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A Prospective Observational Study of Laparoscopic Extended Totally Extraperitoneal (e-TEP) Repair for Bilateral Inguinal Hernia at Tertiary Care Teaching Centre

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Abstract

Introduction

Inguinal hernia is a common surgical condition that affects both men and women worldwide. Laparoscopic approaches, particularly the extended totally extraperitoneal (e-TEP) technique, have gained popularity owing to their minimally invasive nature, which reduces postoperative pain, hospital stay, and recovery time. Despite these advantages, comprehensive literature on the efficacy of e-TEP, particularly for bilateral inguinal hernias, remains limited.

Objective

The study aims to evaluate the short-term perioperative outcomes or clinical outcomes of laparoscopic extended e-TEP procedure in bilateral inguinal hernia repair.

Materials and methods

A prospective observational study was conducted from June 2022 to December 2023 at the Department of General Surgery of Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow. Patients with clinical or radiological evidence of bilateral inguinal hernia, aged >15 years, and undergoing laparoscopic hernia repair were included. The exclusion criteria encompassed patients unfit for general anesthesia, those with prior lower abdominal surgery, pregnancy, lower abdominal malignancy, complicated hernia, morbid obesity (BMI ⩾40), and recurrent hernia. Data collected included demographic information, clinical characteristics, and surgical outcomes. A laparoscopic extended totally extraperitoneal repair was performed using standard guidelines with two 15×12 cm polypropylene meshes.

Results

The mean operative time was 109.16±14.53 min. Postoperative pain, assessed using visual analog scale (VAS), was significantly reduced from day 0 (3.48±0.641) to day 1 (2.29±0.536) at rest, and from 4.88±0.784 to 2.31±0.544 during ambulation. The hospital stay lasted two to three days. Minimal intraoperative complications were noted, with peritoneal rent occurring in only one case. Postoperative complications were also minimal, with 11 patients experiencing port-site pain and nine developing seromas.

Conclusion

Laparoscopic eTEP repair for bilateral inguinal hernia showed favourable short-term outcomes in this single-centre observational study, including acceptable operative time, low early postop pain scores, minimal intraoperative complications and hospital stay. This study underscores the need for further research with larger sample sizes and long-term follow-up to validate these findings and enhance clinical practice for bilateral inguinal hernia repair.

Categories: General Surgery
Keywords: bilateral, complications, e-tep, inguinal hernia, laparoscopic repair

Introduction

Inguinal hernia is a common condition affecting millions of individuals worldwide, with a lifetime risk of 27% in men and 3% in women. It accounts for 75% of abdominal hernias, with an overall incidence of 1.7% across all ages and 4% in those aged >45 years [1]. Laparoscopic approaches have become favored for their minimally invasive nature, resulting in reduced postoperative pain, shorter hospital stays, and quicker recovery times compared with traditional open procedures [2].

Laparoscopic inguinal hernia repair includes transabdominal preperitoneal repair (TAPP), standard totally extraperitoneal repair (TEP), and now extended TEP (eTEP). Extended-TEP (eTEP) was introduced in 2012 by Daes, which has emerged as a promising method, particularly for bilateral hernias. The e-TEP approach allows for the simultaneous repair of bilateral hernias, providing superior visualization of anatomical structures due to a larger operative preperitoneal (PP) space, potentially reducing the risk of recurrence, and resulting in fewer wound complications and faster recovery [3-5].

By accessing the preperitoneal space bilaterally, the e-TEP approach offers the advantage of addressing hernias on both sides simultaneously while preserving the integrity of the peritoneum. This preservation may potentially reduce the risk of intra-abdominal complications such as adhesions and bowel injuries, making e-TEP repair an appealing option for appropriately selected patients.

Despite its advantages, there is limited comprehensive literature on the efficacy and outcomes of e-TEP repair, especially for bilateral inguinal hernias [6]. Existing research primarily focuses on short-term outcomes, highlighting the need for robust studies to evaluate the durability and recurrence rates of this technique.

