

# Hybrid ventral hernia repair: technique and results

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## Abstract

**Background** Open and laparoscopic approaches to ventral hernia repair are generally exclusive of each other. However, select patients with difficult hernias may benefit from combined open/laparoscopic hybrid techniques to avoid dissection of large subcutaneous flaps.

**Methods** Seven patients underwent combined laparoscopic and open approaches for ventral hernia repair. Records were reviewed for technical details, demographics, hernia and mesh characteristics, and postoperative outcomes.

**Results** Two hybrid techniques were used: (1) initial laparoscopic approach converted to open adhesiolysis followed by totally laparoscopic mesh fixation and (2) open repair and adhesiolysis with laparoscopic-assisted mesh fixation. In the first approach, after conversion to open adhesiolysis, mesh with four quadrant sutures was placed intraabdominally. Pneumoperitoneum was re-established, and the mesh was fixed laparoscopically with sutures and tacks in standard fashion. For the second hybrid approach, after hernia reduction and adhesiolysis, mesh was anchored with sutures placed at 3–4 cm intervals with a Reverdin needle and further secured posteriorly with a hernia tacker over 180° circumference. Prior to tying the contralateral transfascial sutures, two 5-mm laparoscopic ports were placed lateral to the mesh under direct vision on the opposite side. Once the facial sutures were tied, pneumoperitoneum was established, and

the contralateral side of mesh was tacked laparoscopically. Mean patient age was 65 years and BMI 38. Mean defect size was 10.6 cm × 8.3 cm and mean mesh size was 25 cm × 19 cm. Operative time was 318 min (210–405 min). Hospital stay was 5 days (4–7 days). Morbidity was 57 % including one deep wound infection and a chronic sinus requiring reoperation. There were no hernia recurrences with average follow-up of 15 months (3–63 months).

**Conclusions** Hybrid laparoscopic and open techniques may be used in obese patients with difficult incisional hernias requiring open adhesiolysis. Further studies need to be done to better delineate hernia characteristics of patients that may benefit from this approach.

**Keywords** Hybrid · Ventral hernia · Incisional hernia

## Introduction

Incisional hernia repair is one of the more common operations done by general surgeons today with ~150,000 being done annually in the United States [1]. Over the last decade, the management of the ventral hernia has evolved and the complexity of the disease process has increased [2]. The reasons for this evolution are multifactorial and can be attributed to a number of variables that include most notably the increasing number of patients who have recurrences after prior mesh repairs and the obesity epidemic [3]. As a result, the technical considerations and risk stratification for this patient population are much different than a patient with a primary ventral hernia or an incisional hernia from a prior operation.

As the hernias have become more complex, the management strategy has evolved as well. Both open and laparoscopic techniques are frequently utilized with a variety of

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meshes, methods of mesh fixation, and location of mesh placement (sublay, onlay, etc.) employed. Although both approaches have been found to have good results [4–7], the laparoscopic approach has some advantages over an open repair that includes less risk of mesh infection and avoidance of the need to develop large subcutaneous flaps [8]. However, some incisional hernias either have too large a hernia sac or a chronically incarcerated component that make an exclusively laparoscopic approach technically challenging or unsafe based on operator judgment. In addition, some VHRs may be started laparoscopically, but are converted to open because of dense adhesions or other factors. Another option in difficult VHR patients is to utilize a hybrid approach by combining open and laparoscopic techniques in order to facilitate broad-based mesh fixation without the need to raise large flaps. The combination of these two options together has been mentioned briefly in the literature, but the indications for the hybrid ventral hernia repair (hybrid VHR) have not been clearly described [9–12]. The purpose of this study is to describe our approach to hybrid VHR and delineate the indications for the procedure.

## Methods

Between August 2006 and May 2011, we performed hybrid VHR in seven patients at Barnes-Jewish Hospital at the Washington University Medical Center. Under an institutional Human Studies Committee approved protocol, medical records of these patients were reviewed retrospectively for patient demographics, comorbidities, prior surgeries, body mass index (BMI), type and size of hernia defect, hybrid technique used, mesh selection, operative time, morbidity, mortality, complications and recurrences.

