Transabdominal retro muscular versus intraperitoneal onlay mesh repair of ventral hernia: a randomized controlled study

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Background
Although laparoscopic ventral hernia repair has become a well-established alternative for open repair, traditional intraperitoneal mesh placement in direct contact with the bowel had many drawbacks and complications; in addition, it requires extensive mesh fixation and special composite mesh. Using the peritoneum and posterior rectus sheath as a barrier between the mesh and the bowel will evade these complications and decrease the cost.
Patients and methods
This prospective study was conducted in between May 2022 and December 2022 on 50 patients with noncomplicated ventral hernia with an average defect size of 5 cm. Patients were randomly allocated into two groups: intraperitoneal onlay mesh (IPOM) group (25) patients and transabdominal retro muscular mesh (TARM) group (25) patients. Both groups were compared as regards preoperative demographics, intraoperative complications and operative time and postoperative outcomes and complications.
Results
With a mean age of (44.96±7.27) of IPOM and (48.92±7.17) of TARM group, a significant longer operative time was spent in TARM repair (108.40±9.43 min). Postoperative pain was less in patients with TARM repair and hence they had earlier recovery and restoration of daily activities. Using a double-face composite mesh made the cost of IPOM repair significantly higher than TARM ($P < 0.001$). Overall postoperative complications and recurrence rate showed no significant difference between both techniques.
Conclusion
TARM repair seems to be a safe and good alternative to IPOM repair in terms of lower economic cost and less postoperative pain.

Keywords:
extraperitoneal mesh, hernia, laparoscopy

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Introduction

However, ventral hernia repair is one of the commonest surgical techniques performed every day all over the world. The optimal technique for surgical repair is still debatable because of the significant recurrence rate varying from 10% to 40% [1].

Because of the great advantages of minimally invasive surgery, different techniques of laparoscopic ventral hernia repair are steadily increasing and gaining popularity; however, many surgeons still favor traditional open techniques because of the difficult learning curve for laparoscopic techniques and the severity of the complications that may follow laparoscopic hernia repair [2].

Laparoscopic ventral hernia repair involves various methods. Leblanc had attempted the first laparoscopic ventral hernia repair by bridging the defect from the peritoneal side with a mesh of size adequate to ensure at least 3–5 cm overlap of the edges of the defect, termed the intraperitoneal onlay mesh (IPOM) repair [3].

Recently, a newer concept of IPOM repair is practiced in which the fascial edges of the defect are sutured in apposition before reinforcement with the mesh, named the IPOM plus repair. In both the IPOM and IPOM plus a special type of composite mesh, which differs from the routine polypropylene mesh is required and a special device for mesh fixation. Both have excellent results, but they have their complications like omental adhesions leading to adhesive colic, adhesive obstruction, enterocutaneous fistula, in addition to the high economic burden [4].

Now, it is clear that nearly all types of meshes regardless of their synthetic material and coatings are inducing different grades of adhesions and hence complications may occur if placed intraperitoneally. So, placing the mesh out of the abdominal cavity is the trend in laparoscopic hernia repair [5].

Based on this concept, retro muscular mesh repair that was first introduced by Revis and Stoppa become modified and done laparoscopically through the transabdominal approach and hence termed transabdominal retro muscular mesh repair (TARM) [1,6].

The main advantage of TARM is using the regular polypropylene mesh placed outside the peritoneal cavity in the retro rectus space with minimal tacker fixation or even using alternative fibrin sealant and hence protecting the bowel from contact with the mesh, decreasing postoperative pain and low recurrence rate [7].

Although it is technically challenging and requires a long learning curve which is why it is not popular, it can be a safe and feasible technique for laparoscopic ventral hernia repair [2].

The study aimed to evaluate early and late outcomes of transabdominal retro muscular mesh repair as a new laparoscopic technique for ventral hernia repair compared with the classic laparoscopic IPOM repair.

Patients and methods

This prospective randomized study was carried out between May 2022 and December 2022.

Out of 70 patients with noncomplicated ventral hernia assessed for eligibility, 50 patients were enrolled in our study after fulfillment of the inclusion criteria and after a written informed consent.

Inclusion criteria were age greater than 18 years, noncomplicated ventral abdominal wall hernia (paraumbilical, umbilical, and epigastric hernia), and patients with hernia defect less than 5 cm.

Exclusion criteria were: Strangulated or obstructed ventral hernia, huge ventral hernia or hernia defect greater than 5 cm, incisional hernia, and patients with severe cardiopulmonary insufficiency or coagulopathy.