This study aimed to address the feasibility and safety of e-TEP approach by conducting a detailed analysis of laparoscopic e-TEP repair for bilateral inguinal hernias at our tertiary care teaching institute. We aim to enhance understanding and guide clinical decision-making regarding the optimal management of bilateral inguinal hernias. This study will contribute to the optimization of clinical practice and improvement of patient outcomes.

Materials And Methods

Study design and participants

This prospective observational study was conducted in the Department of General Surgery at Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, from June 2022 to December 2023. The participants included patients with clinical or radiological evidence of bilateral inguinal hernias.

Inclusion and exclusion criteria

Patients were included in the study if they had clinical and radiological evidence of bilateral inguinal hernia, were over 15 years of age, and were undergoing laparoscopic hernia repair.

The exclusion criteria were as follows: patients unfit for general anesthesia and those with previous lower abdominal surgery, pregnant patients, individuals with lower abdominal malignancy or who had undergone radiation therapy, patients with complicated hernia, morbid obesity (BMI≥40), and recurrent hernia.

Based on previous studies, the operative time for bilateral inguinal hernia repair is estimated to be 127.5±23.4 min. Anticipating a 10% change (13.5 min) in operative duration, the sample size was calculated using the following formula:

$$N = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 \, 2\sigma^2}{(\mu_1 - \mu_2)^2}$$

where ⊠ is the level of significance, that is, 5%, and ⊠ is the type II error, that is, 20%. ⊠=23.4 min is the standard deviation of the operative time for bilateral inguinal hernia, ⊠$_1$=127.5 min is the operative time for bilateral inguinal hernia, and ⊠$_2$=127.5±13.5 min is the expected operative time for bilateral inguinal hernia. Then, the null hypothesis is ⊠$_0$: ⊠ $_1$=⊠$_2$ vs ⊠ $_1$: ⊠ $_1$≠⊠$_2$. After calculation, the sample size was n=47, and after adding a 10% loss of data, the optimum sample size was 52 patients.

Data collection procedure

All patients who presented to the General Surgery Department with clinically proven bilateral inguinal hernias were included. Convenience sampling was used for patient recruitment. Patients with symptomatic unilateral hernias were evaluated using ultrasonography to detect contralateral occult hernias. Data were collected in the local language and English, including demographic details, clinical characteristics, and surgical outcomes.

Patients meeting inclusion criteria were recruited between June 2022 and September 2023 until the required sample size was achieved.

Laparoscopic e-TEP procedures were performed between June 2022 and October 2023 in parallel with patient enrollment, as participants underwent surgery soon after diagnosis and preoperative evaluation.

Data collection and analysis phase was between October 2023 and December 2023. This phase included completion of short-term follow-up, data entry, statistical analysis, and interpretation of results.

Methodology

The patients eligible for the study were informed about the procedure and other treatment options available with their possible benefits and complications, in local languages/languages they understand and due consent was taken from them.

All the procedures were conducted by a single surgeon with >15 years of experience with advanced laparoscopic procedures with the same surgical team.

Procedural Details

Port placement: Under strict surgical asepsis protocols, a 12-mm optical port was created in the left retro-rectal approximately 4 cm above the umbilicus, midway between linea alba and linea semilunaris. Retrorectal dissections were carried over using a zero-degree laparoscopic telescope. A 5-mm working port placed at linea semilunaris at the level of umbilicus. Inferior crossover was done by releasing the medial border of the left posterior rectus sheath, proceeding to preperitoneal dissection. One 5-mm working port was placed just inferior to the umbilicus. Permissible modifications were made to port placement based on ergonomic needs.

Modification in the technique: The surgery was completed using only two working ports, one left at linea semilunaris and one infraumbilical (conventionally, three working ports are described for bilateral inguinal hernia repair; one infraumbilical and one on either side, and the surgeon switches over the side of the operative table to do the contralateral hernia).

Dissection: Dissection was carried in the preperitoneal plane bilaterally up to the pubic symphysis and space of Retzius. The preperitoneal dissection was carried laterally till the identification of the iliopsoas muscle. Hernial sacs were dissected down, and critical view of myopectineal orifice was achieved.

