Original Article

Laparoscopic (IPOM And IPOM Plus) Versus Open Para-Umbilical Hernia Mesh Repair

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Abstract

Background: One of the most common surgical problems is Para-Umbilical Hernia (PUH). We compared the short-term results of open mesh repair versus laparoscopic mesh repair of PUH. Significant advantages offered to patients with laparoscopic mesh repair over open PUH repair. The clinical and economic results were compared as a cost–benefit analysis for both laparoscopic and open procedures.

Methods: Our study was conducted on 60 patients as a prospective randomized comparative study for PUH repair. We divided them into 3 groups, group A (laparoscopic intraperitoneal on lay mesh repair plus closure of the defect (IPOM plus)) 28 patients, group B (laparoscopic intraperitoneal on lay mesh repair (IPOM)) 14 patients and group C (open hernia repair) 18 patients from November 2021 to November 2022 in our surgical department in Theodor Bilharz Research Institute (TBRI) .

Results: In our study, the operating Time (min) was significantly higher in IPOM plus group A than open repair group C (115.63±2.47 vs 76.44±2.09; P<0.001). Wound complication rates were better in laparoscopic 14.2% than open hernia repair 22.3%. The median length of hospital stay was highly significantly shorter with laparoscopic surgery (1 vs 7 days; p = 0.001). Also, time off work is stastically better in the laparoscopic repair groups compared with open mesh repair group

(p<0.01). Post-operative pain was highly stastically significant in the laparoscopic repair groups compared with open mesh repair group (p = 0.001). Recurrence rates were more in IPOM technique over comparable period of follow-up. The mean Cost of IPOM plus surgery was 2850.35±30.73 LE, while in IPOM was 2697.92 ± 80.13LE and in open mesh repair was 2584.22±44.38 LE (p=0.01).

Conclusions: IPOM plus is better than IPOM and open repair as it is more anatomical, closing the defect with sutures with insertion of mesh. With lower complication rate and provide more financial benefits.

Keywords: PUH, Laparoscopy, Umbilicus.

Introduction

Paraumbilical hernias account for 10% to 12% of hernia of the abdominal wall [1]. Obesity &multiparity are the most important pre disposing factors[2].The use of prosthetic materials to repair umbilical hernias reduce the recurrence rates. This can be done by open or laparoscopic techniques[3]. Laparoscopic repair of an adult paraumbilical hernia has also shown better result that open repair [4]. Laparoscopic repair is currently the treatment of choice for cases of abdominal hernia. It is better than open repair. Although the technique has undergone many improvements, there is no standard technique for proper repair, management of the defect, the ideal mesh and fixation techniques are still controversial[5].The literature reports that the primary repair of the defect decreases the possibility of seroma by decreasing the dead space and improves wall strength [6]. laparoscopic IPOM repair, consists of placing of the composite mesh in the underlay defect through the laparoscopic intraperitoneal approach, while laparoscopic IPOM plus includes closing of the defect before mesh fixation[7].

Cost determination is needed to determine the cost analysis. The cost driver must match to the activities[8]. For determining the actual cost for such surgical operations, resource such as house-keeping personnel or nursing or equipment, instrumentation, disposable supplies should be presented in an amount consistent used for such special surgical operation[9]. Now a day, the medical cost control is no longer an academic exercise for determining the cost of surgical procedures. In order to have competition in health care environment, we have to accurately calculate the operation costs, for having good decisions [10].

Aim of study

To compare the outcomes of open and laparoscopic procedures, regarding the costs of operations, the operative time, intra and post-operative complications.

Patient and methods

Our study is the prospective comparative randomized study which was including 60 patients of paraumbilical hernia repair from November 2021 to November 2022 in surgical department of Theodor Bilharz Research Institute. Comparative analysis will be performed regarding pain, wound infection, wound dehiscence and recurrence rate, hospital stay, mesh size, post-operative drain, operative time, return to normal activity and recurrence rate. Age, sex and BMI were evaluated. we divided them into three groups:

Group A: 28 patients will perform laparoscopic intraperitoneal mesh repair with closure of defect by prolene sutures (IPOM plus).

