Extended Totally Extraperitoneal (eTEP) Technique vs. Laparoscopic Intraperitoneal Onlay Mesh (IPOM) in Ventral Hernia Repair: A Randomized Comparative Study

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Background
Repairing of ventral and incisional hernias is a frequently performed surgical intervention in the field of general surgery; this work aimed to compare the extended totally extraperitoneal (eTEP) technique to the intraperitoneal onlay mesh (IPOM) technique for ventral hernias regarding feasibility, cost, operative, and postoperative outcomes of both techniques.

Patients and methods
This randomized controlled study was conducted on 50 patients complaining of ventral hernia. These patients were admitted to Tanta University Hospitals, Egypt, from January 2021 to January 2023. Patients were divided according to the technique used into two2 equal groups: group eTEP (study group): 25 participants were submitted to eTEP repair. Group IPOM (control group): 25 patients were submitted to IPOM repair.

Results
Demographic data were insignificantly different between both groups. Operation time was significantly prolonged in group eTEP compared to group IPOM ($P<0.001$). Cost and hospital stay were significantly decreased in group eTEP compared with group IPOM ($P<0.05$). Pain at rest and restriction to normal activity were significantly lower on the first and 14th postoperative days in group eTEP compared with group IPOM ($P<0.05$). Cosmesis was insignificantly different on the first and 14th postoperative days between both groups. Postoperative seroma, postoperative recurrence, and postoperative ileus were insignificantly different between both groups.

Conclusion
Both eTEP and IPOM demonstrated safety and efficacy in the treatment of de-novo ventral hernia repair (comparable few complications in both groups with no recurrence in this study) with superiority toward eTEP as evidenced by lower hospital stay, cost, postoperative pain, and early return to normal activity.

Keywords:
endoscopic, extended totally extraperitoneal, intraperitoneal onlay mesh, ventral hernia

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Introduction

Repairing of ventral and incisional hernias is a frequently performed surgical intervention in the field of general surgery [1].

A wide range of alternatives exists for the correction of ventral and incisional hernias, including both open and minimally invasive procedures. Nevertheless, there is no definitive evidence to establish the superiority of any certain method over another [1].

Recent research has demonstrated that minimally invasive surgeries are more advantageous than open repair for ventral or incisional hernias. This approach leads to less blood loss, fewer problems during the surgical procedure, and shorter hospitalization periods [2].

In 1993, LeBlanc and Booth introduced the laparoscopic technique for repairing ventral hernias, known as laparoscopic ventral hernia repair (LVHR). This procedure involves placing a barrier mesh in the intraperitoneal underlay region and so-called intraperitoneal onlay mesh repair (IPOM). The repairing method he uses involves extensive mesh overlap, secure attachment with tacks and transabdominal stitching and does not include closing any defects [3].

LVHR exhibited significant problems, including adhesive bowel obstructions, mesh erosions, and enterocutaneous fistula resulting from direct contact between the mesh and intraperitoneal viscera [4].

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The transabdominal preperitoneal technique was developed as a solution to address difficulties associated with LVHR. This method presents the challenge of raising and sealing delicate peritoneal flaps, which is a demanding laparoscopic procedure that is challenging to replicate even by highly skilled surgeons [5].

The extended totally extraperitoneal (eTEP) procedure, which involves laparoscopic inguinal hernia repair, has been documented earlier [6].

Belyansky *et al* [7] used the eTEP repair for laparoscopic retromuscular ventral hernia.

Aim

This work aimed to compare the eTEP technique to the IPOM technique for ventral hernias regarding the feasibility, cost, operative, and postoperative outcomes of both techniques.

Primary outcome

- Operative time, postoperative pain.

Secondary outcomes

- Intraoperative and postoperative complications using Clavien–Dindo classification [8].
- Hospital stay.
- Recurrence rates.
- Quality of life and cosmesis using EuraHS-QoL score (European Registry for Abdominal Wall Hernias Quality of Life Score) [9] score.
- Cost.

Patients and methods

Ethical considerations

- An informed written consent was obtained from all participants in this research.
- Participants were provided with information on the objective and methodology of the research, as well as the advantages and potential drawbacks of participating in it.
- Data were collected anonymously and not used for purposes other than scientific research.
- The research ensured complete privacy and confidentiality throughout its duration.
- Ethical consideration of the study was carried out according to that of the ethics committee of research at Tanta Faculty of Medicine.
- Any unforeseen hazards that arose throughout the study were promptly communicated to both the patients and the ethics committee.