Mesh placement: Two 15x12 cm meshes were placed, one on either side, with medial overlap covering the complete myopectineal orifice of Fruchaud's, bilaterally. No tacks were used for fixation of the meshes. Rectorectal and preperitoneal spaces were deflated under vision to prevent any undue migration of the mesh.

Port site closure: The anterior rectus sheath defect was closed with polyglactin no. 1. Skin was stapled.

Peritoneal rent management: It happened in one patient, which was closed with Polyglactin 3-0, after decreasing the pressure of pneumoperitoneum over Veress needle insertion in the abdominal cavity by the side of the camera port from the same skin incision.

Follow-up: Patients were followed up on postoperative day 7, 14, and after completion of one month.

Post-operative Management

Analgesia: Post-operatively, after one hour, the patients were given injectable Diclofenac 75 mg IV infusion as analgesic protocol. Any undue/discomforting pain was covered with injectable Tramadol 75 mg IV infusion, and a note of it was made.

Ambulation: All the patients in the study were allowed ambulation at four hours postoperatively after regaining complete consciousness.

Visual Analog Scale (*VAS*): VAS was assessed at rest and at ambulation on day 0. Similarly, VAS at rest and ambulation was assessed at 24 hours post-operatively.

The participant flow chart is shown in Figure *1*.

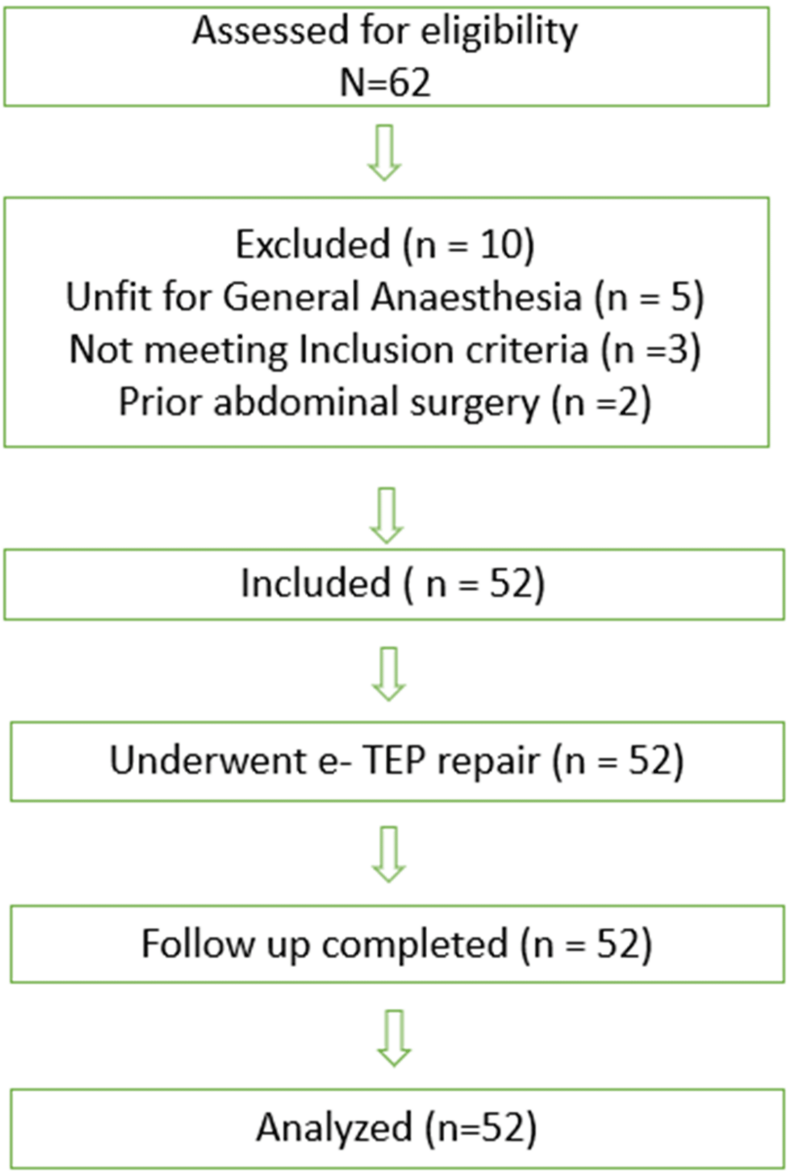


FIGURE 1: Participant flowchart

PowerPoint (Microsoft, Redmond, WA) was used for the creation of this flowchart.

