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A decade of experience with laparoscopic ventral hernia repairs

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ABSTRACT

Background: Few studies have evaluated surgical outcomes in long-term follow-up for patients undergoing Laparoscopic Ventral Hernia Repair (LVHR).
Methods: A retrospective review of long-term follow-up of LVHR patients (2002–2005) at a single institution.
Results: Sixty-three patients (37 males; mean age = 63, mean BMI = 33, 41% for recurrence) underwent LVHR. Mean operative time was 164 min. Mean hospital stay was 3.7 days. Short- and long-term complications occurred in 19% and 44% of patients, respectively.
Mean follow-up was 12.4 years. Recurrent hernias were noted in 15 patients. Seroma formation occurred in 14 patients; small bowel obstruction occurred in 10 patients. Five patients developed mesh infection. Use of PTFE mesh, longer operative time, and a larger hernia defect were risk factors for mesh infection ($p < 0.05$).
Conclusions: Long-term outcomes for patients undergoing LVHR are fraught with complications (44%) and a considerable risk of hernia recurrence (23%).

Introduction

Laparoscopic ventral hernia repair (LVHR) was first reported in the early 1990's and has grown in popularity compared to open ventral hernia repairs.[1] Several types of material are used to buttress the abdominal wall in LVHR, including ePTFE (e.g. GoreTex™), composite mesh (e.g. Composix™), and polypropylene. GoreTex™ and mesh are attached to the abdominal wall in several ways, including tacks, sutures, or both tacks and sutures. Several studies have reported data on outcomes of LVHR – including recurrence rates ranging from 1 to 20%, decreased complication rates, and shorter hospital stays compared to open ventral hernia repairs.[2] Reports of rates of complication and recurrence are often reported with short follow-up (less than 5 years).

Studies with more than 5 years of follow-up show recurrence rates that almost double when comparing one to five years of follow-up.[3] There are only a few long-term studies that characterize the outcomes of patients who have had LVHR beyond a mean follow-up of 7 years. Of these studies, there is a paucity of data analyzing operative risk factors (such as mesh type, fixation method, or demographics) for long-term complications such as bowel obstruction, mesh infection, or hernia recurrence.[3–5] This study aims to report long-term follow-up for patients undergoing LVHR at a large tertiary surgical center as well as risk factors for LVHR outcomes with more than 10 years of follow-up.

Methods

IRB approval was obtained to perform a retrospective review of laparoscopic ventral hernia repairs. Patients were identified as having had a laparoscopic ventral hernia repair performed between 2002 and 2005 at Mayo Clinic-Rochester based on their electronic medical record. Chart review was performed to identify demographic and operative information, as well as any evidence of post-operative complication. Patients were mailed a survey to self-report any complications; patients who did not return a survey were called to ask to participate in a telephone survey to gather information regarding complications of their LVHR.

Only patients with at least 10 years of follow-up information were included in the study. Categorical variables were reported as percentages while quantitative variables were reported as mean ± standard deviation. Categorical variables were compared by Pearson's Chi-squared test and quantitative variables were

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compared by the Student's t-test. Risk factors for recurrence and complications were determined by Pearson's Chi-squared test. Continuous variables were converted to dichotomous factors by the median value of the patients with long-term follow-up. All demographic information and peri-operative details were evaluated as possible risk factors for long-term complications – including: gender, age >63, BMI >30, prior abdominal surgeries, presence of short-term complications, type of hernia, mesh size >285, operative time >140 min, type of mesh, fixation method, surgeon completing the surgery, and if concurrent procedures were performed. We were unable to capture size of the hernia, length of overlap of the mesh on fascia, and purchase of mesh on fascia from the operative notes and medical record consistently, so these factors were not evaluated. $P < 0.05$ was considered to represent statistical significant for all comparisons. Data analysis was supported by Grant Number UL1 TR002377 from the National Center for Advancing Translational Sciences (NCATS). These contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH.

Results

Study population

From 2002 to 2005, 119 patients underwent LVHR at Mayo Clinic. 56 patients were excluded from this study due to having less than 10 years of active follow-up information: 2 died in the hospital following their operation, 4 declined to participate, 16 were unreachable, and 34 died of unrelated disease prior to 10 years after their operation. After exclusion, 63 patients remained in this study. When comparing the included patients to the excluded patients, the significant demographic differences between groups were age and BMI (Table 1).