Patient selection

This randomized controlled study was conducted on 50 patients complaining of ventral hernia. These patients were admitted to Tanta University Hospitals, Egypt, from January 2021 to January 2023. Informed written consent was obtained from all patients.

Randomization was conducted utilizing sealed envelopes. Patients were divided according to the technique used into two groups.

Group eTEP (study group): 25 participants with midline ventral hernias had been submitted to eTEP repair (totally endoscopic retromuscular technique).

Group IPOM (control group): 25 patients with midline ventral hernia were submitted to laparoscopic IPOM repair (laparoscopic IPOM).

Inclusion criteria

- Participants of both sexes ranged in age from 18 to 70 years old.
- Midline ventral hernias defect with maximum diameter 4 cm.

Exclusion criteria

- Recurrent hernia.
- Incisional hernia.
- Rectus diastasis size is more than 2 cm.
- Individuals with contraindications for general anesthesia.
- Hernias that are strangulated or incarcerated.

Study outcomes

Data about demographic, perioperative, and postoperative information were obtained for all participants.

The demographics data:

- As ages, BMI, and preexisting risk variables for hernia recurrence (such as smoking, immune suppression, liver, and renal illness).

The perioperative results as:

(1) The European hernia categorization for ventral and incisional hernia had been utilized to determine the kind of hernia [10].
(2) Defect diameter (cm).
(3) The duration of the procedure (min).

(4) Consequences that occur during surgery.
(5) Transition to open surgeries.

The postoperative results as:

(1) Duration of hospitalization (In hours).
(2) The determination of individuals' readmission status, together with the identification of the reasons for readmission and reoperation, if applicable.
(3) Postoperative consequences were categorized according to the Clavien–Dindo classification. Seroma was diagnosed by clinical assessment and computed tomography imaging [8].
(4) Pain, restriction of normal activity and the cosmetic results were assessed utilizing the EuraHS-QoL [9] score using a scale from 1 to 10 for each, on the first, 14th day, and 3 months.
(5) The evaluation of hernia recurring was conducted by a clinical assessment 6 months after the surgery.

Preoperative workup

Every participant got a comprehensive clinical assessment, standard blood tests, and abdominal ultrasonography. Participants were instructed to cease smoking 1 month before the surgical procedure. Cardiac and pulmonary problems were corrected. In addition, weight reduction was advised.

Surgical techniques

The same surgical team performed all the procedures under general anesthesia. Participants were positioned in a supine posture, with arms resting parallel to their bodies. The surgical staff is positioned on the patient's left side. Antibiotic prophylaxis was delivered throughout the induction of anesthesia, consisting of 1 g of ceftriaxone.

Extended totally extraperitoneal technique

A 2 cm incision was performed beneath the left costal margin, revealing the left anterior rectus sheath.

A retromuscular space was formed with the use of blunt dissection. A single 10 mm trocar was used to accommodate the 30° optic. The retromuscular area was created by utilizing the optic tip and pneumodissection with a pressure of 14 mmHg. Two trocars with a diameter of 5 mm were placed into the left iliac fossa and left hypochondrium, correspondingly. An extra 10 mm trocar on the right retrorectus space may or may not be used (Fig. 1).

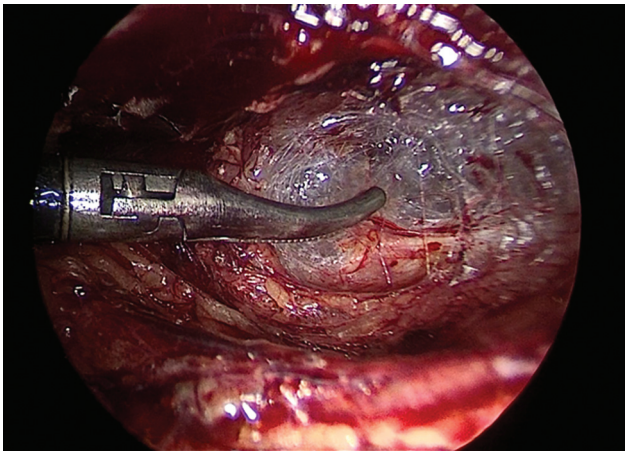
Complete left retrorectus space dissection was achieved (Fig. 2).

