is noted, the posterior rectus fascia is released one side at a time, checking the tension after each release (Fig. 4). Using open components separation, the external oblique muscle is next released by exposing the semilunar lines with large subcutaneous undermining (Fig. 5).

Alternatively, the endoscopic approach may be used. Figure 6 shows the incision lines and trochar sites. First, a small incision is made 5 cm medial to the anterior superior iliac spine, transecting the skin and soft tissue, and bluntly exposing the abdominal wall. The SpaceMaker balloon is placed in the midaxillary line and filled with saline to hydrodissect a vertical pocket (Fig. 7). The space is gently insufflated for exposure, and two smaller trochars are placed under direct vision: the superior one is placed 2 cm below the costal margin, and the inferior one is placed 3 cm medial and superior to the original trochar. The anatomy is then identified, and hemostasis is obtained, if necessary.

The external oblique muscle is retracted laterally from one port and released with an endoscopic electrocautery from the other port (Fig. 8). Instrument position is changed from one port to the other to obtain full fascial release from the costal margin to the level of the anterior superior iliac spine. The external oblique muscle is released 1 cm lateral to its fascial extension at the semilunar line to avoid iatrogenic injury to the underlying internal oblique fascia. The surgeon may place one hand in the abdominal cavity to assist with exposure, palpate the release, and ensure fascial integrity. The endoscope can be used to undermine the external oblique muscle laterally in an avascular plane to provide maximum advancement.

Next, hemostasis is obtained, and a 9F Blake drain is pulled through the subcostal incision, out the inferior incision, and secured. The abdomen is checked for fascial advancement; if fascial release is inadequate for closure, the same procedure is performed on the opposite side. The overlying skin will follow the fascia as it is released; therefore, no additional skin undermining is necessary. Finally, the midline
fascia and skin are closed, and the wounds are dressed (Fig. 9). All patients are instructed to wear an abdominal binder and to avoid heavy lifting for 6 weeks.

CASE REPORTS

Case 1

A 35-year-old Hispanic woman was involved in a motor vehicle accident in 1994; she sustained a closed head injury and a pelvic fracture. A trauma-related abdominal defect was closed with a split-tissue skin graft. Subsequently, she developed a single large ventral defect, 15 × 25 cm in size. Using bilateral endoscopically assisted components separation with the placement of intraabdominal mesh, the defect was closed successfully (Fig. 10). Her long-term course was without complications (Table 1).

Case 2

A 49-year-old Hispanic woman had undergone an open cholecystectomy and three caesarian sections; she had a 10-
year history of a large ventral defect measuring 15 × 21 cm. The medical history was significant for insulin-dependent diabetes mellitus and obesity. Using bilateral endoscopically assisted components separation, the defect was successfully corrected, and the patient was extubated and transferred from the intensive care unit to the floor postoperatively. Six weeks postoperatively, the patient developed a local infection at a trochar site that resolved with oral antibiotic therapy. The midline wound was free of infection; no dehiscence occurred, nor did the defect recur.

**Case 3**

A 50-year-old Hispanic woman had undergone an open cholecystectomy, abdominal hysterectomy, and oophorectomy, with a twice-recurrent ventral defect. Her medical history was significant for hypothyroidism, depression, and obesity. She had two large ventral defects measuring a total of 15 × 21 cm. This patient underwent endoscopically assisted components separation of the left side only because the right abdominal musculofascial tissue was scarred during a previous cholecystectomy. The wound was successfully closed, and the patient was extubated immediately postoperatively. No postoperative complications occurred.

**Case 4**

A 48-year-old Caucasian man had a history of diverticulitis, with colostomy placements in 1994 and 1995, and a course complicated by wound infections. This veteran was obese and tobacco-dependent, and he had a history of alcohol dependence, coronary artery disease, cerebral vascular accident, gastroesophageal reflux disease, and renal failure. He had two large defects totaling 15 × 25 cm in size. This patient underwent bilateral endoscopically assisted components separation with concomitant liver biopsy, ostomy closure, and resection of necrotic omentum. The defect was successfully corrected, and the patient was extubated postoperatively. The postoperative course was unremarkable, without dehiscence or recurrence.