Group B: 14 patients will perform laparoscopic intraperitoneal mesh repair without closure of defect (IPOM).

Group C: 18 patients will perform open on lay mesh repair with closure of defect by prolene sutures.

Patients meeting the inclusion criteria presenting with PUH of defect diameter less than eight cm and generally fit for surgery. Exclusion criteria were contaminated abdominal cavity, patients unfit for general anesthesia, pregnancy and hernial defect more than eight cm.

Preoperative steps include routine laboratory tests [liver function test, complete blood picture, coagulation profile, renal function and written informed consent], chest x-ray and abdominal ultrasound. On anaesthetic induction, intravenous antibiotic was given.

Statistical analysis

Results are evaluated as mean ± standard error or numbers with a percentage. Analysis of continuous variables was performed using A one-way analysis of variance (ANOVA) was used to compare group differences by Bonferroni, and otherwise Chi-square tests were applied, and continuous variables are expressed as; sperman's rho correlation and partial correlation All statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA); as $p< 0.05$ was considered statistically significant.

IPOM plus and IPOM techniques

Endotracheal intubation with general anaesthesia was used in all patients. The patient lie in supine position tilted toward side of operator, with the head up. We mark around the defect. Peumoperitonium was created with a Veress needle at two cm below and to the left of subcostal margin in the midclavicular line (Palmer's point) fig.1A.

A 10-mm port was placed at the same level of umbilicus in anterior axillary line in the right flank Under vision for camera (30° laparoscope), two other ports were placed, one 5 mm port in subcostal area, the other is 10 mm port in right flank.fig.1 B.

-Laparoscopic adhesiolysis was done for adhesions at defect site with diathermy, ligaSure or Harmonic shears. (fig. 1 C) reducing the contents of the hernial sac.

- Defatening of peritoneum was done for proper fixation of the mesh. (fig. D)

-The hernia defect fig.1 E was closed with continues prolene sutures in IPOM plus technique only, while defect not closed in IPOM technique.

- Lightweight double face protheses were used in all patients, (fig. 1 F) they were introduced intraperitoneal and fixed in a standardized technique. As, we mark the skin around the defect. An oval mesh with size of 10 cm × 15 cm which must overlap about 4–5 cm from the defect.

Mesh was deployed through the 12-mm port site. Non absorbable tackers were then used to fix the mesh in all cases (fig. 1 G). The distance between each tacker was about 2–3 cm.

Open on lay mesh repair technique

We started by transverse skin incision above the hernia, dissection of the sac from the surrounding sub cutaneous tissue till the neck of the sac, elevation of flaps, Opening of the hernial sac, reduction of contents and dissection of any adhesions, fascial closure using nonabsorbable monofilament suture, a prolene mesh fixation onlay with proper haemostasis, area of overlapping is 5cm in all directions, suction drain was inserted then subcuticular skin suturing by PDS 3-0 was done then applying abdominal binder for about one week.

