Short-term outcomes of laparoscopic intraperitoneal onlay mesh with facial repair (ipom-plus) for ventral hernia: a randomized controlled trial

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Background
Laparoscopic ventral hernia repair has become a widely used technique.
Objective
This study evaluates the outcomes of laparoscopic ventral hernia repair with and without fascial repair, with particular reference to complications, seromas, and early recurrence.
Patients and methods
A total of 177 patients were divided into three groups. Group I underwent laparoscopic [intraperitoneal onlay mesh (IPOM)] hernioplasty without repair. Group II underwent laparoscopic IPOM hernioplasty with intracorporeal repair. Group III underwent laparoscopic IPOM hernioplasty with transfacial closure using PDS loop. Patients were followed for 6 months for early postoperative morbidity, including seroma formation, whereas the secondary end points were the adequacy of transfacial repair and its effect on early hernia recurrence.
Conclusion
Transfacial suture closure of hernia defect is the simplest method of the hernia repair and effective with less incidence of seroma and early recurrence as compared with nonfascial repair technique. Defect closure strengthens the abdominal wall by regaining its whole function and gives more space for mesh insertion. Whatever technique used for ventral hernia repair, obesity is still the most important risk factor for seroma and hernia recurrence.

Keywords:
laparoscopic ventral hernia repair-transfacial repair, onlay mesh, ventral hernia

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Introduction

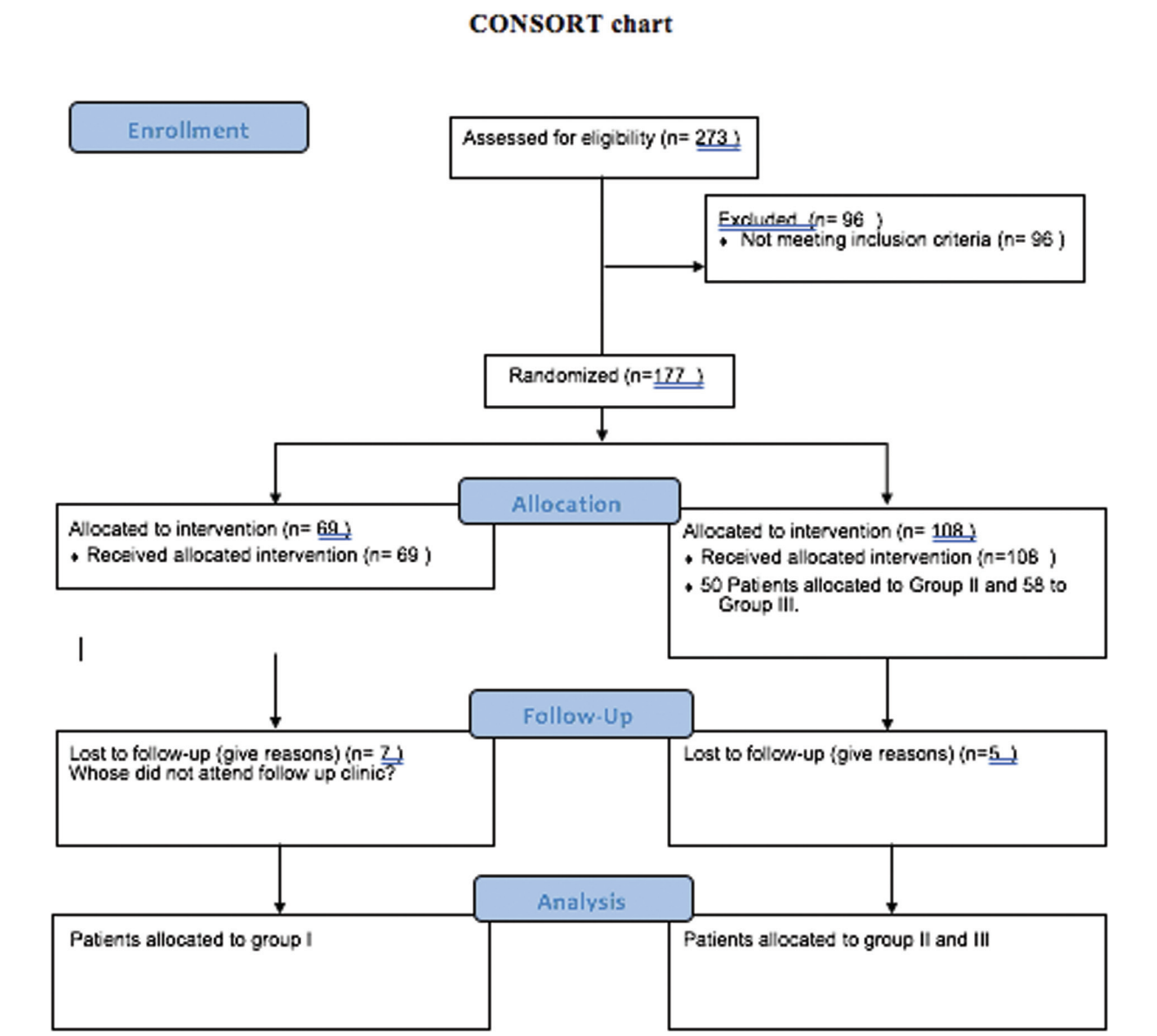
Ventral hernia is a major cause of functional impairment, abdominal pain, and bowel obstruction. The overall incidence of primary ventral hernia is estimated to be between 4 and 5% in the literature, and ventral incisional hernia rates vary from 35 to 60% within 5 years after laparotomy [1,2]. After laparoscopy, this rate is estimated to decline from 5 to 15% even after two decades. Laparoscopic ventral hernia repair (LVHR) or open repair (OVHR) is still a matter of debate because of concerns about seroma formation, recurrence rate, and the intraperitoneal mesh position [3,4]. The laparoscopic technique for repairing ventral and incisional hernias is now well established. However, several issues related to LVHR, such as the high recurrence rate of hernias with large fascial defects and in extremely obese patients, are yet to be resolved. Additional problems include seroma formation. To solve these problems, laparoscopic fascial defect closure with intraperitoneal onlay mesh (IPOM) reinforcement (IPOM-Plus) has been introduced in the past decade, and a few studies have reported satisfactory outcomes [5–12]. Although detailed techniques for fascial defect closure and handling of the mesh have been published, standardized techniques are yet to be established [13].

