

Laparoscopic Versus Open Umbilical Hernia Repair

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ABSTRACT

Background: The use of prosthetic material for open umbilical hernia repair has been reported to reduce recurrence rates. The aim of this study was to compare outcomes after laparoscopic versus open umbilical hernia repair.

Methods: We reviewed all umbilical hernia repairs performed from November 1995 to October 2000. Demographic data, hernia characteristics, and outcomes were compared.

Results: Of the 76 patients identified, 32 underwent laparoscopic repair (LR), 24 primary suture repairs (PSR), and 20 open repairs with mesh (ORWM). Preoperative characteristics were similar between groups. Hernia size was similar between LR and ORWM groups, and both were larger than that in the PSR group. ORWM compared with the other techniques resulted in longer operating time, more frequent use of drains, higher complication rates, and prolonged return to normal activities (RTNA). The length of stay (LOS) was longer in the ORWM than in the PSR group. When compared with ORWM, LR resulted in lower recurrence rates. LR resulted in fewer recurrences in patients with previous repairs and hernias larger than 3 cm than in both open techniques.

Conclusions: LR results in faster RTNA, and lower complication and recurrence rates compared with those in ORWM. Patients with larger hernias and previous repairs benefit from LR.

Key Words: Umbilical hernia, Laparoscopic surgery, Hernia repair, Hernia recurrence.

INTRODUCTION

The umbilicus is one of the potential weak areas of the abdomen and a relatively common site of herniations. Umbilical hernias occur more frequently in women, and obesity and repeated pregnancies are common precursors.¹ They have received little attention in comparison with other types of hernias of the abdominal wall. The technique described by Mayo² in 1901 is the classic method for umbilical hernia repair, consisting of “vest-over-pants” imbrication of the superior and inferior aponeurotic segments. Currently, this technique is infrequently used. For parietal defects smaller than 3 cm in diameter, a primary closure is the preferred technique for most surgeons. For defects larger than 3 cm, a repair with prosthetic material similar to the technique for incisional hernias is recommended.

A primary suture repair for ventral or incisional hernias has recurrence rates of 25% and 52% for fascial defects smaller and larger than 4 cm, respectively.^{3,4} The use of a variety of mesh materials for the repair of these hernias has resulted in a decreased recurrence rate when compared with that in primary suture closure.^{5,6} A prospective randomized trial⁷ has recently reported similar results for umbilical hernia repairs, with 11% versus 1% recurrence rates after primary suture and repair with mesh, respectively.

The purpose of this study was to retrospectively review all patients who underwent umbilical hernia repair and compare results of laparoscopic and open techniques, with emphasis on operative results, complications, and recurrences. Due to the varying results obtained after hernia repair with or without the use of mesh, we further divided the open technique group into patients who underwent a primary suture repair and those who underwent an open repair with mesh.

METHODS

A retrospective review of all umbilical hernia repairs performed from January 1996 to December 2000 was conducted. Patients with incisional hernias were excluded from the study. Patients were divided into 3 groups according to the type of repair performed: laparoscopic

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repair (LR), open primary suture repair (PSR), and open repair with mesh (ORWM). Demographic data (age, sex, and body mass index [BMI]), hernia characteristics (size and previous repairs), operative data (operating time [OR time], mesh size, intraoperative complications, and estimated blood loss [EBL]), and postoperative data (length of stay [LOS], complications, return to normal activity [RTNA], and recurrences) were compared.

A single dose of a first generation cephalosporin was administered during induction of the anesthesia. General anesthesia was used in all patients who underwent LR; local anesthesia and sedation or epidural anesthesia were used in patients without previous repairs having hernia defects of 3 cm in diameter. Once the dissection of the hernia sac was completed, the defect was measured with a sterile ruler. For the calculation of the defect area, we multiplied the length measured in a perpendicular fashion (ie, vertical and horizontal). The surgical technique was chosen on a patient-by-patient basis using the surgeons' judgment. Factors that influenced the decision to use the open technique consisted of age and history of previous multiple hernia repairs. Contraindications for LR included coagulopathy and severe cardiopulmonary disease. The PSR technique consisted of a primary repair with interrupted long-term absorbable sutures. In the ORWM technique, the mesh was placed anterior to the rectus fascia. It consisted of a wide dissection of subcutaneous tissue to allow a mesh overlap of 3 cm beyond the outer border of the fascial defect. The mesh was fixed using interrupted long-term absorbable sutures at 1-cm intervals. The mesh material used for the repair was either polypropylene (USSC, Norwalk, CT) or polytetrafluoroethylene (ePTFE) (Gore-Tex Dual Mesh, W.L. Gore & Associates, Flagstaff, AZ). Drains were placed after any repair of a defect that required extended subcutaneous tissue dissection that resulted in bleeding or creation of a dead space.

