Laparoscopic intraperitoneal onlay mesh versus open hernioplasty in ventral hernia treatment: a nonrandomized controlled trial

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Background
Although ventral abdominal wall hernias are a common problem, the best method for repair remains to be determined, and although laparoscopic repair has shown favorable short-term results, long-term studies are scarce.
Patients and methods
In this prospective nonrandomized controlled trial, a comparison between laparoscopic intraperitoneal onlay-mesh (IPOM) repair and open hernioplasty for ventral abdominal-wall hernias as regards operative time, perioperative and postoperative complications, length of hospital stay, postoperative pain, cost, and recurrence rates. This study was conducted on 80 patients with ventral abdominal-wall hernias admitted to Ain Shams University Hospitals and Dar Al-Fouad hospitals. In total, 40 (50%) patients were managed by laparoscopic IPOM repair (group A), while the other 40 (50%) patients were managed by open hernioplasty (group B).
Results
In our study, the mean age among patients of both groups was 41 ± 10.6, with males representing the majority of cases (70%). Average BMI was 29 kg/m^2, the average defect length for both groups was 2.5 cm. We noted a statistically significant earlier return to work and daily activities among the laparoscopic IPOM-repair group and a lower postoperative pain score. We also found lower rates of complications among laparoscopic IPOM group, however, it was statistically nonsignificant. The mean operative time was 67.5 min for laparoscopic IPOM group compared with 71.62 min for open-hernioplasty group. There were no mortalities in either group.
Conclusion
Laparoscopic IPOM for all ventral hernias is a safe, effective, and feasible approach, with the added benefits of shorter operating time, less hospital stay, lower postoperative pain score, and overall less complication rates than open hernioplasty.

Keywords:
fixation with tacks, intraperitoneal onlay-mesh repair, laparoscopic intraperitoneal onlay-mesh repair, open hernioplasty, paraumbilical hernia, polypropylene mesh, ventral hernias, Ventralight mesh

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Introduction

Ventral abdominal-wall hernias are a common problem that surgeons encounter in their daily practice, with incisional hernias and paraumbilical hernias being the most common subtypes [1]. The prevalence of paraumbilical hernia in adult population is estimated to be 2% and comprises 10–12% of abdominal-wall hernias with the majority being acquired and could be attributed to various factors that increase abdominal pressure and result in stretching and weakening the abdominal musculature [2]. Incisional hernias post various surgeries are reported to occur in a varying range from 11 to 20% [3]. Open hernioplasty remains the conventional method for treatment of ventral abdominal-wall hernias, but laparoscopic repair has been described as a safe and effective alternative approach since the first report in 1992 by LeBlanc and Booth [4]. The best method to repair ventral abdominal-wall hernias is yet to be settled [5].

With multiple factors coming into play in recent days such as financial resources, cost-effectiveness, productivity of individuals, and popular demand, these factors all should be taken into consideration [6]. So, while laparoscopic repair has been deemed three to nine fold more expensive compared with open repair

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in several trials [7], the shorter hospital stay, faster recovery, and better esthetic results are causing a rise in its popularity as an alternative method for traditional repair and could make it a cost-effective choice [8].

The available short-term results show that laparoscopic intraperitoneal onlay-mesh (IPOM) is associated with less blood loss, lower rates of postoperative wound infections, and less perioperative complications than open repair, also, patients reported less postoperative pain. Long-term results as regards recurrence rates are scarce and not readily available [9].

Aim

To compare the rates of perioperative and postoperative complications, hospital stay, cost, postoperative pain, operative time, and recurrence rates between laparoscopic IPOM repair and open repair for ventral abdominal hernias.

Patients and methods

This prospective nonrandomized controlled trial involved 80 patients with ventral abdominal hernias admitted to Ain Shams University Hospitals and Dar Al-fouad hospitals for elective repair during the period from January 2018 to June 2019 with follow-up for 12 months and data were collected and analyzed. The patients were divided into two groups, group A (40 patients) (50%) was treated by laparoscopic IPOM repair, while the other 40 (50%) patients were treated by open hernioplasty (group B). Ethical approval was taken from Ain Shams University ethical committee and written consent was taken from every patient after explanation of all details of the operation, advantages, disadvantages, realistic expectations, and all the possible intraoperative, early, and late postoperative complications. Surgeries were done by the same surgical team throughout the study.

Inclusion criteria: patients between 18 and 60 years old, with uncomplicated ventral abdominal-wall hernias, with a defect ranging from 2 to 6 cm.