### Techniques

Hybrid VHR techniques were used in two scenarios within the patient population. Five cases started laparoscopically and were converted to open for difficult adhesiolysis. The other two cases were started as open procedures for previously placed mesh explantation and hernia reduction and the hybrid technique was utilized for mesh fixation. The hybrid technique for each scenario is described below.

#### *Technique 1: laparoscopic converted to open adhesiolysis and totally laparoscopic mesh fixation*

This technique was utilized when the initial laparoscopic approach was converted to open adhesiolysis due to dense adhesions to the abdominal wall or to previously placed mesh and was followed by totally laparoscopic mesh fixation. Initial access was obtained via a closed Veress

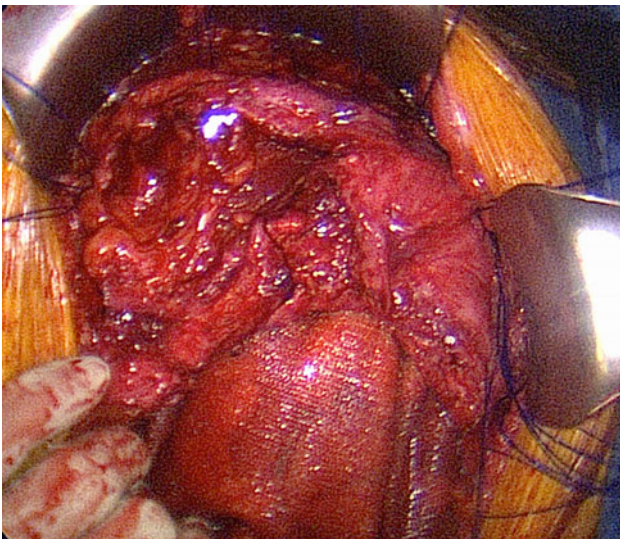
needle approach and subsequent optically guided trocar placement at the initial access point in a free quadrant. Standard port placement consisted of three 5-mm trocars on one side and two 5-mm trocars on the contralateral side of the abdomen. A 5-mm 30° angled laparoscope was used for visualization. Initial laparoscopic adhesiolysis was carried out until there was failure of progression due to dense adherence of intestine to the abdominal wall or previously placed mesh. At that point, an open incision was made and the adhesiolysis was completed and the hernia was reduced. In these cases, the open incision was typically just large enough to carry out the adhesiolysis and did not include development of skin flaps as is commonly done for open suture fixation. A barrier-coated mesh with four quadrant sutures was placed intraabdominally. After intraabdominal placement, the fascia was closed primarily and pneumoperitoneum was re-established. The mesh was then suspended on the abdominal wall with the four quadrant sutures and further secured laparoscopically with permanent monofilament transfixion sutures (minimum eight sutures) and spiral metal tacks (at 1 cm intervals) in a standard fashion. Skin and subcutaneous tissues were then closed with or without drain placement depending on the size of subcutaneous space.

#### *Technique 2: open VHR with laparoscopic-assisted mesh fixation*

The second technique involved initial open adhesiolysis with a combination open repair and laparoscopic-assisted mesh fixation. After open hernia reduction and adhesiolysis, a barrier-coated mesh was anchored to the fascia on one side with sutures placed at 3–4 cm intervals via a Reverdin needle and further secured posteriorly under direct visualization with a hernia tacker over a 180° circumference (Figs. 1, 2). At this point, two to three 5 mm laparoscopic ports were placed lateral to this fixated mesh under direct palpation in preparation for laparoscopic-assisted mesh fixation of the contralateral side. Transfascial sutures were then placed on the contralateral side of the mesh (unfixated side), which was then inserted intraabdominally for laparoscopic fixation. The abdominal fascia was then closed primarily over the mesh with subsequent laparotomy pad packing in the subcutaneous space and placement of an adhesive drape to maintain an airtight seal for insufflation. The abdomen was then insufflated. Using the previously placed ports, the sutures on the unfixated side of the mesh were brought up percutaneously with a suture passer for transfascial fixation in a standard laparoscopic fashion (Fig. 3). Further fixation of the mesh was achieved with a hernia tacker. Skin and subcutaneous tissues were subsequently closed with or without drain placement depending on the extent of the subcutaneous dead space in the open wound (Fig. 4).



