Improved outcomes and quality of life following laparoscopic inguinal hernia surgery

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Abstract

Introduction: The application of 3D technology in laparoscopic surgery is increasingly prevalent. While other medical specialties have shown benefits of 3D over traditional 2D laparoscopic surgery, its use in inguinal hernia repair remains less well-documented.

Patients and Methods: This prospective, descriptive study included 60 patients diagnosed with inguinal hernia, who underwent 3D laparoscopic surgery at Hue Central Hospital and its Branch 2, from October 2022 to May 2024. Patients were divided into two groups: 30 patients underwent the Transabdominal Preperitoneal (TAPP) approach, including emergency cases, and 30 patients the Totally Extraperitoneal (TEP) approach.

Results: The average operative times for the TAPP and TEP technique were 51.4 ± 8.16 minutes and 48.83 ± 8.57 minutes, respectively. There were no severe postoperative complications, and all undesirable symptoms responded well to medical treatment without the need for re-intervention. Patients experienced a short recovery period and returned to normal daily activities quickly. The average CCS score of patients at 2 weeks, 1 month and 3 months were 1.38 ± 2.7, 0.6 ± 0.62, and 0.13 ± 0.34, respectively, classified as very good outcomes.

Conclusions: The 3D technology in laparoscopic surgery for inguinal hernia treatment yields positive results with numerous advantages in improving patients' quality of life after surgery.

Keywords: 3d technology, hernia, quality of life

Introduction

Although open technique for abdominal wall reconstruction using mesh and non-tension repair remains the standard procedure in the treatment of inguinal hernia, laparoscopic surgery, when performed by a skilled surgeon, has demonstrated its advantages over open surgery. [1], [2]. An increasing number of studies have highlighted the advantages of laparoscopic surgery in the treatment of inguinal hernia compared to traditional open surgery methods [3], [4]. The advantages of laparoscopic surgery include reduced postoperative pain, decreased use of postoperative opioid pain medications, and earlier return to daily activities. However, laparoscopic surgery for inguinal hernia treatment also has some limitations: it increases surgical costs, has a longer operation time compared to open surgery, requires a surgeon with advanced skills, involves a longer learning curve, and has higher rates of recurrence and complications in the group of less experienced surgeons.

3D technology has been applied more widely in laparoscopic surgery. Currently, several clinical trials have been conducted to investigate the advantages of 3D laparoscopic surgery compared to conventional laparoscopic procedures. In various surgical specialties, there have been studies highlighting the benefits of 3D laparoscopic surgery over conventional 2D surgery. However, in the field of inguinal hernia treatment, research on the application of 3D laparoscopic surgery remains limited [5].

In addition, 3D technology has also been applied to the production of abdominal wall reconstructive materials. This mesh is modeled according to the specific curvatures of the structures forming the posterior aspect of the inguinal canal, which facilitates easier mesh placement, prevents folding, and reduces the risk of mesh displacement. Numerous studies have demonstrated the effectiveness of 3D mesh compared to 2D mesh in laparoscopic surgery for inguinal hernia repair, resulting in lower recurrence rates, fewer complications, shorter hospital stays, and reduced postoperative pain [6–8]

Patients and methods

Study population

The study was conducted on 60 patients diagnosed with inguinal hernia who underwent laparoscopic surgery using 3D technology at Hue Central Hospital and Hue Central Hospital Branch 2 from October 2022 to May 2024. The patients were divided into two groups:

30 patients underwent surgery using the TAPP technique (including emergency cases).

30 patients underwent surgery using the TEP technique.

All patients participating in the study were thoroughly informed about the surgical procedures as well as the potential complications and adverse events that could occur during and after the surgery.

Inclusion criteria

Patients aged 18 years or older.

Indicated for laparoscopic inguinal hernia repair using 3D mesh

Patients with strangulated inguinal hernia were selected for the TAPP procedure.

ASA classification: I, II, III.

Exclusion criteria

Strangulated inguinal hernia presenting more than 6 hours after onset or accompanied by signs of peritonitis.

