RESEARCH ARTICLE

Laparoscopic Totally Extraperitoneal Repair Using Three-dimension Mesh to Treat Bilateral Inguinal Hernia in Adults

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Abstract

Aim: This study is aimed to examine the effectiveness of laparoscopic totally extraperitoneal (TEP) repair using three-dimension (3D) mesh to treat bilateral inguinal hernia in adults.

Materials and methods: We conducted case series on 50 patients with bilateral inguinal hernias undergoing laparoscopic TEP surgery using 3D mesh at Thanh Nhan Hospital from January 2017 to June 2019.

Results: Of 50 patients, 66.0% of patients had a direct inguinal hernia and 34.0% of patients had an indirect inguinal hernia. The diameter of the herniated hole was mainly from 1.5 to 3 cm in 84.0% of patients. There were 82% of patients using small 3D mesh (8.5 × 13.7 cm) and one case required mesh fixation (2.0%). Seven patients (14.0%) had complications during surgery. The average postoperative pain time was 2.2 ± 1.5 days (1–15 days). Pain degree decreased gradually from day 1 to day 3. By day 3 after surgery, 94% of patients had only slight pain, two patients (4.0%) had mild pain, and one patient (2.0%) had moderate pain. All patients were followed for a mean of 21.4 ± 11.8 months (minimum 1 month, maximum 40 months). At 1 month postoperative, there was one patient with chronic pain in the groin (2.1%). After 6, 12, and 24 months, no recurrence was recorded.

Conclusion: TEP laparoscopic surgery using 3D mesh is a safe, feasible, and effective method in bilateral inguinal hernia in adults, with low rates of complications and recurrence.

Keywords: Bilateral inguinal hernia, Laparoscopic totally extraperitoneal, Three-dimension mesh.

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Introduction

An inguinal hernia is a phenomenon where organs or tissues in the abdomen protrude through the groin or a weak spot of the abdominal muscles, on the inguinal ligament under the skin or down the scrotum. This is a common medical condition occurring in 1–5% of the general population, of which 15–20% are bilateral inguinal hernias.[1,2] Annually, in the United States, more than 800,000 inguinal herniation surgeries are performed, and about 15% of which are bilateral inguinal hernias.[2]

Laparoscopic surgery for inguinal hernia was first reported by Ger.[3] Since then, inguinal hernia treatment has undergone revolutionary technical advances. Among the surgical methods of laparoscopic inguinal hernia, laparoscopic totally extraperitoneal (TEP) and the transabdominal preperitoneal (TAPP) approaches are the widely accepted alternatives with superiority over open surgery such as pain relief, reduction of postoperative complications, short hospital stays, and early return to normal activities.[4–6]

In addition to technical innovations, the advent and the development of artificial mesh revolutionarily change the inguinal hernia treatment. In 1950, Francis Usher used a flat polypropylene mesh for the first time to treat inguinal hernia and surgical herniation. Since then, the artificial mesh has been widely used to reduce the rate of recurrent inguinal hernia.[7] However, a disadvantage of the flat artificial mesh is that it is easy to roll and move from the placement or increase the postoperative pain by 4–6% due to the use of fixed tools or sutures.[8] To minimize this drawback, in 1999, Bell was one of the first surgeons to use a three-dimension (3D) mesh with the bending shape according to the anatomical structure of the groin area in laparoscopic surgery for the treatment of inguinal hernia.[9] Since then, many studies around the world have shown that the use of 3D mesh in the treatment of inguinal hernia is safe and effective as well as causes low postoperative pain rate and low recurrence rate.[4,7,9]

For bilateral inguinal hernia, until now, there is still much debate about the choice of treatment strategy (simultaneous or unilateral repair), approaches (open surgery, TEP, or TAPP), or

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artificial mesh fixation and selection.[2,10–12] Gass et al. reviewed 6,505 unilateral inguinal hernia patients and 3,048 bilateral inguinal hernia patients treated with 3D TEP laparoscopic surgery and showed no difference significantly in terms of postoperative hospital stay and surgical referral rate, but reduced cost and number of treatment days compared to those with double surgeries.[2,12] Therefore, for bilateral inguinal hernia, TEP is a safe, viable treatment option that can be performed with results similar to that of unilateral herniation surgery.[2,12,13] This study aimed to evaluate the effectiveness of 3D artificial mesh in TEP surgery among Vietnamese adults with inguinal hernia.