Exclusion criteria: patients unfit for general anesthesia and with severe comorbidities (ascites, severe cardiopulmonary condition, etc.), patients undergoing emergency repairs for complicated ventral abdominal-wall hernias.

Operative technique

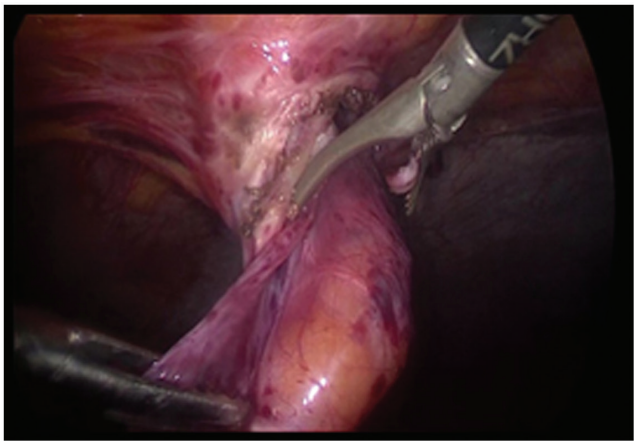
Laparoscopic intraperitoneal onlay-mesh

This was done through three ports: a 12-mm trocar for the camera and later introduction of the mesh, two 5-mm ports, all were placed at the left flank of the patient with the 12-mm trocar being central and at the anterior axillary line, the 5-mm trocars were placed midaxillary. Pneumoperitoneum was established through Veress needle or the 12-mm Vesiport, a 30^0 camera was used to provide visibility to the abdominal wall, adhesiolysis was done if needed, takedown of omentum and bowel from the abdominal wall was done, and complete excision of sac was done to fully visualize the hernial defect (Figs 1 and 2). Introduction of a Ventralight mesh through the 12-mm trocar was done and its fixation with tacks (Protack) (Figs 3 and 4), so that it overlapped the defect for around 5 cm at all sides. Hemostasis and desufflation are done, 12-mm port defects were closed using absorbable suture, and the skin was closed with Monocryl.

Open hernioplasty

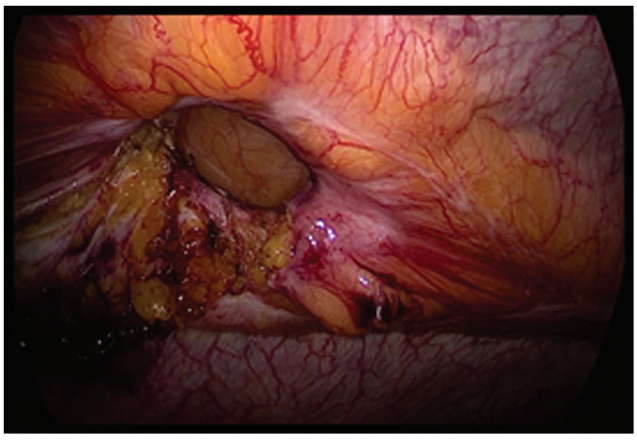
For paraumbilical hernias, a transverse incision was made supra-umbilical, for incisional hernia, the incision was made at the site of old scar with excision of old scar. Dissection of the subcutaneous tissue was

Figure 1



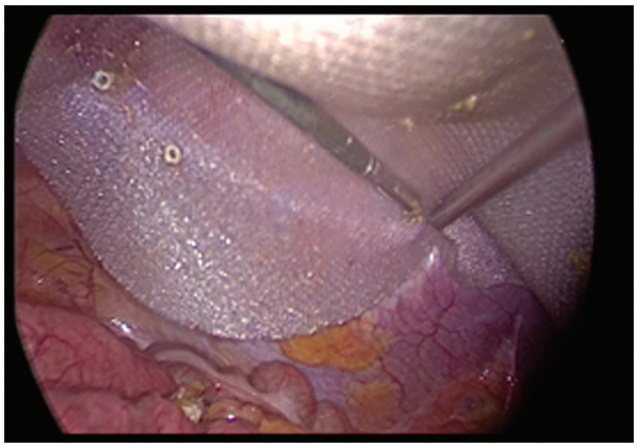
Complete excision and reduction of hernial sac.