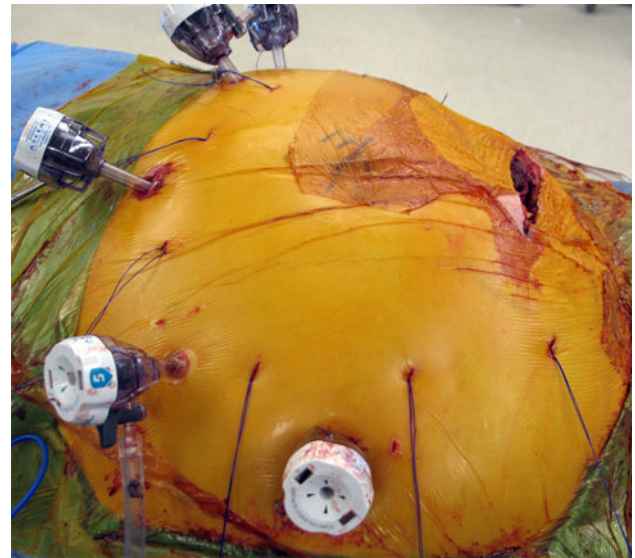
**Fig. 1** Mesh preparation for open fixation with Reverdin needle



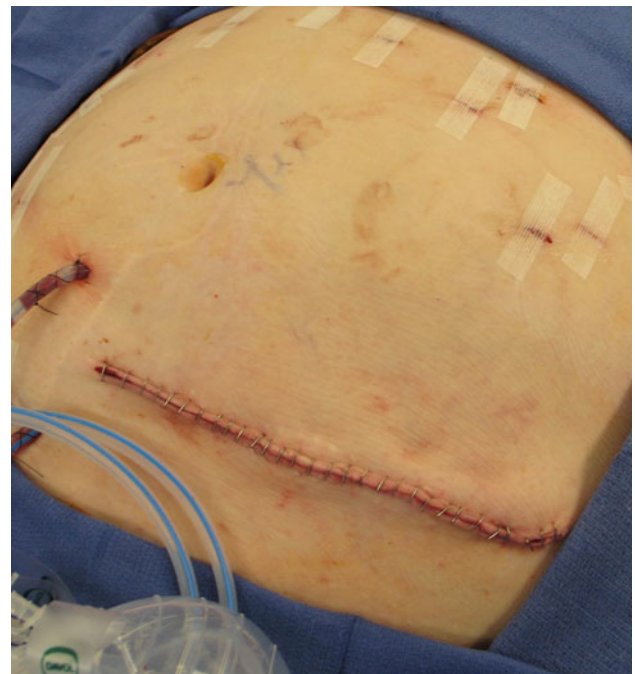
**Fig. 2** Mesh after open fixation with Reverdin needle

## Results

Three patients underwent technique 1, and four patients underwent technique 2. Mean patient age was 65 years (34–80 years). Prior abdominal surgeries are listed in Table 1. Three of the seven patients had prior ventral hernia repairs, two of whom had prior mesh placement. Mean BMI was 38 (28–62). Comorbidities were hypertension in four of seven patients, coronary artery disease in three of seven patients, and type II diabetes mellitus in one patient. All ventral incisional hernias were incarcerated at the time of repair. Total defect size was documented in six patients. Mean defect size was 10.6 cm × 8.3 cm (4–21 cm × 5–12 cm) and four of the seven patients had multiple defects (57 %).



**Fig. 3** External view of laparoscopic placement of transfascial sutures of unfixated side of mesh



**Fig. 4** Skin closure and JP drain placement

Two types of mesh were used in the repairs. Three patients had polytetrafluoroethylene (PTFE) mesh used and four patients had lipid barrier-coated mesh used. Mean mesh size was 25 cm × 19 cm (15–35 cm × 10–25 cm). Mean operative time was 318 min (210–405 min), which reflected the difficulty of the cases. Mean hospital length of stay was 5 days (range 4–7 days). Postoperative complications occurred in four patients (57 %). One patient had a