Above the umbilicus, the crossover into the other retrorectus region had been established. After the left posterior rectus sheath's medial side was incised,

Figure 1

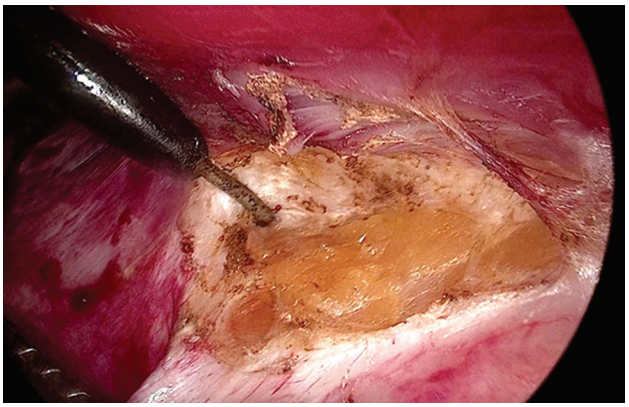
Trocar placement for eTEP. eTEP, extended totally extraperitoneal.

Figure 2



Left retrorectus space dissection.

Figure 3



Incising medial aspect of the left posterior rectus sheath.

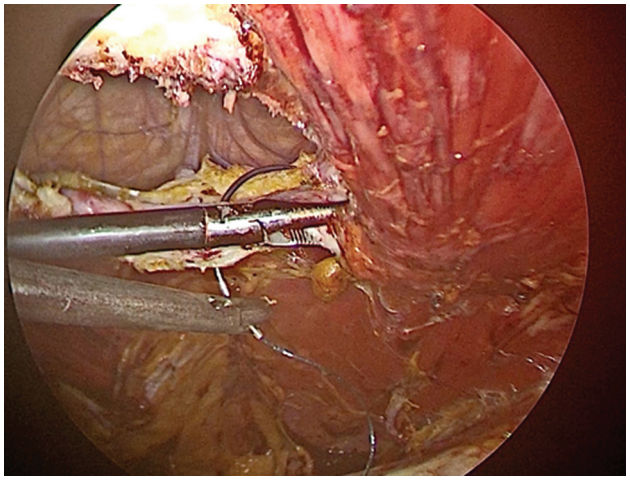
preperitoneal dissection was carried out, reaching the falciform ligament. The medial aspect of the right posterior rectus sheath was identified, cut, and released from the cephalad to the caudal direction (Fig. 3).

The herniated sac was reduced, and the upper section of the right retrorectus space was joined with the lower section, fully freeing both the left and right retrorectus and preperitoneal areas.

Utilizing a nonabsorbable continuous barbed suture (V-Loc n°0). The hernia defect was surgically repaired (Fig. 4).

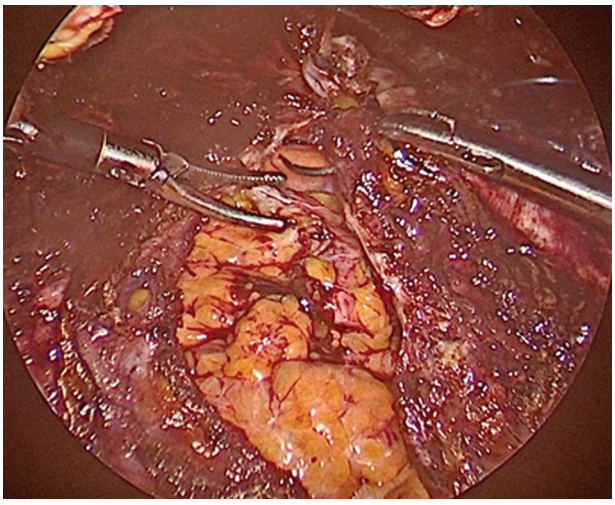
The peritoneal tears were closed with continuous absorbable sutures to prevent mesh from coming into touch with the intra-abdominal contents (Fig. 5).

Figure 4



Repairing the hernia defect in eTEP. eTEP, extended totally extra-peritoneal.

