Laparoscopic versus open ventral hernia repair: a comparative study

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Background
Ventral hernia repair has changed dramatically over the past decades by the introduction of laparoscopy and prosthetic biomaterials. This study aimed to compare the short-term outcomes of laparoscopic ventral hernia repair (LVHR) versus open ventral hernia repair (OVHR).
Patients and methods
This prospective study was conducted on 40 patients with ventral hernia who were randomized to LVHR group or OVHR group to compare operative time, intraoperative complications, postoperative pain, postoperative hospital stay, postoperative complications, and cosmetic results.
Results
LVHR was performed in 20 patients having a mean age of 43.60±8.18 years, and 60% were females. OVHR was performed in 20 patients having a mean age of 48.40±9.45 years, and 50% were females. Operative time of laparoscopic repair (86 min) was shorter than that of open repair (91 min). Only one case was converted from laparoscopic repair to open repair. There was no significant injury to viscera or vessel and no recurrence in either group. In LVHR group, the percentage of patients requiring additional analgesia was 30%, whereas in OVHR group, the percentage of patients requiring additional analgesia was 65% (P=0.027). The mean postoperative hospital stay was shorter for the laparoscopic group than for the open hernia group (1.15 vs. 4.55 days; P=0.002). More wound infection occurred in the open group (15%) than in the laparoscopic group (5%) (P=0.292).
Conclusion
LVHR is better than open repair, with less postoperative pain, shorter hospital stay, faster return to normal activity, lower rate of postoperative complications, and better cosmetic appearance.

Keywords:
hernia, incisional hernia, laparoscopic ventral hernia repair, open ventral hernia repair, ventral hernia

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Introduction

Ventral hernia is defined as any protrusion through abdominal wall, with the exception of hernia through the inguinal and femoral regions [1].

Ventral hernia can be classified as spontaneous (primary) or acquired (secondary) or by their site on the abdominal wall. Spontaneous hernias are classified as epigastric hernia, umbilical hernia, and hypogastric hernia. Acquired hernias commonly occur after surgical incisions, so they are termed incisional hernias [2].

The main challenges in hernia management lie in deciding the surgical approach and type of repair procedure to perform, that is, laparoscopic or open surgery, anatomical or mesh repair and type of mesh to use, and where to place the mesh to guarantee the strongest possible repair with the least probability of recurrence [3].

The use of laparoscope in the treatment of abdominal wall hernia repair was first reported in 1993 by LeBlanc and William [4].

After many years of improvement, laparoscopic ventral hernioplasty is now broadly performed. This may offers benefits for the patients from the use of laparoscopic surgery in which there is less operative time, shorter hospital stay, improved the patient outcome and fewer complications in comparison to open hernia repair [5].

The aim of this study was to compare between laparoscopic and open hernioplasty in noncomplicated

ventral hernia regarding operative data, postoperative pain and recurrence rate, intra and postoperative complications, and return to normal activity.

Patients and methods

Study design

This prospective randomized study was conducted from December 2015 till December 2016. All patients with noncomplicated ventral hernia were included in this study. Exclusion criteria included complicated ventral hernia, recurrent hernia, patients unfit for general anesthesia, and pregnancy.

This study involving 40 patients with ventral hernia, who were classified into two groups: group I included 20 patients with ventral hernia who were operated by laparoscopic repair and group II included 20 patients with ventral hernia who were operated by open repair.

All details of the research were explained to all patients, and they understood they would be selected randomly to undergo either laparoscopic ventral hernia repair (LVHR) or open ventral hernia repair. All patients provided informed consent to participate in the trial and for the surgical procedure. The procedure was approved by the local health committee.

Operative technique

Laparoscopic repair

Veress needle was used to create pneumoperitoneum, usually at the umbilicus or in the left hypochondrium according to the site of the hernia. Carbon dioxide gas was used, and intra-abdominal pressure of 15 mmHg was considered safe. One 10-mm port for the telescope and two or three 5-mm ports are placed depending on the location of the hernia. The most frequent location of the ports is the left flank.

Omental and bowel adhesions were taken down by the use of diathermy (Fig. 1). The defect was identified, and careful survey of the whole parietal wall was done to search for another defect. The size of the defect was measured by the use of scale. The dual mesh of a suitable size (with 3–5 cm overlap beyond the margins of the defect) was introduced and fixed to anterior abdominal wall after reduction of the intra-abdominal pressure to 6–8 mmHg.