Perioperative details (Table 1)

Males outnumbered females (37 M: 26 F); the overall mean age of patients was 60 years and mean BMI was 33. Patients typically had numerous previous abdominal operations before their LVHR (mean 2.5; range: 0–9). Patients underwent LVHR for incisional (81%), umbilical (13%), Spigelian (4%), and a combination (2%) of hernias. While the majority of operations were for first-time hernias (59%), 26 patients had previous hernia repairs (range: 1–8). Ten different surgeons performed the LVHR operations at our institution.

All material for hernia repairs was placed as an underlay with a GoreTex™ panel being most common (74%; other meshes = composite [10%], prolene [1.5%], biologic meshes [1.5%], or no mesh [13%]). Mean panel size was 333 cm^2 (range 25–936 cm^2). During the majority of procedures, a combined approach of permanent sutures and titanium tacks were used (70%); solely suture (13%) or solely tacks (5%) were used in other procedures. One-fifth of operations had concurrent procedures (Roux-en-Y gastric bypass [4], inguinal hernia repair [3], intestinal mass resection [1], sebaceous cyst removal [1], port-a-cath removal [1], enterocele and rectocele repair [1], nexus punch biopsy [1], thyroidectomy [1]) that were performed during the same operation. While there were no intraoperative complications in this group of elective LVHR, six operations were converted to open procedures: difficult adhesions (4), concerning mass (1), and another identified small hernia defect (1). Mean operative time was 164 min (range: 50–439 min) and mean length of hospital stay was 3.7 days (range 0–22 days). For operations that had a concurrent operation, mean operative time was 169 min (range 96–365 min) and mean length of hospital stay was 4.3 days (range 0–22 days).

Short-term complications occurred in 12 patients (19%): ileus (5), two complications of concurrent procedures (both gastric leaks

Table 1
Demographics and peri-operative details.

	Patients with >10 years of follow-up	Patients without 10 years of follow-up	Comparison between groups ($P < 0.05$)
Mean Length of Follow-Up (months)	149 ± 16	41 ± 36	
Proportion Male	58.7%	57%	0.861
Mean Age (years)	60 ± 12.8	68 ± 12.9	0.001*
Mean BMI	32.6 ± 6	29.7 ± 6.7	0.015*
Mean Number of Previous Abdominal Operations	2.5 ± 2	2.9 ± 3.4	0.464
Proportion of Operations Converted to Open (%)	9.5	12.5	0.603
Proportion that were Recurrent Hernias (%)	41.3	43	0.861
Mean Mesh Size (cm^2)	333.6 ± 222.4	328 ± 258.7	0.908
Mean Operative Time (minutes)	163.9 ± 77.7	152.7 ± 83.1	0.478
Proportion with Additional Procedures Performed Concurrently (%)	22.2	26.8	0.563
Mean Length of Hospital Stay (days)	3.7 ± 3.8	5.9 ± 13.2	0.22
Proportion with Intraoperative Complications (%)	0	1.8	0.287
Proportion with Short-Term Complications (%)	19	20	0.896
Proportion with Long-Term Complications (%)	44.4	32.1	0.169
Type of Hernia, proportion (%)			0.4
Incisional	80.4	80.9	
Spigelian	4.4	9.5	
Umbilical	13	4.8	
Incisional & Umbilical	2.2	4.8	
Type of Mesh, proportion (%)			0.273
PTFE	74.6	77	
Composite	9.5	1.8	
Biologic	1.6	0	
Polypropylene	1.6	5.4	
No Mesh	12.7	14.3	
Type of Fixation Method (%)			0.982
Suture	12.7	8.9	
Tacks	4.8	5.4	
Suture & Tacks	69.8	71.4	
No fixation	12.7	14.3	

after Roux-en-Y gastric bypass), pneumonia (2), adrenal insufficiency (1), transient small bowel obstruction (1), and one patient with small bowel obstruction requiring re-operation for lysis of adhesions. Fourteen patients developed a seroma (time to diagnosis 78 days; range: 7–772 days); no seromas required treatment.