Figure 5

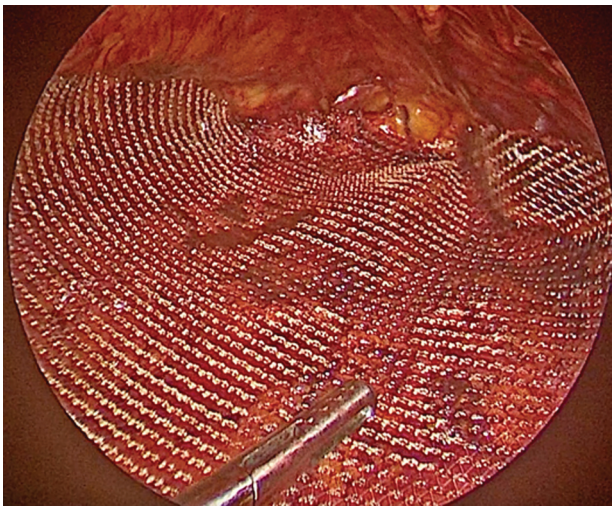


Closing the peritoneal tear.

The dimensions of the retrorectus space were assessed using a ruler in order to determine the appropriate size of mesh required for total coverage. A 15×25 cm polypropylene mesh was placed via the 10-mm trocar after being rolled. The mesh subsequently expanded to fully include the retrorectus area. No fixation was used (Fig. 6).

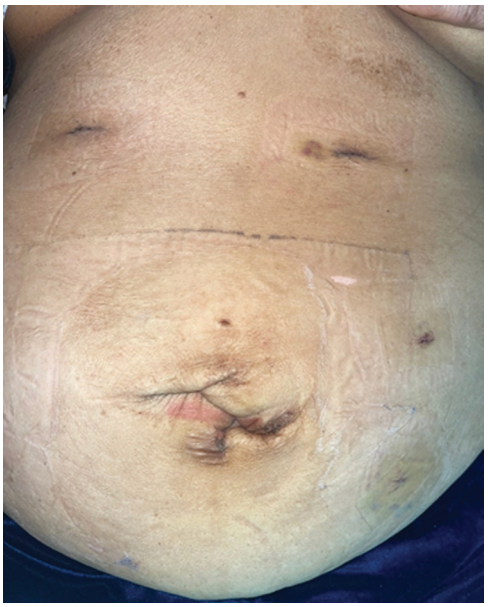
A drain was inserted anterior to the mesh. The process of evacuating the pneumoperitoneum and trocar removal were carried out under vision. The incisions made with a 10 mm trocar had been sutured closed with a 2/0 absorbable stitch (Fig. 7).

Figure 6



Extension of the mesh over the retrorectus space.

Figure 7

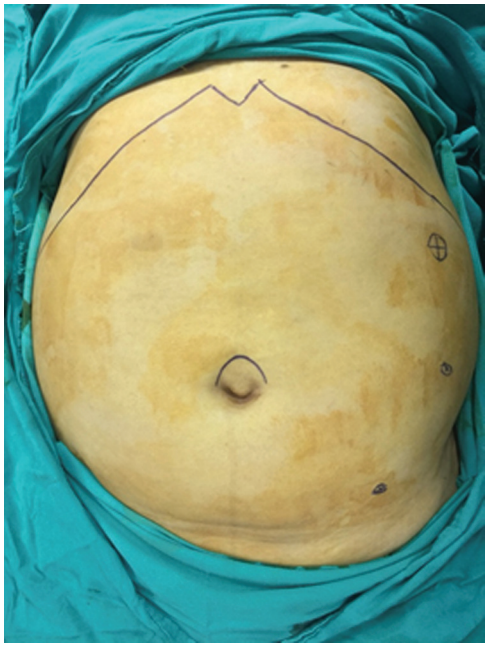


Hernia site and scars on the 14th postoperative day. (The same case in Fig. 1).