Patients were randomly allocated into two groups:

IPOM group

Patients underwent IPOM repair (25 patients).

TARM group

Patients underwent TRAM repair (25 patients).

All the patients had detailed general and local examinations, routine preoperative laboratory blood works, and abdominal ultrasound to assess the size of hernia defect. A single perioperative dose of second-generation cephalosporins was given to all patients.

Technique

All patients were operated under general anesthesia in a supine position.

IPOM technique

After induction of pneumoperitoneum by the closed technique Palmer's point three ports (two 11 mm and one 5 mm) were inserted in the anterior axillary line. Reduction of the content of the hernial sac into the abdomen and assessment of the hernial defect were done.

The hernial defect was closed by proline (size 0) using a sheath closure device. Double face mesh of a suitable size (15×15 cm) was inserted and centered over the defect and fixed in place using a tacking device to the anterior abdominal wall in a double crowning manner.

TARM technique

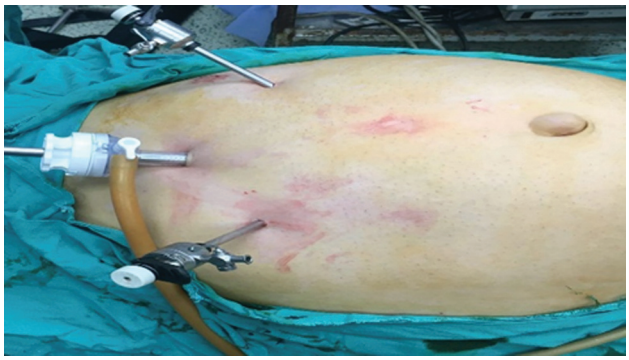
Patients were put in the Trendelenburg position with a table break at the hip (Fig. 1). Ports placement is as shown in Fig. 2: 11 mm port for the camera at the epigastrium and two 5 mm working ports at the right and left hypochondrium at the midclavicular line.

After reduction of the content of the hernial sac gently, an incision of the peritoneum and posterior rectus

Figure 1

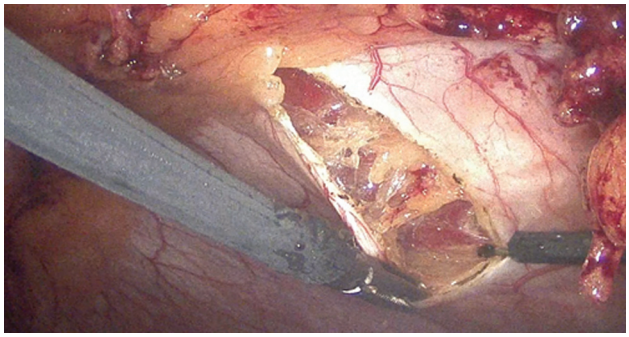
Patient positioning.

Figure 2



Port placement.

Figure 3



Incision of the posterior rectus peritoneal flap (PPF).

sheath in a transverse manner was done using diathermy on a hook starting 5 cm cranial to the hernial defect (Fig. 3).

Creation of a flap composed of the posterior rectus sheath and peritoneum (PPF) was done, and then dissection of this flap off both recti muscles with great caution in the midline to avoid damage of the linea alba. Continuation of the flap dissection in the caudal direction and dissection of the hernia sac till crossing the defect by at least 5 cm distally (Figs 4 and 5).

Closure of the posterior rectus sheath defect was done using Vicryl size 0 in an interrupted manner, while the defect in the anterior rectus sheath was closed using sheath closure by proline size 0.

Suitable size (at least covering 5 cmm all around the defect) regular proline mesh was inserted and kept in place using tackers (Figs 6 and 7).

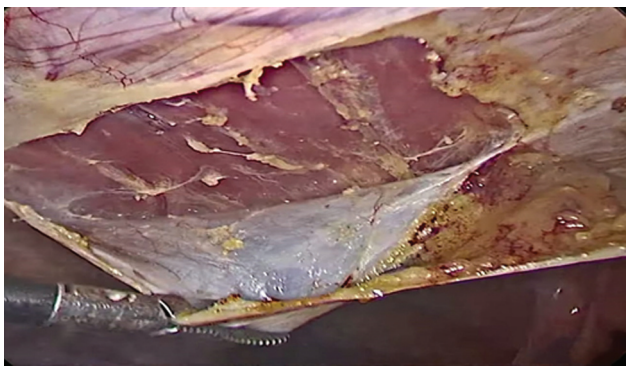
Finally, closure of the posterior rectus sheath flap using proline size 0 (Fig. 8) and then port closure were done.