**RESULTS**

The technique of endoscopically assisted components separation was used in the repair of seven patients; 30 patients underwent open components separation. All patients were followed postoperatively for complications. The patient demographics, including mean age and body mass index, of the two groups were not significantly different (endoscopic group: mean age, 52.9 years; body mass index, 35.2 kg/m²; open group: mean age, 45 years; body mass index, 33.2 kg/m²). The endoscopic group was 57 percent female, and the open group, 50 percent female. The mean defect size was 13.9 × 20.7 cm (288 cm²) in the en-

### TABLE I

**Patient Summary**

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (years)</th>
<th>Surgery Date</th>
<th>Defect Size (cm)</th>
<th>History</th>
<th>Repair</th>
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<tbody>
<tr>
<td>1</td>
<td>35</td>
<td>2/26/97</td>
<td>15 × 25</td>
<td>Motor vehicle accident with multiple injuries</td>
<td>Bilateral release of posterior rectus sheath and external oblique muscle</td>
</tr>
<tr>
<td>2</td>
<td>53</td>
<td>3/13/97</td>
<td>10 × 17</td>
<td>Open laparotomy for diverticulitis</td>
<td>Bilateral release of posterior rectus sheath and external oblique muscle</td>
</tr>
<tr>
<td>3</td>
<td>49</td>
<td>3/19/97</td>
<td>15 × 21</td>
<td>Open cholecystectomy and 3 caesarian sections</td>
<td>Bilateral release of posterior rectus sheath and external oblique muscle</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
<td>3/24/97</td>
<td>12 × 16</td>
<td>Abdominal aortic aneurysm repair</td>
<td>Bilateral release of posterior rectus sheath and external oblique muscle</td>
</tr>
<tr>
<td>5</td>
<td>65</td>
<td>4/30/97</td>
<td>15 × 20</td>
<td>Appendectomy, perforated appendicitis</td>
<td>Bilateral release of posterior rectus sheath and external oblique muscle</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>5/6/97</td>
<td>15 × 21</td>
<td>Open cholecystectomy, abdominal hysterectomy, and oophorectomy</td>
<td>Release of left posterior rectus sheath and left external oblique muscle</td>
</tr>
<tr>
<td>7</td>
<td>48</td>
<td>5/28/97</td>
<td>15 × 25</td>
<td>Diverticulitis, colostomy</td>
<td>Bilateral release of posterior rectus sheath and external oblique muscle</td>
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</table>

### TABLE II

**Patient Information**

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>BMI* (kg/m²)</th>
<th>ASA Class†</th>
<th>Tobacco Smokers n (%)</th>
<th>Diabetes Mellitus n (%)</th>
<th>Steroid-Dependent n (%)</th>
<th>Defect Size (cm²)</th>
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<tr>
<td>Open group (n = 30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>45</td>
<td>33.2</td>
<td>2.3</td>
<td>13 (45)</td>
<td>7 (25)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Median</td>
<td>45</td>
<td>31.3</td>
<td>2</td>
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<tr>
<td>Range</td>
<td>16–68</td>
<td>19–61</td>
<td>1–3</td>
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<tr>
<td>Endoscopic group (n = 7)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>52.9</td>
<td>35.5</td>
<td>2.7</td>
<td>3 (43)</td>
<td>1 (14)</td>
<td>1 (14)</td>
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<tr>
<td>Median</td>
<td>50</td>
<td>30.8</td>
<td>3</td>
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<tr>
<td>Range</td>
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<td>27–47</td>
<td>2–3</td>
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* BMI indicates body mass index; a BMI > 25 indicates overweight, and a BMI > 30, obese.
† American Society of Anesthesiologists Classification, range of I to V.
TABLE III
Intraoperative Data

<table>
<thead>
<tr>
<th></th>
<th>Operative Time (min)</th>
<th>Estimated Blood Loss (cc)</th>
<th>Defects Closed n (%)</th>
<th>Mesh Used n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open group (n = 30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>288</td>
<td>293</td>
<td>23 (77)</td>
<td>10 (33)</td>
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<tr>
<td>Median</td>
<td>273</td>
<td>300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>120–525</td>
<td>50–700</td>
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<td></td>
</tr>
<tr>
<td>Endoscopic group (n = 7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>294</td>
<td>193</td>
<td>7 (100)</td>
<td>1 (14)</td>
</tr>
<tr>
<td>Median</td>
<td>280</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>250–420</td>
<td>100–350</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

doscopic group and 11.6 × 18 cm (209 cm²) in the open group (Table II).

Mean operative time and estimated blood loss were 294 minutes and 193 cc, respectively, in the endoscopic group and 288 minutes and 293 cc, respectively, in the open group. In the endoscopic group, 100 percent of defects were successfully closed with fascial approximation, and 14 percent required mesh. In the open group, 77 percent of wounds were successfully closed, and 33 percent required mesh (Table III). The postoperative hospital stays were 7.1 and 12.5 days in the endoscopic and open groups, respectively (Table IV).