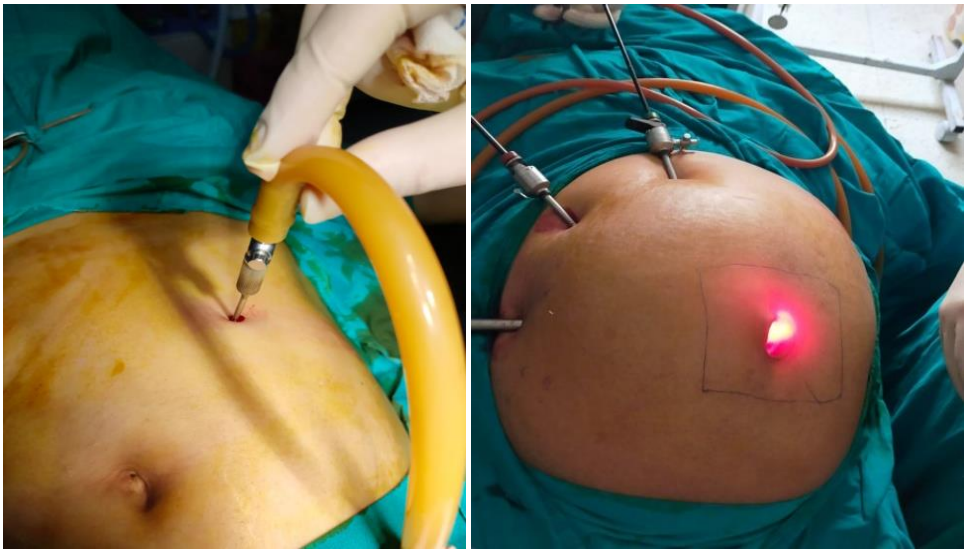


Fig. 1 A: Verss needle insetionfig.1 B**:** three ports insertion and marking the site for mesh

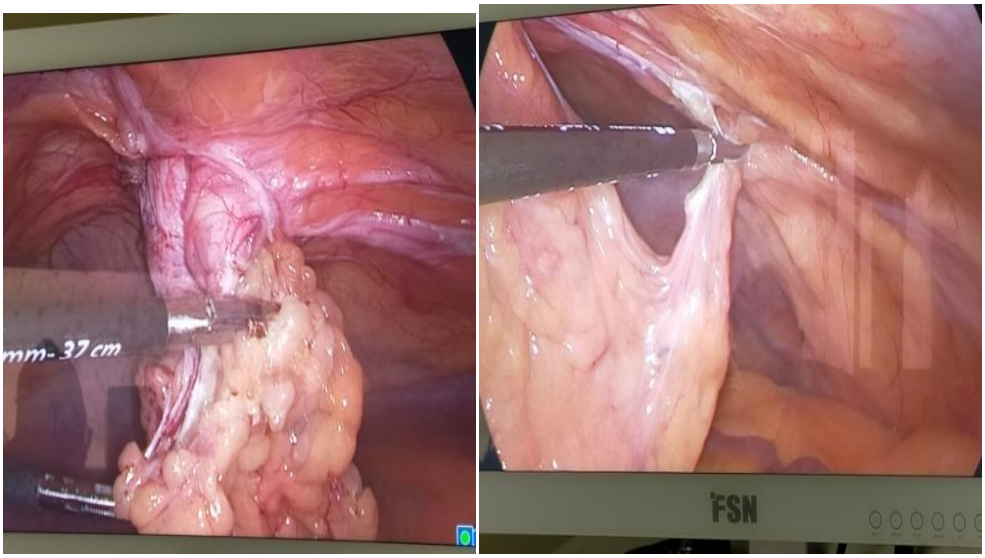
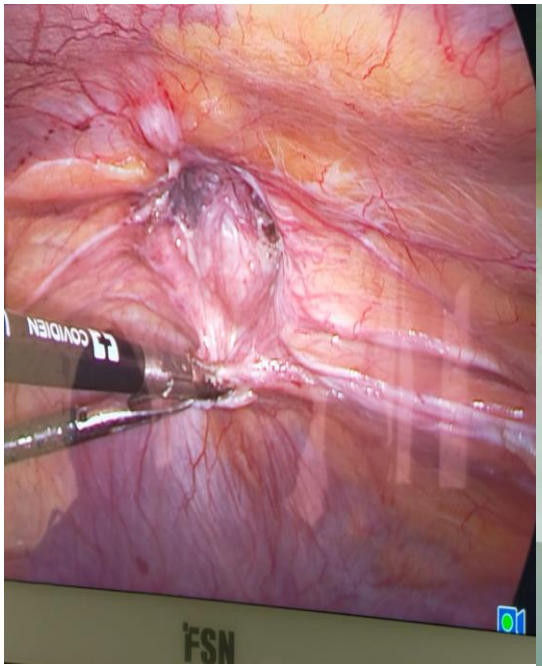


Fig. 1C: **Laparoscopic** adhesiolysis fig.1 D: Defatening by ligasure reduction of contents**.**