Long-term outcomes (Table 2)

At a mean follow-up of 149 months (range: 10–15 years), the long-term complication rate was 44% (28 patients). Complications included: hernia recurrence (23%), seroma formation (22%), bowel obstruction (16%), and mesh infection (8%). Of the 15 patients who had a hernia recurrence, mean time to diagnoses was 28.1 months (2–81 months). Thirteen patients underwent re-operation at our institution, and the procedure was performed via laparoscopic (7) or open (6) technique.

Of the 10 patients who developed a bowel obstruction, the mean number of obstructions was 1.6 (range: 1–5) and 7 required operations (4 lysis of adhesions, 2 small bowel resection, 1 repaired at outside hospital with no operative note). Of five patients who developed a mesh infection, mean time to diagnosis was 78 months (individual time to diagnosis: 0, 4, 102, 113, and 169 months). All five patients required treatment (antibiotics only [1] or re-operation with mesh removal [4]).

Several risk factors with development of long-term complications post-LVHR were evident (Table 2): 1. Operating initially on a recurrent hernia was associated with an increased risk of developing a hernia. 2. Prolonged operative time (above median time: 140 min) was associated with later increased rates of both bowel obstruction and mesh infection. 3. Developing mesh infection was also associated with the use of GoreTex™ and larger mesh size (greater than median size: 285 cm^2).

Discussion

This study reports complication and recurrence rates significantly higher for LVHR than studies with short-term follow-up, but rates that are similar to those studies with longer follow-up data.[2–6] The important features of this study include the documentation and clinical risks of subsequent bowel obstruction and mesh infection – with many being detected further out than previously reported.[7] Ongoing improvements in laparoscopically treating patients with first-time and recurrent ventral hernias remain necessary to decrease the rates of complications seen in long term follow-up.

Most studies of laparoscopic ventral hernia repair have very short follow-up. While easier to complete and generate such studies with larger numbers, the data misrepresents reality for patients that expect to remain active for several decades of life. Short term follow-up of ventral hernia repairs report complication rates of 10%–25% and low recurrence rates; indeed, one recent prospective trial with 2000 patients detected a 21% complication rate and 4% recurrence rate at two years.[8] With 12 years of follow-up our study group is far smaller and showed more complications, a higher rate of recurrence, and increased mesh infections. Others with long-term follow-up confirm the same: more complications, more recurrences, and more infections.[2–6] The importance of long-term follow-up to identify complications in patients undergoing LVHR is essential.

Identifying risk factors of post-operative complications remains critical to selecting the best patients for surgical intervention or altering patient risk factors (smoking, obesity, skin flora, etc.) prior to offering LVHR. In this study of 63 patients undergoing LVHR from 2002 to 2005, long-term follow-up identified only one significant risk factor for patient recurrence: repairs for recurrent hernias had a higher recurrence rate. While other studies with follow-up approaching 10 years are limited, they do offer important insight into predicting post-operative troubles. At 9 years of follow-up, Chi-Cheng et al. noted that risk factors for abdominal wall laxity/eventration were larger defects (>30 cm^2) and prolonged operative time.[4] Nardi et al. studied risk factors for hernia recurrence in 185 patients at 5 years post-operatively, noting that a BMI above 31, age above 50, larger hernia defects, an overlap of the mesh on fascia of <5 cm, and the presence of significant comorbidities increased the risk for recurrence.[6] Similarly, in short-term follow-up (2 years), Sanchez et al. performed a multi-center (8 institutions) prospective review of nearly 2000 patients, identifying longer length of hospital stay, longer operative times, and previous recurrence as risk factors for future recurrence.[8] Intuitively, bigger hernias, longer operations, larger patient BMI, and elderly/frail patients having greater recurrence rates in logical. But with 12 + years of follow-up, our study only identified a previous recurrence as the key factor in predicting another hernia recurrence. From a technical standpoint, we agree that placing mesh well beyond 5 cm from the hernia's edges is mandatory to limit hernia recurrence.

