

## A prospective study comparing the complication rates between laparoscopic and open ventral hernia repairs

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### Abstract

**Background:** Although ventral hernia repair is increasingly performed laparoscopically, complication rates with this procedure are not well characterized. For this reason, we performed a prospective study comparing early outcomes after laparoscopic and open ventral hernia repairs.

**Methods:** We identified all the patients undergoing ventral (including incisional) hernia repair at a single tertiary care center between September 1, 1999 and July 1, 2001 (overall  $n = 257$ ). To increase the homogeneity of the sample, we excluded umbilical hernia repairs, parastomal hernia repairs, nonelective procedures, procedures not involving mesh, and repairs performed concurrently with another surgical procedure. Postoperative complications (in-hospital or within 30-days) were assessed prospectively according to standardized definitions by trained nurse clinicians.

**Results:** Of the 136 ventral hernia repairs that met the study criteria, 65 (48%) were laparoscopic repairs (including 3 conversions to open surgery) and 71 (52%) were open repairs. The patients in the laparoscopic group were more likely to have undergone a prior (failed) ventral hernia repair (40% vs 27%;  $p = 0.14$ ), but other patient characteristics were similar between the two groups. Overall, fewer complications were experienced by patients undergoing laparoscopic repair (8% vs 21%;  $p = 0.03$ ). The higher complication rate in the open ventral hernia repair group came from wound infections (8%) and postoperative ileus (4%), neither of which was observed in the patients who underwent laparoscopic repair. The laparoscopic group had longer operating room times (2.2 vs 1.7 h;  $p = 0.001$ ), and there was a nonsignificant trend toward shorter hospital stays with laparoscopic repair (1.1 vs 1.5 days;  $p = 0.10$ ).

**Conclusions:** The patients undergoing laparoscopic repair had fewer postoperative complications than those receiving open repair. Wound infections and postopera-

tive ileus accounted for the higher complication rates in the open ventral hernia repair group. Otherwise, these groups were very similar. Long-term studies assessing hernia recurrence rates will be required to help determine the optimal approach to ventral hernia repair.

**Key words:** Ventral hernia repair — Laparoscopy — Open repair

Approximately 109,000 ventral hernias are repaired surgically each year in the United States [10]. Whereas open repair, preferably with mesh, [8] had long been the standard approach, the introduction of laparoscopic ventral hernia repair in the early 1990s [7] brought about new options for surgeons facing this challenging problem. Several studies have reported the potential advantages with laparoscopic repair, such as greater patient acceptance, shorter lengths of hospital stay, and lower recurrence rates [1–3, 5, 9]. Although many believe that laparoscopic repair also may be associated with lower complication rates, this assumption is not well tested. Most studies have involved case series lacking control groups (i.e., patients undergoing open repair) [4, 13]. Of the small number of controlled studies, most have been limited by small sample size [2, 5] or retrospective assessment of outcome variables, raising concerns about ascertainment bias. For a better examination of short-term outcomes after laparoscopic and open ventral hernia repairs, we performed a prospective cohort study of laparoscopic and open ventral hernias at our rural tertiary care medical center.

### Methods

#### Patient selection

We prospectively identified all 257 patients undergoing ventral hernia repairs at our tertiary care medical center between September 1, 1999

and July 1, 2001. To increase the homogeneity of the sample, we excluded umbilical hernias, parastomal hernias, nonelective procedures, hernia repairs not using mesh, and ventral hernia repairs performed concurrently with another procedure.

### Operative technique

Hernia repairs were performed predominantly by seven surgeons. Four of these surgeons performed open repair exclusively. The remaining three surgeons performed laparoscopic repair in the large majority of cases (>90%). Although no standardized protocol was used in this study, open ventral hernia repair generally used a polypropylene mesh, which was secured to the perimeter of the fascial defect with full-thickness bites of a nonabsorbable suture. When a hernia was small enough to be reapproximated without tension, the hernia edges were sutured together with nonabsorbable simple interrupted sutures, and a polypropylene mesh overlay was applied. The laparoscopic approach generally involved gas insufflation of the abdominal space (Veress technique), hernia reduction, and mesh underlay using either Dual Mesh (GORE, Flagstaff, AZ, USA) or Composix Mesh (Bard; Cranston, RI). The mesh selected was larger than the hernia defect, allowing at least 3 cm of mesh beyond the perimeter of the fascial defect. The mesh then was fixed to the abdominal wall using full-thickness sutures around the circumference of the mesh, leaving no more than 6-cm gaps. Fascial screws (Protacker; US Surgical Corporation, Norwalk CT, USA) were used to close residual gaps.

### Main outcome measures, data collection, and analysis

Our main outcome measures were postoperative complications, operative time (from incision to closure), and length of hospital stay. Data pertaining to postoperative complications were collected by trained nurse clinicians as part of a prospective clinical registry maintained by our division of general surgery. Complications were coded according to prospective definitions, modified slightly from those used by the VA National Surgical Quality Improvement Program [6]. All the patients were followed postoperatively until hospital discharge or for 30 days. All complications identified in the data registry were confirmed by chart review. Coding controversies were arbitrated by a clinical endpoints committee consisting of two attending surgeons and two nurses blinded to patient and surgeon identifiers. Although the main outcome measures were determined prospectively, some data elements (e.g., history of prior hernia repairs) were collected retrospectively by chart review.

All data were collected and analyzed using Microsoft Excel (Microsoft, Seattle, WA, USA) and Stata (Stata Corporation, College Station, TX, USA). Student's *t*-tests then were used to determine the significance between the continuous variables, and Fisher's exact test was used for categorical variables. All tests of significance are at the 5% level, and all *p*-values are two-tailed.