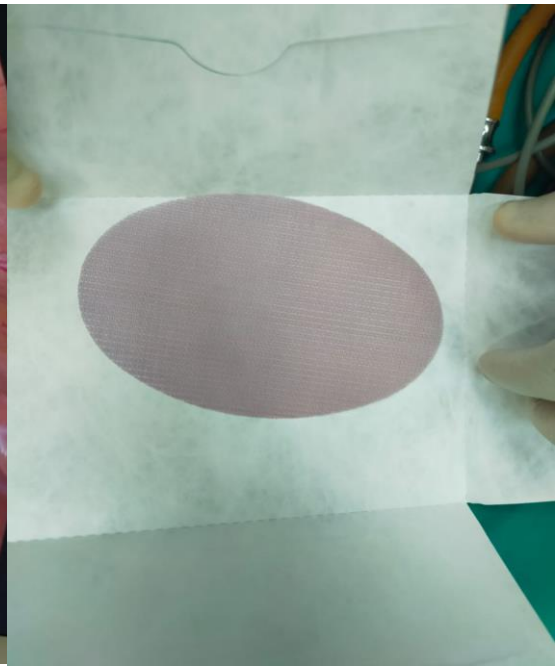
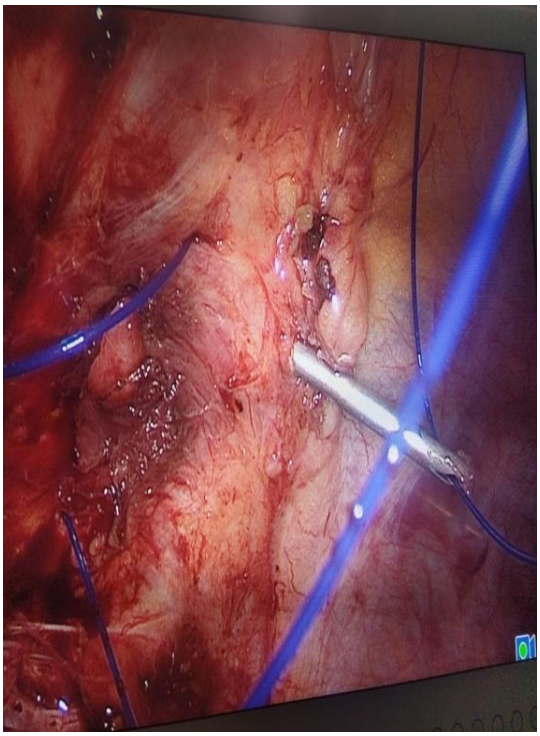


Fig.1 E: defect site fig.1 F: Oval shaped double face mesh



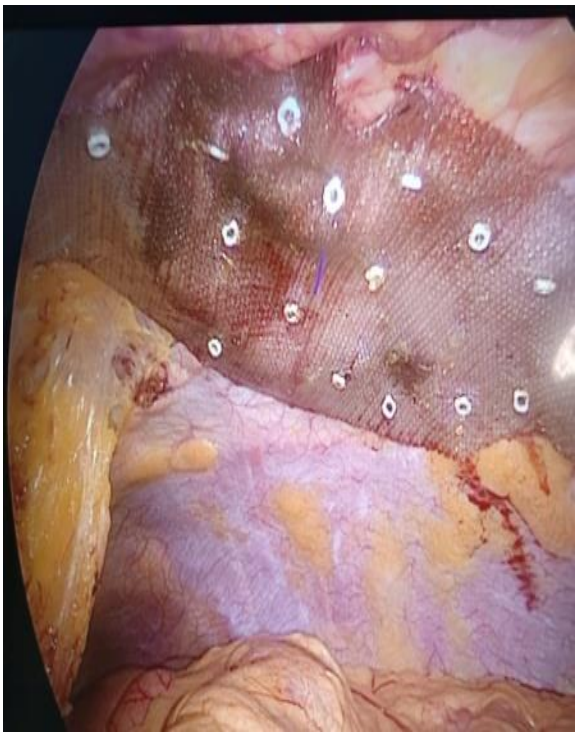


Fig.1 G : repair of defect by prolene sutures Fig.1 H: Mesh fixation with tackers

Results

Our study included 60 patients, starting from 18 to 67 years old; 39 females and 21 males. All have PUH, we divided them into three groups. Group A: IPOM plus technique, including 28 patients, Group B: IPOM, including 14 patients while Group C: open only mesh repair including 18 patients. The demographic characteristics of the groups are presented in table (1).