LR was performed using a technique similar to the one previously reported for ventral hernias.⁸ Briefly, after the laparoscope is used for inspection of the abdominal cavity, two 5-mm trocars are placed as far away as possible from the hernia defect. The hernia contents are reduced by blunt and sharp dissection with judicious use of electric cautery. The mesh is measured with the abdomen deflated, allowing for at least a 3-cm overlap beyond the borders of the fascial defect and is fixed with tacks and full thickness sutures (Gore-Tex Dual Mesh, W.L. Gore & Associates, Flagstaff, AZ). The tacks are placed every cen-

timeter, and the full thickness sutures are placed every 3 cm to 5 cm. The mesh materials used for the repair were Gore-Tex Dual Mesh and Bard Composix (Bard Cardiosurgery Division, Billerica, MA).

Patients were evaluated by physicians at 1 and 6 months after surgery and yearly thereafter. Complications were recorded in clinical charts. All infections requiring antibiotic therapy were included. Seroma was considered a complication when fluid accumulation persisted beyond 6 weeks, became infected, increased steadily in size, or produced pain. Recurrences and their treatments were evaluated.

Statistical Analysis

For categorical data, either the chi-square or Fisher's exact test was used. For continuous parametric variables, either a 2-sided *t* test, Mann-Whitney test, or ANOVA was used. For continuous nonparametric variables, Kruskal-Wallis' test (nonparametric ANOVA) was used. Results are reported as mean \pm SEM, and a $P < 0.05$ was deemed significant.

RESULTS

Seventy-six patients were identified in the database. Of these patients, 32 underwent LR, 24 underwent PSR, and 20 underwent ORWM. No difference existed in sex, age, or BMI between the 3 groups (**Table 1**). Previous abdominal operations were present in 20 patients in the LR group (mean, 2.4), in 14 patients in the PSR group (mean, 1.6), and in 12 patients in the ORWM group (mean, 1.8) ($P = \text{NS}$). No patients had previous umbilical hernia repairs in the PSR group. Previous umbilical hernia repairs had been performed in 9 and 6 patients in the LR and ORWM groups, respectively ($P < 0.001$ vs PSR). The hernia size was similar in the LR (19 cm², range 1 to 100) and ORWM (16 cm², range 1 to 64) groups, and was larger than that of the PSR group (4 cm², range 1 to 25) ($P < 0.001$) (**Table 1**). The percentage of incarcerated hernias was similar between groups. The laparoscopic technique aided in the identification of a previously undiagnosed second ventral hernia defect in 2 patients.

The OR time for the ORWM was longer than that for the PSR group ($P < 0.001$). No difference existed in OR times between LR and both open repairs. No intraoperative complications occurred in any of the patients. The EBL was higher in the ORWM group compared with that in

Table 1.
Demographic Data and Hernia Characteristics: Comparison Between Groups

	Laparoscopic Group (n=32)	Primary Suture Repair Group (n=24)	Open Repair With Mesh (n=20)
Age (yrs)	49±3	48±3	57±3
Sex M/F	18/14	16/8	13/7
BMI (kg/m ²)	32±2	30±1	36±2
Previous Hernia Repair (%)	9	0	6 (30)†
Hernia Size (cm ²) (range)	19 (1–100)*	4 (1–25)	16 (1–64)†

**P*<0.001, laparoscopic repair vs primary suture repair.
†*P*<0.001, open repair with mesh vs primary suture repair.

Table 2.
Operative Results: Comparison Between Groups

	Laparoscopic Group (n=32)	Primary Suture Repair Group (n=24)	Open Repair With Mesh (n=20)
Mesh Size (cm ²) (range)	141 (32–400)	Not applicable	110 (20–144)*
Operating Time (min)	62±9	37±4	82±9*†
Estimated Blood Loss (cc)	21±5	15±3	32±5†
Postoperative Drains (%)	0	1 (4)	10 (50)*†
Postoperative Complications (%)	2 (6)	1 (4)	6 (30)*†
Length of Stay (hours)	27±3	20±2	91±53†
Return to Normal Activity (weeks)	3.1±0.5	4.3±0.6	7.7±0.3*†
Recurrences (%)	0	2 (8)	4 (20)*

