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ORIGINAL ARTICLE

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Recurrences after laparoscopic ventral hernia repair: Results and critical review

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Abstract We describe the whole cohort of patients operated on laparoscopically for ventral hernias at our institution. Information on early results, complications, and long-term follow-up was collected prospectively. Of 90 operations attempted, five (5.8%) required conversion. Of the remaining 85 patients, 65 (76%) had an incisional hernia, while 20 (24%) had primary defects. Three trocars were routinely employed (Hasson and two 5-mm). The prosthetic mesh used was ePTFE inserted through the first trocar and fixed using helicoidal staplers. Patients were periodically followed in the outpatient clinic for at least 12 months postoperatively and contacted at the time of this review. Mean operative time was 101 min. We had three small bowel injuries repaired laparoscopically. Postoperative pain was limited. Bowel movements, deambulation, and discharge were prompt. We had six (7%) urinary retentions, eight (9%) seromas, three (3.5%) cases of pneumonia, two (2%) cases of postoperative vomiting, and one (1%) prolonged ileus, which resolved spontaneously on postoperative day 2. Mean postoperative stay was 4 days. One patient was readmitted after 4 weeks with incomplete obstruction, resolved conservatively. There were three recurrences (3.5%), which developed within 1 year of the operation, and a trocar-site herniation (1%). The technique appears safe and efficacious.

Keywords Incisional hernia · Laparoscopic repair · Recurrence · Gore-Tex mesh

Introduction

Ventral hernias include both postincisional and primary abdominal defects, such as umbilical, epigastric, and spigelian hernias. Postincisional hernias are more common, representing about 80% of all adult abdominal defects, with an incidence of between 2 and 13% of laparotomies in large series [1, 2]. Male sex, wound infections, obesity, diabetes, and severe chronic illness (such as respiratory impairment or liver failure) are the most important risk factors influencing hernia development [1, 2].

In recent decades, surgical treatment of ventral hernias has been modified greatly, mainly due to the introduction of prosthetic meshes to reinforce the muscoloaponeurotic layer. Before that development, when the most employed techniques were direct suture with or without aponeurotic overlapping, recurrences amounted to more than 40%, while the advent of prosthesis decreased those unacceptable failures to 10–20% [3].

However, mesh displacement (both over and beneath the muscles) required long skin incisions and wide surgical dissections, leading to high postoperative pain, wound complications, and long hospital stay [4]. In addition, a recent American large population-based analysis failed to demonstrate any improved outcomes in the cure of incisional hernia, in recent years [5].

Fortunately, since the early 1990s, laparoscopic ventral hernia repair (LVHR) has put a new weapon in the hands of frustrated surgeons; in fact, minimally invasive surgery could, theoretically, bring the same good results of the traditional mesh approach with fewer complications and some other peculiar advantages of laparoscopic surgery (less pain, short length of stay, and fewer recurrences). The exploding interest on this topic is best demonstrated in Fig. 1.

Moreover, preliminary results published on LVHR seem to raise the hypothesis of a lower recurrence rate when compared with open traditional mesh repair. The purpose of this study is to show the results of 85 patients treated laparoscopically in our unit. The information was collected prospectively for a long period. The incidence of recurrence was investigated and stressed during the analysis.

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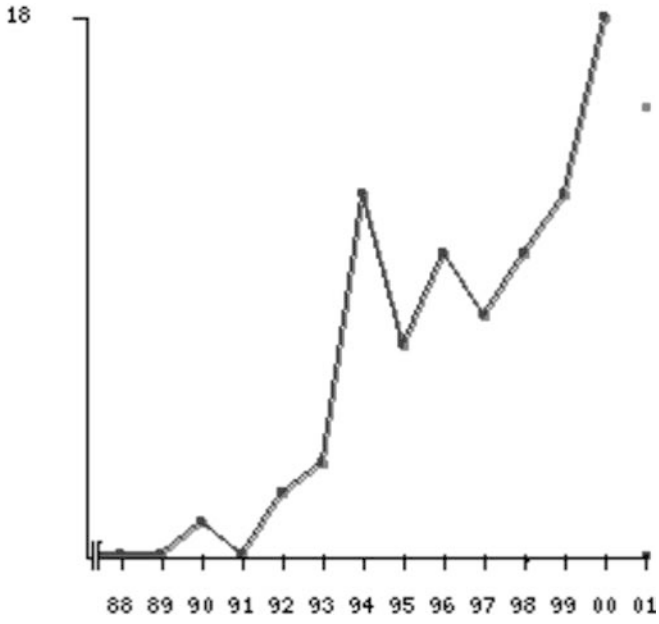