Table 1: Demographic Data and Hernia Characteristics: Comparison Between Groups

Groups / Variables	Group A IPOM plus N=28	Group B IPOM N=14	Group C Open mesh repair N= 18	p-value
Age (yrs) Mean±SEM Range	44.44±2.33 38 (26-64)	41.29±3.04 39 (21-60)	46.89±2.76 40 (27-67)	NS
Gender Male Female	 10 (35.71%) 18 (64.29%)*	 7 (50.0%) 7 (50.0%)	 4 (22.2%) 14 (77.8%)*	<0.02
BMI (Kg/m2) Morbid Normal Over weight	 8 (28.57%) 12 (42.86%) 8 (28.57%)	 3 (21.4%) 5 (35.7%) 6 (42.9%)	 5 (27.8%) 7 (38.9%) 6 (33.3%)	>0.724
Hernia Size (cm^2) Mean±SEM Median(range)	3.52±0.36*** 3 (1-8)	3.14±0.50*** 3 (1-8)	3.39±0.33*** 3 (1-8)	NS

*p<0.02 significant differences between female versus male;[a]p<0.05 significant between IPOM plus than Open mesh repair;***p<0.001 significant differences between IPOM plus ,IPOM decrease than Open mesh repair.

In the IPOM plus group a total of 28 repairs were performed. Mean age was 44.44 years (range 26 to 64) and 18 (46.29 %) of the patients were female. Repair to the defect was done for all patients. Mean defect size was 3.52 cm^2 range from 1 to 8 cm^2 (table 1), and mean mesh size was 117.64±3.98 cm^2. Mean total operating room time was 115.63±2.47 min. All repairs were accomplished laparoscopically without conversion to open. There were no postoperative wound problems during the course of the 28 repairs, although there were 4 patients who developed 2 wound infections and 2 seromas (14.8%). No post-operative drain was used in any patient. Total hospital stay was 1day±0, Post-operative pain was 2.12±0.27, the mean time off work was 6.04±0.27, and the overall cost was6037.04±32.97 L.E ,There have been no recurrences in follow-up period (Table 2 and 3).

In the IPOM group a total of 14 repairs were performed. Mean age was 41.29 years (range 26 to 64) and 7 (50.0%) of the patients were female. No Repair to the defect was done. Mean defect size was 3.14cm2 range 1 to 8 cm2 (table 1), and mean mesh size was 114.43±7.39 cm2. Mean total operating room time was 50±1.06 min. All repairs were accomplished laparoscopically without conversion to open. With regard to the 14 repairs, there were no intraoperative complications, although there were 2 patients (14.2%) who developed seroma and postoperative wound infection, no post-operative drain was used in any patient (Table 2). Total hospital stay was 1day±0, Post-operative pain was 2.14±0.35, the mean time off work was 6.57±0.44, and the overall cost was5950.71±101. 50L.E, recurrence occurs in 2 patients (14.3%)during follow-up period (Table 2 and 3).

In the Open mesh repair group, a total of 18 repairs were performed. Mean age was 46.89 years (range 26 to 64) and 14 (77.8%%) of the patients were female. Repair to the defect was done for all patients. Mean defect size was 6.39 cm2 range 1 to 8 cm2 (table 1), and mean mesh size was 135.44±10.69 cm2. Mean total operating room time was 76.44±2.09 min. Open mesh repair was done for all patients. No intraoperative complications occurred and 4 patients experienced a total of 3 postoperative wound complications infection and seroma (14.8%) in 18 repairs, drain was inserted to all patients. Total hospital stay was 7.12±0.71, Post-operative pain was 7.06±0.22, the mean time off work was 11.06±0.38, and the overall cost was4927.5±80. 68L.E, there was 1 case of recurrences during follow-up period (Table 2 and 3).