Severe underlying medical conditions such as unstable Graves' disease, severe diabetes with complications, unstable angina, renal failure, and advanced pulmonary tuberculosis.

Increased intra-abdominal pressure due to cirrhotic ascites or ongoing peritoneal dialysis.

Study design

A prospective, descriptive study.

Surgical procedures

Instruments

3D endoscope system 1S from Karl Storz with angled cameras at 30^{O} and 0^{O}.

The endoscope system is positioned on the same side as the hernia.

The distance from the screen to the surgeon's standing position should be approximately 1 to 1.5 meters to benefit from the 3D effect of the display.

The 3D mesh is modeled according to the anatomy of the inguinal region.

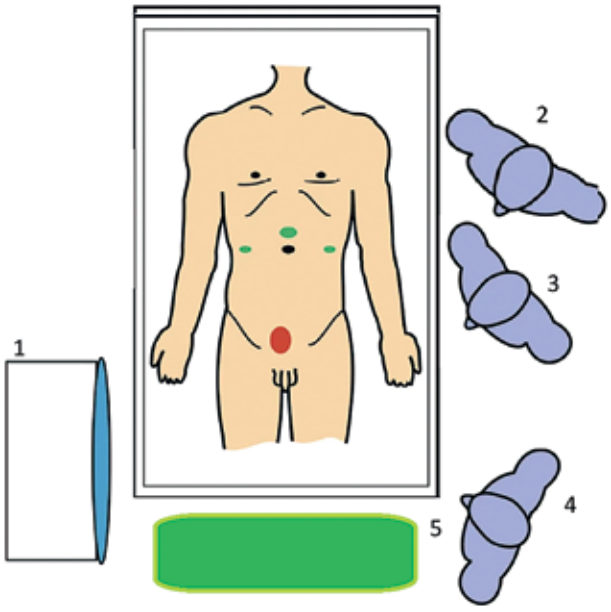

Figure 1. Positioning of the 3D laparoscopic surgical system and the operating team

(illustrated by the author)

Surgical procedures

Except for cases of strangulated hernia, patients were randomly assigned to either the TEP or TAPP groups. All surgical procedures were performed according to the standard techniques for TEP and TAPP approaches.

For direct hernia sacs, due to the lack of involvement with the spermatic cord and the vas deferens, complete dissection of the hernia sac is usually straightforward. For indirect hernia sacs, it is essential to dissect the spermatic cord until the ivory-colored hernia sac is visible. At this stage, the enhanced 3D visualization allows for accurate identification and safe grasping of the hernia sac without causing injury to the spermatic cord or vas deferens. With 3D imaging, the dissection of the hernia sac is significantly easier due to the precision of movements; the depth perception helps avoid incorrect maneuvers or excessive force that could lead to bleeding or injury to the spermatic cord and vas deferens.

After adequate dissecting of the pre-peritoneal space, the anatomically contoured 3D mesh is placed into the pre-peritoneal space through a 10mm trocar. The broad flat portion of the mesh covers the hernia defect, ensuring full coverage of the hernia orifice, with the central tendon running along the bend of the iliopsoas muscle, and the inner-lower edge of the mesh extending down to cover the obturator foramen. We typically do not fix the mesh in cases where the neck of the hernia sac measures less than 3 cm.

Evaluation of Short-Term Outcomes

All immediate complications as well as pain levels, time to return of bowel movement, and duration of postoperative hospitalization was recorded.

Patients were followed up at 2 weeks, 1 month, and 3 months post-surgery through: outpatient visits and telephone consultations.

During the 2-week follow-up, we recorded the duration for patients to return to normal activities, categorized into the following intervals: 1-7 days, 8-14 days, 15-21 days, and after 21 days. Quality of life was assessed using the Carolinas Comfort Scale (CCS). Postoperative complications were monitored, including groin and scrotal pain, sensory disturbances in the groin and scrotal region, abdominal hematoma, seroma in the groin and scrotal area, and hernia recurrence.