Fig. 1 Laparoscopic ventral hernia repair: articles cited in Medline. The *gray line* reports the number of published papers regarding the selected topic for each year (referred to the maximum value). The *black line* reports the "interest index" expressed as the number of published papers regarding the selected topic/the total number of published articles. The two lines are coincident. Data about 2001 is partial. Modified and reprinted with permission from: Servizio Dematel Medline, Dematel srl (Catania, Italy), http://www.dematel.it

Patients and methods

From December 1999 to July 2003, 230 patients suffering from ventral hernias were treated in the First Unit of General Surgery and Transplantation of Careggi Hospital, Florence, Italy. Laparoscopic repair was attempted in 90 (39%) of these patients. Data regarding this subgroup of patients were collected in a prospective fashion, using popular computer software designed for operating-room reports, file notes, and outpatient visit follow-ups. The study was conducted according to the Helsinki Declaration, and informed written consent was obtained from all patients before surgery. The risk of conversion to open repair was clearly explained. Five (5.8%) patients required conversion to open surgery and were withdrawn from the rest of data analysis. All conversions occurred during the first 30 cases and were caused by bowel injuries and severe adhesions.

The remaining group of 85 patients included 29 males and 56 females (F/M = 2). Mean age was 63 years ± 11 SD (range, 32–89 years). ASA 1–2/3–4 ratio was 6 (73/12), whereas obesity (considered as Body Mass Index, BMI > 28) was present in 22 patients (26%). Sixty-five patients (76%) presented with an incisional hernia (18 supraumbilical, 17 subumbilical, 18 whole midline, five transverse, two subxiphoid, two suprapubic, one juxtaumbilical, one lumbar, and one parastomal), whereas 20 (24%) had a primary defect (six epigastric hernias, 13 umbilical hernias, and one spigelian hernia). All defects were estimated to be wider than 4 cm in the maximum diameter, with a size varying from 10 to 260 cm^2 (mean 69 ± 71 SD). Two (2%) patients required laparoscopic incisional repair in emergent situations for incarcerated and strangulation hernias.

Standard bowel preparation was done in every patient on the day before operation, except for those operated on urgently. Prophylactic short-term antibiotic therapy, with a second-generation cephalosporin and antithrombotic therapy with unfractioned or low-weight molecular heparin, were also added, according to standard protocols adopted in the unit.

Nasogastric suction and bladder catheterization were utilized routinely for the duration of the operation only. All the operations were performed under general anesthesia.

Our technique was exhaustively described elsewhere [6]. The mesh (ePTFE, Dual Mesh, WL Gore, Flagstaff, Ariz. USA) was inserted through the Hasson (left subcostal space) and accurately distended beneath the wall defect (using two additional 5-mm ports, rarely 10 mm, inserted far from the defect, preferably in the left flank), suturing the four stitches transparietally utilizing the Endo-Close device (AutoSuture USSC, Norwalk, Conn. USA). The definitive fixation of the prosthesis was obtained with a double circular line of helicoidal clips (ProTack 5 mm, AutoSuture USSC, Norwalk, Conn. USA), avoiding excessive tension and reducing the abdominal pressure to 7 mm Hg. In every case, the mesh should overlap the defect for at least 4–5 cm in all directions. Cardinal stitches were cut at the end of the procedure. A compressive dressing was placed in the site of the defect to prevent seroma formation. Local anesthetics were also employed to infiltrate the small incisions.