Patients and methods

After obtaining Institutional Review Board approval in Zagazig University Hospitals, a prospective randomized controlled trial was conducted on 177 consecutive patients who underwent LVHR with IPOM. The study was performed in two institutions, Zagazig University Hospitals and Tertiary Hospital in Riyadh, Saudi Arabia, from October 2016 to October 2019. All patients signed informed consent after detailed procedure was explained to them (Fig. 1).

Group assignment: patients were divided by random allocation into three groups:

Fig. 1



Patient groups.

(1) Group I (control group): it included 69 patients who underwent laparoscopic IPOM hernioplasty without repair.
(2) Group II: it included 50 patients who underwent laparoscopic IPOM hernioplasty with intracorporeal repair using prolene 0 or stratifix PDS.
(3) Group III: it included 58 patients who underwent laparoscopic IPOM hernioplasty with transfacial closure using PDS loop 0.

The primary end point was the early postoperative morbidity, including hematoma, seroma formation, surgical site infection (SSI), and pain, whereas the secondary end point was the adequacy of transfacial repair and its effect on early hernia recurrence.

Preoperative data and selection criteria

Inclusion criteria

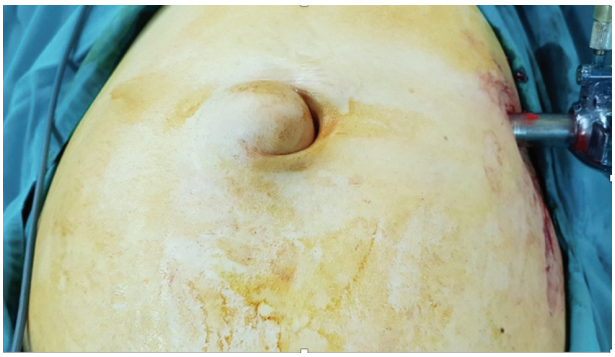
Patients older than 18 years undergoing surgery for primary or incisional ventral hernia and having defect whose width did not exceed 10 cm were enrolled after informed consent.

Exclusion criteria

Patients undergoing revision or emergency surgery were excluded from study. Parastomal or recurrent hernias were not included. Patients not candidate for laparoscopy were excluded, including patients with cardiac disorders and those with COPD.

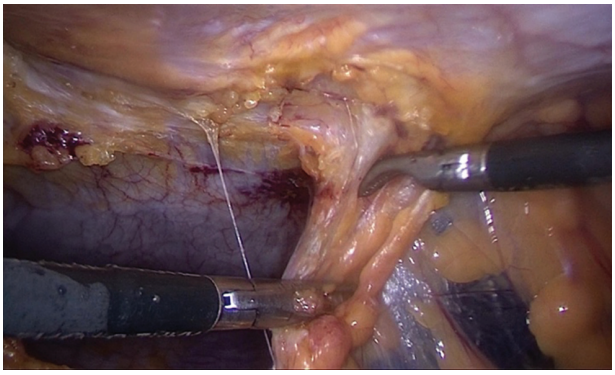
All patients underwent routine laboratory investigations, ultrasound soft tissue for establishing

Fig. 2



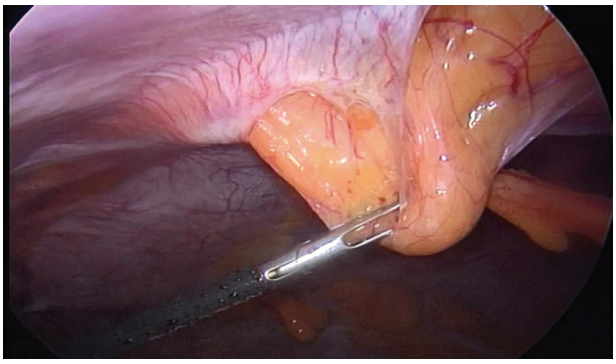
Visiport 12 mm in the left anterior axillary line.

Fig. 3



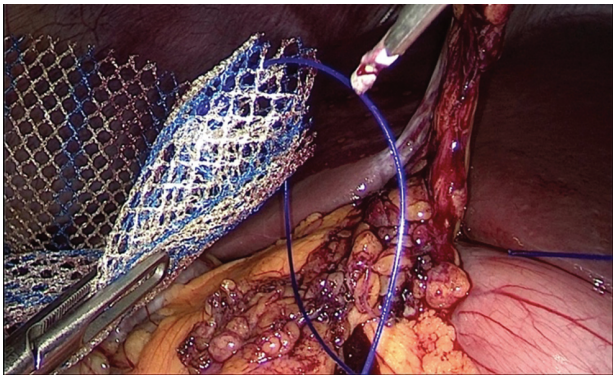
Adhesiolysis.

Fig. 4



Contents of hernia were reduced.

Fig. 5



Mesh corner suture hanged by endoclose.

diagnosis, detection size of defect, and chest radiography. Prophylactic first generation cephalosporin was given for patients before operation.

Intraoperative data and surgical procedure

Under general anesthesia, with the patient in supine position, lateral visiport 12 mm was inserted in the left anterior axillary line (Fig. 2). Other two 5 mm ports were inserted under vision with more 'as necessary'; 'as laterally as possible from the hernial defect', usually all ports on the left side. A 30° optic was used. Adhesiolysis was done (Fig. 3). The contents of hernia were reduced (Fig. 4). The borders of the defect were illuminated and outlined. The abdominal wall was marked from outside for measurement of defect size and for corners fixation of mesh with 5 cm away from defect edge. Small defects are less than 4 cm width, moderate defects are 4–7 cm width, and large defects are 9–10 cm width.