Figure 2



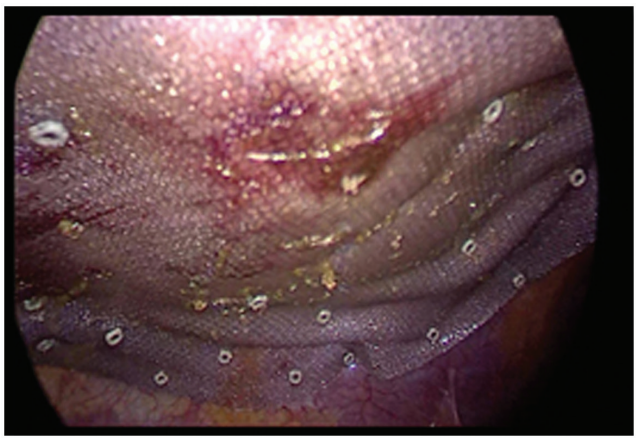
A paraumbilical hernia defect.

Figure 3



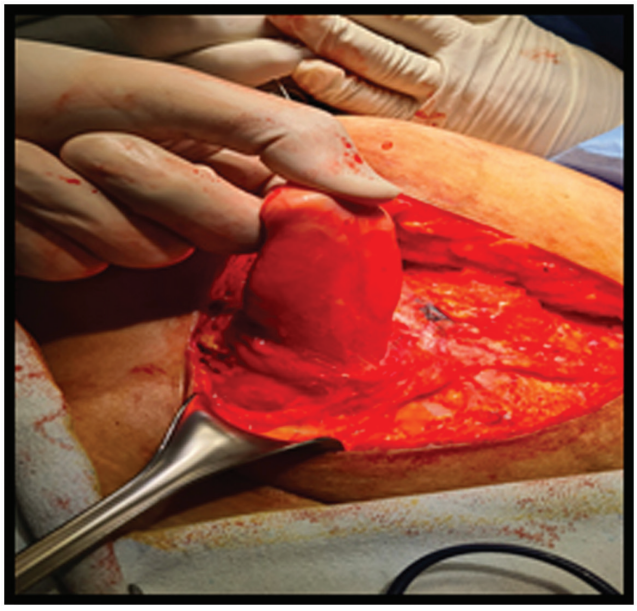
The process of fixation.

Figure 4



Mesh after circumferential fixation with tacks.

Figure 5

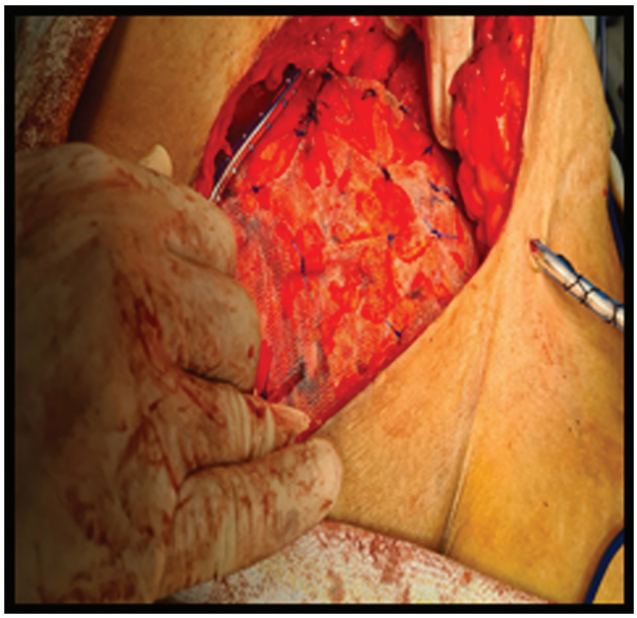


The hernial sac and defect.

Figure 6

Flaps and complicated defect.

Figure 7



Mesh after fixation with prolene sutures.

done till the anterior rectus sheath was identified; dissection of the sac was done with consideration to avoid opening of the sac (Fig. 5). Dissection of circumferential flaps above the anterior rectus sheath was done to allow for placement of the mesh, we closed the defect with prolene sutures (Fig. 6). Placement of prolene mesh and its fixation with prolene 2-0 sutures was done, so that it overlaps defect size 5 cm all around (Fig. 7). A suction drain was then placed and closure in layers was done (Fig. 8).

Figure 8

Drains inserted in place.

Study outcomes and patient follow-up

One day prior to the operation, a detailed physical examination with determination of routine blood parameters was done. Postoperatively, patients were followed up to collect study data, this was done through face-to-face interview and detailed physical examination in addition to reviewing operative, postoperative, and financial notes. The following data were collected:

(1) Operative time.
(2) Hospital stay (in days).
(3) Time to return to work (in days).
(4) Cost.
(5) Postoperative complications.

