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Laparoscopic ventral and incisional hernioplasty

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Abstract.
Background: While the first laparoscopic ventral hernia repair was reported in 1992, there have been no studies comparing laparoscopic to conventional ventral herniorrhaphy.
Methods: Twenty-one ventral hernias repaired laparoscopically are compared to a similar group of 16 patients undergoing traditional open repair during a 2-year period. Operative and hospital courses along with outcomes and cost analysis are analyzed.
Results: There was no statistical difference between groups in number of previous abdominal operations, prior hernia repairs, and comorbidities. Patients undergoing open repair were older with larger fascial defects. Open repairs had a shorter operative time as compared to the laparoscopic group, but statistically longer postoperative stays and costs. Postoperative complications occurred in 31% of the open group and 23% of the laparoscopic group. There were two recurrences in each group.
Conclusions: Laparoscopic herniorrhaphy is as safe and effective as the traditional open technique with shorter length of stay and decreased hospital costs.

Key words: Laparoscopy — Incisional herniorrhaphy — Hernia — Mesh

The laparoscopic approach to inguinal herniorrhaphy first reported by Ger [7] had led to a variety of laparoscopic hernia repairs. The first laparoscopic incisional herniorrhaphy publication appeared in 1992 [9]. Since that time there have been numerous case reports in the literature [2, 4, 5, 8, 15] but comparative studies have not been presented. This study retrospectively reviewed our recent experiences with laparoscopic incisional herniorrhaphy and compares them to our patients who underwent a traditional open repair during the same time period. Operative and hospital courses as well as patient outcome and cost were analyzed in order to help better define the role of laparoscopic repair of incisional and ventral hernias.

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Materials and methods

We retrospectively reviewed 37 incisional and ventral herniorrhaphies performed by the senior author between January 1993 and October 1995. All patients encountered during the review period with fascial defects greater than 25 cm^2 were included in the series (i.e., small defects such as umbilical hernias were excluded). Sixteen traditional open repairs were performed on 16 patients, and 21 laparoscopic repairs on 20 patients with one conversion to an open repair.

In the open group the mean age was 60.4 ± 10.2 years with an average 2.8 ± 1.8 comorbidities which would directly effect wound healing or tension on the abdominal wall (Table 1). There were an average of 3.6 ± 2.6 previous abdominal operations; four patients had had prior repair of their incisional hernias (range 1–9). In the laparoscopic group the mean age was 51.9 ± 13.5 years—an average of 3 ± 1.5 comorbidities which would directly effect wound healing or tension on the abdominal wall. On average there were 2.3 ± 1.4 previous abdominal operations; eight patients had had prior open repair of their incisional hernias (range 1–4) (Table 2).

Operations in both groups were performed under general anesthesia on an elective basis. Open repairs were performed one of three ways. The smaller hernias were closed primarily with simple interrupted nonabsorbable suture as described by Skandalakis [17]. Larger defects requiring prosthetic material were repaired either with an inlaid prosthesis [18] or a modified Gallie repair [10].

Laparoscopic repairs were performed by lateral and inferior (when possible) trocar placement. Specific port placement was dependent on the location and size of the hernia. Intra-abdominal adhesions were taken down with sharp and blunt dissection. No attempt was made to resect the hernia sac. With the hernia completely identified and a minimum of 4 cm of healthy tissue surrounding the defect on the posterior aspect of the anterior abdominal wall, a piece of Marlex mesh was secured. The mesh was attached to the abdominal wall using a standard laparoscopic hernia stapler. Attempts to cover the mesh with omentum were made when possible. This was accomplished either by simple interposition of the omentum between the exposed mesh and underlying bowel or by actually stapling the omentum to the abdominal wall to cover the mesh. The mesh was not covered by peritoneum, nor was a composite prosthesis utilized.

Hospital charts were reviewed for operative times, complications, and costs. Postoperative course was determined by review of hospital and clinic charts. Follow-up was conducted by phone interview to determine long-term complications and patient satisfaction. Four patients were lost to follow-up, two from each group.

Statistical analysis was performed using unpaired Student's *t*-tests of unequal variance.

Table 1. Comorbidities which adversely effect hernia repair

	Open	Laparoscopic
•Obesity	9	13
•Age (>70)	4	2
•Malnutrition		
Hypoproteinemia	—	—
Scurvy	—	—
•Pulmonary insufficiency		
COPD[a]	9	14
Chronic cough	3	7
•Immunosuppression		
Steroids	3	6
Immunodeficiency states	1	—
•Uremia	—	1
•Jaundice/hepatic insufficiency	—	—
•Diabetes mellitus	5	9

[a] Chronic obstructive pulmonary disease

Table 2. Patient demographics[a]

	Traditional	Laparoscopic	
Age	60.4 ± 10.2	51.9 ± 13.5	$p = 0.01$
Comorbidities	2.8 ± 1.9	3 ± 1.5	$p > 0.8$
Prior operation	3.6 ± 2.6	2.3 ± 1.4	$p > 0.09$
Prior repair	4 ± 3.6	2.1 ± 1.4	
Defect size	148 ± 172 cm^2	105 ± 86 cm^2	$p = 0.13$