Intraperitoneal onlay mesh technique

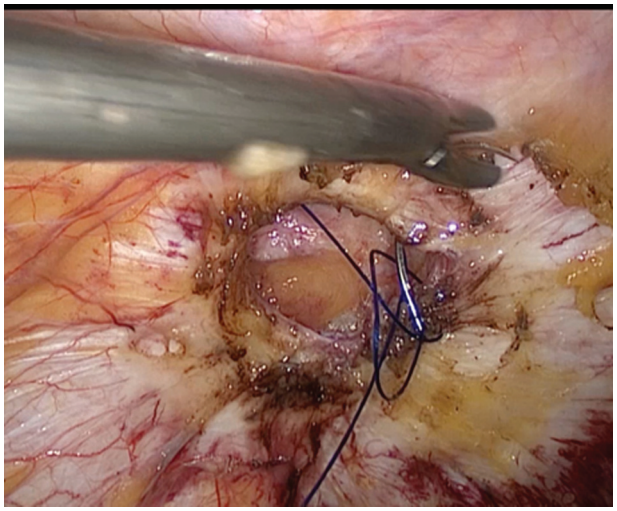
A pneumoperitoneum was established utilizing a Veress needle. Trocars were inserted on the left abdominal side, namely on the anterior axillary line. Trocars were placed on the left side of the abdomen on the anterior axillary line 10 and 5 mm at the level of the umbilicus. In addition, another trocar 5 mm was used medial to the anterior superior iliac spine. A total of three trocars were utilized: a single 10 mm trocar for the 30° optic and two 5 mm trocars (Fig. 8).

Figure 8



Trocar sites for IPOM. IPOM, intraperitoneal onlay mesh.

Figure 9



Repairing the hernia defect in IPOM. IPOM, intraperitoneal onlay mesh.

After establishing a pneumoperitoneum, the working pressure was consistently sustained at 14 mmHg. The adhesiolysis was carried out, and the hernia content was decreased to expose the hernia defect.

The pneumoperitoneum working pressure was reduced to 8 mmHg to minimize the overestimation of hernia size. The defect closure will be executed using a nonabsorbable, continuous barbed suture (V-Loc n°0; Medtronic) by making stitches on the lining of the herniated sac (to prevent bulging of the hernia sac and postoperative hernia sac seroma) (Fig. 9).

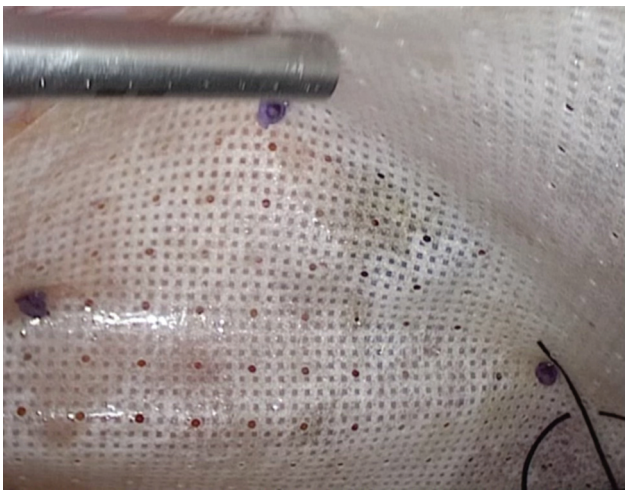
Double sided Polypropylene with Silicone mesh, Sil Promesh ® 15×20 cm was used. Absorbtack tacks had been utilized for mesh fixing (Fig 10).

The pneumoperitoneum was evacuated, and the trocar was removed under direct vision. The incision made by the 10 mm trocar was sutured with a 2/0 absorbable sutures.

All patients received antiemetic, antibiotic, intravenous, and paracetamol 500 mg injections during the postoperative period. All patients received 8 mg of Lornoxicam intravenously on demand. After 6 h, the oral diet was typically reintroduced, beginning with a clear fluid. Patients were discharged when they could tolerate a soft diet, their pain score was less than 3, and there were no surgical complications.

In both eTEP and IPOM groups, it was advised to avoid lifting heavy weights for 3 months and to adhere to a well-balanced dietary regimen to avoid obesity and minimize the risk of future recurrence.

Figure 10



Absorbtack tacks had been utilized for mesh fixing.

Follow up

Patients were followed up weekly for the first month after discharge and then after 3 and 6 months of surgery.

Statistical analysis

The statistical analysis was performed using SPSS, v26 (IBM, Chicago, Illinois, USA). The normality of data distribution was assessed by doing the Shapiro–Wilks test and examining histograms. The quantitative parameters were expressed as the mean and SD and were analyzed utilizing the unpaired Student's *t* test. The qualitative variables were displayed using frequencies and percentages and were analyzed using χ^2) and Fisher's exact tests. Two tails *P* value less than or equal to 0.05 was deemed statistically significant.