Intramuscular or intravenous ketorolac analgesia and meperidine as rescue therapy were administered postoperatively, registering prescriptions on the clinical files. All patients were encouraged to move as soon as possible, and oral feeding was allowed 12 h after the operation. Discharge was prompt in almost every patient, independently of whether they had evacuated or not.

Follow-up in the outpatient clinic was scheduled at 1 week, 1 and 6 months, and after 1 year. All the patients operated on were contacted by phone or seen in the outpatient clinic at the time of this study.

Patient baseline characteristics are summarized in Table 1.

Results

Mean operation time was 101 min ± 36 SD (range, 40–240 min). Concomitant laparoscopic cholecystectomy was performed in seven cases, using additional trocars. We had three (3.5%) bowel injuries (at the serosal level, two in the small bowel and one on the descending colon)

Table 1 Patient baseline characteristics. Values are expressed as mean ± standard deviation and range, or as a number and percentage

Patients	85
Gender	M: 29, F: 56; F/M = 2
Age	63 ± 11 (32–89) years
ASA 1–2/3–4	73/12
Obesity (BMI > 28)	22 (26%)
Type of hernia	
Primary 20 (24%)	6 epigastric 13 umbilical hernia 1 spigelian
Incisional 65 (76%)	18 supraumbilical 17 subumbilical 18 whole midline 5 transverse 2 subxiphoid 2 suprapubic 1 parastomal 1 juxtaumbilical 1 lumbar
Defect's size	69 ± 71 (10–260) cm^2
Emergent laparoscopic repair	2 (3%)
Previous repair (failed)	15 (18%)

made during hernia dissection and repaired laparoscopically without conversions.

Postoperative pain was limited, with a mean ketorolac injections consumption of 2 ± 1 (range 0–5). Fourteen patients (19%) required additional opiates to relieve uncontrolled pain. Few patients required further nonsteroidal antiinflammatory drugs (NSAIDs) by mouth, during the days following surgery. Six (9%) patients had urinary retention that was treated by catheterization for 8 h.

Oral fluid intake was allowed 12 h after the operation. Bowel movements were present after a mean time of 2 ± 0.87 days (range 1–4), but the lack of evacuation was not a contraindication for early discharge. One (1%) patient developed prolonged ileus and vomiting. Ileus resolved with conservative management (intravenous fluids and antiemetics), without further complications. Three (3.5%) patients experienced minor pneumonia, which was treated with oral antibiotics.

Length of hospital stay was between 1 and 13 days (mean of 4 ± 2 days, and < 3 in the last consecutive 60 patients). All patients were able to return to normal activities in a few days. Seromas were detected in eight patients (9%) and were treated with aspiration or compressive dressing. No wound or deep infections were detected, including those who received intestinal injury repair.

None of the patients operated on was lost during the follow-up. One patient was readmitted to the ward 1 month after the operation with suspected incomplete intestinal obstruction. A contrast meal through nasogastric tube 3 days later excluded obstruction. The patient was treated conservatively, and the symptoms resolved spontaneously.

Three patients (3.5%) developed a recurrence 10, 12, and 12 months after the operation (mean follow-up 20 months). One (1%) patient developed a trocar-site herniation, far from the repaired defect, 18 months after laparoscopy. Results and complications are summarized in Table 2.

Table 2 Results and complications. Values are expressed as mean ± standard deviation and range, or as a number and percentage

Conversions	5/90 (5.8%)
Operative time	101 ± 36 (40–240) min
Major complications	3 (3.5%) bowel injuries
Minor complications	6 (7%) urinary retention
	1 (1%) prolonged ileus
	2 (2%) postoperative vomiting
	3 (3.5%) pneumonia
	8 (9%) seroma formation
Total complications	23 (27%)
n Patients analgesics requirement	2 ± 1 (0–5) ketorolac injections
	14 (19%) opiates as rescue
Bowel movements	2 ± 0.8 (1–4) postoperative days
Hospital stay	4 ± 2 (1–13) days
Follow-up	18 ± 11 (2–50) months
Readmissions	1 (1%)
Recurrences	3 (3.5%)
	1 (1%) trocar site

Discussion

Data regarding laparoscopic ventral hernia repair are less than accurate in the surgical literature. Most of the published papers report only surgical technique, early results, and short-term follow-up. The number of the patients enrolled in these preliminary experiences seems to be too small. Moreover, there are very few level-1 evidence-based studies comparing traditional open surgery to laparoscopic repair, whereas important factors, such as type of hernia, age, size of the defect, Body Mass Index, or associated diseases, are often omitted.