Data collection

Preoperative sociodemographic data and the type of the hernia were evaluated. Any intraoperative complications like uncontrolled bleeding, injury to the bowel or tearing of the flap. The operative time was recorded as the time from skin incision until skin closure.

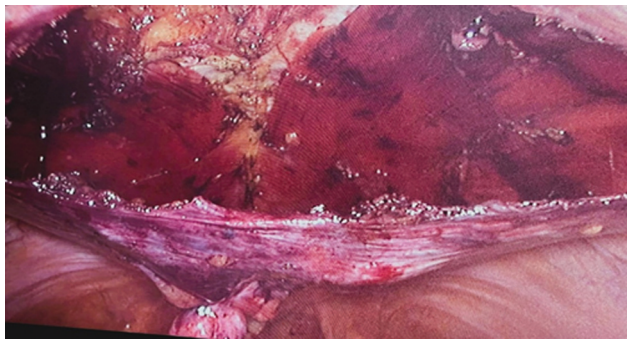
All the patients received NSAID injection very 12 h. Postoperative pain was evaluated after the first 24 h

Figure 4



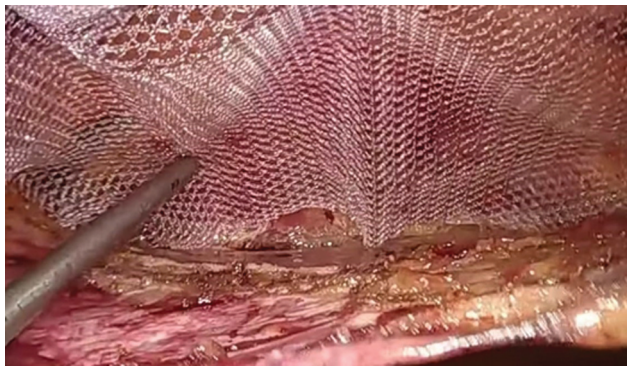
Extension of PPF on both sides.

Figure 5



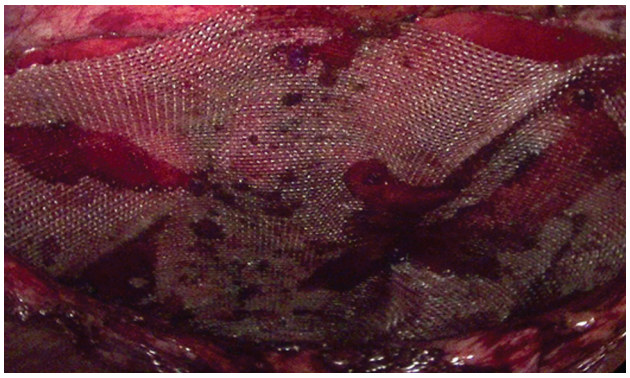
Dissection of the hernia sac and extension of PPF.

Figure 6



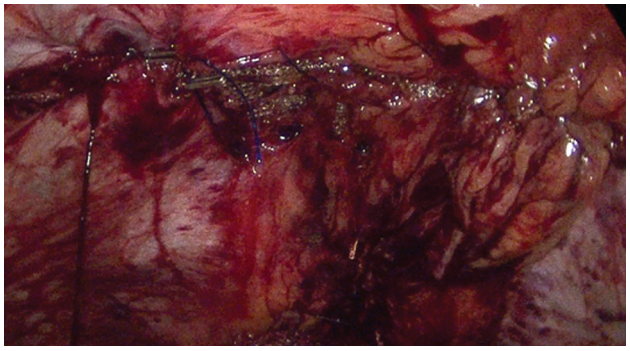
Mesh placement and fixation.

Figure 7



Mesh placement and fixation.

Figure 8



Closure of PPF.

post-operatively using the visual analog score and extra analgesic consumption was recorded. Postoperative complications during the period of admission like abdominal distension, abdominal wall hematoma, or postoperative bleeding were recorded. Hospital stay and time consumed by the patient to resume his normal daily activities like return to work, sexual practice, and regular daily exercise were reported.

Patients had follow-up appointment in the surgical outpatient clinic in the first, fourth week, and after 6 months. Any postoperative complications like wound or mesh infection, seroma collection, abdominal wall hematoma, or edema were also reported. The recurrence rate was assessed after the first 6 months.