Group I

Prolene 1 sutures were applied at the corners of the mesh introduced into the peritoneal cavity. Endoclose was passed at the marked site from abdominal wall, sutures were hanged and tied subcutaneously, and completion of mesh fixation was done using a secure strap (Fig. 5).

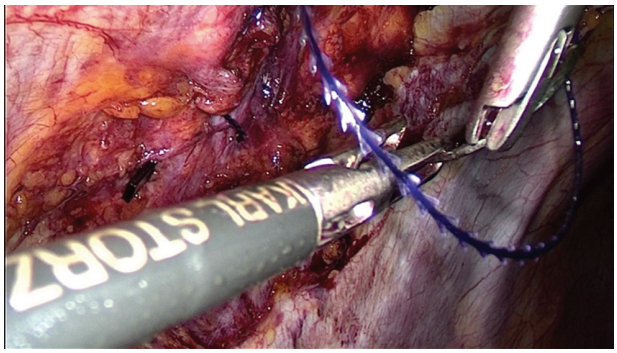
Group II

PDS 0, a stratifix suture (STRATIFIX Symmetric PDS Plus Knotless Tissue Control Device, Ethicon, Somerville, New Jersey USA) (Fig. 6), or prolene 1 (Fig. 7), was used to repair and plicate the defect, and then mesh fixation was done. We aimed to compare the two types of sutures that could be used for repair. Stratifix knotless sutures has many advantages, starting from more efficiency and consistency and antibacterial protection compared with the continuous prolene suture used in the other group (reviewer 4).

Group III

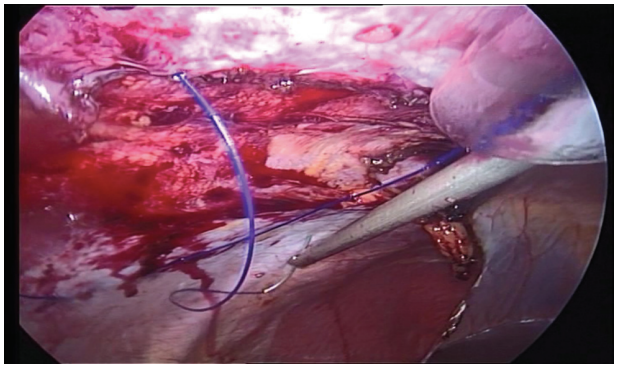
The PDS loop sutures were prepared by cutting the needles, keeping two detached ends and one blind end. A small curved supraumbilical incision was done. The endoclose was passed through upper border of incision penetrating the abdominal wall above the defect, hanging the blind end of the PDS loop to outside (Fig. 8). It was passed through the lower border of the wound crossing the defect. It hanged one detached end

Fig. 6



A stratifix suture.

Fig. 7



Repair and plicate the defect by prolene 1.

of the PDS (Fig. 9) loop suture to outside and passed again through lower border of incision to catch the other detached end. The two ends were hanged and not tied to avoid incision closure. The process is repeated by passing 1–2 cm lateral or medial to the previous sutures, and then blind ends were divided. Lastly, all sutures are tied. Mesh was fixed as before.

Postoperative data and follow-up

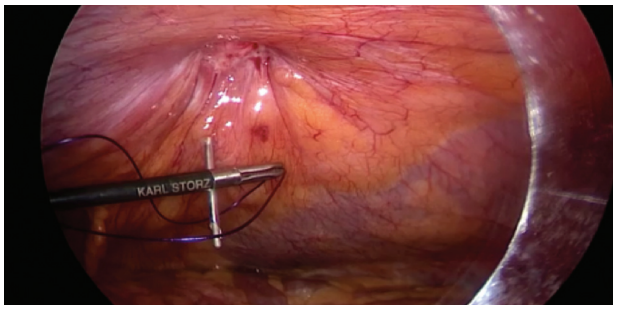
Abdominal binder was applied postoperatively. Patients were advised for early ambulation. Patients were discharged on the second day and followed up in outpatient clinic, scheduled after 4–5 days for dressing. Patients were followed weekly in the first month, then monthly till the end of 6-month postoperatively for early detection of the hernia recurrence.

Results

Patient characteristics

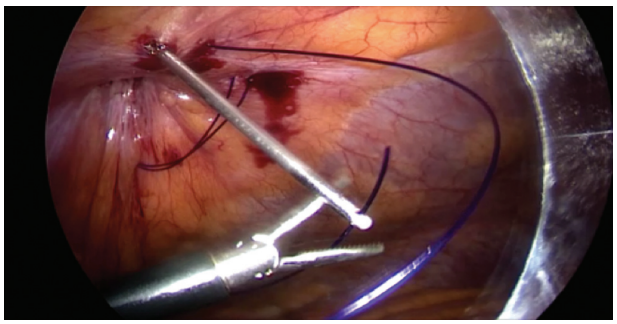
There were 98 females and 79 males. In males, the age range was 34–49 years, and in females, 24–47 years. Obesity is defined as a BMI greater than or equal to 30 kg/m^2 and morbid obesity also termed class III obesity as BMI greater than or equal to 40 kg/m^2. BMI ranged from 27 to 43 kg/m^2 (Tables 1 and 2).

Fig. 8



Endoclose hanging the blind end of the PDS loop.

Fig. 9



Endoclose hanged one detached end of the PDS.

Intraoperative data

Mesh fixation was always ensured with four corners transfascial nonabsorbable sutures and completion of fixation using intraperitoneal fixation devices. Repair was done with intracorporeal sutures or transfacial closure in vertical direction even in large size defects.

There were three conversions in group I (4.3%) owing to large nonreducible hernia containing the small bowel. They were converted to midline incision, adhesiolysis, reduction of content, and application of onlay prolene mesh. There was no conversion in group II and group III, even though previous surgery existed.