In table 1 and 2 summarizes the comparative analysis among the three groups. There were no statistical differences in age but incidence of PUH in greater in females. There were no statistical differences in blood loss between groups. The laparoscopic IPOM plus repairs took longer time to perform relative to the other

groups. Although no statistical difference existed in the occurrence of postoperative complications, there was a trend toward fewer complications favoring laparoscopic repairs. Drain was inserted to all patients in open repair while no drain was used in laparoscopic repairs. Hospital stay was highly stastically significant better in the laparoscopic repair groups compared with open mesh repair group ($p<0.001$). Also, time off work is stastically better in the laparoscopic repair groups compared with open mesh repair group ($p<0.01$). Post-operative pain was stastically significant better in the laparoscopic repair groups compared with open mesh repair group, Recurrence rates were more in IPOM technique over comparable period of follow-up.

In table 3 summarizes the comparative analysis of costs among the three groups, the mean Cost of IPOM plus surgery was 2850.35±30.73 LE, while in IPOM was 2697.92 ± 80.13LE and in open mesh repair was 2584.22±44.38 LE ($p=0.01$). This is related to the higher cost of materials in Laparoscopic surgery is remarkable, resulting from the use of helical fixing staplers, the type of mesh and the work trocars. The surgical instruments used for the 2 cases were reusable and were not included in the cost calculation. The hospital cost IPOM plus were 1414.25±36.67 LE, in IPOM was 1406.78±37.72 LE and in Open repair was 2389.33±71.86 LE ($p<0.05$), this increase cost in open surgery is due to the increase in hospital stay than laparoscopic surgery. The overall costs were in IPOM plus were 6037.04±32.97LE, for IPOM were5950.71±101.50 and in Open repair were 4927.5 ±80.68 ($p=0.05$).

Table 2: Operative Results: Comparison Between Groups

Groups / Variables	Group A IPOM plus N=28 (%)	Group B IPOM N=14 (%)	Group C Open mesh repair N= 18 (%)	p-value
Mesh Size	117.64.±3.98	114.43±7.39	135.44±10.69	>0.110
Operating Time (min	115.63±2.47***	50±1.06	76.44±2.09	<0.001
Estimated Blood Loss (cc)	15(53.57%	8(57.14%)	18 (100%)	NS
Postoperative Drains	____	____	18 (100%)	
Postoperative (Complications)				
seroma	2 (7.4%)	1(7.1%)	1(5.6%)	NS
infection	2 (7.4%)	1(7.1%)	3(16.7%)	
Time off work	6.04±0.27	6.57±0.44	11.06±0.38**	<0.01
Post op.pain	2.12±0.27	2.14±0.35	7.06±0.22**	<0.001
Recurrences (%)	-----	2 (14.3%)	1 (5.6%)	>0.134
Hospital stay	1day±0	1 day±0	7.12±0.71***	<0.001

Data was represented Mean±SEM; ***$p<0.001$ was highly significant; **$p<0.01$ was significant; In the current study the mean hospital stay in group A and group B was reduced to 1 day, while it was 2-8 days in the group C.