The laparoscopic extended totally extraperitoneal repair procedure was performed using standard guidelines. Figure *2* shows the position of ports.



FIGURE 2: Position of camera port and working ports

Yellow arrow indicates position of camera port, Red and blue arrows indicate the position of working ports.

Original image captured in a camera.

Two 12x15 cm polypropylene meshes were placed after adequate reduction of sac and adequate visualization of myopectineal orifice on both sides as shown in Figures *3*, *4*.

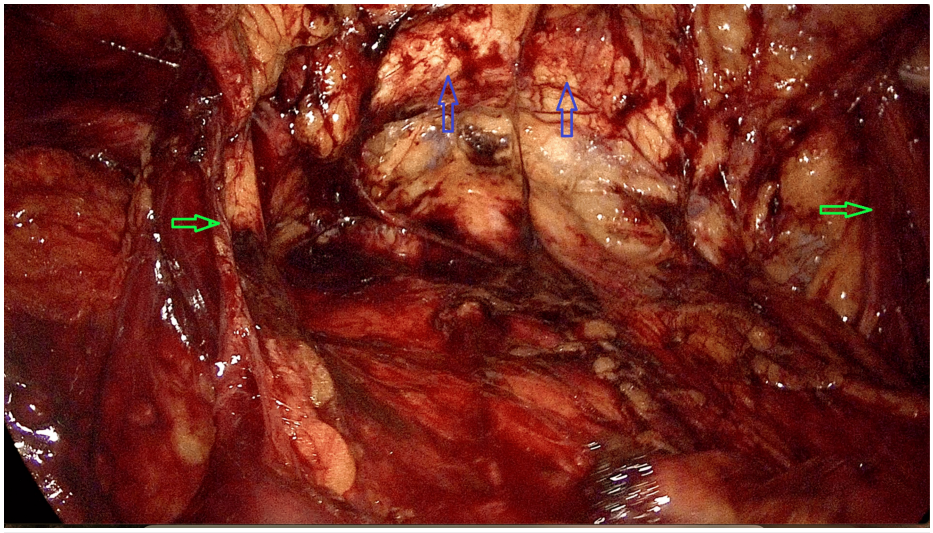


FIGURE 3: Image showing myopectineal orifice of both sides.

Blue arrows represent light house on both sides. Green arrows represent dissected cord structures.

Original image captured by a camera.

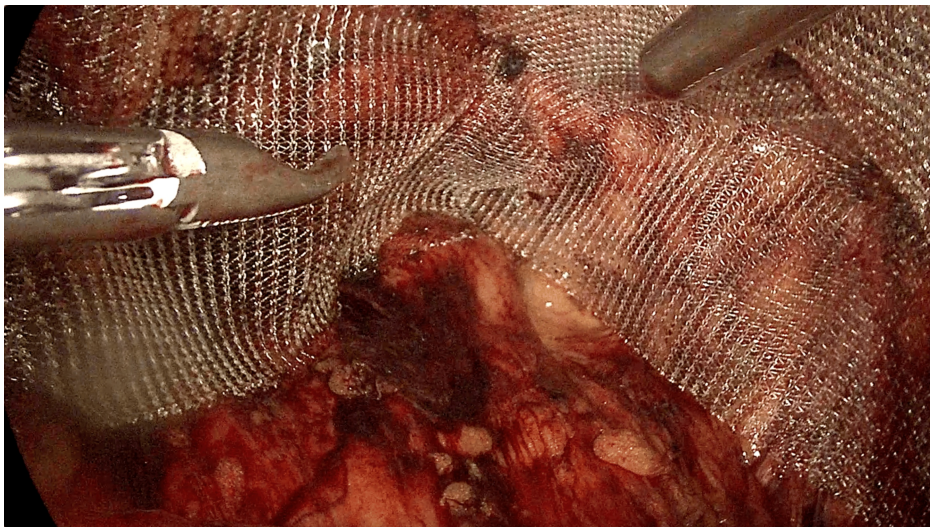


FIGURE 4: Image showing placement of two 15x12 polypropylene mesh on both sides

Original captured by a camera.