The intraoperative complications were three cases: one case in group I (1.4%) owing to small bowel injury during content dissection. Laparoscopic repair was done in one layer using PDS 3/0, as the tear did not exceed more than 30% of wall circumference. Other two cases in group II (4%) represented bleeding owing to omental excessive bleeding and epigastric artery injury during mesh fixation. Both were treated by means of coagulation and ligation. There was no significant difference between the groups (Table 3).

Table 1 Basic characteristics

	Group I (*N*=69) [*n* (%)]	Group II (*N*=50) [*n* (%)]	Group III (*N*=58) [*n* (%)]	*P* value
Sex				
Males	29 (42)	22 (44)	28 (48.3)	0.775§
Females	40 (58)	28 (56)	30 (51.7)	
Age (years)				
Mean±SD	35.68±6.27	36.84±6.33	37.65±6.62	0.322•
Median (range)	37 (24–49)	37 (24–48)	38 (24–49)	
BMI (kg/m^2)				
Mean±SD	32.65±5.06	32.68±4.92	33.17±5.27	0.835•
Median (range)	32 (27–43)	32.50 (27–43)	32.50 (27–43)	
Average weight	27 (39.1)	19 (38)	18 (31)	0.815§
Overweight	20 (29)	12 (24)	18 (31)	
Obese	22 (31.9)	19 (38)	22 (38)	
Previous surgery				
No	27 (39.1)	16 (32)	22 (38)	0.709§
Yes	42 (60.9)	34 (68)	36 (62)	
Number of previous procedures				
0	27 (39.1)	17 (34)	22 (38)	0.052§
1	18 (26.2)	19 (38)	24 (41.4)	
2	17 (24.6)	14 (28)	6 (10.3)	
3	7 (10.1)	0	6 (10.3)	
Previous hernia repair				
No	34 (49.3)	36 (72)	37 (63.8)	0.036§
Yes	35 (50.7)	14 (28)	21 (36.2)	

•Kruskal–Wallis *H* test. §χ^2 test. $P<0.05$ is significant.

Table 2 Intraoperative data

Intraoperative data	Group I (*N*=69) [*n* (%)]	Group II (*N*=50) [*n* (%)]	Group III (*N*=58) [*n* (%)]	*P* value§
Excessive use of cauterization				
No	59 (85.5)	39 (78)	50 (86.2)	0.446
Yes	10 (14.5)	11 (22)	8 (13.8)	
Defect				
Small size	28 (40.5)	19 (38)	22 (37.9)	0.673
Moderate size	22 (32)	19 (38)	18 (31.05)	
Large size	19 (27.5)	12 (24)	18 (31.05)	
Conversion to open				
No	66 (95.7)	50 (100)	58 (100)	0.092
Yes	3 (4.3)	0	0	

§χ^2 test. $P<0.05$ is significant.

Table 3 Intraoperative complication

Intraoperative complication	Group I (*N*=69) [*n* (%)]	Group II (*N*=50) [*n* (%)]	Group III (*N*=58) [*n* (%)]	*P* value§
Small bowel injury				
No	68 (98.6)	50 (100)	58 (100)	0.455
Yes	1 (1.4)	0	0	
Bleeding				
No	68 (100)	49 (98)	58 (100)	0.443
Yes	0	2 (2)	0	

§χ^2 test. $P<0.05$ is significant.

Postoperative outcome

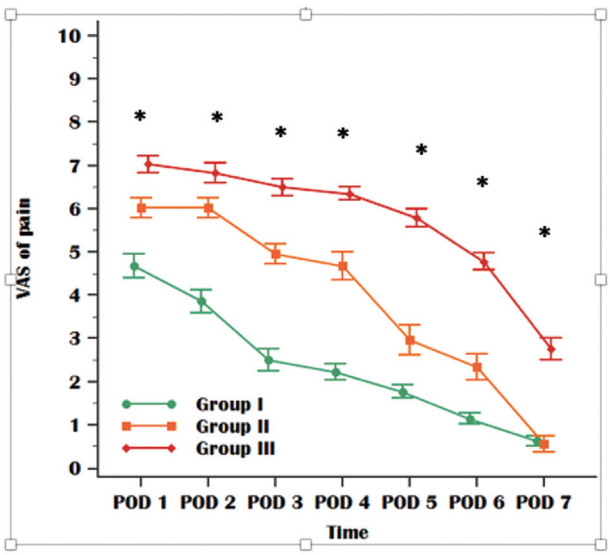
Postoperative pain (acute phase)

It was evaluated using a visual analog scale. It was 3-2-1/10 for group I, 4-3/10 for group II and 7-6-5/10 for group III on first, second, and third postoperative day (POD), respectively. Pain decreased on POD 4 to 2/10 for group I, 3/10 for group II, and 6/10 for group 3. After one week, the pain score became 1/10 for group 1, 2/10 for group 2, and 4/10 for group 3.

The analysis showed increase in the incidence of pain on POD 1. group III patients experienced more pain.

Less pain was also encountered in less bulky abdominal wall in thin individuals. The tacks may be anchored subcutaneously, causing little pain. High BMI individuals had more postoperative pain, especially in group III. There is a significant difference among the three groups (Fig. 10).

Fig. 10



A line graph shows comparison between the studied groups regarding visual analog scale of pain; markers represent mean, Y-error bar represent 95% confidence interval of mean. *Significant difference as $P<0.05$.