All collected data and patient's demographics were statistically analyzed using SPSS 24. Quantitative data were represented as mean and standard deviation, and qualitative data were expressed as relative percentages and frequencies. The Mann–Whitney *U* test was used to analyze the difference between the reported values of the two groups. *P* value less than 0.05 was significant.

Results

The mean age of the patients in the TARM group was 48.92±7.17 with a predominant female sex (64.0%) with no detected significant difference between both groups. Paraumbilical hernia represented the commonest type (70%) as shown in Table 1.

Concerning operative parameters, the mean operative time was found much longer in the TARM technique than IPOM (108.4±9.43 vs 77.48±12.72), respectively, which was statistically significant. Assessment of intraoperative complications revealed that overall complications in the TARM group were in the form of tearing of PPF (32%) that was controlled by suturing. Intraoperative bleeding that was because of tacking the mesh against the abdominal wall was the main operative undesired event (8%) in the IPOM group as shown in Table 2.

Upon assessment of postoperative pain, in the TARM group patients expressed significantly less postoperative pain on VAS score and required less extra analgesics, which was statistically significant ($P = 0.004$, $P = 0.009$). Different postoperative complications were assessed and there was no statistically significant difference between both groups except for postoperative seroma collection,

Table 1 Patient demographic data

	TARM *n*=25 (%)	IPOM *n*=25 (%)	test of significance
Age/years			$t = 1.94$
Mean±SD	48.92±7.17	44.96±7.27	$P = 0.06$
Sex			
Male	9 (36.0%)	7 (28.0%)	$\chi^2 = 0.368$
Female	16 (64.0%)	18 (72.0%)	$P = 0.544$
Hernia type:			MC = 0.362
Umbilical	1 (4.0%)	2 (8.0%)	$P = 0.834$
Paraumbilical	18 (72.0%)	17 (68.0%)	
Epigastric	6 (24.0%)	6 (24.0%)	

Table 2 Intraoperative parameters

Operative variables	TARM *n*=25 (%)	IPOM *n*=25 (%)	test of significance
Operative time/mins	108.40±9.43	77.48±12.72	t = 9.77 P<0.001*
Intraoperative complications			
No complications	17 (68.0)	23 (92.0)	MC=10.9
PPF tear	8 (32.0)	0	P = 0.004*
Intraoperative bleeding	0	2 (8.0)	

Table 3 Postoperative pain and complications

	TARM *n*=25(%)	IPOM *n*=25(%)	test of significance
VAS pain	5.12±1.01	5.92±0.86	t=1.87 P=0.004*
Extra analgesics need	5 (20.0%)	14 (56.0%)	χ^2=6.88 P= 0.009
Postoperative ileus	0	2 (8.0)	FET=2.08 P = 0.490
Hematoma	2 (8.0)	0	FET=2.08 P = 0.490
M. infection	0	0	
Seroma	1 (4)	7 (28)	FET=5.36 P = 0.02*
Wound infection	1 (4)	0	FET = 1.02 P = 1.0

Table 4 Postoperative course and cost

Variables	TARM *n*=25 (%)	IPOM *n*=25 (%)	test of significance
Hospital stays (days)	1.16±0.37	1.44±0.65	t=1.87 P=0.07
Return to work (days)	5.28±1.21	6.88±1.39	t=4.34 P<0.001*
Recurrence rate	2 (8.0)	1 (4.0)	FET=0.355 P = 1.0
Conversion	0	0	
Cost (EGP)			
400	25 (100)	0	FET=50
9500	0	25 (100)	P < 0.001*

which was reported in 28% of IPOM patients ($P = 0.02$) as shown in Table 3.

However, there was no statistically significant difference in mean hospital stay in patients of both groups. The economic burden and cost were significantly lower in the TARM group ($P < 0.001$). In addition, patients in the TARM group had the ability for restoration of their normal domestic daily activities and earlier return to work than those in the IPOM group ($P < 0.001$). None of the patients were converted to open surgical repair in both groups. When the recurrence rate was assessed 6 months postoperatively, there was no significant difference between both techniques as shown in Table 4.

Discussion

In 1993, when Le Blanc attempted the first laparoscopic ventral hernia repair and gained wide popularity, different techniques of laparoscopic ventral hernia repair are steadily increasing because of the great advantages of minimally invasive intervention over the conventional open techniques in terms of less postoperative pain, wound infection, mesh infection, hospital stay, early recovery, and low recurrence rates Sancheza and colleagues, Zhang and colleagues [8,9].