Outcome variables

Demographic and Clinical Characteristics

Continuous variables included age, weight, height, and infra-umbilical girth, while categorical variables included sex, presenting complaints, and hernia types.

Procedure-related Variables

Continuous variables included operative duration and blood loss. Categorical variables included the type of hernia defect, hernia sac contents, intraoperative events, complications, and space creation difficulty.

Conversion

Conversion to an open or other laparoscopic approach was noted.

Postoperative Recovery

Continuous data included pain scores, analgesic requirement, bowel movements, and hospital stay. Pain was recorded on a VAS [7] where 0 indicates no pain and 10 indicates the worst possible pain. Categorical data included scrotal emphysema, nausea, vomiting, oral feed tolerance, and urinary retention.

Postoperative Complications

Binary outcomes included seroma, hematoma, scrotal emphysema, peritoneal rents, wound infection, and recurrence.

Morbidity and Mortality

Morbidity and mortality were recorded.

Ethical considerations

The study was approved by the Institutional Ethics Committee of Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, India (IEC No. 120/22; dated November 1, 2022). Written informed consent was obtained from all participants for surgery, study participation, and use of anonymized clinical/images data. Participant confidentiality was maintained.

Data analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS), version 23.0.0.0 (IBM Corp., Armonk, NY). Continuous variables are presented as mean±SD, and categorical variables are presented as numbers (percentages).

A one-sample t-test was used to compare the observed and expected operative durations. Repeated measures analysis of variance (ANOVA) was used to assess the effectiveness of e-TEP in terms of changes in the VAS scores from day 0 to day 1.

Results

The mean age of the study participants was 52.59±15.18 years. The majority (36.5%) of the study participants were in government service or office ranks, 28.8% were farmers, and 26.9% were shopkeepers. Hypertension was present in 11.5% of the study participants and diabetes was also present in 11.5% of the study participants. The mean±SD time for space creation was 20.50±6.82 min. The mean±SD time for sac dissection was 71.25±22.81 min. The mean±SD time for mesh replacement was 15.21±3.76 min. The mean±SD of the total operative time was 109.16±14.53 min, with a median time of 108 min. The maximum total operative time was 193 min, and the minimum time was 70 min.

The mean±SD of the observed operative time was 109.16±14.53 min, and the mean±SD of the expected operative time was 127.5±13.5 min. This difference was statistically significant (p=0.002) (Table *1*).

Time (min)	Mean±SD	Mean difference	t value	p value*
Observed Operative Time	109.16±14.53	-6.24	2.834	0.002
Expected Operative Time	127.5±13.5			

TABLE 1: : Comparison of observed total operative time of the study participants with bilateral inguinal hernia undergoing e-TEP with the expected time

e-TEP: Extended totally extraperitoneal technique.

The VAS score on postoperative day zero was three among 48.1% of the study participants and four among 44.2% of the study participants during rest. The VAS score on postoperative day zero during ambulation was four among 50.0% of the study participants and three among 25.0% of the study participants during ambulation after four hours of surgery (Table *2*).

VAS at Post Op Day 0	VAS at Post Op Day 0	N=52	%
During rest	2	2	3.8%
	3	25	48.1%
	4	23	44.2%
	5	2	3.8%
During Ambulation (After 4 hours)	2	2	3.8%
	3	13	25.0%
	4	26	50%
	5	11	21.2%

TABLE 2: VAS for pain among the study participants at post operative day 0

N stands for total number of study participants, VAS is Visual Analog Scale for measurement of intensity of pain.