Materials and Methods

Study Design and Patients

We performed a case series at Thanh Nhan Hospital, Hanoi, Vietnam. Eligible patients were people aged 18 years old or above; were diagnosed as bilateral inguinal hernia based on clinical and radiology examination (ultrasound, computed tomography); and were treated with TEP surgery to place an artificial 3D mesh outside the peritoneum. Other selection criteria included patients having complete medical records and patients who agreed and signed informed consent to participate in the study. Exclusion criteria included: (1) unilateral inguinal hernia, choking hernia, recurrence hernia; (2) patients with contraindications to TEP laparoscopic surgery for inguinal hernia; (3) patients with systemic or bilateral inguinal infection; (4) patients with pre-anesthesia health classification score, American Society of Anesthesiology (ASA) >III; (5) patients with blood clotting disorder; (6) patients who did not agree to participate in the study; and (7) patients with incomplete medical records. The study was approved by the Institutional Review Board (IRB) of Thanh Nhan Hospital (Code: 01/BVTN-HDDD).

Surgical Preparation

All patients admitted to the hospital were clinically examined and performed paraclinical tests, such as abdominal ultrasound, blood biochemistry, basic hematology, echocardiography (for patients over 60 years old), electrocardiogram, or chest X-ray. Then, we consulted specialists in cardiology, endocrinology, and anesthesia to assess the condition of the patient and treat any medical diseases (if any) before surgery. We explained to patients and their families about surgical techniques, complications in surgery, and possible postoperative complications. The patients had completely fasted before surgery for at least 6 hours and evacuated stool in enema twice before surgery by Fleet 133 mL. We then cleaned and marked the operating area. We then let the patients to urinate 30 minutes before surgery to ensure that the bladder was collapsed. No urinary catheter was placed before and during surgery. Cephalosporin generation II or III was used for intravenous 30 minutes before surgery and repeated 6 hours after surgery.

A laparoscopic surgery machine was prepared with full equipment including monitors, image transceivers from cameras, CO_2 pumps, and cold light sources. We used one trocar 10 mm and two trocars 5 mm, two optic endoscopies with 10 and 5 mm with diameter 30° or 0° viewing angle, laparoscopic grasper 5 mm (grasper), laparoscopic dissector 5 mm, electric hook (L-hook), needle-bearing pliers, endoscope, straw, clip Hemlock 5 mm, and other common open surgery tools. In this study, we used 3D meshes from the Bard-Davol (France) (trade name 3DMax™ Mesh) with polypropylene structure, size 8.5 × 13.7 cm or 10.8 × 16 cm.

Surgical Procedures

The surgical procedures were performed as per the following steps: First, all the patients underwent endotracheal anesthesia, lying on their back in Trendelenburg position, with their hands closed along the torso. The first trocar with a 10 mm diameter was placed at the navel. We dissected through peritoneum with fingers and pumped CO_2. We then placed the remaining two trocars with 5 mm diameter in three positions (Fig. 1).

Then, we performed dissection of the anterior peritoneal cavity, treated the right herniated sac (Figs 2A and B), and dissected the right anterior peritoneum, revealing the lateral umbilical folds, the right inferior epigastric artery, and lateral abdominal wall to the lower margin of the pelvic lumbar muscle. For a direct inguinal hernia, we pushed the herniated sac into the abdominal cavity. For indirect inguinal hernia, we performed constriction and cut at the neck of the herniated sac. Subsequently, we dissected the anterior peritoneum and treated the same left side herniation sac similarly to the opposite side.