In a Medline search using the keywords "laparoscopic ventral hernia repair" or "laparoscopic incisional hernia repair," we found good preliminary results published since the 1990s. Park et al. [7], in 1998, reported a reccurence rate of 10%. Costanza et al. [8], in 1998, reported 16 patients treated and only one recurrence (6.7%) after a median follow-up of 18 months, while Franklin et al. [9], in the same year, reported 176 cases, using (surprisingly) a polypropylene intraperitoneal mesh, with recurrences amounting to 1%. In the only multicenter study, Toy and co-workers [10] operated on 114 patients, with a recurrence rate of less than 4%, but the follow-up was frankly insufficient (7 months). Furthermore, in 1999, Scott Roth et al. [11] reported a recurrence rate of 9% during an average follow-up of 17 months.

The largest retrospective cohort was that recently published by Heniford et al. [12], including more than 800 patients. Recurrence rates amounted to 4.7%, but again, the follow-up was not homogeneous (range 1–94 months). Other works report very good results: both Ben-Haim et al. [13] and Carbajo et al. [14] reported a recurrence rate of 2% and 4.4%, respectively, and few complications. The longest reported average follow-up (more than 50 months) was that of LeBlanc et al. [15] in 2001; recurrences and major complications amounted to 9.3% and 4.1%, respectively (Table 3).

Comparative studies are also inhomogeneous due to different numbers and type of hernia, with the exception of that published by Carbajo [16] and co-workers. In this study, the only one conducted in a prospective, randomized, controlled fashion, the investigators compared two groups of 30 patients each, treated by open traditional repair and laparoscopic approach, with epidemiologic data, defects, and follow-up strictly comparable. Recurrence rates were lower in the laparoscopic group, and most of them were caused by inadequate mesh placement. The same results (involving many more patients) were reported by Ramshaw et al. [17]: 21% of recurrences in the open group vs 2% in the laparoscopic group were reported (Table 4).

Larson [18], in his speculative review of literature regarding LVHR, concludes that many advantages are

Table 3 Preliminary results published in literature

	Patients *n*	Prosthesis	Defect's size (cm^2)	Operation time (min)	Complications (%)	Hospital stay (days)	Follow-up (months)	Recurrences *n* (%)
Park et al. (1998) [7]	56	ePTFE PP	104	108	18	–	24	6 (10)
Toy et al. (1998) [10]	114	ePTFE	98	120	22	2.3	7.4	6 (4)
Scott Roth et al. (1999) [11]	73	ePTFE/Marlex	99.5	105	19	2.9	17	7 (9)
LeBlanc et al. (2001) [15]	100	ePTFE	155	–	14	1–2	51	9 (9.3)
Ben-Haim et al. (2002) [13]	100	ePTFE	6.2 cm	119	24	5	19	2 (2)
Bageacu et al. (2002) [19]	159	ePTFE	–	–	44	3.5	49	19 (15)
Berger et al. (2002) [32]	150	ePTFE	96	90	–	10	15	4 (2.7)
Carbajo et al. (2003) [14]	270	ePTFE	145	85	14	1.5	44	12 (4.4)
Rosen et al. (2003) [34]	100	ePTFE	115	126	16	1.8	30	17 (17.7)
Heniford et al. (2003) [12]	850	ePTFE	118	120	13.2	2.3	20	35 (4.7)

ePTFE = expanded polytetrafluoroethylene; PP = polypropylene

Table 4 Complications of comparative studies (laparoscopic ventral hernia repair vs open repair)