Mesh type and fixation method have commonly been identified as possible factors for hernia recurrence. However, the Sanchez study[8] and one by Baker et al., a nationwide cohort study comparing fixation methods and recurrence rates at 3.5 years, did not see any difference in recurrence rates between fixation methods.[9] We similarly did not find the type of material or fixation technique to be critical in predicting recurrences in long-term follow-up.

With 12 years of follow-up, we found 16% of our patients struggled with small bowel obstruction (SBO). Studies with shorter follow-up and larger study size would suggest that SBO is one of the least common complications reported after LVHR, compared to studies with longer follow-up and smaller study size showing rates similar to ours.[8,10,11] For instance, Sanchez et al. reports in 2000 patients at 2-year follow-up a SBO rate of only 0.3% compared to Burger et al. reporting a rate of 12% in 126 patients at 5-year follow-up.[8,11] Our study identified increased operative time as a risk factor for obstruction – often a marker of previous adhesions and perhaps foreshadowing subsequent difficulties with adhesive SBO.

Table 2
Long-Term Complications in 28 patients and Risk Factors for Complications. NS indicates no significance.

	Seroma	Mesh Infection	Hernia Recurrence	Bowel Obstruction
Complication Rate (%)	22.2	7.9	23.4	15.9
Mean Time to Diagnosis (months)	2.6 ± 6.7	77.6 ± 73.6	28.1 ± 23	NA
Proportion of Patients that Required Treatment (%)	0	80	86.7 (53.8% of re-repairs were laparoscopic)	60
Risk Factors				
Operative Time > 140 min	NS	p = 0.049	NS	p = 0.004
Mesh Size > 285 cm^2	NS	p = 0.054	NS	NS
GoreTex™ versus other mesh	NS	p = 0.0186	NS	NS
Recurrent Hernia	NS	NS	p = 0.022	NS

Anecdotally we noted that several patients with SBO difficulties in long-term follow-up had undergone additional surgical procedures after their LVHR (laparoscopic cholecystectomy, appendectomy, etc.). We found no studies that shed light on this potential risk with a previous LVHR.

An infection of the mesh that repairs an abdominal hernia is a devastating complication. Mesh infection rates can be seen from 1 to 4% in short-term studies and occur in up to 10% in studies with longer follow-up.[4,5,8,12] It is important to note that in our study, those 5 patients developing infected mesh (8% rate) did so at a median time to diagnosis of 8 years. Of our patients, the risk factors identified for mesh infection were longer operative time and larger mesh size. Other studies offer important insights on mesh infection. Bueno-Lledo et al. studied predictors of mesh infection after hernia repair, identifying the use of immunosuppressive drugs, the need for urgent repair, and the development of a surgical site infection post-operatively as risk factors for mesh infection.[7] They similarly reported that the use of GoreTex™ was a predictor for need for mesh explantation with mesh infection.[7] Although GoreTex™ is easier to remove when infected, perhaps the lesser tissue incorporation increases the risk of subsequent infection. We have decreased our usage of GoreTex™ based on this study's findings.

There are several limitations of this study. It is a retrospective study and several important details (defect size, size of mesh, complication details, etc.) were only as accurate as reported in the medical record and by patient recollections in follow-up contact. Additionally, with only 63 patients having at least 10 years of follow-up information, this study is not adequately powered to identify all connections between peri-operative details and complications. Another limitation of a study with long-term follow-up is that our patients underwent LVHR from 2002 to 2005, and modern technology (mesh types, robotics, antibiotics, etc.) and patient care algorithms (better nutrition, mandated no nicotine pre-operation, nasal swabs for MRSA, etc.) have changed over time. Finally, this study looks at patients from one tertiary care institution, with patients trending to be older, harbor more co-morbidities, having more previous operations, and ultimately having longer operative times.

In conclusion, this study indicates a significant risk of long-term complications and recurrence in patients undergoing and followed for a laparoscopic ventral hernia repair. Short-term complication rates after LVHR clearly under-estimate the true risk for recurrence and mesh infection. It remains essential for physicians to have candid and honest conversations with their patients about the long-term complication rates associated with LVHR. Armed with such information, patients can make an informed decision about undergoing elective hernia repair.

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Conflicts of interest

Authors have no conflicts of interest to disclose.

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