We used a 3D MAX™ polypropylene mesh from Bard-Davol (France), with dimensions of 8.5 × 13.7 cm or 10.8 × 16 cm. After the peritoneal cavity on the two sides was dissected large enough, we inserted two artificial 3D meshes through the 10 mm trocar. We then placed the 3D Max mesh in the position that the outer corner of the mesh was placed on the outer pelvic artery; the top of the mesh was placed in the inguinal ligament; the directional marker (blue) was placed on the pubic tubule helping to align the grid in the correct position; the upper edge of the net was placed in front which was far enough to cover the entire myopectineal orifice (the distance from the edges of the mesh to myopectineal orifice was at least 2.5–3 cm). We did not actively fix the mesh (Fig. 3). We released CO_2 under the direct camera observation and closed the trocar holes.

Variables

In this study, we collected the following information from patients:

Patient Characteristics

Age, sex, history of abdominal surgery, body mass index (BMI), inguinal hernia classification by anatomical location (direct, indirect), and herniation diameter.

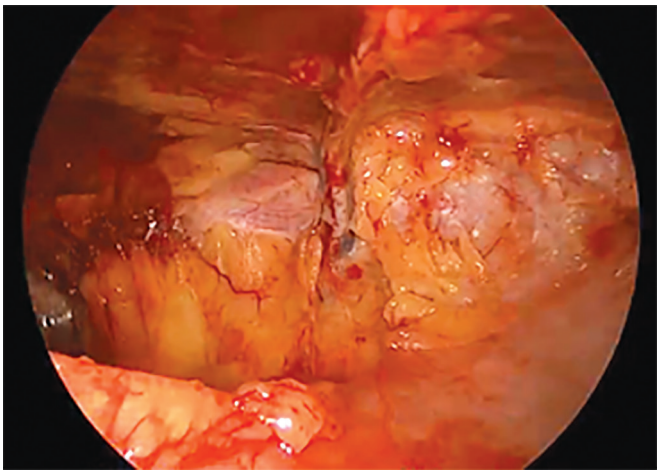
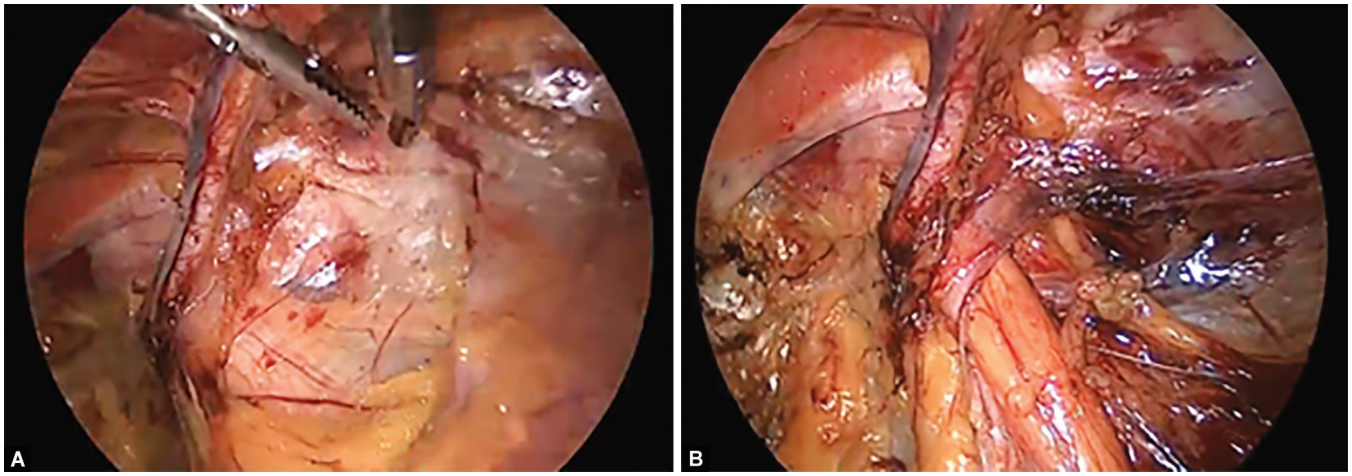
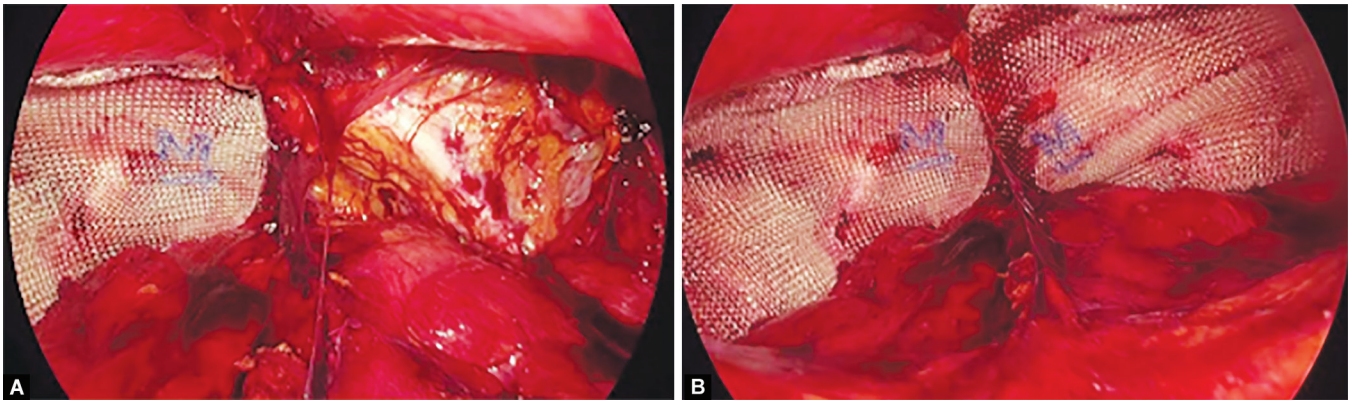