[a] Patients in the traditional group tended to be older but had a similar number of prior operations and comorbidities which would adversely affect hernia repair. Size was statistically different; the patients in the open group had larger fascial defects

Results

In the open group, the mean fascial defect was 148.4 ± 172.4 cm^2 (range 28–600) compared to the laparoscopic group with a mean fascial defect of 105.1 ± 86.2 cm^2 (range 15.5–401) ($p = 0.13$). Five hernias were closed primarily in the open herniorrhaphy group and three in the laparoscopic group. The remaining 11 traditional open incisional hernia repairs required prosthetic material (10 Marlex, one Gore-Tex) and the remaining 18 laparoscopic repairs were completed with prosthetic material (Marlex).

Operative time for the open repair ranged from 45 to 259 min with a mean of 97.6 ± 63.6 min. The laparoscopic group had an operative time ranging from 70 to 211 min with a mean of 128.5 ± 37.0 min. Though the time required for laparoscopic repair has diminished, the duration is highly dependent on the size and complexity of the hernia. Statistically there was no difference in operative time ($p = 0.09$). Four operations in the open group were performed on an outpatient basis and the remaining 12 patients had a 4.9 ± 5.6-day average length of hospitalization. Though there were no intraoperative complications, five of these patients had a prolonged length of stay which can be attributed to the morbidity of the operation. The postoperative complications included prolonged ileus (inability to tolerate liquids 72 h after operation, two), wound infection (one), bowel obstruction (one) requiring reexploration, and postoperative hypoxia (one). Two laparoscopic operations were performed on an outpatient basis and the remaining 19 patients had a 1.6 ± 0.9-day average length of hospitalization. There was one operative complication involving an enterotomy which required conversion to an open procedure in order to avoid the use of prosthetic material. This patient remained hospitalized for 4 days and has had no further complications at 5 months' follow-up. Three patients in the laparoscopic group had a prolonged length of stay, which can be attributed to the morbidity of the operation. They included patients with pulmonary edema (one), persistent nausea and vomiting (one), and a small-bowel obstruction (one) which resolved with nonoperative management. One patient experienced transient shortness of breath immediately postoperatively but resolved spontaneously without prolonging the hospitalization. Only one patient in the laparoscopic group developed a postoperative seroma, which resolved without intervention. Overall there was a 31% postoperative complication rate in the open group and 23% in the laparoscopic group. Complications in the open group required additional hospital stays averaging 11.4 days compared to those in laparoscopic group which averaged of 1.6 extra hospital days (Table 3).

Open herniorrhaphies incurred total hospital costs of $7,299 ± 5,312 ($2,056–21,744) with operative costs of $1,435 ± 145 for the operating room and $528.2 ± 261 for surgical appliances. The laparoscopic cost averaged $4,395 ± 840 ($2,802–6,248) with operative costs of $1,572 ± 603 for the operating room and $905 ± 465 for surgical appliances. The one laparoscopic procedure converted to an open operation had a total cost of $6,506 with $1,664 operating room costs and $1,879 in surgical appliances. The operating room costs were not statistically different, $p > 0.4$, but total hospitalization costs were significantly different; the laparoscopic group was more cost effective ($p < 0.05$). As is currently seen with other laparoscopic procedures, surgical appliance costs were significantly higher in the laparoscopic group ($p < 0.004$) (Table 4).

Follow-up was similar for both groups with a mean time of 18.8 ± 8.3 months (range 5–29) in the open herniorrhaphies and 20.0 ± 10.2 months (range 6–38) in the laparoscopic group, $p = 0.7$. Telephone interviews of the open herniorrhaphy group revealed two patients who claimed to have recurrences (one which has been repaired). The other 14 patients have returned to daily activities and report no problems. Follow-up with the laparoscopic repairs revealed two patients who developed recurrences (both of whom underwent repeat laparoscopic repair at our institution). One patient developed a wound infection at a trocar site. Four patients complained of occasional pain for which they have not sought medical attention. Fifteen of the 19 patients have returned to daily activities and four remain on disability.

Discussion

The ultimate role of the laparoscopic approach to ventral and incisional herniorrhaphy is unclear. There are many who believe that it is not warranted because of unknown effectiveness and costs. This study has taken a retrospective view of some of the parameters by which we need to critically assess the role of laparoscopy in the management of patients with ventral and incisional fascial defects.