Data management and analysis

Data were revised, coded, entered on a computer, and analyzed using SPSS, version 19 for Windows (SPSS Inc., Chicago, Illinois, USA). Quantitative data were tested for normality with Shapiro–Wilk test and described as mean and SD as a measure on variability within the data. Student *t* test was used for comparing quantitative variables between two study groups. Qualitative data were expressed as frequencies (*n*) and percentage (%). χ^2 and Fisher exact tests were used to test the association between qualitative variables. *P* value less than or equal to 0.05 was considered significant.

Results

In our study that involved 80 patients, 40 (50%) patients were enrolled in laparoscopic IPOM group and 40 (50%) patients in open-hernioplasty group. Mean age in laparoscopic IPOM group was 39.90 ± 11.47 (range, 19–59 years) compared with 42.05 ± 13.19 (range, 19–60 years) in open-repair group, the difference between the groups was insignificant (*P*>0.05). In laparoscopic IPOM group, 22 (55%) were males and 18 (45%) were females, in open group, 34 (85%) were males and six (15%) were females, the difference between both groups was significant (*P*=0.003). Table 1 gives a summary about baseline characteristics to the patients.

Regarding the traditional operative metrics, mean operative time in laparoscopic IPOM group was 67.50 ± 13.16 compared with 71.62 ± 26.17 in open group, the difference between both was statistically insignificant (*P*>0.05). Mean postoperative pain scores were 3.72 ± 0.82 in laparoscopic IPOM group, in open-repair group, it was 6.25 ± 1.01, which was highly significant (*P*=0.001). Laparoscopic IPOM-group patients stayed in the hospital between 1 and 2 days (mean, 1.13 ± 0.33), this also ranged between 1 and 2 days in open-repair group (mean, 1.33 ± 0.47), however, the difference between the means in both arms was statistically significant (*P*=0.03). Mean cost (calculated in Egyptian pounds) in laparoscopic IPOM group was 30 525.00 ± 1413.99 compared with 10 950.00 ± 1060.96 in open-repair group, the difference between the means was highly statistically significant (*P*=0.001). Table 2 gives a summary regarding traditional operative metrics, Fig. 9 compares between postoperative pain scores in laparoscopic IPOM group, and Fig. 10 shows the difference in cost (expressed in Egyptian pounds) between both groups.

Regarding patient-related outcomes and complications, mean time to return to work was 6.30 ± 1.36 in laparoscopic IPOM group, compared with 9.10 ± 3.95 in open-repair group, the difference between means was highly statistically significant (*P*=0.001). Complications were higher in open-repair group, it occurred in two (5.0%) patients in laparoscopic IPOM group compared with five (12.5%) patients in open-repair group, however, the difference was not statistically significant (*P*=0.43). Only two (5.0%) patients developed seroma in laparoscopic IPOM group compared with four (10.0%) patients in open-repair group, however, it was not statistically significant. Wound infection did not occur in any patient in laparoscopic IPOM group (0%), compared with three (7.5%) patients in open-repair group, this, however, was not statistically significant. Table 3 summarizes the differences between study arms regarding time to return to work and complications, Fig. 11 shows the difference regarding hospital stay and time to return to work.

Table 1 Baseline characteristics of the patients

	Laparoscopic IPOM			Open repair			*P* value
	Mean±SD	Minimum	Maximum	Mean±SD	Minimum	Maximum	
Age	39.90±11.47	19.00	59.00	42.05±13.19	19.00	60.00	NS
Sex: male	22±55.0%	–	–	34±85.0%	–	–	0.003
Sex: female	18±45.0%	–	–	6±15.0%	–	–	

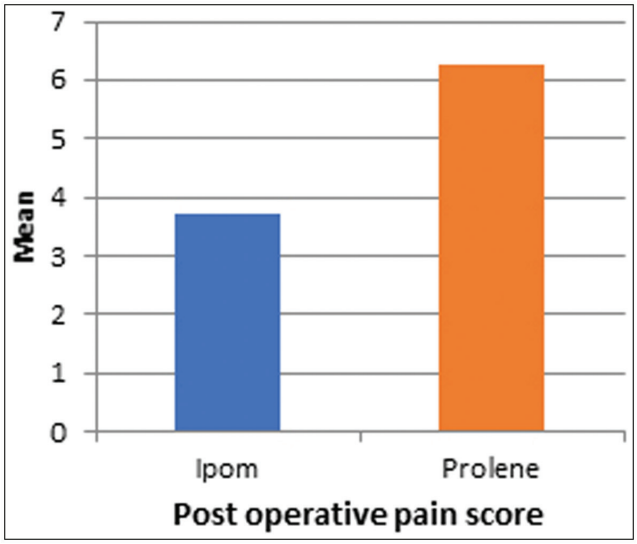
IPOM, intraperitoneal onlay-mesh.