Complications in the endoscopic group included a 14 percent incidence of ileus, with no cardiac or renal complications. In the open group, the incidence of ileus and cardiac and renal complications was 27, 23, and 3 percent, respectively. The incidence of respiratory complications was 14 percent in the endoscopic group and 23 percent in the open group (Table V).

The endoscopic group had no incidence of midline wound infections, ischemia, or dehiscence. In the open group, the incidence of infection, ischemia, and dehiscence was 40, 20, and 43 percent, respectively. The recurrence rate in the endoscopic group was 14 percent, and in the open group, 10 percent (Table VI).

**DISCUSSION**

Ventral herniation at an incision site is a postoperative complication in 10 percent of abdominal surgeries. Predisposing factors to herniation include obesity, pulmonary disease, wound infection, sepsis, malnutrition, anemia, and corticosteroid dependency. Left untreated, herniation may result in intestinal incarceration, strangulation, and obstruction.

Successful repair of ventral herniation is a challenge to both general and plastic surgeons. The goals of ventral hernia repair, as stated by DiBello and Moore, include (1) the prevention of visceral eventration, (2) the incorporation of the abdominal wall, (3) the provision for a tension-free repair, and (4) the provision for dynamic muscular support. Ger and Duboys emphasized that the use of innervated and vascularized musculofascial flaps is superior to use of synthetics or denervated and devascularized myofascia in the repair of large hernia defects.

Abrahamsom and Eldar state the importance of recreating a linea alba to achieve wound healing. In the absence of the linea alba, the lateral abdominal musculofascial tissue is anchorless. Lateral contraction of the musculature allows for the protrusion of viscera through the midline defect. If the midline anchor for the abdominal musculature is reestablished through tensionless coaptation of the wound borders, the chance of hernia recurrence is minimized. The linea alba is most effectively recreated using autologous fascia.

In smaller defects, primary repair can be achieved without wound tension, incorporating the abdominal wall and providing support to the intraabdominal viscera. However, in large defects, closure cannot be tension-free,

**TABLE IV**
Recovery Data

<table>
<thead>
<tr>
<th></th>
<th>Postoperative Antibiotic (days)</th>
<th>Postoperative Stay (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open group (n = 30)</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>Mean</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Median</td>
<td>0–54</td>
<td>1–57</td>
</tr>
<tr>
<td>Endoscopic group (n = 7)</td>
<td>4.4</td>
<td>7.1</td>
</tr>
<tr>
<td>Mean</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Median</td>
<td>0–8</td>
<td>5–11</td>
</tr>
<tr>
<td>Range</td>
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</table>
and support is not dynamic. The failure of a ventral hernia repair is a common problem for the reconstructive surgeon, and recurrence rates after a secondary repair are reported to be as high as 50 percent.16–18

Prosthetic mesh has been used to augment primary closure, and it specifically aids in relieving tension across the repair. The use of prosthetic materials reportedly lowers recurrence rates to between 10 and 20 percent.2,19 However, prosthetic material lacks the dynamics of innervated, autologous tissue. The use of mesh is also associated with complications, including extrusion, fistula formation, and infection. Finally, the use of prosthetic material is contraindicated in the contaminated wound.

Musculofascial flaps have many advantages, including providing strength and dynamic support to the muscle tissue, supporting the intra-abdominal contents, tension-free closure, and incorporating the abdominal wall. The use of local musculofascial flaps to correct midline defects is hindered by a limited arc of rotation and weakening at the donor site.11 Likewise, distant flaps and free tissue transfer are limited by poor cosmesis and donor-site morbidity.7

Byrd and Hobar20 describe the tissue expansion of autologous muscle as a method for correcting hernia defects in children; Hobar et al.21 later reported its use in the repair of a posttraumatic defect in an adult. This procedure is advantageous in that innervated, vascularized, autologous tissue is used, which allows dynamic, tension-free support without necessitating tissue transfer. However, tissue expansion is a staged procedure, and a significant amount of time and expense may be required before closure is achieved. Additionally, a 20 percent complication rate of premature exposure and infection of the expander has been reported.22

Abdominal components separation is a technique that achieves the four goals of reconstruction using innervated and vascularized tissue, without necessitating tissue transfer. Additionally, this method can recreate the linea alba, successfully providing a midline anchor. Thomas et al.23 reported 100 percent success using components separation in a series of seven patients. DiBello and Moore2 report a recurrence rate of 8.5 percent using open components separation in a series of 35 patients. However, 15 of these patients required buttress with synthetic mesh.