The VAS score on postoperative day one was two in 63.5% of the study participants and three in 32.7% of the study participants during rest. It was two among 61.5% of the study participants during ambulation after 24 h from day 0, and it was three among 34.6% of the study participants during ambulation after 24 h from day 0 (Table *3*).

VAS at Post Op Day 1	VAS at Post Op Day 1	N=52	%
During rest	1	2	3.8%
	2	33	63.5%
	3	17	32.7%
During Ambulation (After 24hr from day 0)	1	2	3.8%
	2	32	61.5%
	3	18	34.6%

TABLE 3: VAS pain score among the study participants at post operative day 1

N stands for total number of study participants, VAS is Visual Analog Scale for measurement of intensity of pain.

The mean±SD VAS for pain at rest was 3.48±0.641 and 2.29±0.536 on days 0 and 1, respectively. A statistically significant association was found between the VAS score for pain on days 0 and 1 at rest (p=0.0001). The mean±SD VAS for pain during ambulation was 4.88±0.784 and 2.31±0.544 on days 0 and 1, respectively. A statistically significant association was found between the VAS for pain on days 0 and 1 during ambulation (p=0.0001).

Postoperative analgesia was required by 92.3% of the study participants on first mobilization, which was after four hours of surgery. A total of 59.6% of the study participants required additional analgesic doses (Table *4*).

Dose	Postoperative Analgesia	N=52	%
After first mobilization (after four hours)	Yes	48	92.3 %
	No	4	7.7%
Requirement of additional dose	Yes	31	59.6%
	No	21	40.4%

TABLE 4: Postoperative analgesia after first mobilization and requirement of additional doses

N stands for total number of study participants.

Fifty percent of the study participants had a hospital stay of two days, while the remaining 50% had a hospital stay of three days. Only 1.92% of the study participants had a peritoneal rent during surgery. None of the patients experienced any other intraoperative complications (Table *5*).

Intraoperative Complications	N=52	%
Port site insertion	0	0
Peritoneal rent	1	1.92%
Bleeding from inferior epigastric artery	0	0
Emphysema of abdominal wall	0	0
Placement of Verres needle	0	0

TABLE 5: : Intraoperative complications among the study participants undergoing e-TEP.

N stands for total number of study participants

Port site pain was the most common postoperative complication, occurring in 21.2% of the study participants, followed by seroma, which was reported by 17.3% of the study participants (Table *6*).

Post-operative complications	N=52	%
Abdominal discomfort	0	0
Port site pain	11	21.2%
Any bulge/recurrence	0	0
Inguinal cord thickening	0	0
Seroma	9	17.3%

TABLE 6: Postoperative complications among the study participants undergoing e-TEP.

N stands for total number of study participants.

Discussion

Laparoscopic approaches have emerged as the preferred modality because of their minimally invasive nature and associated benefits, such as reduced postoperative pain, shorter hospital stays, and quicker recovery

times, compared to traditional open procedures [8].

The present study explored the descriptive features of the laparoscopic e-TEP approach for the repair of bilateral inguinal hernias. The laparoscopic e-TEP technique involves the creation of a larger extraperitoneal space, allowing the repair of bilateral inguinal hernias.

Several researchers have used three to four working ports for sac dissection; however, in our study, we used only two ports on the left side. This method allows for the simultaneous repair of both hernias while maintaining peritoneal integrity, offering the advantage of being minimally invasive [9].

The primary objective of this study was to evaluate the short-term perioperative outcomes of e-TEP approach in patients with bilateral inguinal hernias. The mean operative time observed in our study was 109.16±14.53 min, which was significantly lower than the expected time of 127.5±13.5 min (p=0.002). This finding is consistent with the study by Srivastava et al., who reported a mean operative time of 107.52±23.44 min for e-TEP [9]. However, Baig and Priya observed a higher mean operative time of 176.48 min (range: 138-310 min), compared with our range of 70-193 min [3]. The variability in operative time can be attributed to the learning curve associated with e-TEP, which varies based on the individual's skill and expertise. As proficiency with the technique increases, operative times tend to decrease [9-11]. Shorter operative times are beneficial because they reduce anesthesia duration, lower surgical stress, enhance cost-effectiveness, and optimize resource utilization in a healthcare setting.