**P*<0.001, laparoscopic repair vs open repair with mesh.
†*P*<0.001, open repair with mesh vs primary suture repair.

the LR and PSR groups (*P*<0.01). The mesh used in the LR group was larger than that used for the ORWM group (*P*=0.002) (**Table 2**). Fewer patients required hospitalization longer than 24 hours in the PSR group (4%) than in the LR (32%) and ORWM (45%) groups (*P*<0.05). Only 1 patient in the PSR group required overnight hospitalization due to postoperative ileus. The use of drains was significantly greater in the ORWM group than in the LR and PSR groups (*P*<0.001) (**Table 2**). Ninety-seven percent of the patients reported symptomatic improvement shortly after surgery.

The number of postoperative complications was greater in the ORWM (30%) group than in the LR (6%) or PSR

(4%) groups (*P*<0.05). No wound complications occurred in either the LR or PSR groups. The higher wound infection rate in the ORWM group (15%) did not reach statistical significance when compared with that in LR (*P*=0.052) and PSR (*P*=0.08) groups (**Table 2**). Seromas were found in 56% and 40% of patients in the LR and ORWM groups, respectively (*P*=NS). Of the 8 patients who developed a seroma, 3 had a drain placed postoperatively and were diagnosed at the postoperative office visit. All seromas resolved within 6 weeks of surgery without aspiration and were not considered complications. Complications in the LR included ileus (1) and urinary tract infection (1). The only complication in the PSR group was an ileus. Complications in the ORWM group

included wound infections (3), pulmonary failure (1), and urinary retention (1).

Two patients required reoperation in the ORWM group, one for mesh removal due to an infected seroma 15 days after the hernia repair, and one underwent an exploratory laparotomy for drainage of an intraabdominal abscess 16 days after surgery. This last patient had a history of steroid use and had postoperative pulmonary failure. The source of the abscess was unknown. Mesh removal was not required, and the patient was discharged after 53 days and is currently doing well. The PSR group had the shortest LOS (20 ± 2 hr), but the difference was significant only when compared with that in the ORWM group (91 ± 53 hr). No difference occurred in RTNA between the LR (3.1 ± 0.5 weeks) and the PSR (4.3 ± 0.6 weeks) groups, and both had shorter RTNA than did the ORWM group (7.7 ± 0.3 weeks) ($P < 0.01$ and $P < 0.05$, respectively). In the LR group, only 1 patient had prolonged RTNA (7 weeks) due to arthritis.

Follow-up was possible in all patients. The mean follow-up time was 22 ± 2 months for the LR group, 28 ± 3 months for the PSR group, and 25 ± 4 months for the ORWM group ($P = \text{NS}$). One patient in the LR group died of severe cirrhosis 3 months after surgery. No recurrences took place in the LR group. No statistical difference existed in recurrence rates between the PSR (8%) and ORWM (20%) groups. ORWM resulted in a significantly higher recurrence rate than did LR ($P < 0.05$) (**Table 2**). One recurrence in the PSR group was repaired without mesh and recurred 5 months later. Factors associated with higher recurrence rates were the size of the defect and previous hernia repairs. Only 1 recurrence was noted following the repair of a hernia less than 3 cm in diameter, which occurred in the PSR group. All of the recurrences in the ORWM group were in patients with a defect greater than 3 cm in diameter ($P < 0.05$ vs the LR group). Three of the recurrences (50%) in the ORWM group were in patients with previous hernia repairs ($P < 0.05$ vs the LR group). No difference existed in recurrence rates between groups in patients with BMI > 30 kg/m².

DISCUSSION

Umbilical hernias generally develop from small fascial defects. Because of their size, a common practice is to repair the defect with primary sutures with the patient under local anesthesia with sedation on an outpatient basis. Recurrence rates of up to 15% have been associat-

ed with this technique.⁹ The use of prosthetic materials during inguinal and ventral hernia repairs has reduced the incidence of recurrences. In a prospective randomized trial of 200 patients followed for 64 months, Arroyo and colleagues⁷ recently reported the same results for umbilical hernia repairs, with recurrence rates of 11% and 1% after PSR and ORWM, respectively. They found no difference in recurrence rates following repair of defects greater or smaller than 3 cm.