	Patients *n*	Prosthesis	Defect's Size (cm^2)	Operative Time (min)	Complications (%)	Hospital stay (days)	Follow-up (months)	Recurrences *n* (%)	Type of study
Carbajo et al.	30 open	ePTFE/PP	141	111	35	9.1	27	2 (6)	Prospective
(1999) [16]	30 lap	ePTFE	139	87	5	2.2	27	0 (0)	Randomized
Ramshaw et al.	174 open	PP	34	82	30	2.8	21	36 (21)	Retrospective
(1999) [17]	79 lap	ePTFE	73	58	19	1.7	21	2 (2)	
Chari et al.	14 open	PP	–	78	14	5.5	6 – 24	0 (0)	Prospective
(2000) [20]	14 lap	ePTFE	–	124	21	5	6 – 24	0 (0)	Controlled
Zanghi et al.	15 open	ePTFE/PP	120	120	60	11	40	0 (0)	Retrospective
(2000) [21]	11 lap	ePTFE	104	140	18	3.5	18	0 (0)	
De Maria et al.	18 open	PP	–	–	72	4.8	24	0 (0)	Prospective
(2000) [25]	21 lap	ePTFE	–	–	67	0.8	24	1 (5)	Comparison
Wright et al.	119 open	None	70	70	22	1.5	24	11 (9)	Prospective
(2002) [22]	90 open	PP	102	102	36	2.5	32	5 (6)	Comparison
	86 lap	ePTFE	131	131	22	2	24	1 (1)	

ePTFE = expanded polytetrafluoroethylene; PP = polypropylene

offered over the conventional mesh repair, while recurrence rate decreases to 10–15%.

Unsurprisingly, other studies report less convincing or opposite conclusions. Bageacu et al. [19], in 2002, retrospectively analyzed more than 150 patients treated laparoscopically over a 6-year period. Early postoperative complications (3% of wound infections and 8% of hematomas) were high as compared with the above-mentioned casistics. Moreover, recurrence rate was also unacceptably high, amounting to more than 15%. Furthermore, the employed meshes included both polypropylene (two enterocutaneous fistulas occurred) and ePTFE. However, good results are reported even when using intraperitoneal polypropylene mesh, without intestinal fistulas, as remarked by Larson [18].

Chari et al. [20] do not agree with such enthusiastic results because they found a lack of significant advantages and tangible technical difficulties. Others [21, 22] confirmed the efficacy of LVHR but failed to demonstrate any superiority over open mesh replacement. Nevertheless, recent original [23, 24], comparative [22, 24, 25], and review [26] articles focused on the rising importance of LVHR among surgeons. Feasibility as an outpatient procedure was also studied [27]. However, the only available meta-analysis [28] on short-term results after LVHR confirmed LVHR as better than open repair, when considering rigorous statistical parameters in the early outcomes.

In our series, all the procedures were laparoscopically completed without major complications. Three bowel injuries (at the serosal level, two in the small bowel and one on the descending colon) did not compromise the procedure and were repaired laparoscopically. These kinds of complications were similar to those described,

especially when considering the learning curve [24, 29]. Furthermore, neither the converted patients for bowel injuries nor the two continued laparoscopically experienced subsequent superficial or deep infections.

The other main end point to be considered is the number of recurrences. Those could have been prevented by a more careful technique application (mainly mesh overlapping), as speculated during the laparoscopic reintervention of one of the three observed in our experience. The first two recurrences occurred in morbidly obese female patients, suffering from primary umbilical hernia. Both were first repaired using a 10×15 ePTFE mesh that probably failed to cover the entire fascial's weakness. The first lady was reoperated on using the laparoscopic approach, and the recurrent hernia was found to be near the prosthesis' edge. Therefore, these findings suggested a technical mistake occurred during the first operation (inadequate mesh overlap). Another piece of mesh was then overlapped to the old one, covering the defect entirely. The patient has been free from recurrence for 12 months after the second repair.

The second lady was urgently reoperated on (open) elsewhere, for intestinal occlusion, caused by the recurrent hernia. A polypropylene mesh was employed in the subfascial position. A video of this operation was available, and the defect was located near the mesh's edge. Again, an insufficient overlapping was suspected to have occurred during the first laparoscopic attempt of repair.