Table 2 Difference in traditional operative metrics

	Laparoscopic IPOM			Open repair			*P* value
	Mean±SD	Minimum	Maximum	Mean±SD	Minimum	Maximum	
Operative time (min)	67.50±13.16	50.00	90.00	71.62±26.17	30.00	180.00	0.376
Postoperative pain scores	3.72±0.82	2.00	5.00	6.25±1.01	4.00	8.00	0.001
Hospital stay	1.13±0.33	1.00	2.00	1.33±0.47	1.00	2.00	0.03
Cost (EGP)	30525±1414	28000	35000	10950±1060	10000	13000	0.001

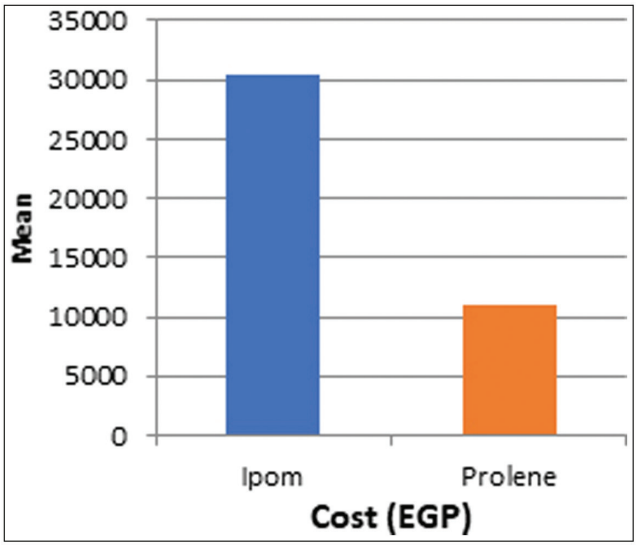
IPOM, intraperitoneal onlay-mesh.

Figure 9



Postoperative pain scores.

Figure 10



Cost difference.

Table 3 Return to work (days) and complication rates

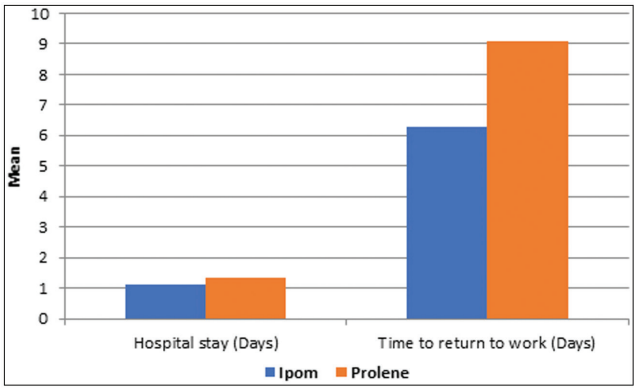
	Laparoscopic IPOM			Open repair			*P* value
	Mean±SD	Minimum	Maximum	Mean±SD	Minimum	Maximum	
Return to work (days)	6.30±1.36	3.00	7.00	9.10±3.95	7.00	21.00	0.0001
Complications							
Negative	38±95%	–	–	35±87.5%	–	–	0.43
Positive	2±5%			5±12.5%			
Seroma							
Negative	38±95%	–	–	36±90.0%	–	–	0.67
Positive	2±5%			4±10.0%			
Wound infection							
Negative	40±100%	–	–	37±92.5%	–	–	0.241
Positive	0±0%			3±7.50%			

IPOM, intraperitoneal onlay-mesh.

Discussion

In this clinical trial of 80 patients with ventral hernias treated with either laparoscopic IPOM or open repair, postoperative pain scores were lower in laparoscopic IPOM group compared with open-repair group. Mean hospital stay was less in laparoscopic IPOM-treated patients and they returned earlier to their work. Mean operative time was comparable between both study arms

Figure 11



Hospital stay (days) and time to return to work (days).

and was not statistically significant. Patients in open-arm group developed higher rates of complications, namely seroma formation and wound infection, however, this was not statistically significant, this may be related to sample size and larger studies may be able to find significant results. Although laparoscopic IPOM repair had a better profile regarding traditional operative metrics and patients' complication, it was more costly than open repair and required a higher level of technical expertise.