At the 1-month and 3-month follow-up visits, we evaluated postoperative complications and assessed quality of life using the Carolinas Comfort Scale (CCS). It is a validated tool for assessing patients who have undergone inguinal hernia repair with mesh. It evaluates three main aspects: postoperative pain, sensation of the mesh, and limitations in mobility. Patients were interviewed and assessed on a scale from 0 to 5:

0: Asymptomatic;
1: Mild symptoms, not bothersome;
2: Mild symptoms, bothersome;
3: Moderate or frequent symptoms;
4: Severe symptoms;
5: Significant impact on daily activities

Results

Preoperative characteristics

The mean age of the patients was 58.6 ± 17.9 years (range: 21-93 years). The age group from 60 to <80 years was the most prevalent, accounting for 26 cases. The majority of patients had a BMI ranging from 18.5 to 23. 4 patients were classified as overweight, with a BMI above 25. 5 cases exhibited signs of strangulation, accounting for 8.3% of the study population.

There were 7 patients with a history of previous abdominal surgery:

In the TAPP group: 1 female patient with a history of surgery for uterine fibroids and ovarian cysts, 2 cases with a history of laparoscopic cholecystectomy, 1 case with a history of laparoscopic appendectomy, 2 cases with a history of bladder stone drainage and surgery.

In the TEP group: one patient had a history of surgery for contralateral inguinal hernia.

On clinical examinations, 13.3% of patients presented with inguinal-scrotal hernias. There were 14 cases of irreducible hernias, including 5 patients with strangulated hernias and 9 patients with incarcerated hernias. There were 32 cases of right-sided hernias, accounting for 53.3%. Regarding preoperative risk assessment, the majority of patients were classified as ASA II, comprising 49 individuals (81.7%).

Operative characteristics

The average surgical time was 50.15 ± 8.4 minutes (TAPP group - 51.4 ± 8.16 minutes, TEP group - 48.83 ± 8.57 minutes).There was no statistically significant difference in operative time between the two procedures.

Similarly there was no statistically significant difference in the time for creating the pre-peritoneal space between the TAPP (9,6 ± 1,77 minutes) and TEP (9,6 ± 1,42 minutes) groups. The average time for closing the pre-peritoneal space in the TAPP procedure was 5.37 ± 0.76 minutes.

There were no cases with the hernia neck diameter greater than 3 cm, including those with strangulated hernias. There was no statistically significant difference in surgical time between the two groups with different hernia neck diameters (<1.5 vs 1.5-3cm).

Indirect hernias represented the majority of cases, accounting for 86.7%. The majority of patients were graded as Nyhus II, accounting for 71.7% of cases and 15% of cases were classified as IIIa and 13.3% as IIIb.

No intraoperative complications were observed. Specifically, there were no vascular injuries, nerve injuries, or any other organ damage recorded.

Postoperative characteristics

Early postoperative complications

All patients were encouraged to engage in early functional rehabilitation after surgery, and there were no early complications such as dysuria, urinary tract infections, pulmonary embolism, or deep venous thrombosis.

Postoperative pain

Table 1. Assessment of Postoperative Pain in TAPP and TEP Group

VAS	Procedures	Mean	
24h	TAPP	4,73 ± 1,08	p=0,02
	TEP	4,13 ± 0,73	
48h	TAPP	3,1 ± 0,66	p=0,1
	TEP	2,4 ± 0,72	
72h	TAPP	1,8 ± 0,48	p=0.35
	TEP	1,77 ± 0,62	

At 24 hours postoperatively the TAPP group reported statistically higher VAS pain scores compared to the TEP group.

There was no statistically significant difference in VAS pain scores at 48 hours and 72 hours postoperatively between the TAPP and TEP groups.

Time to first bowel movement

71.7% of patients experienced their bowel movement within the first 12 hours after surgery.

The remaining 28.3% of patients had bowel movement within 24 hours after surgery.

Postoperative hospital stays

66.7% were able to return to normal personal activities within 12 hours after surgery.

More than half of patients (58.3%) were able to return to normal daily activities within 7 days.

The average hospital stay after surgery was 3.81 ± 1.4 days (TAPP 4.16 ± 1.32 days, TEP 3.23 ± 1.5 days). The difference in hospital stay between the two groups was not statistically significant, with p = 0.365.