Fixation of mesh was done using transfascial sutures and two rows of tacks (Figs 2 and 3). The first row is placed right at the fascial defect and the second row is placed at the edge of mesh ~5 cm from the edge. Peritoneal flaps, or greater omentum were used to avoid contact of mesh with abdominal organs. The skin was closed by 3–0 sutures or skin stapler. A ball of gauze was placed over the region of the hernia defect, with a pressure dressing applied and maintained for 2 weeks.

Figure 1

Adhesiolysis.

Figure 2

Fixation of mesh by prolene sutures.

Figure 3

Fixation of mesh by tackers.

Open repair

The skin incision was made according to the site of the hernia. Subcutaneous flap was raised ~5 cm around the defect. Dissecting out the hernia sac and reducing its contents back into the abdominal cavity were done. The defect was closed primary, if possible, by 1 nylon loop suture. Polypropylene mesh of a suitable size was used. The mesh was fixed over the anterior rectus sheath (onlay mesh repair) with 0 polypropylene sutures. The skin was closed over the suction drain.

Postoperative follow-up

Postoperative pain assessment was done according to the visual analog scale in first postoperative day and analgesia needed: intramuscular diclofenac sodium till resuming oral intake. The wounds were inspected with respect to hematoma, seroma, and wound infection. Postoperative skin complications included cellulitis, flap necrosis, and infection. Skin infection was either superficial, which needed no surgical interference and treated by dressing and antibiotic therapy, or deep infections, which may extend to mesh. Treatment of deep infections may include debridement with antibiotic. Resistant infections may need mesh removal.

Other complications such as bowel injury and vascular injury were searched for by physical examination and follow-up abdominal ultrasound. Hernia recurrence was diagnosed by physical examinations, which were performed serially in the inpatient and outpatient setting. The patients were instructed to avoid lifting heavy objects and other strenuous activities for at least 6 weeks, and then return to normal activity gradually. Patient follow-up examination was done during a weekly visit in the first month followed by a monthly visit. Follow-up of the patients ranged from 6 to 12 months. Assessments of postoperative complications in the form of wound infection, seroma, and recurrence were done.

Statistical analysis

The collected data were coded, processed, and analyzed using the statistical package for the social sciences (SPSS) version 21 for Windows (SPSS Inc., Chicago, Illinois, USA). Qualitative data were presented as number and percent. Comparison between groups was done by χ^2-test. Quantitative data were presented as mean±SD and range. Student's *t*-test was used to compare between two groups. *P* value less than 0.05 was considered to be statistically significant.

Results

LVHR was performed in 20 patients having mean age of 43.60±8.18 years; 60% were females, and mean BMI was 30.15±4.53. Open ventral hernia repair was performed in 20 patients having mean age of 48.40± 9.45 years; 50% were females and mean BMI was 28.35±2.83 (Table 1).

In our study, incisional hernia represented 25% of the cases in group I (three cases postexploratory, one postappendectomy, and one port site hernia) and 45% of cases in group II (seven cases postexploratory, one postappendectomy, and one port site hernia). Paraumbilical hernia represented 45% of the cases in group I and 35% of cases in group II. Epigastric hernias were true hernias with defect of more than 3 cm in diameter represented 30% of the cases in group I and 20% of cases in group II (Table 2 and Fig. 4).

Operative time of laparoscopic repair (86 min) was shorter than that of open repair (91 min). However, this difference is statistically insignificant. Only one case was converted from laparoscopic repair to open repair.

Table 3 shows that postoperative seroma following laparoscopic repair accounted for 30 versus 10% following open repair. Four patients developed wound infection, three of them in the open repair group (15%) and one of them in the laparoscopic repair group (5%). Recurrence rates were 10% in laparoscopic repair versus 5% in the open repair. Three (15%) cases in open group and one (5%) case in laparoscopic group had postoperative ileus and were managed conservatively. No vascular nor bowel injuries were reported in both groups of this study.