The main concern surrounding the use of a prosthetic material for hernia repair is its association with complications, such as wound infections, seromas, mesh extrusion, fistula formation, and adhesions.^{6,10-13} Infections occur in 15% to 45% of patients following open hernia repair with mesh materials. These infections closely correlate with recurrence rates.¹⁴⁻¹⁶ Both may be secondary to the larger incision with which the mesh is in contact and the wider soft tissue dissection needed for mesh placement.

The laparoscopic technique for ventral and incisional hernia repairs has resulted in decreased postoperative pain and LOS, shorter RTNA, and lower recurrence rates.⁸ This technique is based on Stoppa's method for hernia repair,⁴ which involves posterior patching of the fascial defect with a large overlap of mesh, based on Laplace's law. The large surface of the mesh allows substantial tissue ingrowth for permanent mesh fixation, and the intraabdominal pressure tends to hold the mesh in place against the posterior fascia. The main differences compared with the open technique are the smaller incisions and minimal soft tissue dissection needed for the placement of a large mesh overlap, which decreases the incidence of wound complications.

To our knowledge, no reports exist in the literature comparing laparoscopic versus open umbilical hernia repairs. The only publication of laparoscopic surgery specifically addressing umbilical hernias is the one by Nguyen et al,¹⁷ in which 16 patients underwent LR with no intra- or postoperative complications, and a mean OR time of 35 minutes. All surgeries were performed on an outpatient basis, and no recurrences were found at the 5.9-month follow-up.

In our study, the smaller hernia size in the PSR group was probably due to the surgeons' preference in technique. Generally, surgeons tended to repair smaller hernias using the PSR technique. This is important to consider when comparing the repair of small versus large

hernias in the other groups. The PSR group had the shortest OR time, but the difference was significant only compared with that in the ORWM group. LR was safe, with no intraoperative complications, even in the presence of adhesions in 20 patients, with an average of 2.4 previous abdominal surgeries. A larger, prospective trial would be necessary to determine whether PSR has higher recurrence rates than LR does, because our results show that the 8% recurrence rate in the PSR group was not significantly higher compared with the 0% in the LR group.

None of the ORWM repairs were performed using the Stoppa-Rives technique described for large ventral hernias, currently considered the standard of care, which is reported to have the lowest recurrence rate. The ORWM repairs in this study were performed by placing the mesh anterior to the rectus fascia, as opposed to the Stoppa repair, in which the mesh is placed in the posterior rectus fascia. The mesh used most commonly in the LR group was the Gore-Tex Dual Mesh, which is recommended when a prosthetic material is placed in contact with intraabdominal structures. The 3- μ m size pores in the side of the mesh in contact with the abdominal structures reduces adhesion formation and inhibits tissue ingrowth. Although not addressed in this study, we agree with most surgeons^{18,19} that full-thickness fascial sutures should be used to fix the mesh to the abdominal wall.

We used long-term absorbable sutures in the PSR group because it is our experience that they provide better long-term results after ventral hernia repair. They provide adequate tension during tissue incorporation into the wound repair and are absorbed, relieving the tension after the healing process has been completed. We believe that nonabsorbable sutures may cause prolonged postoperative pain and fascial tears due to the permanent tension to which the tissue is subjected. This was corroborated in a recent metaanalysis by van't Riet et al²⁰ in which they reported similar incidences of hernia recurrence after repair with slowly absorbable and nonabsorbable sutures. However, more wound pain and more suture sinuses occurred after the use of nonabsorbable sutures. They also reported similar outcomes between continuous and interrupted sutures.

The repair in the PSR group was performed with local anesthesia and sedation. Therefore, the LOS was shorter than that of the other 2 groups, although the difference was only significant when compared with that in the

ORWM group. Interestingly, PSR performed with local anesthesia for smaller hernias had RTNA similar to that of the LR group. We believe that the prolonged RTNA in the ORWM group was caused by immobilization due to postoperative pain and the use of drains. Not using drains after LR and PSR may have helped diminish wound complications. Contrary to what others have shown, a similar recurrence rate existed for the PSR and ORWM groups. This may have been secondary to the smaller hernia size in the PSR group or the higher number of previous hernia repairs in the ORWM group. The high recurrence rate in the ORWM group may be related to the higher incidence of postoperative wound complications, because 3 of the 4 patients who developed a hernia recurrence had a wound infection postoperatively. As opposed to Arroyo's data,⁷ we did find a higher recurrence rate in hernias greater than 3 cm in diameter. We also found higher recurrence rates in patients with previous hernia repairs, which is consistent with previous reports of ventral hernia repairs.^{3,5} We found that patients with previous hernia repairs had a higher incidence of recurrences when treated with the ORWM versus the LR technique.