Fig. 1: Creation of anterior peritoneum and trocar placement



Figs 2A and B: Dissection of the (A) Anterior peritoneal cavity; and (B) Treatment of herniated sac



Figs 3A and B: Placing the artificial 3D mesh completely outside the peritoneum

Technical Characteristics

Mesh size, reinforced mesh fixation, complications, surgical switching (open surgery or TAPP surgery), mesh placement and fixation time, and total surgery time.

Short-term Results

Postoperative pain time, early complications, and hospital stays. For pain level, we asked the patients to report their pain by using a 10-point visual analog scale (VAS) 1, 2, and 3 days after surgery and classified patients into five levels: no pain (0), slight pain (1–2), mild pain (3–4), moderate pain (5–6), severe pain (7–8), and extreme pain (9–10). Short-term results were further classified into four levels:

- Good: No complications after surgery.
- Fair: Having complications but not requiring any interventions such as epidermal numbness in the thigh area, hematoma, and self-absorbed scrotal hematoma.
- Moderate: Having complications that require intervention but not re-surgery such as urinary retention, scrotal hematoma, or scrotal fluid accumulation that requires interventions, superficial wound infection to separate the incision.
- Poor: Have to perform re-surgery or die during hospitalization.

Long-term Results

Patients were scheduled to be re-examined at the time of 1 month, 6 months, and 1 year after surgery and the end of the study to examine complications (chronic pain, reticulum movement, reticulocytosis), recurrence rate, and causes (if any). Long-term results were classified into four levels:

- Good: No complications, no recurrence
- Fair: Self-absorbed scrotal fluid.
- Moderate: Chronic pain in the groin and testicular cord that responded to medical treatment within 1 year.
- Poor: Recurrence; chronic pain in the groin and testicular cord that lasted more than 1 year without response to medical treatment or required surgical intervention; testicular atrophy.