All 40 patients received single dose of postoperative analgesic in the form of intramuscular injection of

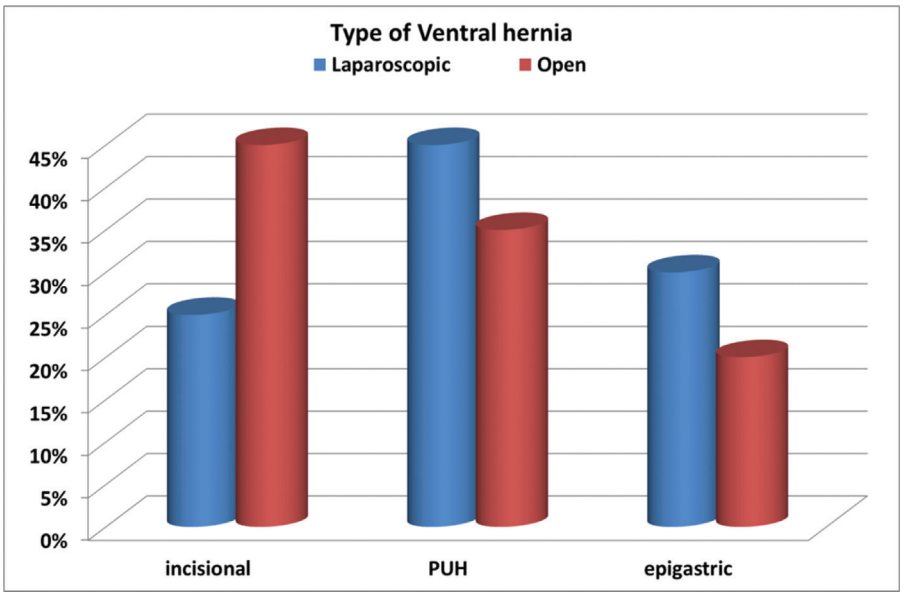
Table 1 Demographic criteria of the patients

	Laparoscopic (*N*=20)	Open (*N*=20)	*t*	*P*
Age	43.60±8.18	48.40±9.45	1.036	0.307
BMI	30.15±4.53	28.35±2.83	1.506	0.140
Sex [*n* (%)]				
Male	8 (40)	10 (50)	0.143	0.705
Female	12 (60)	10 (50)		

Table 2 Types of included ventral hernias

Types	Laparoscopic (*N*=20) [*n* (%)]	Open (*N*=20) [*n* (%)]	χ^2	*P*
Epigastric	6 (30)	4 (20)	1.73	0.408
Paraumbilical	9 (45)	7 (35)		
Incisional	5 (25)	9 (45)		

Figure 4



Types of ventral hernia.

Table 3 Postoperative complications

Complications	Operation [*n* (%)]		χ^2	*P*
	Laparoscopic (*N*=20)	Open (*N*=20)		
Seroma	6 (30.0)	2 (10.0)	2.500	0.114
Wound infection	1 (5.0)	3 (15.0)	1.111	0.292
Postoperative ileus	1 (5.0)	3 (15.0)	1.111	0.292
Mesh infection	0 (0.0)	0 (0.0)		
Recurrence	2 (10.0)	1 (5.0)	0.360	0.548
Bowel injury	0 (0.0)	0 (0.0)		
Vascular complications	0 (0.0)	0 (0.0)		

NSAIDs, but 30% of patients from group I and 65% of patients from group II needed extra analgesics, with significant difference between both groups in postoperative pain.

There was a statistical significance regarding the postoperative pain score according to the VAS within 24 h postoperatively between the two groups ($P<0.001$). In the laparoscopic group, it ranged from 2 to 7, with a mean of 4.11±1.91, whereas in the open group, it ranged from 4 to 9, with a mean of 6.45±1.24 (Table 4).

Table 5 shows that there is a significant difference between the periods of hospital stay between both groups. Hospital stay extended up to 14 days in open repair group for management of deep infection. Most of hospital stay periods in laparoscopic group did not exceed 2 days within few cases stayed in hospital for 3 days. The return to normal activity took longer time for the open group, with significant difference between both groups.

Table 4 Postoperative pain score according to the visual analog scale

	Operation		*t*	*P*
	Laparoscopic (*N*=20)	Open (*N*=20)		
Pain score				
Mean±SD	4.11±1.91	6.45±1.24	5.516	0.001*
Range	2–7	4–9		

**P* value is significant.

Discussion

Ventral hernias are associated with reduced daily activities and high socioeconomic costs for its operations. The use of mesh has reduced surgical failure. Before the introduction of prosthesis, recurrence rate exceeded 50% of cases [6]. The introduction of laparoscopic repair is an increasingly used alternative technique to open repair [7].