The conventional laparoscopic approach involves bridging the peritoneal surface of the hernia defect with adequate size mesh covering at least 5 cms all around the defect to ensure proper coverage that was named IPOM repair.. Then the concept closure of the fascial defect was introduced (IPOM plus) Bittner and colleagues [3].

Sahoo and colleagues [10], Ott and colleagues [11], Chew and colleagues [12], and Kaufman and colleagues [13] had reported a risk of development of dense intraperitoneal adhesions, intestinal obstruction, and enterocutaneous fistula if regular polyproline mesh was laid in direct contact with the bowel; so, a special type of composite mesh is required for IPOM and IPOM and that represents an economic burden because of its high cost in addition of using absorbable tackers for fixation of the mesh to the abdominal wall.

So many surgeons now tend to place the mesh outside the peritoneal cavity using the peritoneum as a protective barrier to protect the bowel to be in direct contact with the mesh to eliminate those complications and to decrease the cost using regular polyproline mesh and hence our TARM technique has been evolved Yang and Tung [14].

In our current study, we aimed to evaluate and compare the early outcomes of transabdominal retro muscular mesh repair of noncomplicated primary ventral hernia with an average size of the defect less than 5 cm versus the classic IPOM repair.

Paraumbilical hernia represented the majority of included cases in both groups (70%) with a predominant female gender (68%) with no significant difference between both groups.

The mean operative time in the TARM group was (108.40±9.43), which was significantly longer than patients who underwent the IPOM technique (77.48 ±12.72) and this can be explained by spending extra time in space creation by posterior rectus and peritoneal flap dissection and its closure in addition to double closure of the hernia defect (posterior sheath and anterior sheath).

Jani and Contractor [4] documented 108 min (94-145 min) of operative time for TARM. Also Masurkar [7] in his study reported a longer mean operative time (192 min) for TARM because of included cases of incisional hernia with large defects in addition to performing the posterior component separation technique in some cases.

Also in the studies performed by Christofferson and colleagues [15], Prasad and colleagues [16], and Sarli and colleagues [17], a significantly longer operative time was consumed in extraperitoneal mesh placement compared with IPOM repair.

However, Gokcal and colleagues [18] and Megas and colleagues [19] had found nonsignificant differences in operative time between both techniques.

In our study, the overall incidence of intraoperative undesirable events was (8%) in the IPOM group in the form of minor controlled bleeding that had happened because of extensive mesh fixation to the peritoneum by tackers that may injure inferior epigastric vessels. While tearing of PPF represented the main intraoperative complication (28%) in TARM patients, none of our cases in both groups were converted to open repair.

Awad and colleagues [20] reported minor bleeding in 12.5% of IPOM patients and PPF tearing in 16.7% of TARM patients. Conversion to IPOM repair had happened in 8.3% in the TARM group because of extensive PPF tears. There was nonsignificant difference between both groups in the overall incidence of intraoperative complications.

Olmi and colleagues [21] in a large-scale retrospective study including 1029 patients who underwent IPOM reported intraoperative small bowel injury in 0.19% only and conversion to open repair in 0.58%.

Prasad and colleagues [16] reported minor bleeding in 1.4% and serosal bowel injury in 2.9% of patients, who underwent extraperitoneal mesh placement.

Jani and Contractor [4] Gokcal and colleagues [18], and Megas and colleagues [19] found a nonsignificant difference in the incidence of intraoperative complications between both techniques.

Concerning postoperative pain, in the literature there is a direct significant relationship between the pattern and extent of mesh fixation by tackers and the magnitude of postoperative pain Brill and Turner, Nguyen and colleagues [22,23].

In our study, patients who underwent the IPOM technique had experienced more postoperative pain on VAS score and in terms of extra analgesia needed than those who underwent TARM, which can be explained using extensive mesh fixation by tackers in a double crowning manner.

That came in agreement with the study of Megas and colleagues [19] as they reported significantly more postoperative pain in patients who underwent the IPOM technique.

In the studies by Ngo and colleagues [24], Jani and Contractor [4], and Christoffersen and colleagues [15], similar outcomes to our study in terms of less postoperative VAS score in patients who underwent extraperitoneal mesh placement.

On the contrary, Gokcal and colleagues [18], Awad and colleagues [20], and Prasad and colleagues [16] found that there was no significant difference in postoperative pain between both techniques.

As regards postoperative complications, seroma collection represented the most common one, 28% in the IPOM group versus (4%) in the TARM group.