Statistical Analysis

Data were collected and analyzed using SPSS 20.0 software (IBM Corp., New York, USA). Descriptive statistics were performed by using mean ± standard deviation (X ± SD) for continuous variables, and frequency and percentage for categorical variables. Chi-squared and Fisher's exact tests were used to examine differences between left and right inguinal hernia. The *p*-value <0.05 was used to determine statistical significance.

Results

A total of 50 patients with bilateral inguinal hernia underwent TEP laparoscopic surgery using artificial 3D mesh. The mean age of the patients was 52.1 ± 17.2 years old. All patients were male. Four patients (8.0%) had a history of abdominal surgery, including two

patients having a laparoscopic appendectomy (4.0%), one patient having cholecystectomy (2.0%), and one patient having open appendectomy (2.0%). The average BMI was 21.3 ± 2.6 kg/m^2 (Table 1).

In terms of clinical and surgical technical features, Table 2 shows that 66.0% of patients had a direct inguinal hernia and 34.0% of patients had an indirect inguinal hernia. The diameter of the herniated hole was mainly from 1.5 to 3 cm with 84.0%. There were 82.0% of patients using small 3D mesh (8.5 × 13.7 cm) and one case required mesh fixation (2.0%). Seven patients (14.0%) had complications during surgery including peritoneal perforation (four patients—8.0%), bleeding during dissection, peritoneal perforation and bleeding, damage to the inferior epigastric artery, and vascular bundle lesions in the testicular cord. Neither of the patients had to use an additional trocar or switch surgery. The average mesh insertion and fixation time was 21.9 ± 4.3 minutes (range 15–40 minutes), and the average surgical time was 75.2 ± 11.0 minutes (range 60–100 minutes). No difference was found regarding clinical and surgical characteristics between right and left inguinal hernia ($p > 0.05$).

Table 1: Demographic and clinical characteristics

Characteristics	*Frequency*	*Percentage*
Age (years), mean (SD)	52.1 ± 17.2	
Gender		
Male	50	100.0%
Occupation		
Retired	20	40.0%
Self-employed	18	36.0%
Blue-collar worker	4	8.0%
Farmer	1	2.0%
Student	3	6.0%
Office staff	4	8.0%
Comorbidities, Yes	11	22.0%
Body mass categories		
Underweight	4	8.0%
Normal weight	41	82.0%
Overweight/obesity	5	10.0%
Time of onset (months)		
<12	43	86.0%
12–<36	4	8.0%
≥36	3	6.0%

Table 3 shows the degree of pain after surgery. The average postoperative pain time was 2.2 ± 1.5 days (1–15 days). Pain degree decreased gradually from day 1 to day 3. By day 3 after surgery, 94% had only slight pain, two patients (4.0%) had mild pain, and one patient (2.0%) had moderate pain. The difference in pain level from day 1 to day 3 after surgery was statistically significant with $p < 0.05$.

Table 4 depicts that early postoperative complications were observed in five patients (10.0%), including hematoma in the groin–scrotal region (4.0%), wound infection (2.0%), numbness in the outer thigh (2.0%), and urinary retention and numbness in the outer thighs (2.0%).

All patients were followed for a mean of 21.4 ± 11.8 months (minimum 1 month, maximum 40 months). At 1 month postoperative, there was one patient with chronic pain in the groin (2.1%). After 6, 12, and 24 months, no recurrence was recorded (Table 5).

Discussion

In this study, we performed the TEP laparoscopic surgery using 3D meshes to treat a bilateral inguinal hernia. In most cases, we used small 3DMax meshes (8.5 × 13.7 cm) for each side of the herniation.