In our experience, open components separation has been associated with complications of wound ischemia, infection, and dehiscence. Presumably, these complications are secondary to surgical interruption of the perforating vessels during tissue undermining and exposure of the external oblique muscle. Undermining also necessitates a large subcutaneous wound in continuity with the midline.

Endoscopy has allowed us to modify the components separation technique, eliminating the need for lengthy subcutaneous undermining and, thus, better preserving the cutaneous perforating vessels. Additionally, should infection, hematoma, or dehiscence occur, subcutaneous progression will be minimized. Intraoperative blood loss is diminished using endoscopy, and operative time is not significantly longer. Finally, in our experience, endoscopy shortened recovery time and decreased the postoperative stay by nearly 50 percent.

**TABLE V**
Associated Complications

<table>
<thead>
<tr>
<th>Urinary Tract Infection</th>
<th>Renal Complications</th>
<th>Ileus</th>
<th>Pulmonary Complications</th>
<th>Cardiac Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open group (n = 30)</td>
<td>1 (3)</td>
<td>1 (3)</td>
<td>8 (27)</td>
<td>7 (23)</td>
</tr>
<tr>
<td>Endoscopic group (n = 7)</td>
<td>1 (14)</td>
<td>0</td>
<td>1 (14)</td>
<td>1 (14)</td>
</tr>
</tbody>
</table>

**TABLE VI**
Wound Complications

<table>
<thead>
<tr>
<th>Midline Infection</th>
<th>Midline Ischemia</th>
<th>Dehiscence</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open group (n = 30)</td>
<td>12 (40)</td>
<td>6 (20)</td>
<td>13 (43)</td>
</tr>
<tr>
<td>Endoscopic group (n = 7)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
We could successfully correct abdominal defects as large as 15 × 25 cm in a relatively high-risk group with minimal morbidity. One patient had a local infection at a trochar site. As expected, the infection remained limited to the small lateral incision and responded promptly to oral antibiotics. The midline defect remained uninvolved in the infectious process.

The single recurrence occurred in a particularly high-risk patient: he was a smoker, steroid-dependent, and had chronic obstructive pulmonary disease. Additionally, this patient had a postoperative open wound secondary to hematoma formation and subsequent operative evacuation. Despite the fact that this patient had a recurrence, the new defect is small and uncomplicated, which is an improvement over his previous condition.

Finally, mesh was required in one endoscopic patient (14 percent) and 10 open patients (33 percent). The use of adjuvant mesh was required in the first endoscopic patient to achieve tension-free closure, but fascial approximation was achieved. The size of the mesh in both groups was substantially smaller than that which would be necessary for closure in a traditional herniorrhaphy. Preferably, both endoscopically assisted and open components separation should be attempted without the use of prosthetic materials.

In conclusion, we think that endoscopically assisted components separation is a safe and practical choice for repair in patients with large ventral midline defects. The closure of large defects can be achieved with maximal preservation of the vasculature of the abdominal wall (in particular, the midline perforating vessels), with minimal postoperative morbidity.

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REFERENCES


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1. What is the reported recurrence rate of a recurrent ventral hernia after conventional repair?
   A) 0 percent
   B) Less than 25 percent
   C) As high as 50 percent
   D) 100 percent

2. Which of the following has been reported as a potential risk of the conventional repair of midline ventral hernias?
   A) Midline wound ischemia
   B) Fistula formation
   C) Midline wound infection
   D) Recurrence
   E) All of the above

3. Which of the following is a goal of ventral herniorrhaphy, as stated by DiBello and Moore?
   A) Prevention of visceral eventration
   B) Incorporation of the abdominal wall
   C) Provision of tension-free repair
   D) Provision of dynamic muscular support
   E) All of the above

4. What is the reported recurrence rate of recurrent ventral hernia repair using the open method of components separation?
   A) 0 to 10 percent
   B) 10 to 20 percent
   C) 20 to 40 percent
   D) 40 to 50 percent

5. At the level of the umbilicus, how much midline tissue advancement can be achieved using bilateral components separation?
   A) 6 cm
   B) 10 cm
   C) 20 cm
   D) 30 cm

To complete the examination for CME credit, turn to page 824 for instructions and the response form.