Results

In this study, 61 individuals checked to find out if they would be eligible; eight individuals failed to fulfill the specified criterion, and three patients declined to participate in the study. The remainder patients had been randomly assigned to two equal groups, with 25 participants in each group (Fig. 11). Occurred dropout in the follow-up [one participant in group eTEP (*n*=24), two patients in group IPOM (*n*=23).

Demographic data were insignificantly different between both groups (Table 1).

European hernia classification and defect diameter were insignificantly different among the two groups (Table 2).

Operation time was significantly prolonged in group eTEP compared to group IPOM ($P<0.001$). Cost and hospital stay were significantly lesser in group eTEP compared with group IPOM ($P<0.05$) (Table 3).

Pain at rest, restriction to normal activity, cosmesis, and total score (EuraHS-QoL) were insignificantly different at 3 months postoperative between both groups.

Pain at rest, restriction to normal activity, and total score (EuraHS-QoL) were significantly lower on the first and 14th postoperative days in group eTEP compared with group IPOM ($P<0.05$). In contrary, cosmesis was insignificantly different on the first and 14th postoperative days between both groups (Table 4).

Postoperative seroma, postoperative hematoma and postoperative ileus were insignificantly different between both groups. In the first five cases in eTEP,

Table 1 Demographic data of the studied groups

	Group eTEP (*N*=25)	Group IPOM (*N*=25)	*P* value
Age (years)	36.2±5.66	38.52±6.46	0.183
Sex			
Male	16 (64)	18 (72)	0.544
Female	9 (36)	7 (28)	
Weight (kg)	93.24±6.76	96.04±6.44	0.140
Height (m)	1.69±0.07	1.72±0.07	0.172
BMI (kg/m^2)	32.69±2.08	32.62±2.01	0.912
Smoking	6 (24)	8 (32)	0.529

Data are presented as mean±SD or *n* (%). eTEP, extended totally extraperitoneal; IPOM, intraperitoneal onlay mesh.

Table 2 European hernia classification and defect area of the studied groups

	Group eTEP (*N*=25)	Group IPOM (*N*=25)	*P* value
European hernia classification			
M2 (Epigastric)	6 (24)	5 (20)	1
M3 (Umbilical)	19 (76)	20 (80)	
Defect diameter (cm)	2.45±0.55	3.13±0.45	0.413

Data are presented as mean±SD or *n* (%). eTEP, extended totally extraperitoneal; IPOM, intraperitoneal onlay mesh.

Table 3 Operation time, cost and hospital stay of the studied groups

	Group eTEP (*N*=25)	Group IPOM (*N*=25)	*P* value
Operation time (min)	171±18.14 (115-195)	120.4±18.25	<0.001*
Cost (USD)	331.2±42.58 (255-395)	987.6±57.39	<0.001*
Hospital stay (h)	26.88±2.11 (24-72)	29.16±3.78	0.011*

Data are presented as mean±SD. eTEP, extended totally extraperitoneal; IPOM, intraperitoneal onlay mesh.

we did not put a drain, and seroma appeared in two patients, so a drain was then routinely placed anterior to the mesh in all cases (eTEP group). After that was removed when the amount of drained exudate was less than 50 ml/ day. Readmission and reoperation, postoperative recurrence, wound infections, and periumbilical necrosis of the skin did not exist in any participants in either group (Table 5).

Discussion

The eTEP approach provides the opportunity to utilize the retromuscular space. It enables the total exclusion of mesh from the peritoneal cavity, preventing direct contact between the mesh and visceral components. In addition, this work has deliberately refrained from using penetrating transfascial fixation. Instead, a large-sized mesh is placed between the anterior and posterior layers of the abdominal wall, creating a sandwich-like structure.

In this study, eTEP had lower postoperative pain in comparison with IPOM, which was statistically significant on the first day and 14th postoperative day and statistically nonsignificant at 3 months postoperative.

These results are comparable with the results reported by Bellido Luque *et al* [11], which revealed less pain in the eTEP group, which was statistically significant ($P < 0.05$) on the first day, seventh day, and 30th day.

These results were also comparable with Taşdelen [12], which demonstrated significantly less pain on the first and 10th day postoperatively compared to the IPOM group ($P<0.001$).