In view of the above, this study was conducted to assess the laparoscopic repair of ventral hernia in comparison with open repair of ventral hernia. To achieve this aim,

Table 5 Periods of hospital stay and time to return to normal activity (days)

	Operation		*t*	*P*
	Laparoscopic (*N*=20)	Open (*N*=20)		
Hospital stay				
Mean±SD	1.15±0.49	4.55±4.14	3.651	0.002*
Range	1–3	1–14		
Return to normal activity				
Mean±SD	3.55±1.76	13.80±4.30	9.866	<0.001*
Range	2–7	8–20		

**P* value is significant.

40 patients were included in this study who were divided into two groups: group I included 20 patients with ventral hernia who were operated on by laparoscopic repair and group II included 20 patients with ventral hernia who were operated by open repair. Uncomplicated primary ventral and incisional hernias in adult population were included. However, patients with obstructed or strangulated hernias, infection (local or systemic) or uncontrolled medical diseases were excluded.

The number of female patients in this study was slightly higher than male patients [22 (55%) patients vs. 18 (45%) patients], due to higher cosmotic concerns of females. This goes with the studies of Anderson *et al.* [6], with 30 (53.6%) female patients and 26 (46.4%) male patients, and Ecker *et al.* [8], with 8303 (61.2%) female patients and 5.264 (38.8%) male patients. However, it differs from the studies of Ferrari *et al.* [9], with 17 (47.3%) female patients and 19 (52.7%) male patients; Wassenaar *et al.* [10], with 64 female patients and 108 male patients; and Juo *et al.* [11], with 1139 (31.7%) female patients and 2455 (68.3%) male patients, in which the number of male patients exceed that of female patients.

Incisional hernias represented 25% of cases included in group I and 45% of the cases included in group II, and 71.4% of included incisional hernias were postexploratory midline hernia. A lower percentage was recorded by Israelson *et al.* [12], with 65.5% of included incisional hernias were postexploratory. The situation differs in the study of Misra *et al.* [13] who noted that half of included cases were complaining from incisional hernias followed lower abdominal gynecologic operations.

Regarding the operative time in this study, the operative time of laparoscopic repair (86 min) was shorter than that of open repair (91 min), as open repair often requires extensive lateral dissection and flap creation, which takes a lot of time, whereas fixation of mesh by tacks in laparoscopy is not time consuming. These findings agreed with the results of Ahonen-Siirtola *et al.* [14], with 93 min for laparoscopic group versus 121 min for open group; Rogmark *et al.* [15], with 100 min for laparoscopic repair versus 110 min for open repair; Misra *et al.* [13], with 75 min for laparoscopic repair versus 86 min for open repair; and Olmi *et al.* [7], with 61 min for laparoscopic repair versus 150 min for open repair.

In our study, all patients received single dose of postoperative analgesic in the form of intramuscular injection of NSAIDs, but 30% of patients of laparoscopic group versus 65% of patients of open group needed extra analgesics, with significant difference between both groups in postoperative pain. This goes with the study of Navarra *et al.* [16] with significant difference in postoperative pain between laparoscopic and open groups, as mean analgesic requirement was 1.4 for laparoscopic group versus 4.9 for open group. However, in Eker *et al.* [17] at the 4-week follow-up, 25% of the laparoscopic group and 24% of the open group reported persisting pain, requiring prolonged analgesia use.

In this study, there was a significant difference between hospital stay of both groups. Mean hospital stay of laparoscopic group was 1.15 days whereas that of open group was 4.55 days. This was consistent with the previous studies of Froylich *et al.* [18], with 3.2 for laparoscopic group versus 3.8 days for open group; Olmi *et al.* [7], with 2.7 days for laparoscopic repair versus 9.9 days for open group; Misra *et al.* [13], with 1.5 days for laparoscopic repair and 3.4 days for open repair; Navarra *et al.* [16], with 5.7 days for laparoscopic repair and 10 days for open repair; and Barbaros *et al.* [19], with 2.5 days for laparoscopic repair and 6.3 days for open repair.

In our study, surgical debridement of necrotic tissues was done in some cases of open repair, which made hospital stay of this group longer than that of laparoscopic group. Hospital stay affected the return

to normal activity in our study, which occurs after 13.8 days in open repair and 3.55 days in laparoscopic repair.

In our study, 5% of laparoscopic cases were converted to open repair owing to unsafe procedure with laparoscopic lysis. Other studies showed different rates of open conversion. Open conversion represented 11.1% in Asencio *et al.* [20], 13.6% in Itani *et al.* [21], 8.5% in Eker *et al.* [17], 7.8% in Rogmark *et al.* [15], and 2.5 and 2.7% in Ferrari *et al.* [9]. The indication of conversion varied, among studies, from unsafe procedure with laparoscopic lysis of sever adhesions, obesity with inability to reduce the hernia content, to bowel injury [8].