The third recurrence occurred recently in a lady who underwent three failed attempts of repair by the open approach. The fourth, laparoscopic, operation was carried out, fixing the lower edge of the mesh in the inferior middle point of the abdomen. During reintervention for recurrence (the fifth), the prosthesis was found to have slipped into a higher position, suggesting a wrong fascial fixation. A further polypropylene mesh was then secured to the pubis. Briefly, we can state that all the recurrences were correlated to a deficient mesh overlapping. Furthermore, all the patients with recurrences had a BMI >28, and the prosthesis only measured 10×15 cm; this supports the insufficient-overlapping theory.

Finally, a trocar-site herniation developed in a 64-year-old, morbidly obese, diabetic lady 18 months after the operation; in this case, no mesh (or mesh positioning) failure was involved.

Seroma was the most frequent minor complication that occurred, but it was lowered by local dressing compression, although someone [30] did not consider its formation as a true failure but as an inevitable consequence of this kind of operation (sac left in situ). Nevertheless, a gross hernia sac could be coagulated in order to promote adhesions and to avoid dead spaces. CT scan could be of some help in detecting subclinical seromas and the risk of complications [31]. Results in the postoperative pain, oral feeding, and hospital stay were satisfactory.

Laparoscopic wide-mesh positioning guarantees a low number of recurrences [32, 33](Table 3 and Table 4), except for one recent study [34] that reported unexpectedly high failure rates.

In our experience, expanded polytetrafluoroethylene (ePTFE) prosthesis seems to be suitable for this kind of procedure because it can be safely left in direct contact with viscus. Apart from the theoretical advantages, no study definitely shows evident benefits for the ePTFE over a more rigid prothesis, and results are comparable [18]. Large tissue dissection is avoided in the laparoscopic route, while mesh displacing follows classical "tension-free" criteria of modern herniorrhaphy. These factors could explain the lower complication rate when compared with the traditional open procedure.

Finally, our study presents a bias regarding the mean defect's size. Most of the cited articles [26, 28] reported data about patients suffering from larger defects, and that could undoubtedly affect the complication and recurrence rates. However, if technical criteria (mainly mesh overlapping at least 4–5 cm in all directions of the entire defect) are strictly followed, a parietal hole measuring more than 15×10 cm should carry out a prosthesis replacement of about 23×18 cm that requires good skills to be displaced laparoscopically. In these cases, mesh tension could be an additional factor for hernia development.

Furthermore, patients with little defects who are scheduled for another laparoscopic procedure or patients whose previous open mesh repair failed (cholecystectomy or antireflux repair) could be good candidates for LVHR, although the defect is 5 cm in the maximum diameter [25].

Costs seem to be the one of the most immediate points against this approach, but this disadvantage is probably largely balanced by short operation time, low complication rates, lack of recurrences, and prompt return to normal activities.

Conclusions

LVHR looks promising to guarantee the same safety of a prosthetic mesh, avoiding extensive dissection and wide surgical wounds. Patients undergoing LVHR are expected to have a shorter postoperative stay, few analgesic requirements, and fewer wound complications. Those advantages would result in return to normal activities earlier, when compared with open traditional surgery.

According to our experience, and on the basis of published literature, expanded polytetrafluoroethylene (ePTFE) prosthesis seems to be suitable for this kind of defect because it can be safely left in direct contact with viscus. Mesh overlapping should be at least 4−5 cm in all directions, and this fact seems to be of crucial importance to avoid recurrences. Four cardinal transfascial sutures are of great help to favor the correct mesh positioning, but they can be removed after the tacks'

application. Transfascial sutures should be left in cases of very difficult hernia sites, such as in the subxiphoid or the subcostal region.

According to this preliminary long-term result, we believe that laparoscopic ventral hernia (primary or incisional) repair could be a safe, easy, and efficacious technique. Further prospective, randomized controlled trials are needed because LVHR is gaining acceptance as the gold standard in ventral hernia repair.

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