Postoperative complications

Table 2. Postoperative complications

Complications	02 weeks	01 month	03 months
Inguinoscrotal pain	10(16.7%)	3 (5%)	0
Inguinoscrotal collections	4 (6.7%)	1 (1.7%)	0
Inguinoscrotal paresthesia	6 (10%)	2(3.3%)	0
No complications	44 (73.3%)	55 (91.7%)	60 (100%)

One month after surgery, only 5% of patients reported remaining groin and scrotal pain, and 1.7% (1/60) of patients had a small seroma in the groin and scrotal region with no signs of infection and did not require re-intervention.

At the 3-month follow-up, no postoperative complications were recorded.

Assessment of Quality of Life Using the Carolina Comfort Scale

Table 3. Assessment of Quality of Life Using the Carolina Comfort Scale

		02 weeks	01 month	03 months
1. Laying down	Sensation of mesh	0	0	0
	Pain	0	0	0
2. Bending over	Sensation of mesh	4	0	0
	Pain	0	0	0
	Movement limitations	0	0	0
3. Sitting	Sensation of mesh	4	1	0
	Pain	1	0	0
	Movement limitations	0	0	0
4. ADL	Sensation of mesh	3	1	0
	Pain	4	0	0
	Movement limitations	0	0	0
5. CB	Sensation of mesh	5	3	0
	Pain	4	0	0
	Movement limitations	0	0	0
6. Walking	Sensation of mesh	7	4	0
	Pain	4	1	0
	Movement limitations	0	0	0
7. Stairs	Sensation of mesh	7	9	0
	Pain	8	8	0
	Movement limitations	0	0	0
8. Exercise	Sensation of mesh	7	10	6
	Pain	10	3	0
	Movement limitations	0	0	0
9. Total	Sensation of mesh	1,38 ± 2,7	0,6 ± 0,62	0,13 ± 0,34
	Pain	0,68 ± 1,57	0,3 ± 0,47	0,13 ± 0,34
	Movement limitations	0,7 ± 1,8	03 ± 0,15	0

Symptoms affecting patients quality of life improved gradually. There were no patients having restrictions in mobility. The mean CCS score was classified as "very good". Quality of life scores showed significant improvement at both the 1-month and 3-month follow-up visits. By the 3-month follow-up, no patients reported any sensation of pain related to the hernia repair.

Discussion

When compared with other studies, our operative time seems to be significantly shorter.

Specifically, the operative time for the TAPP technique in our study was generally less than those reported in most previous publications. For instance, a study conducted within the same unit, by author Nguyễn Thanh Xuân in 2014 also noted a surgical duration of approximately 57 minutes. During the TAPP procedure, the time for creating and closing the peritoneal space is often longer and requires more maneuvers. This is particularly true if the peritoneum is closed using sutures. This maneuver is especially challenging due to the unfavorable suturing position and the length of the suture line. Our improved operative times are likely attributable to the advantages of 3D technology, which provides surgeons with enhanced precision and greater comfort during the procedure. Furthermore, the use of 3D mesh technology also helps shorten the time required for mesh placement.

There are still not many randomized controlled studies comparing the effectiveness of 3D versus 2D laparoscopic surgery in the treatment of inguinal hernias. In two studies comparing the effectiveness of 3D laparoscopic surgery for inguinal hernias by Patrzyk and Koppatz published in 2018 and 2020 respectively, although there was no statistical significance, the results still indicated advantages of 3D laparoscopic surgery with shorter operating times, lower complication rates, and less postoperative pain. In the Asia region, a recent publication in 2021 by AY Kim also yielded similar results, encouraging the use of 3D laparoscopic surgery.

Another important issue to address in the surgical treatment of inguinal hernia is the use of synthetic mesh. Numerous studies and improvements have been made regarding the material and design of synthetic mesh to reduce recurrence rates, minimize migration, and enhance the fixation of the mesh in open surgery. In laparoscopic surgery for inguinal hernia reapair, the altered anatomical perspective and the creation of a much broader space compared to open surgery, present challenges in ensuring proper mesh fixation and adequate coverage of the hernia defect. Another application of 3D technology that has been integrated into the treatment of inguinal hernias is the 3D mesh. This mesh is designed to accurately mimic the contours of the anatomical structures of the posterior abdominal wall, facilitating easier placement without folding or displacement [16].