Postoperative complications

SSIs accounted for 10 (5.6%) cases among the total patients. They comprised nine (5%) patients with superficial site infection at trocar site (four in group I, three in group II, and two in group III). There was no postoperative peritonitis infection (0.0%) but one mesh infection (0.5%) in group I. The case of mesh infection was marked by postoperative cellulitis and skin necrosis, resulting in chronic suppurative abdominal wall infection and early hernia recurrence. At first, ultrasound-guided drainage was done under broad-spectrum antibiotic coverage. Several months later, the patient was re-operated on for a two-stage strategy: the first stage was for mesh removal, and

Table 4 Postoperative complication

Postoperative complication	Group I (N=69) [n (%)]	Group II (N=50) [n (%)]	Group III (N=58) [n (%)]	P value[§]
Postoperative complication				
No	52 (75.4)	42 (84)	51 (87.9)	0.168
Yes	17 (24.6)	8 (16)	7 (12.1)	
SSI				
No	64 (92.8)	47 (94)	56 (96.6)	0.648
Yes	5 (7.2)	3 (6)	2 (3.4)	
Superficial site infection at trocar site				
No	65 (94.2)	47 (94)	56 (96.6)	0.786
Yes	4 (5.8)	3 (6)	2 (3.4)	
Mesh infections				
No	68 (98.6)	50 (100)	58 (100)	0.455
Yes	1 (1.4)	0	0	
Ileus				
No	65 (94.2)	50 (100)	58 (100)	0.041
Yes	4 (5.8)	0	0	
Hematomas				
No	65 (94.2)	49 (98)	57 (98.3)	0.367
Yes	4 (5.8)	1 (2)	1 (1.7)	
Seroma				
No	52 (75.4)	43 (86)	54 (93.1)	0.007*
Yes	17 (24.6)	7 (14)	4 (6.9)	
Persistent seroma				
No	59 (85.5)	48 (96)	57 (98.3)	0.009*
Yes	10 (14.5)	2 (4)	1 (1.7)	
Neurological pain				
No	62 (89.9)	47 (94)	54 (93.1)	0.669
Yes	7 (10.1)	3 (6)	4 (6.9)	
Early hernia recurrence				
No	59 (85.5)	48 (96)	57 (98.3)	0.008*
Yes	10 (14.5)	2 (4)	1 (1.7)	

SSI, surgical site infection. [§]χ^2 test. $P<0.05$ is significant. *Significance.

the second stage was new mesh repair using large prolene mesh onlay. There was no significant difference between groups regarding SSI, whereas high BMI is a significant risk factor for postoperative SSI. Moreover, there is no significant difference between stratifix knotless sutures and prolene regarding SSI on statistical analysis (Table 4).

Hematomas

Overall, six patients had abdominal wall localized hematomas (four in group I, one in group II, and one in group III), especially in obese patients with BMI 35. All patients underwent conservative measures, and no one required intervention, either radiological or surgical. High BMI is a significant risk factor for postoperative hematoma. There was no significant difference among the three groups.

Seroma

Overall seroma rate was 15.8% (28 patients). Group I had 17 (24.6%) patients with seroma (15 patients with BMI more than 37, comprising four patients with SSI and four patients with hematoma). Group II had seven (14%) patients with seroma (three patients with SSI, four with large sized defect, and two patients with high BMI). Moreover, four (6.8%) patients in group III has seroma (seroma was attributed to such patients owing to excessive use of cautery, high BMI, and SSI). A total of 15 patients required repeated wound care with antibiotics and lastly resolved. Moreover, 13 (7.4%) patients had a large persistent seroma which lasted more than 3–6 months (type III) and required ultrasound-guided drainage. Persistent unresolved seroma rate requiring invasive treatment and open drainage was 1.7% (three patients). Three patients required local punctures with diluted povidone iodine injection–suction.

The predictive risk factors for seroma are BMI (obesity), previous surgery, number of previous procedures, previous hernia repair, SSI, size of defect, and excessive use of cauterization. There is a statistical difference among the three groups, with least seroma formation in group III, with *P* value of 0.007.

Neurological pain (chronic phase)

A total of 14 patients complained of some sort of lower abdominal wall pain and numbness (seven in group I, three in group II, and four patients in group 3). Gabapentin tablets were prescribed for all 14 patients; 10 patients improved and four patients are still under treatment after 6 months. There was no statistical difference among the three groups.

Early recurrence

Early recurrence is described as recurrence within the first 6 months postoperatively. A total of 13 (7.3%) patients showed early recurrence, including 10 patients in group I (eight patients with BMI more than 32, four patients with SSI, and two patients with large sized defect); two patients in group II, who developed port site hernia preceded with SSI and with high BMI; and only one patient in group III, who already had early postoperative hematoma and SSI. There was a significant difference among groups, with group III with least recurrence, with *P* value 0.008. Obesity, postoperative complication, and large sized hernia were independent factors for early hernia recurrence in the three groups.

Ileus

A total of four (2.2%) patients developed ileus, with mean time of 2 days: two patients already underwent conventional open repair and two patients were in group I underwent LVHR (due to delayed mobilization postoperatively). There was no significant difference among the three groups. The range of ileus duration was 2–7 days.

Length of stay

Most of patients with postoperative complication stayed more than 2 days, but most cases stayed from 1 to 2 days. There was no significant difference among the three group (Table 5).

Statistical analysis

Continuous data are expressed as the mean±SD and median (range), and the categorical data are expressed as a number (percentage). Continuous variables were checked for normality by using Shapiro–Wilk test.

Table 5 Length of stay

Length of stay	Group I (*N*=69) [*n* (%)]	Group II (*N*=50) [*n* (%)]	Group III (*N*=58) [*n* (%)]	*P* value
Length of stay (days)				
Mean±SD	2.01±1.64	1.72±1.41	1.60±1.33	0.100•
Median (range)	1 (1–7)	1 (1–6)	1 (1–6)	
1–2 days	55 (79.7)	42 (84)	50 (86.2)	0.610§
>2 days	14 (20.3)	8 (16)	8 (13.8)	

•Kruskal–Wallis *H* test. §χ^2 test. $P<0.05$ is significant.