Because this is a retrospective review there is an obvious selection bias. Small hernias (less than 25 cm^2) have little to gain from a laparoscopic repair. These can usually

Table 3. Operative and postoperative course[a]

	Operative time (min)	Length of stay (days)	Morbidity	Recurrence
Open	98 ± 64	4.9 ± 5.6	31%	2
Laparoscopic	128 ± 37	1.6 ± 0.9	23%	2

	Open	Laparoscopic
Wound infection	1 (required mesh removal)	1 (local treatment)
Bowel obstruction	1	1
•Requiring exploration	1	
Ileus	2	
Hypoxia	1	1
Recurrence	2	2

[a] Comparison of open vs laparoscopic hernia repair groups. Though the average laparoscopic procedure was longer, the patients had a shorter hospital stay. Though the actual number of postoperative morbidities was similar, those in the open group tended to be more severe and led to a longer hospitalization

Table 4. Cost analysis[a]

	Traditional	Laparoscopic	
OR costs	$1,435 ± 145	$1,572 ± 603	$p > 0.4$
Surgical supplies	$528 ± 261	$905 ± 465	$p = 0.003$
Total costs	$7,299 ± 5,312	$4,395 ± 840	$p = 0.05$

[a] Operative costs were similar except for the surgical appliances. Overall hospital costs were statistically different; the laparoscopic group was more cost effective due to shorter hospital stays and less-severe postoperative complications

be repaired primarily through small incisions and be sent home following an outpatient procedure. We also found that extremely large hernias can be difficult to approach laparoscopically due to the inability to place functional trocars. If we are to attempt to have a minimum of 4 cm overlap of mesh and healthy fascia, the trocars must be placed further away from the defect in the abdominal wall. With large hernias, this can sometimes result in placement of trocars too far laterally in the flanks, thereby making the operation either very difficult or impossible. For this reason there was a tendency to perform traditional open repair for the larger and more complex hernias. This obviously skews the data; However, some knowledge can still be gained from review.

These results demonstrate some of the advantages and disadvantages of a laparoscopic approach in the repair of incisional hernias. As with other laparoscopic procedures there appears to be a marked advantage to the patient in the immediate postoperative period. Though we did not directly measure postoperative pain, laparoscopic repairs in other abdominal procedures have demonstrated decreased pain as well as a lower incidence of gastrointestinal and pulmonary complications [6, 11, 14]. The earlier discharge of patients in the laparoscopic group reflects some of these advantages. Length of hospitalization alone had a significant bearing on the overall cost of the repair. Avoidance of painful abdominal wall incisions led to a quicker voluntary mobilization and to a decreased incidence of severe pulmonary complications; this shortened the postoperative hospital stay by an average of 3 days in the laparoscopic group.

As previously mentioned, patients in whom the hernias can be repaired primarily were generally approached with an open technique. Many of the hernias which were approached laparoscopically for repair were incisional in nature. After lysis of adhesions, the majority of these defects are ultimately a ''swiss-cheese'' defect signifying undue tension on the abdominal wall, which we feel is best repaired in a tension-free fashion—i.e., with mesh or relaxing incisions. The three laparoscopic cases which were repaired primarily included two laparoscopic patients with an earlier recurrence due to insufficient stapling of one edge of the mesh. These patients simply had the free edge of the mesh reinforced with a hernia stapler. The other patient had a spigelian hernia which allowed adequate suture placement for a tension-free closure.

Some have criticized the laparoscopic technique due to the intraperitoneal utilization of the prosthetic material as well as the choice of Marlex. The qualities of synthetic biomaterials have been well described by Scales [16] and Parviz et al. [13]: The proper synthetic mesh is not physically altered by tissue fluids, is chemically inert, does not produce foreign body reaction, is noncarcinogenic, is nonallergenic, is capable of resisting mechanical strains, and can be sterilized. Monofilament polypropylene meshes are the only biomaterials available today that fulfill all the above-mentioned requirements. Macroporous biomaterials with pore sizes larger than 10 μm, such as Marlex, allow infiltration of neutrophilic granulocytes which average 10–15 μm. Biomaterials with pore sizes smaller than 10 μm can harbor infection of bacteria averaging 1 μm due to inadequate neutrophilic infiltration [12]. Also associated with the macroporous structure of Marlex mesh is a rapid fibrinous fixation by the host's endogenous fibrin glue and therefore a lower incidence of seroma formation.

Furthermore, the utilization of intraperitoneal Marlex mesh is not a forbidden practice. Several surgical atlases describe incisional herniorrhaphy techniques which involve intraperitoneal prosthetics [1, 3, 10, 13, 17, 19]: ''Where possible, the omentum should be spread and interposed between the bowel and the mesh. A few rare cases have been reported of erosion and formation of a fistula in a loop of bowel in contact with the mesh'' [1]. Though popular in the repair of inguinal hernias, a preperitoneal approach to incisional hernias is virtually prohibitive. Attempts to separate the peritoneum of the hernia sac are met with serious obstacles at the site of scar formation. This frequently results

in a large peritoneal defect, which not only obliterates the preperitoneal space but also leaves exposed mesh, defeating any advantage that might have been gained by this approach.

Conclusion

Laparoscopic incisional herniorrhaphy is a technically feasible procedure. To date, the patients in our series have tolerated the procedure well and had shortened postoperative hospitalizations. This appears to be related to decreased pulmonary, gastrointestinal motility, and wound complications. Given the potential decrease in morbidity due to the smaller abdominal wall incisions, the overall hospital cost can be reduced, making this a more attractive approach to incisional and ventral hernias. A prospective randomized trial will help to further define the role of this operation in today's surgical practice.

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