## Results

### Patient characteristics

Of the 257 ventral hernia repairs evaluated, 136 met our study criteria. There were 71 (52%) open ventral hernia repairs, and 65 (48%) laparoscopic ventral hernia repairs. Three patients in the laparoscopic group (4.6%) underwent conversion to open repair, but were kept in the laparoscopic group for outcomes analysis. Although the patients in the laparoscopic group were slightly more likely to have undergone prior ventral hernia repair (40% vs 27%;  $p = 0.14$ ), the patient characteristics of the two groups were otherwise similar (Table 1).

**Table 1.** Patient characteristics at the time of the index procedure

Patient characteristic	Laparoscopic	Open	<i>p</i> value
Ventral hernia repairs ( <i>n</i> )	65	71	
Age (mean years)	53.8	55.8	0.44
Male (%)	55.4	56.3	0.86
Prior (failed) ventral hernia repairs <i>n</i> (%)	26 (40)	19 (27)	0.14

**Table 2.** Outcome measures after ventral hernia repair

Outcome measure	Laparoscopic	Open	<i>p</i> value
Conversions to open procedure <i>n</i> (%)	3 (5)	—	—
Patients with complications <i>n</i> (%)	5 (8)	15 (21)	0.03
Surgery time (average h)	2.2	1.7	> 0.01
Length of stay (average days)	1.1	1.5	0.09
Hospital charges (average \$)	9,316	5,858	> 0.01

### Operating room time, length of hospital stay, and complications

As compared with open repair, laparoscopic repair was associated with longer operating room times (2.2 vs 1.7 h;  $p < 0.001$ ), but there was a trend toward shorter average hospital stays (1.1 vs 1.5 days;  $p = 0.10$ ) (Table 2). There were fewer complications among patients undergoing laparoscopic repair (8% vs 21%;  $p = 0.03$ ). There were five complications in the laparoscopic group (2 seromas, 2 mesh infections, and 1 unrecognized enterotomy). Both seromas were managed with percutaneous drainage, without the need for reoperation. However, the remaining three complications (2 mesh infections and 1 unrecognized enterotomy) required subsequent reoperation and mesh removal. The open group had a total of 15 complications. Of these, 12 were minor (6 wound infections, 3 drained seromas, 3 ileuses). The remaining complications were more serious (1 wound dehiscence, 1 intraperitoneal abscess, and 1 respiratory failure).

The incidence of major complications was the same, at three in each group. There was increased overall morbidity among the open hernia repairs because ileuses and wound infections were found exclusively in this group. These results are summarized in Table 3.

## Discussion

In this prospective cohort study, laparoscopic repair of ventral hernias was associated with fewer complications than open repair. The operative times were longer with laparoscopic repair, whereas the length of hospital stays tended to be shorter. Several prior studies [1, 5, 9, 11, 12] have compared complication rates between laparoscopic and open ventral hernia repairs. Most studies, including one randomized trial [1], found that laparoscopic ventral hernia repair results in fewer perioperative complications. However, this finding was not consistent across all

**Table 3.** Postoperative complications

Complication	Laparoscopic ( <i>n</i> = 65) <i>n</i>	Open ( <i>n</i> = 71) <i>n</i>	<i>p</i> value
Unrecognized enterotomy	1	—	
Mesh infection	2	—	
Seromas (drained)	2	3	
Ileus	—	3	
Wound infection	—	6	
Respiratory failure	—	1	
Wound dehiscence	—	1	
Intraperitoneal abscess	—	1	
Total <i>n</i> (%)	5 (8%)	15 (21%)	0.03

studies [2], nor was the size of the hernia defect similar in all studies. Many of the prior studies comparing laparoscopic and open repairs also examined operating room times and length of hospital stay. Again, most, but not all, showed general trends toward longer operative times and shorter length of hospital stay in laparoscopic repair.

One obvious weakness of this study was its observational design, which created the potential problem of patient selection bias. However, we believe it is unlikely that our findings resulted from systematic selection of the more difficult ventral hernias to be repaired by the open technique. In our series, surgeon preference rather than individual patient characteristics seemed to be the major determinant of whether patients received open or laparoscopic surgery. Moreover, there is no evidence that patients receiving laparoscopic surgery were less complex. Although data about some risk factors were not available for this study (most notably obesity), the patients in the laparoscopic group were almost twice as likely to have undergone prior (failed) mesh repair, a known risk factor for complications. There may also have been provider selection bias. However, we have no reason to believe that the four surgeons performing open repair at our institution are any more or less complication prone than the three surgeons favoring laparoscopic repair.

The scope of clinical outcomes assessed in this study was limited. Only two patients in the laparoscopic group (3%) and three patients in the open group (4%) underwent drainage procedures for large or symptomatic seromas. Because we did not document postoperative physical findings systematically or perform imaging tests routinely, our study likely underestimated the true incidence of seromas. However, the clinical importance of such occult seromas is small. More importantly, our prospective data did not extend more than 30 days beyond the operation. Thus, this study does not adequately answer questions about hernia recurrence and durability of laparoscopic ventral hernia repairs.

Our study showed that the risk of short-term complication is lower with laparoscopic ventral hernia than with open ventral hernia repair. The reduction in postoperative ileus and wound infections accounts for the decreased morbidity with laparoscopic ventral hernia repair in this study. This study lends power to the existing body of work comparing laparoscopic and open ventral hernia repairs, which shows fewer complications, shorter hospital stays, and longer operative times when ventral hernias are repaired laparoscopically. Randomized trials, with objective imaging applied to all patients, and longer follow-up evaluation are needed to determine the durability of laparoscopic repair in relation to the open repair.

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