The most common postoperative complication of the laparoscopic repair is seroma formation. In this study, postoperative seroma following laparoscopic repair accounted for 30 versus 10% following open repair. This goes with the studies of Rogmark *et al.* [15], with 10.9% for laparoscopic group versus 8.6% for open group; Colavita *et al.* [22], with 9.7% for laparoscopic group versus 7.5% for open group; and Tsuruta *et al.* [23], with 9.5% for laparoscopic group and no seroma in open group. However, other studies showed higher rate of seroma in open repair than laparoscopic repair, such as Ahonen-Siirtola *et al.* [14] with 5.3% for laparoscopic group versus 6.9% for open group and Itani *et al.* [21], with 8.3% for laparoscopic group and 24.7% for open group.

Wound-related infectious complications included superficial infection, deep infection, and flap necrosis. In this study, four patients developed wound infection, with one of them in the laparoscopic repair group (5%) and three of them in the open repair group (15%). However, these differences did not reach statistical significance, and this ratio is not surprising as the open approach is associated with greater tissue handling and dissection. Wound secretions and the placement of a foreign body like mesh in such an environment may increase the probability of wound-related complications. This finding agreed with the result of Ecker *et al.* [8], with 0.9% for laparoscopic group versus 1.9% for open group; Ahonen-Siirtola *et al.* [14], with 3.2% for laparoscopic group versus 8.6% for open group; Colavita *et al.* [22], with 0.3% for laparoscopic group versus 3% for open group; Rogmark *et al.* [15], with 1.5% for laparoscopic group versus 18.8% for open group; Itani *et al.* [21], with 2.8% for laparoscopic group versus 21.9% for open group; and Tsuruta *et al.* [23], with 4.1% for laparoscopic group versus 4.7% for open group. Most of the cases presented with infection were treated by strong antibiotic therapy and frequent dressing, except two patients in the open repair group, who needed surgical interference and debridement without need of mesh removal.

Regarding the recurrence, laparoscopic and open repair showed recurrence rates of 10% in the and 5%, respectively. This goes with studies of Ahonen-Siirtola *et al.* [14], with 4.2% for laparoscopic group versus 2.7% for open group. However, many studies reported that the recurrence rate of laparoscopic repair was markedly reduced, such as Colavita *et al.* [22] with 5.2% for laparoscopic group versus 6% for open group; Froylich *et al.* [18] with 20% recurrence rate for laparoscopic group versus 27.1% for open group; and Stickel *et al.* [24] with 5.2% for laparoscopic group versus 10% for open group. However, recurrence was absent in laparoscopic repair compared with open repair at 9.5% in the study by Tsuruta *et al.* [23] and that by Barbaros *et al.* [19], with no recurrence in laparoscopic group versus 4.3% recurrence rate for open group. It seems that the learning curve of the laparoscopic repair plays an important role in the recurrence rate of this procedure.

There was no hollow viscous injury reported in both groups of this study. The result of this study agreed with many studies such as Misra *et al.* [13], Olmi *et al.* [7], and Navarra *et al.* [16]. Other studies showed variable rates of bowel injuries like Rogmark *et al.* [15], with 4.6% for laparoscopic group versus 1.4 for open group; Barbaros *et al.* [19], with 4.3% for laparoscopic group and no bowel injury in open group; and Itani *et al.* [21], with 4.1% for laparoscopic group and no bowel injury in open group.

There was no vascular complications reported in our study as there was no reported cases of DVT or pulmonary embolism, because all patients received a prophylactic dose of clexan preoperatively, and all patients have low BMI (25–35) of Rogmark *et al.* [15] and Itani *et al.* [21] with no reported cases of DVT or pulmonary embolism. However, in other studies like Colavita *et al.* [22], the reported rate of DVT was 0.5% for laparoscopic group versus 0.7% for open group; in Ecker *et al.* [8] was 0.2% for laparoscopic group versus 0.3% for open group; and in the study by Ahonen-Siirtola *et al.* [14], the reported rate was 0.4% of laparoscopic group versus 0.62% of open group for pulmonary embolism.

Conclusion

LVHR is better than open repair, with respect to less postoperative pain, shorter hospital stay, faster return to normal daily activity, lower rate of postoperative

complications regarding wound infection and ileus, and better cosmetic appearance. So, laparoscopic repair is considered as first choice for ventral hernia repair. More randomized trials with longer follow-up evaluation are needed to determine the durability of laparoscopic repair in relation to the open repair of ventral hernia.

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Conflicts of interest
There are no conflicts of interest.

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