Kruskal–Wallis *H* test was used to compare more than two groups of non-normally distributed data. Categorical data were compared using χ^2-test. All tests were two tailed. *P* less than 0.05 was considered statistically significant. All data were collected, tabulated, and statistically analyzed using SPSS 22.0 for windows (SPSS Inc., Chicago, Illinois, USA) and MedCalc 13 for windows (MedCalc Software bvba, Ostend, Belgium).

Discussion

Many surgical procedures exist for LVHR. There is controversy regarding the type of mesh, how to fix it, the closure of hernia defect, and the mesh position. However, all surgeons still follow the universal principles that apply to LVHR [14].

The conversion of laparoscopic repair to open repair was 1.6% in the total patients. The intraoperative complication rate was 1.6%, with only one case of perforated intestine (0.5%). These results are comparable to the studied group of Qadri and colleagues, where major complication of enterotomy was seen in one (2.5%) patient andone1 (2.5%) patient had conversion in laparoscopic repair group [14].

The incidence of SSI was 5.6% with no significant difference between groups and between patients who underwent repair with stratifix or prolene sutures. We reviewed the literature on IPOM-Plus in the PubMed database and identified 5 reports in which the SSI rate was less than 3% [6,15–18]. Other studies of Itani and colleagues and Kurmann and colleagues matched our results regarding the incidence of SSI [16,19].

In this study, the seroma rate was 15.8%. Most of the patients responded to conservative measures and minimal invasive approach. Only 1.7% of seroma cases needed open drainage. These results partly match with other studies, which confirms that the seroma is the most common complication after hernia repair, in ~30% of cases, although it can resolve spontaneously [15,20,21]. Other studies like that of Palanievelu [22] showed low rate of postoperative seroma, in 7.6% of cases. Group III showed the least incidence of seroma, like some evidence that closure of the fascial defect may decrease the seroma rate, but this remains disputed in the literature [15,20].

There are no postoperative peritonitis infections and one mesh infections (0.05%). Patel *et al.* [23] operated 733 patients with LVHR. The average age was 56.5 years, BMI 33.9 kg/m^2, and hernia size 11.5 cm. After a mean follow-up of 19.4 months, the overall hernia recurrence rate was 8.4%, which is close to our recurrence (7.3%). Overall rate of SSI after reoperation was 5.6%. Our rate of mesh infection was 0.5%. This compares favorably with the 5.5% rate of mesh infection experienced after index LVHR by Puraj and colleagues, who documented that reoperating a patient with prior intraperitoneal mesh is safe, without any increased risk of having the mesh to become secondarily infected, despite performing a contaminated field surgical procedure.

Postoperative seroma can naturally evolve in different ways, namely, resorption, persistence, or complication. Because of the high incidence of seroma, we considered a persistent symptomatic seroma that needed intervention as a complication. The risk factors for seroma were BMI (obesity), previous surgery, SSI, number of previous procedures, previous hernia repair, size of defect, and excessive use of cauterization. Colon *et al.* [24], with the data based on the Morales–Conde classification (type III and IV), showed the persistence of seroma would, in turn, relate to the size of the mesh, which could delay its resorption.

In a recent study done by Dimitrios Prassas *et al.* [25], laparoscopic IPOM combined with electric cauterization of the hernia sac significantly reduces the rate of postoperative seroma compared with the IPOM technique in patients with ventral and incisional hernias, and this is not compatible with our study.

Postoperative pain was not significantly different among the three groups. It was attributed to application of secure strap, and the mesh was fixed by staples in all patients. In this study, fixation devices influence neither PO complications nor the recurrence rate. However, the group of patients with metal tacks experienced a higher PO pain and 10 of them improved with medical treatment. A recent Danish study showed more recurrence after the use of absorbable tacks versus metal tacks [26]. A systematic review concluded the same results for PO pain and also for recurrence, ranging from 0 to 9% [27].

The recurrence rate in this series was 7.3%, with significant difference between the groups and lowest rate of incidence in group III. The researchers identified three main causes of early recurrence (obesity, postoperative complications, and large defect). These results are supported by the study of Chlaes *et al.* [15].

There is paucity of data regarding comparative outcomes of abdominal wall hernia repair in obese and nonobese patients. The limited data available have significant heterogeneity within patient groups, the hernia defect size and location, follow-up, and the population [28].

Moreno-Egea *et al.* [29] evaluated the size of the defect in 315 patients operated on for hernias between 5 and 15 cm in size. The size of the defect was an independent prognostic factor for recurrence with a threshold of 10 cm. In a study done from 2005 to 2014 by Mercoli *et al.* [30], 417 patients underwent LVHR. Mean age and BMI were 54 years and 31 kg/m^2, respectively. The overall recurrence rate was 9.8%. In a multivariate analysis, previous interventions [odds ratio (OR): 1.44; confidence interval (CI): 1.15–1.79; *P*=0.01], postoperative complications (OR: 2.57; CI: 1.09–6.03; *P*=0.03), and Clavien–Dindo score greater than 2 (OR: 1.43; CI: 1.031–1.876; *P*=0.02) appeared as independent prognostic factors of recurrence. Minor complications were associated with 14.7% of recurrence and major complications with 30% of recurrence. Overall seroma rate was 18.7%, with 1.4% of persisting or complicated seroma. BMI (OR: 1.05; CI: 1.01–1.08; *P*=0.026) and vascular surgery history (OR: 5.74; CI: 2.11–15.58; *P*<0.001) were independent predictive factors for seroma. Recurrence did not appear to be related to seroma.

Several factors were studied for their effect on seroma or recurrence. Age has no effect on seroma nor recurrence in the study of Muysoms *et al.* [31] comparable results, but got a longer length of hospital stay in patients over 65 years. Age was another factor for longer length of stay, which can be explained by several factors, namely, co-morbidities and complex and bulky hernias, requiring larger dissections.