Table 3: Costs Comparison between Groups

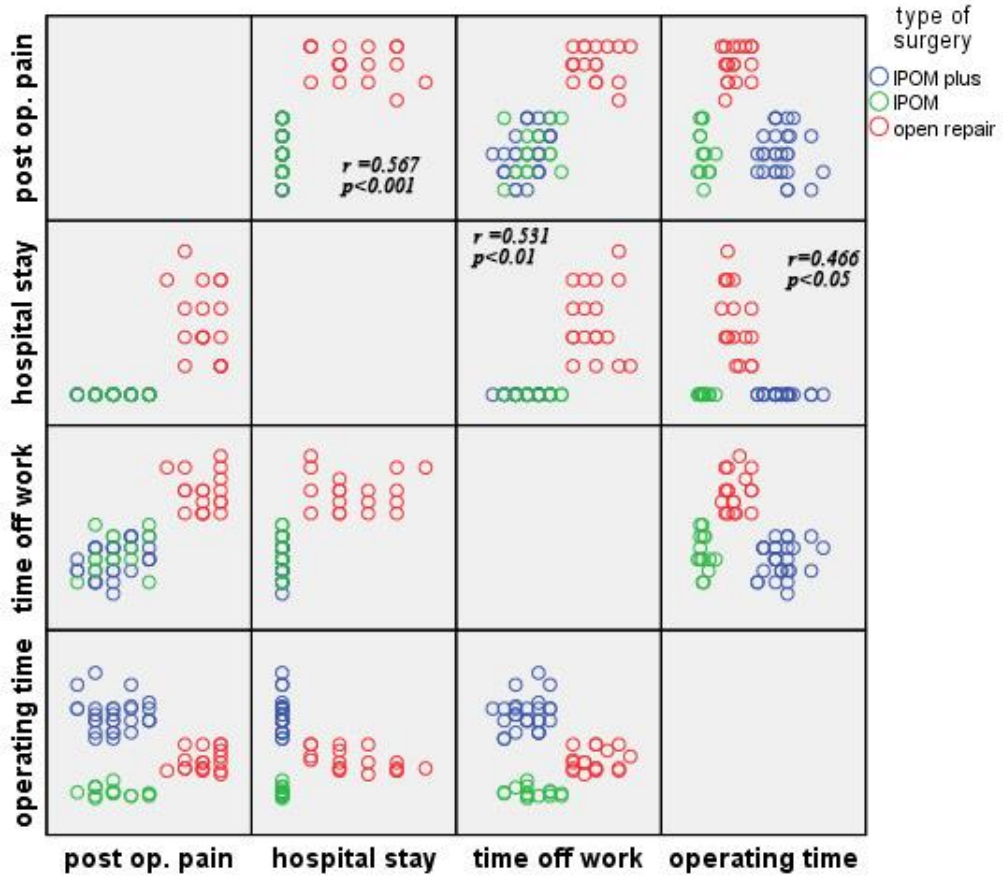
Groups	Group A	Group B	Group C	p-value

Variables	IPOM plus N=28	IPOM N=14	Open mesh repair N= 18	
Cost surgery (LE)	2850.35±30.73**	2697.92 ± 80.13**	2584.22±44.38	<0.01
Hospital cost (LE)	1414.25±36.67	1406.78±37.72	2389.33±71.86*	<0.05
Overall cost (LE)	6037.04±32.97*	5950.71±101.50*	4927.5±80.68	<0.05

Operative costs were calculated by assessing all resources, cost factor for operative time. hospital costs were provided by the administration of the hospital integrating personnel salaries, materials, and equipment. The results are presented in Egyptian pound using values for the year 2021-2022

			cost	type of surgery	hospital stay	post op. pain
Spearman's rho	Cost	Correlation Coefficient	1.000	r = 0.744**	r=0.801**	
		Sig. (2-tailed)		p<.001	p<.001	
	type of surgery	Correlation Coefficient			r=0.841**	r=0.693**
		Sig. (2-tailed)			p<.001	p<.001
	time off work	Correlation Coefficient			r=0.785**	r=0.763**
		Sig. (2-tailed)			p<.001	p<.001

The Spearma's rho coefficient of correlation to cost versus type of surgery and hospital stay ($r = 0.744 p<0.001$; $r = 0.801$ $p<0.001$ respectively) positive correlation between type of surgery versus hospital stay and post op.pain ($r = 0.841$ $p<0.001$; $r =0.693$ $p<0.001$ respectively) and significant correlation between time off work versus hospital stay and post op.pain ($r = 0.785$ $p<0.001$; $r =0.763$ $p<0.001$ respectively).



According to the type of operation. There is a partial correlation between post op. pain and hospital stay, according to the type of operation r = 0.567 p<0.001; partial correlation hospital stay vs time off work r=0.531p<0.01 and partial correlation between hospital stay vs operating time r= 0.466 p<0.05

Discussion

Laparoscopic mesh repair for PUH is increasingly being shown to be superior than open mesh repair in terms of operative time, post-operative pain and post-operative complications, , and total morbidity and mortality[11,12] . We compare between open techniques of repair and the laparoscopic PUH repair in terms of operating time, overall hospital stays, post-surgical pain, post-operative complications, and cost.