**Table 1** Summary of patient characteristics and hybrid technique

Patient	Surgeries	Technique	Mesh used
1	Open gastric bypass	1	PTFE
2	Open cholecystectomy/ umbilical hernia repair with mesh	2	PTFE
3	Right paramedian appendectomy	1	PTFE
4	Laparoscopic cholecystectomy/umbilical hernia repair	1	Lipid barrier synthetic
5	Open hysterectomy/ laparoscopic cholecystectomy/primary ventral hernia repair	2	Lipid barrier synthetic
6	Hysterectomy/ventral hernia repair × 2 with mesh	2	Lipid barrier synthetic
7	Cesarean section/open hysterectomy	2	Lipid barrier synthetic

postoperative seroma that spontaneously resolved (technique 1). Another patient had postoperative *Clostridium difficile* colitis that was treated with oral metronidazole (technique 1). A third patient had a lower extremity deep vein thrombosis that required anticoagulation. Two patients who were repaired with technique 2 developed infections that ultimately led to reoperation and mesh excision. One of these patients had undergone prior ventral hernia repairs and had a large lower midline hernia that extended to the left into a large lower abdominal wall panniculus, filling much of left lower abdominal wall with several loops of small bowel. The patient had an initial laparoscopic approach that was converted to open because of the extent of herniated small bowel that could not be reduced laparoscopically and then had a combined open and laparoscopic mesh fixation using a lipid barrier-coated mesh. She developed an infected abdominal wall seroma at 2 months postoperatively that was surgically drained and ultimately required excision of mesh at 7 months postoperatively. The second patient had a BMI of 62 and had undergone two prior periumbilical incisional hernia repairs, one of which done at an outside institution led to removal of chronically infected mesh. A third repair was done over 1 year after the mesh excision and was started laparoscopically, but converted to open due to extensive adhesions. A PTFE mesh was placed and secured in a combined open and laparoscopic fashion. She did well until 5 years later when an abdominal wall suture abscess developed that extended to the mesh. The patient was managed by mesh excision, placement of biologic mesh and primary fascial closure.

At a mean follow-up interval of 15 months in the seven patients (3–63 months), no hernia recurrences have been identified.

## Discussion

Ventral hernia disease is becoming more complex due to multifactorial causes. Among these, the obesity epidemic and the increasing use of mesh, which means that more patients who recur today are more likely to have had mesh placed previously, are two of the principal factors [1, 2]. A major advance in hernia surgery occurred with the introduction of laparoscopic repair techniques in the early 1990s. As the laparoscopic approach has gained increasing penetrance and acceptance, the principles of broad-based mesh fixation, avoidance of the development of skin flaps, and the use of a combination of transfascial sutures and tacks to secure the mesh to the abdominal wall may be carried over to open incisional hernia repair as well.

The hybrid approach as described herein makes use of these principles derived from the laparoscopic approach with the added advantage of fascial reapproximation, which is not routine in our standard laparoscopic ventral hernia repair where the defect is bridged. Hybrid VHR in our series originated from the need to convert from a laparoscopic to an open approach secondary to dense adhesions. In these cases, much of the adhesiolysis had already been done laparoscopically, and there was only a relatively limited section of the hernia or abdominal wall that remained to be freed. Despite open conversion, there can still be benefits to maintaining some aspects of the laparoscopic approach, which include smaller skin flaps and broad mesh underlay. These principles are also what guided the differences between technique 1 and technique 2. Technique 1 was used in situations where laparoscopic conversion to an open procedure for adhesiolysis was done but minimal skin flaps were needed to do the adhesiolysis. In this situation, mesh with transfascial sutures was placed intraabdominally and the fascia was closed. The abdomen was then reinsufflated and the mesh was fixated laparoscopically. Technique 2 was used in more difficult hernias. Two of the three patients undergoing this technique started with open adhesiolysis for the purposes of mesh excision. In all three cases, a more extensive dissection was required at least on one side of the defect (e.g., a hernia that bulged laterally to one side), which ultimately required a larger subcutaneous dissection albeit minimized compared to conventional open techniques. While difficult or unsafe adhesiolysis and mesh explantation were the reasons for a hybrid approach in this series, it is important to note that there are other factors that lend itself to a combined approach. Examples include wide defects which can make an exclusive laparoscopic approach technically difficult, as well as morbid obesity, which can limit the laparoscopic approach due to decreased intraabdominal working space through less distensibility of the abdomen and intraabdominal fat. Other factors include incarcerated or

strangulated intestine. Finally, clinical judgment and surgeon experience with laparoscopy are determining factors. These situations are descriptors of a complex ventral hernia case. Accordingly, operative times for these cases were long (mean 318 min).