One of the most serious complications is the incidence of postoperative hematomas. In our series, we observed six hematoma cases (3.3%), two of which were significant. Both patients were obese. One patient was successfully managed by cauterization and the other one was managed by intracorporeal ligation, which can be related to the accidental injury of the epigastric artery during mesh fixation. Hematoma prevalence is estimated to be between 0.4 and 4% in the literature [32,33]. This can be related to transfascial suturing or to mesh fixation devices (tackers).

In this study, the postoperative ileus incidence was 2.2% owing to conversion of two cases to open technique and delayed patients' mobilization. The mean of ileus duration was 2 days with range of 2–7 days. A retrospective study demonstrated a 1.3% incidence of postoperative ileus with a duration greater than 7 days [34]. A prospective trial of 144 patients undergoing LVHR reported a mean time of 1.8 days to return of bowel function with a range of 0–8 days [35]. A study of 819 laparoscopic hernia repairs reported a 3% incidence of prolonged ileus, although the duration of the ileus was not defined. In each of these studies, postoperative ileus resolved uneventfully [17].

From 2005 to 2014, Mercoli *et al.* [36] operated 417 patients by LVHR. Intraoperative complications occurred in three patients. The overall recurrence rate was 9.8%. Median time for recurrence was 15.3 months (3–72). In a multivariate analysis, previous surgery (OR: 1.44; CI: 1.15–1.79; *P*=0.01), postoperative complications (OR: 2.57; CI: 1.09–6.03; *P*=0.03), and Clavien–Dindo score 2 (OR: 1.43; CI: 1.031–1.876; *P*=0.02) appeared as independent prognostic factors of recurrence. Minor complications were associated with 14.7% of recurrence and major complications with 30% of recurrence. Emergency LVHR (6%) did not increase the rate of complications. Overall seroma rate was 18.7%, with 1.4% of persisting or complicated seroma. BMI (OR: 1.05; CI: 1.01–1.08; *P*=0.026) and vascular surgery history (OR: 5.74; CI: 2.11–15.58; *P*=0.001) were independent predictive factors for seroma. Recurrence did not appear to be related to seroma, superficial abscesses, PO peritonitis, and mesh infections up to 1 year after the procedure. The overall SSI rate was 2.15%. Long postoperative follow-up of at least 12 months is needed for more evaluation.For chronic neurological pain at the later stages, after 3–6 months, Gabapentin was used as a main line of the treatment, and there was no significant difference among groups. Gabapentin was recommended as one of the first line of treatment of chronic pain in the study of Bjurstrom *et al.* [37]. This did not match with a Cochrane review including 40 randomized clinical trials, which concluded, cautiously, that preoperatively administered ketamine may reduce the risk of chronic pain, but that there is no evidence for recommending gabapentinoids, pregabalin, or other drugs for prevention of chronic postoperative pain [38].

Conclusion

LVHR is a favored procedure for correction of abdominal wall defects. Many techniques can be

used for LVHR according to the experience of the surgeon and available resources. Closure of fascial defect appears to decrease postoperative morbidity and give chance for good fixation of the mesh. Seroma and recurrence are the main postoperative complications, which are related to obesity. Other complications like chronic pain, ileus, and hematoma are limited and can be avoided by following the guidelines of LVHR.

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Conflicts of interest
There are no conflicts of interest.

References

1 Comajuncosas J, Hermoso J, Gris P, Jimeno J, Orbeal R, Vallverdú H, *et al.* Risk factors for umbilical trocar site incisional hernia in laparoscopic cholecystectomy: a prospective 3-year follow-up study. Am J Surg 2014; 207:1–6.

2 Lee L, Mappin-Kasirer B, Sender Liberman A, Stein B, Charlebois P, Vassiliou M, *et al.* High incidence of symptomatic incisional hernia after midline extraction in laparoscopic colon resection. Surg Endosc 2012; 26:3180–3185.

3 Augustine A, Pai M, Shibumon M, Karthik S. Analysis of laparoscopic port site complications: a descriptive study. J Minim Access Surg 2013; 9:59.

4 Lee D, Rehmani S, Guend H, Park K, Ross R, Alkhalifa M, *et al.* The incidence of trocar-site hernia in minimally invasive bariatric surgery: a comparison of multi versus single-port laparoscopy. Surg Endosc 2012; 27:1287–1291.

5 Forbes S, Eskicioglu C, McLeod R, Okrainec A. Meta-analysis of randomized controlled trials comparing open and laparoscopic ventral and incisional hernia repair with mesh. Br J Surg 2009; 96:851–858.

6 Itani K. Comparison of laparoscopic and open repair with mesh for the treatment of ventral incisional hernia: a randomized trial. Arch Surg 2010; 145:322–328.

7 Rogmark P, Petersson U, Bringman S, Eklund A, Ezra E, Sevonius D, *et al.* Short-term outcomes for open and laparoscopic midline incisional hernia repair. Ann Surg 2013; 258:37–45.

8 Eker HH, Hansson BM, Buunen M, Janssen I, Pierik R, Hop W, *et al.* Laparoscopic vs. open incisional hernia repair: a randomized clinical trial. JAMA Surg 2013; 148:259–263.

9 Sajid M, Bokhari S, Mallick A, Cheek E, Baig M. Laparoscopic versus open repair of incisional/ventral hernia: a meta-analysis. Am J Surg 2009; 197:64–72.

10 Kapischke M, Schulz T, Schipper T, Tensfeldt J, Caliebe A. Open versus laparoscopic incisional hernia repair: something different from a meta-analysis. Surg Endosc 2008; 22:2251–2260.

11 Sauerland S, Walgenbach M, Habermalz B, Seiler C, Miserez M. Laparoscopic versus open surgical techniques for ventral or incisional hernia repair. Cochrane Database Syst Rev 2011; 16:7771–7781.

12 Colavita P, Tsirline V, Belyansky I, Walters A, Lincourt A, Sing R, Heniford B. Prospective, long-term comparison of quality of life in laparoscopic versus open ventral hernia repair. Ann Surg 2012; 256:714–722.