In our current study, laparoscopic repair has lower morbidity due to no placement of the drain and pain is significantly better in the laparoscopic group (P=0.001). The patient's functional recovery is also improved by the lower need for analgesics and morphine during and after surgery, which enables earlier return to the patient's regular activities and shorter sick leave. This is in line with a study conducted on 75 cases by Wasim et al. to demonstrate the safety in laparoscopic hernia surgery (13)

In our study, laparoscopic hernia repair had a wound complication rate of 14.2% compared to 22.3% for open hernia repair. This is in line with a study conducted on 40 patients by Korukonda et al., whose findings indicate that laparoscopic repair is linked to a lower risk of infection because of the tiny incision and incision site. The longer open repair incision and the fact that it is situated in a region with high levels of contamination increase the risk of wound infection by 15% to 45%.[13]

Another study conducted by Bell-Allen demonstrates that open hernia mesh repair causes higher morbidity in terms of postoperative pain, drain installation, extended recovery, and increased risk of infection, which may increase the recurrence rate[14].

according to our current study, Laparoscopic repair typically results in earlier patient discharge than open repair, because there is less postoperative pain and morbidity. In the current study, the average hospital stay for the laparoscopic group was one day, compared to seven days for the open repair group. This difference is statistically significant favoring laparoscopic surgery over open repair. Multiple studies have documented a shorter overall hospital stay in laparoscopic surgery that can be attributed to decreased post-operative pain, absence of surgical drains, less wound complications and more rapid return of oral intake a more rapid return of ambulatory activity [15, 16].

In our study, there was significant difference in prolongation of the time in IPOM plus technique than open surgery. Most of the time is consumed in handling the mesh intra-peritoneally, but with experience this difficulty can be overcome. Al-Mulhim et al., [17] and Nijas et al[18] reported a similar difference between their groups. The time for laparoscopic repair decreases with the progress in the learning curve

In our recent study, two of our patients (14.3) experienced recurrence in cases without defect closure as opposed to (5.6) in open repairs with defect closure. When both of these patients underwent revision surgery, it was discovered that the mesh had shrunk and had partially exposed the initial defect. Laparoscopic surgery was used in both cases to perform IPOM plus repair. In comparison to normal IPOM surgery, IPOM plus has a decreased recurrence rate, according to the literature. Sadava EE et al. [19]reported in their cohort study, recurrence rate in patients without defect closure was threefold more common (18% vs 6%).

In our study, Operative costs in laparoscopic repair are significantly increased than open surgery, but hospital cost is significantly increase is open surgery than laparoscopic due to increase hospital stay. In open surgery, the costs benefit from the delay in returning to normal activity, both at work and at home is greater and increases the daily losses per person in our government. But in laparoscopic surgery, based on the lower rate of relapse, the lower average length of stay, the shorter duration of sick leave, and the duration of the work sick leave period would provide more financial benefits for laparoscopic repair. Similarly, Lobato et al,[20] in their study Cost–Benefit Analysis Comparing Open and Laparoscopic abdominal Hernia Repair found the total cost of laparoscopic hernia repair to be higher but provide more financial benefits than for the open approach.

Conclusion

IPOM plus is better than IPOM and open repair as it is more anatomical, closing the defect with sutures with insertion of mesh. With lower complication rate and provide more financial benefits

We recommend IPOM plus for PUH repair once double face mesh is available

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Conflicts of interest

Authors declared that they have no competing interests

Availability of the data and materials

All relevant data analyzed during this study are presented in tabular form in this published article. The original datasets used during the current study are available from the corresponding author on reasonable request

Informed consent statement was obtained from all the participants in the study.

Authors' contribution

Mohamed Elashry, Hesham A.Elmeligy and Mahmod Rady were sharing in design of the study and the concept. Mohamed Elashry, Ahmed M.Abdelaziz, Mohamed Abbas, and Hesham A.Elmeligy were involved data analysis, interpretation and manuscript writing. Hoda Abu Taleb, Maged Nasr, and, Hesham A.Elmeligy collected the data from medical records. All authors shared in reviewing and approval of the final manuscripts.

Ethical approval:

Our study protocol number 581, was approved by the TBRI ethical committee board under Federal Wide Assurance (FWA 00010609), and the study was conducted in accordance with the World Medical Association's Code of Ethics for Human Experiments (Declaration of Helsinki).

Consent for publication

Not applicable

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