Postoperative seroma collection after laparoscopic ventral and inguinal hernia repair has been documented as an inevitable event that occurred in almost all patients Cihan and colleagues [25].

Some authors Birch [26] consider it just an incident, other authors Palanivelu and colleagues [27] consider it a minor complication, and others Perrone and colleagues [28] consider it as the main complication, according to what extent it causes patient discomfort and the necessity for intervention.

Many factors contribute to the extent of seroma formation, like the size of the hernia defect, fascial closure, extent of dissection, and site of mesh placement [29].

Prasad and colleagues [16] in a study performed on 279 patients comparing IPOM and extraperitoneal mesh placement had reported a higher incidence of seroma collection in IPOM (8.5%) than in TARM (5.8%). In another study seroma collection after TARM was noticed in 5.6%.

Retro rectus mesh placement in laparoscopic ventral hernia repair provides better outcomes and less incidence of seroma collection as reported by Jani *et al.* Ngo and colleagues [24], Sosin and colleagues [30], and Yang [31].

A higher incidence of seroma formation (25%) was reported by Sharma and colleagues [32] after the intraperitoneal mesh placement technique.

Gokcal and colleagues [18], Megas and colleagues [19], and Awad and colleagues [20] had found nonsignificant differences between IPOM and TARM as regards the incidence of seroma formation.

For the incidence of other postoperative complications like hematoma, wound infection, or mesh infection, there was no significant difference between either technique.

In our study, although there was no significant difference in the duration of hospital stay in both groups, patients who underwent TARM had earlier recovery and restoration of regular daily activities (5.28 ±1.21 days) than those in the IPOM group (6.88±1.39 days).

Hilling and colleagues [33] in a pilot study reported mean hospital stay for extraperitoneal mesh repair (2.2 ±0.6) days. Also, Jani and Contractor [4] had reported median 2 days of hospital stay after extraperitoneal mesh repair.

Similarly, Parasad and colleagues. [16] and Awad and colleagues [20] found no significant difference in hospital stay between both techniques.

However, Megas and colleagues [19] had reported a hospital stay of (2.87±0.86) days in IPOM patients, which was significantly longer than in patients of the extraperitoneal mesh group.

Gokcal and colleagues [18] had found that patients who underwent IPOM had more discomfort and more frequent visits to the emergency department than those who underwent TARM in the first 30 days postoperatively, which was explained by extensive use of tackers for mesh fixation.

In the current study, the estimated recurrence rate after 6 months was higher in the TARM group (8%) compared with the IPOM group (4%), which may be due to our starting learning curve in the TARM technique; however, this was not statistically significant.

However, Megas and colleagues [19] and Hilling and colleagues [33] reported no recurrence rate in their patients; other studies reported a recurrence rate after extraperitoneal mesh repair ranging from 2% to 6.8% Masurkar, Prasad and colleagues, Gokcal and colleagues, Awad and colleagues [7,16,18,20].

Concerning economic impact and cost, a highly significant difference was found between both groups in favor of the TARM technique in which we had applied regular polypropylene mesh that cannot be applied intraperitoneally because of extensive bowel adhesions and intestinal fistula risk. So, a special type of mesh (composite double face) was applied in IPOM patients which is very expensive. This came in agreement with other studies Shahdhr and Sharma, Masurkar, Prasad and colleagues, Megas and colleagues, Awad and colleagues [1,7,16,19,20].

Conclusion

TARM repair is a safe and effective technique in treating noncomplicated ventral hernia with comparable postoperative complications and recurrence rates.

Although it had a longer operative time, the TARM technique seems to be a better alternative for IPOM repair for reducing intraperitoneal bowel adhesions and complications by extraperitoneal mesh placement and by using regular proline mesh with minimal fixation, which leads to less economic cost and less postoperative pain.

Limitations of the study

The small sample size because of limited resources and economic burden (use of composite mesh and tacking devices) is a limitation of this study. Also, the short term follow-up may not be conclusive for the recurrence rate, but we think that obvious technical reasons for recurrence could be evaluated.

Recommendations

More large-scale randomized controlled trials should be considered and long-term results need to be assessed.

Acknowledgments

Ethical consideration: Our study was evaluated and approved by the Institutional Research Board (IRB) belonging to our medical school.

Declaration of informed consent: All authors verify that appropriate informed consent was taken from all patients regarding surgical techniques and possible complications and also intraoperative photos without clearing their identity. The patients were informed about the possible publication of these photos without names or identity.

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Nil.

Conflicts of interest

All the above-mentioned authors had declared no conflicts of interest.

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