Also, these findings were comparable with Penchev *et al* [13], which demonstrated significantly less pain on the first and seventh day postoperatively compared with the IPOM group ($P<0.05$).

Table 4 EuraHS-QoL score of the studied groups

	Group eTEP	Group IPOM	*P* value
1st day postoperative			
	N=25	*N*=25	
Pain at rest	1.9±1.04	2.8±1.05	0.007*
Restriction to normal activity	5±1.57	6.7±1.65	0.001*
Cosmesis	1.5±0.51	1.7±0.75	0.275
Total	8.4±2.27	11.2±2.03	<0.001*
14th day postoperative			
	N=25	*N*=24	
Pain at rest	0.9±0.67	1.5±0.78	0.004*
Restriction to normal activity	1.7±0.61	2.7±1.01	<0.001*
Cosmesis	1.2±0.82	1.5±0.51	0.087
Total	3.8±1.19	5.5±1.78	<0.001*
3 months postoperative			
	N=24	*N*=23	
Pain at rest	0.5±0.51	0.7±0.45	0.051
Restriction to normal activity	0.8±0.79	1±0.82	0.298
Cosmesis	0.5±0.51	0.4±0.5	0.395
Total	1.6±0.99	1.9±1.12	0.354

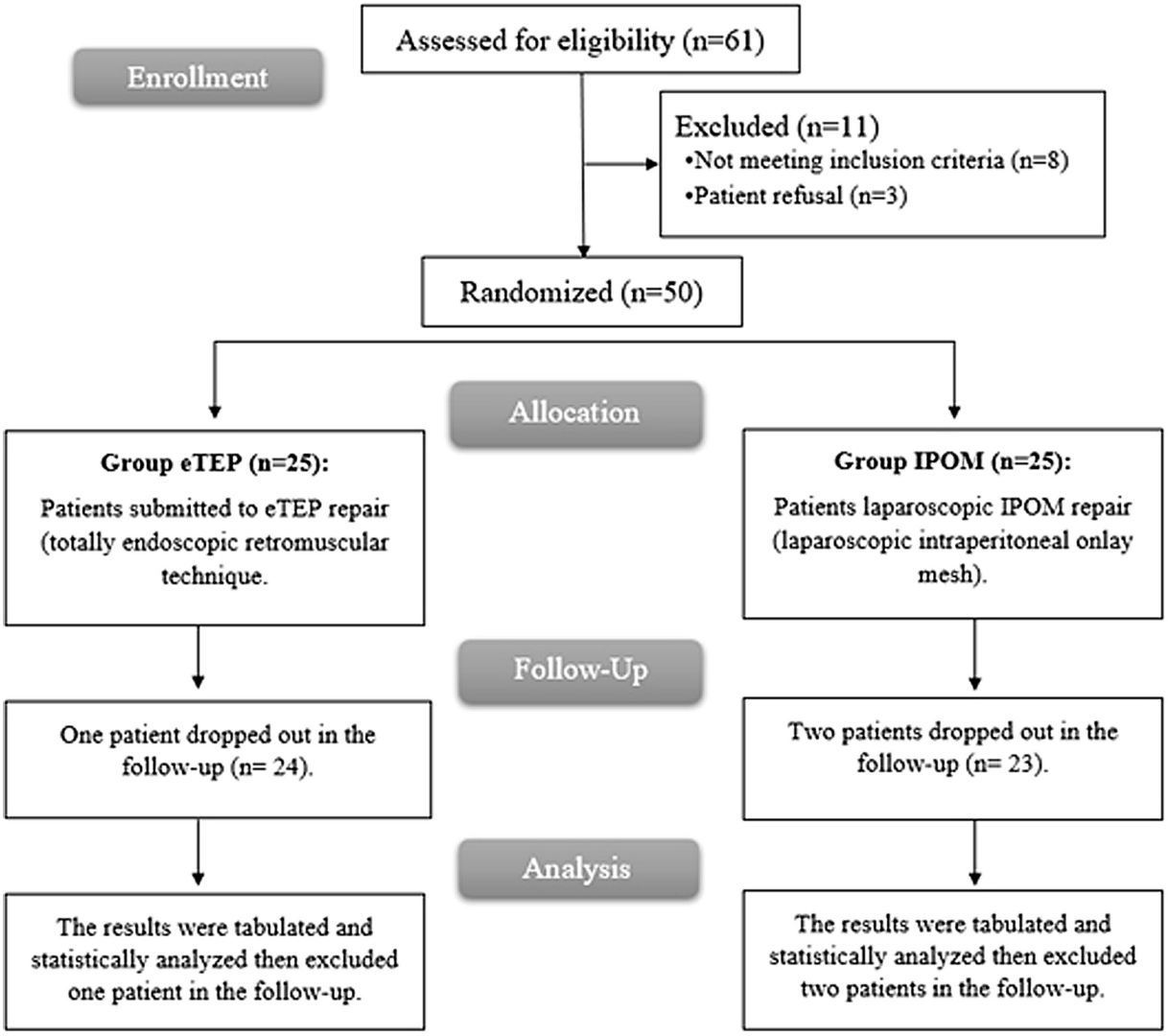
Data are presented as mean±SD. eTEP, extended totally extraperitoneal; IPOM, intraperitoneal onlay mesh.