Table 2: Clinical and surgical characteristics

	Right inguinal hernia (n = 50)		*Left inguinal hernia (n = 50)*		*Total (n = 100)*		
Characteristics	*n*	*%*	*n*	*%*	*n*	*%*	*p value*
Inguinal hernia classification							
Direct	35	70.0%	31	62.0%	66	66.0%	0.45
Indirect	15	30.0%	19	38.0%	34	34.0%	
Abdominal organ herniation							
None	48	96.0%	45	90.0%	93	93.0%	0.42
Small intestine	1	2.0%	2	4.0%	3	3.0%	
Omentum	1	2.0%	3	6.0%	4	4.0%	
Diameter of herniated hole							
<1.5 cm	8	16.0%	4	8.0%	12	12.0%	0.40
1.5–<3 cm	41	82.0%	43	86.0%	84	84.0%	
≥3 cm	1	2.0%	3	6.0%	4	4.0%	
Technique for dissection and treatment of herniated sac							
Push herniated sac into abdomen	35	70.0%	31	62.0%	66	66.0%	0.45
Constrict and cut herniated sac	15	30.0%	19	38.0%	34	34.0%	
Artificial 3D mesh used							
Small mesh 8.5 × 13.7 cm	41	82.0%	41	82.0%	82	82.0%	1.00
Large mesh 10.8 × 16.0 cm	9	18.0%	9	18.0%	18	18.0%	
Mesh fixation							
No	49	98.0%	50	100.0%	99	99.0%	1.00
Yes	1	2.0%	0	0.0%	1	1.0%	

Table 3: Pain degree after surgery

	Pain degree				
	Slight pain	*Mild pain*	*Moderate pain*	*Severe pain*	*VAS score*
After surgery	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*Mean (SD)*
1st day (T_1)	0 (0.0%)	5 (10.0%)	42 (84.0%)	3 (6.0%)	5.1 ± 0.7
2nd day (T_2)	6 (12.0%)	42 (84.0%)	2 (4.0%)	0 (0.0%)	3.0 ± 0.8
3rd day (T_3)	47 (94.0%)	2 (4.0%)	1 (2.0%)	0 (0.0%)	0.9 ± 0.7
p value (T_1–$T_{2)}$			<0.01		<0.01
p value (T_2–$T_{3)}$			<0.01		<0.01

Table 4: Early postoperative complications

Early postoperative Complications	*Frequency (n = 50)*	*Percentage (%)*
Hematoma in groin-scrotal region	2	4.0%
Wound infection	1	2.0%
Numbness in the outer thighs	1	2.0%
Urinary retention and numbness in the outer thighs	1	2.0%

Table 5: Short- and long-term surgical outcomes

	After surgery (n = 50)		*After 1 month (n = 47)*		*After 6 months (n = 39)*		*After 12 months (n = 30)*		*After 24 months (n = 17)*	
Outcome	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Good	44	88.0	46	97.9	39	100.0	30	100.0	17	100.0
Fair	6	10.0	1	1.8	0	0.0	0	0.0	0	0.0
Moderate	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Poor	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

For patients with large herniated hole, weak inguinal muscles or in elderly patients with comorbidities that frequently increased abdominal pressure, we actively used a large mesh (10.8 × 16.0 cm) for each side of the herniation to cover myopectineal orifice and that the upper and lower margins of the mesh were at least 2.5–3 cm from the herniation hole. One of the advantages of the 3D mesh is the flexible structure and shape with the anatomical structure of the groin area. Thus, when placing the 3D mesh into the peritoneal cavity, the 3D mesh automatically attaches itself to the posterior wall structures of the groin, thereby covering the entire myopectineal orifice. Therefore, in most of our cases, we did not need to fix the mesh. Only one case had to sew the mesh tension through endoscopy with Vicyl 3/0 sutures because the mesh was folded when placed in the peritoneal cavity.