13 Suwa K, Okamoto T, Yanaga K. Closure versus non-closure of fascial defects in laparoscopic ventral and incisional hernia repairs: a review of the literature. Surg Today 2015; 46:764–773.

14 Morales-Conde S. Erratum to: a new classification for seroma after laparoscopic ventral hernia repair. Hernia 2012; 17:153–153.

15 Claes K, Beckers R, Heindryckx E, Kyle-Leinhase I, Pletinckx P, Claeys D, Muysoms F. Retrospective observational study on the incidence of incisional hernias after colorectal carcinoma resection with follow-up CT scan. Hernia 2014; 18:797–802.

16 Papageorge C, Funk L, Poulose B, Phillips S, Rosen M, Greenberg J. Primary fascial closure during laparoscopic ventral hernia repair does not reduce 30-day wound complications. Surg Endosc 2017; 31:4551–4557.

17 Heniford B, Park A, Ramshaw B, Voeller G. Laparoscopic repair of ventral hernias. Transacti Meeting Am Surg Assoc 2003; 121:85–94.

18 Chowbey PK, Sharma A, Khullar R, Mann V, Baijal M, Vashistha A. Laparoscopic ventral hernia repair. J Laparoendosc Adv Surg Tech A 2000; 10:79–84.

19 Kurmann A, Visth E, Candinas D, Beldi G. Long-term follow-up of open and laparoscopic repair of large incisional hernias. World J Surg 2011; 35:297–301.

20 Bittner R, Bingener-Casey J, Dietz U, Fabian M, Ferzli G, Fortelny R, *et al.* Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias International Endo hernia Society (IEHS)-part 1. Surg Endosc 2014; 28:2–29.

21 Dey S, Parthasarathi R, Sabnis S, Jain R, Raj P, Senthilnathan P, *et al.* Laparoscopic management of recurrent ventral hernia: an experience of 222 patients. Hernia 2019; 23:927–934.

22 Tandon A, Pathak S, Lyons N, Nunes Q, Daniels I, Smart N. Meta-analysis of closure of the fascial defect during laparoscopic incisional and ventral hernia repair. Br J Surg 2016; 103:1598–1607.

23 Patel P, Love M, Ewing J, Warren J, Cobb W, Carbonell A. Risks of subsequent abdominal operations after laparoscopic ventral hernia repair. Surg Endosc 2016; 31:823–828.

24 Colon MJ, Kitamura R, Telem D, Nguyen S, Divino C. Laparoscopic umbilical hernia repair is the preferred approach in obese patients. Am J Surg 2013; 205:231–236.

25 Dimitrios P, Schumacher F-J. Electric cauterization of the hernia sac in laparoscopic ventral hernia repair reduces the incidence of postoperative seroma: a propensity score-matched analysis. Hernia 2018; 22:747–750.

26 Morales-Conde S, Suarez-Artacho G, Socas-Macias M, Barranco-Moreno A. Retro-prosthetic seroma after laparoscopic ventral hernia repair: incidence, risk factors and clinical significance. Hernia J Hernias Abdom Wall Surg 2015; 19:943–947.

27 Christoffersen M, Brandt E, Helgstrand F, Westen M, Rosenberg J, Kehlet H, *et al.* Recurrence rate after absorbable tack fixation of mesh in laparoscopic incisional hernia repair. Br J Surg 2015; 102:541–547.

28 Polavarapu HV, Kurian AA, Josloff R. Laparoscopic ventral hernia repair in the elderly: does the type of hernia matter? Hernia J Hernias Abdom Wall Surg 2012; 16:425–429.

29 Moreno-Egea A, Carrillo-Alcaraz A, Aguayo-Albasini JL. Is the outcome of laparoscopic incisional hernia repair affected by defect size? A prospective study. Am J Surg 2012; 9203:87–94.

30 Mercoli H, Tzedakis S, D'Urso A, Nedelcu M, Memeo R, Meyer N, *et al.* Postoperative complications as an independent risk factor for recurrence after laparoscopic ventral hernia repair: a prospective study of 417 patients with long-term follow-up. Surg Endosc 2016; 31:1469–1477.

31 Muysoms F, Vander Mijnsbrugge G, Pletinckx P, Boldo E, Jacobs I, Michiels M, Ceulemans R. Randomized clinical trial of mesh fixation with 'double crown' versus 'sutures and tackers' in laparoscopic ventral hernia repair. Hernia 2013; 17:603–612.

32 Awaiz A, Rahman F, Hossain M, *et al.* Meta-analysis and systematic review of laparoscopic versus open mesh repair for elective incisional hernia. Hernia 2015; 19:449–463.

33 Reynvoet E, Deschepper E, Rogiers X, *et al.* Laparoscopic ventral hernia repair: is there an optimal mesh fixation technique? A systematic review. Langenbecks Arch Surg 2013; 399:55–63.

34 Toy F, Bailey R, Carey S, *et al.* Prospective, multicenter study of laparoscopic ventral hernioplasty. Surg Endosc 1998; 12:955–959.

35 Schoenmaeckers E, Wassenaar E, Raymakers JV, *et al.* Bulging of the mesh after laparoscopic repair of ventral and incisional hernias. JSLS 2010; 14:541–546.

36 Mercoli H, Tzedakis S, D'Urso A, *et al.* Postoperative complications as an independent risk factor for recurrence after laparoscopic ventral hernia repair: a prospective study of 417 patients with long-term follow-up. Surg Endosc 2016; 31:1469–1477.

37 Chen D, Bjurstrom M, Amid P, Nicol A. Pain control following inguinal herniorrhaphy: current perspectives. J Pain Res 2014; 7:277–290.

38 Chaparro L, Smith S, Moore R, Wiffen P, Gilron I. Pharmacotherapy for the prevention of chronic pain after surgery in adults. Cochrane Database Syst Rev 2013; (7):8301–8307.