Table 5 Complications of the studied groups

	Group eTEP (*N*=25)	Group IPOM (*N*=25)	*P* value
Readmission and reoperation	0	0	–
Postoperative recurrence	0	0	–
Postoperative seroma	4 (16)	1 (4)	0.349
Postoperative hematoma	1 (4)	0	1
Postoperative ileus	0	2 (8)	0.489
Wound infections	0	0	–
Periumbilical skin necrosis	0	0	–

Data are presented as *n* (%). eTEP, extended totally extraperitoneal; IPOM, intraperitoneal onlay mesh..

Figure 11



CONSORT flowchart of the enrolled patients.

In this study, eTEP had less restriction to normal activity, which was statistically significant on the first and 14th day postoperative and statistically not significant at 3 months postoperative.

These results were comparable with the results reported by Bellido Luque *et al* [11], which showed less restriction to normal activity, which was statistically significant less than 0.05 on the 30th day.

The lower pain and better functional activity in the eTEP group in this study may be attributed to the avoidance of traumatic fixations of the mesh because it was placed in a retromuscular position.

In this study, cosmetic results were insignificantly different between both groups, which were inconsistent with the results reported by Bellido Luque *et al* [11], which showed significant variation had existed among the groups on the 30th and 180th day postoperatively in favor of the eTEP group ($P<0.05$).

Regarding operative time was significantly longer in the eTEP group ($P<0.001$), which was comparable with results reported by Bellido Luque *et al* [11], Penchev *et al* [13], Xu *et al* [14], and Taşdelen [12], but inconsistent with Bui *et al* [15], which showed an insignificant difference between both group ($P=0.091$). The duration of the laparoscopic eTEP method was notably greater compared to that of the IPOM approach, which is understandable given that the eTEP technique is a new approach, requiring a longer learning curve, and involving more extensive dissection between the layers of the abdominal wall.

In this study, hospital stay was significantly lower in eTEP group than IPOM ($P=0.011$), which was

comparable with the results reported by Bellido Luque *et al* [11], Xu *et al* [14], Taşdelen [12], and Bui *et al* [15] and inconsistent with Penchev *et al* [13]. which showed nonsignificant difference between both groups.

In this study, eTEP had a lower cost, which was statistically significant ($P<0.001$), which was comparable with results stated by Xu *et al* [14] and Prasanth *et al* [16]. The lower cost in eTEP was due to the use of ordinary noncoated polypropylene mesh without fixation (no need for double layered mesh or fixation tacker that were used in IPOM).

Limitations

The current study had a few drawbacks, such as a relatively limited sample size being conducted at a single center and a shorter follow-up period.

Conclusion

In conclusion, both eTEP and IPOM demonstrated safety and efficacy in the treatment of de-novo ventral hernia repair (comparable few complications in both groups with no recurrence in this study) with superiority toward eTEP as evidenced by lower hospital stay, cost, postoperative pain, and early return to normal activity. At the same time, eTEP was associated with prolonged operation time, which may be improved with time. While it was statistically nonsignificant, but eTEP group had more cases of seroma formation, and that is why we recommend putting a drain in the eTEP technique. We recommend continuing the study of the eTEP technique with many more cases, longer follow-up periods and with multiple surgical teams.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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