In literature, whether mesh fixation (with protacks or sutures) is necessary or not is controversial. While some authors considered mesh fixation to be necessary to reduce the risk of mesh slipping, which helped to reduce recurrence rates, other authors argued that fixing was not necessary as there was no difference in the recurrence rate.[14] In addition, mesh fixation might increase the risk of nerve damage caused by the use of protack and increase surgical costs.[14] In a study of Acar et al. on 178 patients (98 patients had right inguinal hernias, 72 patients had left inguinal hernias, and 8 patients had bilateral inguinal hernias), patients were treated with TEP laparoscopic surgery using 3D mesh (Bard 3D Max) with an average follow-up period of 45 months. Results showed that there was no difference in the rates of complications (both short- and long-term) between the two groups, with and without mesh fixation. The author suggested that the mesh fixation in TEP surgery with a 3D mesh did not increase the complication and recurrence rates compared with the group without mesh fixation.[14] According to Krishna et al., the two-point protack fixation can be performed in elderly patients with large herniation, weak abdominal wall muscle, and based on the operator's decision.[6]

All of our patients were successfully treated with TEP laparoscopic surgery using 3D mesh, with no additional trocar or switching to surgery. The percentage of switching surgical methods when performing TEP laparoscopic surgery to treat bilateral inguinal hernia in Gass et al.'s study was 1.1%.[2] Krishna's study had a total of 81 patients who had to change the surgical method (TAPP or open surgery).[6] The average total surgical time in this study was 75.2 ± 11.0 minutes (range 60–100 minutes) and the average mesh insertion and fixation time was 21.9 ± 4.3 minutes. The time of 3D mesh insertion surgery for bilateral inguinal hernia treatment in Krishna's study was 77.9 ± 26.2[6] and 60.3 minutes in Kockerling et al.'s study.[15] Our study had nice cases of complications during surgery (14%), which was higher than some previous studies. According to Gass et al., the complications rate in TEP laparoscopic surgery for bilateral inguinal hernia was 3.1%.[2] The rate in the study of Kockerling et al. was 1.45%.[15] Krishna et al. showed that 4.3% of patients had complications in surgery, such as damage to the lower epigastric artery during peritoneal cavity surgery.[6]

Most authors emphasize the advantages of using non-fixed 3D mesh in TEP laparoscopic surgery for bilateral inguinal hernia, thereby reducing the risk of nerve damage and relieving pain

after surgery. The study of Ayyaz et al. showed that for the group of patients with mesh fixation, the average pain level was 4.7 ± 0.68, which was significantly higher than the group of patients without mesh fixation at 4.1 ± 0.86 with $p < 0.001$.[16] In our study, with most cases without mesh fixation, the average postoperative pain time of 2.2 ± 1.5 days was observed, which was similar to other studies.

Early complications after TEP laparoscopic surgery might include urinary retention, epididymitis, wound infection, hematoma, fluid accumulation, and chronic pain in the groin–scrotum.[14,17] According to Gass, patients undergoing bilateral TEP endoscopy had an early complication rate of 3.2%.[2] This rate in the study of Kockerling was 1.82%.[15] In our study, early complications were found in 10.0% of patients.

All patients were followed for a mean of 21.4 ± 11.8 months (minimum 1 month, maximum 40 months). One patient (2.1%) was observed with chronic pain in the groin area, who also had prolonged pain after surgery, possibly due to the process of dissection or mesh fixation in the surgery, causing damage to the nerve branch. The rate of chronic pain after inguinal hernia ranged from 1 to 63%.[18] For this patient, at the time of follow-up after 1 and 3 months, the pain reduced gradually but still made the patient feel uncomfortable. The patient was treated with pain relievers, anti-inflammatory drugs, and the pain gradually decreased after 5 months.

Conclusion

TEP laparoscopic surgery using 3D mesh is a safe, feasible, and effective method in bilateral inguinal hernia in adults, with low rates of complications and recurrences. However, with the limited sample size and follow-up time of the study, it is necessary to perform further studies with a larger sample size and longer follow-up time to evaluate the effectiveness of this method.

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