Numerous studies have demonstrated the efficacy of 3D mesh compared to 2D mesh in laparoscopic surgery for inguinal hernias, showing lower recurrence rates, fewer complications, shorter hospital stays, and reduced postoperative pain [16–18]. A 2017 study by DTD Phan also yielded similar results. In the present study, we utilized a newer generation of mesh. Thanks to 3D technology that simulates detailed anatomical structures associated with the posterior abdominal wall, the anatomical mesh currently closely mimics the curves of the relevant anatomical structures in the posterior abdominal wall. As a result, mesh placement is facilitated, it fits firmly against anatomical structures and the reinforcement of the abdominal wall is significantly enhanced.

In our study, no intraoperative complications were observed, and there were no vascular injuries, nerve injuries, or damage to any other organs within the abdominal cavity. With 3D technology, the anatomical structures are visualized similarly to binocular vision, providing excellent depth perception. Our surgical team was able to accurately gauge the depth of the surgical field, ensuring that dissection remained within the intended boundaries and thereby minimizing the risk of complications.

Postoperative pain gradually decreased over time, indicating good recovery among patients after surgery. This is consistent with many other studies on laparoscopic surgery for inguinal hernia repair (TAPP and TEP), in which pain levels typically show a significant reduction 72 hours postoperatively [19].

Postoperative pain is also influenced by technical factors. Some studies suggest that fixing the mesh or closing the peritoneum with staples may increase the rate and severity of postoperative pain. There are still some debates regarding whether TAPP or TEP procedures result in less pain [20]. However, in our study, we did not find any significant difference between these two methods when specifically examining postoperative pain characteristics.

The results of our study regarding the time to bowel movement and the time to return to normal activities following inguinal hernia surgery using laparoscopic techniques with 3D technology demonstrate rapid and effective recovery. In our study, 71.7% of patients had bowel movement within 12 hours after surgery, and 28.3% within 12-24 hours postoperatively. This is a very positive outcome and surpasses many previous studies. For example, in the study by Yang et al. (2016), the average time to first bowel movement was reported to be between 18 and 24 hours, which is longer than what we observed in our patient population [21].

In our study, the average CCS score was 1.38 ± 2.7 at two weeks and 0.6 ± 0.62 at one month postoperatively, which is classified as very good. With the emergence of mesh, the Carolina Comfort Scale™ (CCS™) was developed at the Carolina Medical Center in the United States to assess the quality of life of patients following abdominal wall hernia repair using mesh. This assessment scale consists of a set of 23 questions accompanied by scores ranging from 0 to 5, focusing on three aspects of postoperative quality of life related to the mesh: mesh sensation, pain, and activity. The score ranges from a minimum of 0 to a maximum of 115.

Heniford et al. (2008) compared the general quality of life assessment tool (SF-36) with the hernia-specific assessment tool (CCS™) for hernia surgery involving mesh, and found that the CCS™ provides a superior evaluation of quality of life and patient satisfaction following hernia repair using mesh. By 2016, the authors further evaluated the role of the CCS in hernia surgery in a study involving 3.788 patients and concluded that the Carolina Comfort Scale is valuable, sensitive, and effective. The authors suggested that the CCS should be utilized as a specialized tool for this surgical field.

In a study conducted by Roy P. (2016), which evaluated quality of life following laparoscopic inguinal hernia repair with mesh in 188 patients between April 2010 and November 2013, a favorable response rate of 55.3% was reported. The authors argued that the CCS helps to objectively measure pain levels, mesh sensation, and activity limitations in patients post-surgery, thereby achieving the aims of a quality of life assessment tool while remaining concise and easy to understand [22].

Conclusions

The 3D technology in laparoscopic surgery for inguinal hernia treatment yields positive results with numerous advantages in improving patients' quality of life after surgery.

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