Minimizing the extent of the wound becomes especially important when dealing with obese patients. In this study, all patients were at least overweight or obese with a mean BMI of 37.5 (range 28–62). Limiting the size of the wound via the hybrid approach could help prevent or minimize wound complications, which is one of the advantages of maintaining portions of the laparoscopic approach. Despite this theoretical advantage, two patients in this series developed mesh infections at intervals of 2 months and 5 years after their repairs that required mesh explantation. Both of these patients had very complex hernia disease and local factors that increased their risk of infection. Potentially, if their procedures could have been done completely laparoscopically, then the mesh infection risk may have been significantly reduced. However, both ended up with substantial open incisions necessitated by a combination of their hernia condition and intraabdominal adhesions. The subsequent laparoscopic portion of their mesh fixation was done to avoid having to develop large skin flaps on one side of the repair and would not have been expected to have impacted their infection risk.

Prior studies have described various hybrid techniques [3, 9], however, none of these reports have attempted to characterize the complexity of the ventral hernias or the types of patients requiring a hybrid technique as case descriptions have been small. Neff et al. [3] described case report of a laparoscopic-assisted ventral hernia repair in a technique similar to technique 1 as described in this paper. Similarly, Griniatsos described a series of four patients repaired with an approach similar to technique 1 as well [9]. The types and complexity of the hernias and patient parameters such as obesity were not described as the focus was the technical aspects of the repair. Chelala has described a large experience of laparoscopic ventral hernia repairs with defect closure. 49 % of patients in the series required minilaparotomy and external closure for defects larger than 10 cm, which would be similar to technique 1 in this series [13]. To our knowledge there has been no description similar to technique 2 in the literature, which was used in cases where prior mesh was utilized and hernia characteristics were very complex. Furthermore, attempts to identify the characteristics of patients undergoing hybrid approaches are lacking and likely secondary to the small volume of these techniques being used.

In our population, patients were obese with moderately large defects (mean size  $10.6 \times 8.3$  cm) that were all incarcerated. Three of the seven patients had prior ventral

hernia repair with two of these patients having prior mesh placed intraabdominally.

While increased morbidity after both open and laparoscopic ventral hernia repair have been described in obese patients [14, 15], there is a general diversity in the complexity of ventral hernias within the patient populations described. Moreover, it is hard to establish a classification system or a spectrum of the disease since there is so much variability from patient to patient. Attempts at classifying complex ventral hernias have been made [16], but further delineation of the disease needs to occur to better understand the expectations and implications of repairing a certain type of hernia with a given level of complexity. This diversity can also skew outcomes and make it difficult to compare results across or even within published reports.

In our study, complicating factors included: obesity, the presence of incarceration, prior ventral hernia repairs, and prior mesh placement. Though this study is small, the cases herein in which the hybrid approach was used generally had multiple factors that made them challenging. However, the three principal variables that have led to our use of the hybrid approach are: (1) the need to convert a laparoscopic approach to open due to dense adhesions; (2) explantation of prior mesh; and (3) the opportunity to avoid wide subcutaneous flap dissection on one side during an open approach in which the hernia preferentially bulges toward one side of the abdomen.

## Conclusions

The hybrid ventral hernia repair technique is an alternative approach to difficult ventral hernias that require conversion to open adhesiolysis or planned open adhesiolysis or mesh explantation. It allows for preservation of some of the advantages of laparoscopic ventral hernia repair such as minimization of subcutaneous dissection and broad mesh underlay and fixation under direct visualization. We believe that the scenarios that we have described involving the use of a hybrid approach may be of use to surgeons who deal with these complex hernia patients. Further studies are needed to determine long-term outcomes of this approach and to better define the clinical setting in which hybrid laparoscopic open VHR may be utilized.

**Conflict of interest** NS declares no conflict of interest, LMB declares no conflict of interest, MQ declares no conflict of interest.

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