Postoperative pain was evaluated using the VAS at 24 and 48 h, both at rest and during ambulation. Pain scores were significantly lower at rest than during ambulation. The mean VAS scores were less than five on day 0 (3.48±0.641) and less than three on day 1 (2.29±0.536), indicating reduced postoperative pain. These results align with those of Srivastava et al., who reported VAS scores of 2.92±0.277 and 1.24±0.436 at 24 and 48 hours post-e-TEP, respectively [9,10]. Non-fixation of the mesh in e-TEP may contribute to less postoperative pain, as aggressive mesh fixation has been associated with increased pain. Reduced postoperative pain facilitates early recovery, shorter hospital stays, and faster return to normal activities, ultimately decreasing the financial burden on patients [9-11]. Consequently, the postoperative analgesia requirements were lower in the study participants.

Intraoperative complications were minimal, and peritoneal rent occurred in one patient, which was promptly repaired. The ports used in e-TEP provide access to a large extraperitoneal space, improving ergonomics for the surgeon [10]. Postoperative complications were minimal. None of the patients experienced abdominal discomfort, inguinal cord thickening, or issues with port-site insertion. However, 11 patients reported port-site pain, and nine developed seromas. Srivastava et al. also observed seroma/hematoma in nine patients, which resolved spontaneously [9]. Mahadar and Arora reported seroma in six patients [10]. Factors such as extensive dissection, mesh placement, and inflammatory responses contribute to seroma formation [11].

The length of hospital stay in our study was two to three days for all participants. Other studies have reported similar short hospital stays, ranging from one to two days [10,11]. Kumar et al. reported a mean hospital stay of 2.8±1.2 days for e-TEP [11], while other studies reported stays of 1.2-2.56 days. The minimally invasive nature of e-TEP results in less tissue trauma, reduced postoperative pain, and shorter hospital stay.

This study provides a comprehensive overview of operative time, postoperative pain, and intraoperative and postoperative complications in patients who underwent e-TEP for bilateral inguinal hernias. The study is limited by small sample size, sampling method (potential selection bias), single-center design, lack of control/comparison group, short follow-up, and restricted patient population, reducing the strength and generalizability of its conclusions. The highly experienced single-surgeon setting limits external validity and may substantially influence operative time, complications, and technical feasibility. The exclusion of recurrent, complicated, morbidly obese, and previously operated patients also results in a selected relatively favorable population. This study can describe outcomes after e-TEP but cannot demonstrate that the technique reduces pain, hospitalization, complications, or operative time compared with alternative approaches.

Despite its limitations, the findings highlight the advantages of e-TEP, such as shorter operative times, reduced postoperative pain, minimal complications, and shorter duration of hospitalization. These benefits contribute to improved patient outcomes and resource optimization in healthcare settings. Since it is an observational study, superiority over conventional TEP, TAPP, or open repair cannot be commented upon.

Future research on laparoscopic e-TEP repair for bilateral inguinal hernia should focus on conducting large-scale, multicenter prospective studies with larger sample sizes and long-term follow-up to enhance the generalizability of findings across diverse patient populations and healthcare settings.

Conclusions

The e-TEP technique for bilateral inguinal hernia repair was technically feasible in this selected cohort of 52 patients and was associated with low intraoperative morbidity, relatively low early pain scores, a hospital stay of two to three days, and a limited number of early postoperative complications. The short hospital stay enhances healthcare efficiency by freeing up resources and also increases workforce productivity.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Supervision: Rudra Mani

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethics Committee, Dr Ram Manohar Lohia Institute of Medical Sciences, Vibhuti Khand, Gomti Nagar, Lucknow issued approval IEC No. 120/22. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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Data are available on reasonable request. The data are stored as de-identified participant data which are available on request to sapnasnmc001@gmail.com

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