Treatment of abdominal-wall hernias is changing from day to day, this corresponds to major demographical shifts in the general population with an increase in the numbers of older patients with weaker connective tissue, increase in risk factors of hernia development, and increase in the number of major operations, with its subsequent complications of incisional hernia [10]. Mathes *et al.* [11] performed a meta-analysis between suture repair and mesh-based repairs in ventral hernias, suture repair was associated with more hernia recurrences compared with mesh-based repair, the relative risk for recurrence was 0.36 [95% confidence interval (CI) (0.27, 0.49)], the difference was highly statistically significant (P<0.00001), however, it was associated with an increase in the risk of chronic postoperative pain. This matches the results derived from the work of Nguyen *et al.* [12], which showed that pooled mesh-based repairs had 2.7% recurrence rates compared with 8.2% in suture-repair group. The International Endohernia Society (IEHS) recommends mesh reinforcement in all ventral hernia repairs with diameter larger than 1 cm [10]. In our study, we performed mesh-based repairs for all patients (defect size ranged between 2 and 6 cm).

Al Chalabi *et al.* [13] conducted a systematic review of five randomized controlled trials comparing between open and laparoscopic approaches for incisional hernia repair, recurrence rates were similar between both groups (*P*=0.30), wound infection was higher in open group (*P*<0.001), and length of hospital stay and operative times were not significant. Awaiz *et al.* [14] conducted another meta-analysis comparing open and laparoscopic repair for elective incisional hernia repair, open repair was associated with statistically significant reduction in the risk of bowel injury (*P*=0.02), however, no difference was found regarding overall complications, wound infection, wound hematoma, and seroma formation and reoperation rates (*P*>0.05). It is to be noted that laparoscopic repair performs better in obese patients, in a nationwide hospital survey comparing both approaches, laparoscopic repair was associated with lower complication profile in obese patients (6.3 vs. 13.7%, *P*<0.00), shorter length of hospital stay, and lower hospital costs [15]. In our study, mean operative times were comparable between both groups, hospital-stay profile was better in laparoscopic group, and time to return to work was significantly less in laparoscopic group.

Sajid *et al.* [16] compared between using tacker fixation versus suture fixation in laparoscopic ventral hernia repair, suture fixation was significantly shorter regarding operative time, however, in four to six weeks of follow-up, the scores of postoperative pain were significantly lower in tacker group (*P*<0.004). Guided by these results, we included tack fixation in all laparoscopic IPOM repairs, however, the exact contribution of tacks to postoperative pain reduction remains to be clearly examined.

A study by Arita *et al.* [17] examined the difference between laparoscopic and open-hernia repair regarding surgical-site infections (SSI), open repair was associated with higher incidence of SSI for both primary [odds ratio (OR) 4.17, 95% CI (2.03–8.55)] and incisional [OR 5.16, 95% CI (2.79–9.57)] hernia groups when compared with laparoscopic repair. A study based on American College of Surgeons National Surgical Quality Improvement Program database identified multiple risk factors for postoperative SSI, these included BMI more than 30, smoking, prolonged operation time, American Society of Anesthesiology grade 3 or more, and open compared with laparoscopic repair [18]. In our study, three (7.5%) patients developed SSI in open-repair group compared with 0 (0%) in laparoscopic IPOM-repair group, although the difference between both was not statistically significant, this may occur in part due to the small sample size of the study. A study by Köckerling *et al.* [7] compared between laparoscopic IPOM versus open repair of ventral hernia regarding postoperative complications, of note, seroma-formation rate was 1.94 in laparoscopic IPOM group versus 5.12 in open-repair group, this translates to OR of 0.379 (*P*<0.001). In our four patients, 10% developed seroma in open-repair group compared with two (5%) in laparoscopic IPOM

group, the difference was not statistically significant. The limitations of our study include small sample size and the nonrandomization process of the study.

Conclusion

Laparoscopic IPOM is a safe, effective, and feasible approach with the added benefits of lower postoperative pain scores and early return to work compared with open repair. Hospital stay was also less in laparoscopic arm compared with open-repair arm. Although the pure cost may be higher in laparoscopic IPOM repair, this should not be the only element of evaluation, as this cost may be outweighed by better postoperative complication profile in the IPOM group and the early return to work and the less overall hospital stay.

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Nil.

Conflicts of interest

No conflict of interest.

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