CONCLUSIONS

Laparoscopic umbilical hernia repair is a safe and effective technique, even in the presence of multiple previous abdominal surgeries, with two thirds of patients requiring less than 24 hours of hospitalization. It also allows for identification of previously undiagnosed second hernia defects. When compared with ORWM, the LR resulted in less use of postoperative drains, shorter RTNA, and lower complication and recurrence rates. Patients with hernia defects larger than 3 cm and previous umbilical hernia repairs of any size benefit from the LR technique. Umbilical hernia repair using PSR can be performed safely with local anesthesia and sedation in patients with hernias smaller than 3 cm on an outpatient basis, however recurrence rates may be higher than LR.

References:

1. Wantz GE. Abdominal wall hernias. In: Schwartz SI, Shires GT, Spencer FC, eds. *Principles of Surgery*. 7th ed. New York: McGraw-Hill; 1999:1585-1611.
2. Mayo WJ. An operation for the radical cure of umbilical hernia. *Ann Surg*. 1901;34:276.
3. Hesselink VJ, Luijendijk RW, de Witt JHW, Heide R, Jeekel J.

An evaluation of risk factors in incisional hernia recurrence. *Surg Gynecol Obstet.* 1993;176:228-234.

4. Stoppa RE. The treatment of complicated groin and incisional hernias. *World J Surg.* 1989;13:545-554.

5. Luijendijk RW, Hop WCJ, van der Tol MP, et al. A comparison of suture repair with mesh repair for incisional hernia. *N Engl J Med.* 2000;343:392-398.

6. Morris-Stiff GJ, Hughes LE. The outcomes of nonabsorbable mesh placed within the abdominal cavity. Literature review and clinical experience. *J Am Coll Surg.* 1998;186:352-367.

7. Arroyo A, García P, Pérez F, Andreu J, Candela F, Calpeña R. Randomized clinical trial comparing suture and mesh repair of umbilical hernia in adults. *Br J Surg.* 2001;88:1321-1323.

8. Ramshaw BJ, Esartia P, Schwab J, et al. Comparison of laparoscopic and open ventral herniorrhaphy. *Am Surg.* 1999;65:827-832.

9. García-Ureña MA, Rico P, Seoane J, et al. Hernia umbilical del adulto. *Cirugía Española.* 1994;56:302-306.

10. Lamb JP, Vitale T, Kaminski DL. Comparative evaluation of synthetic meshes used for abdominal wall replacement. *Surgery.* 1983;93:643-648.

11. Leber GE, Barb JL, Albert AI, Reed WD. Long-term complications associated with prosthetic repair of incisional hernias. *Arch Surg.* 1998;133:378-382.

12. White TJ, Santos MC, Thompson JS. Factors affecting wound complications in repair of ventral hernias. *Am Surg.* 1998;64:276-280.

13. Deguzman LJ, Nyhus LM, Yared G, Schlesinger PK. Colocutaneous fistula formation following polypropylene mesh placement for repair of a ventral hernia: diagnosis by colonoscopy. *Endoscopy.* 1995;27:257-261.

14. Mudge M, Gughes LE. Incisional hernia: A 10-year prospective study of incidence and attitudes. *Br J Surg.* 1985;72:70-71.

15. George CD, Ellis H. The results of incisional hernia repair in a 12-year review. *Ann R Coll Surg.* 1986;68:185-187.

16. Mueller CB. Abdominal incisional hernia: the role of wound infection [editorial]. *Can J Surg.* 1974;17:195.

17. Nguyen NT, Lee SL, Mayer KL, Furdui GL, Ho HS. Laparoscopic umbilical herniorrhaphy. *J Laparoendosc Adv Surg Tech.* 2000;10:151-153.

18. Park A, Gagner M, Pomp A. Laparoscopic repair of large incisional hernias. *Surg Laparosc Endosc.* 1996;6:123-128.

19. Saiz A, Willis IH. Laparoscopic ventral hernia repair. *J Laparoendosc Surg.* 1994;4:365-367.

20. van't Riet M, Steyerberg EW, Nellensteyn J, Bonjer HJ, Jeekel J. Meta-analysis of techniques for closure of midline abdominal incisions. *Br J Surg.* 2002;89:1350-1356.

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