Left Side Approach in Laparoscopic Transabdominal Preperitoneal Inguinal Herniorrhaphy is Feasible for Any Type of Inguinal Hernia

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Purpose: The transabdominal preperitoneal (TAPP) method has been as popular as the totally extraperitoneal (TEP) approach for laparoscopic inguinal hernia repair. The preferred approach to TAPP has been inserting two operative trocars in the contralateral midclavicular line, respectively. This can be uncomfortable for surgeons with a shorter reach. For this reason, we developed an only left side TAPP approach(L-TAPP) through an ipsilateral trocar position on the patient's left side regardless location of inguinal hernia.

Methods: We included patients who underwent laparoscopic inguinal hernia repair by a single surgeon between April 2016 and August 2017. The patients were divided into TEP and L-TAPP groups and compared regarding the clinical characteristics and surgical outcomes.

Results: There were no differences in clinicopathologic characteristics between the 33 patients in L-TAPP group and 11 patients in TEP group. The mean operative time for the L-TAPP group was 71.4 ± 20.5 min, and 75.8 ± 17.4 min for the TEP group ($p=0.522$). The mean length of hospital stay for the L-TAPP group was 2.5 ± 0.7 days, and 2.5 ± 0.5 days ($p=0.797$) for the TEP group. There was one postoperative scrotal hematoma and cord edema in the TEP group and no complications in the L-TAPP group ($p=0.219$). There were no early recurrences in both groups.

Conclusion: In conclusion, L-TAPP is a feasible and safe procedure compared with TEP. In addition, this procedure might be adopted with more comfort for surgeons who have short reaches.

Keywords: Laparoscopy, Abdominal wall, Inguinal hernia

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INTRODUCTION

Among the abdominal wall hernias, an inguinal hernia is the most common type requiring surgery. Historically, open hernia repair has been progressively replaced by laparoscopic hernia repair, due to evidence for the superiority of tension-free repair.¹ Laparoscopic herniorrhaphy is now a popular method, and is performed by totally extraperitoneal (TEP) or transabdominal preperitoneal (TAPP) methods.² Although

the optimal approach remains a subject of discussion, there is still insufficient evidence to prove the superiority of one or the other.³ There are pros and cons to both, but the advantage of TAPP is technical simplicity and a better anatomical view, making it preferable in the patient with prior abdominal surgery or a complicated incarcerated hernia.⁴

The preferred approach in TAPP is to insert an optical trocar in the umbilicus and the other two operative trocars in the contralateral midclavicular line, respectively.⁵ This is probably

Fig. 1. (A) First 5-mm operative trocar was placed at the left midaxillary line, 4 cm upward from the anterior superior iliac spine. (B, C) Second 5-mm operative trocar was placed in 4 ~ 5 cm in a cephalic direction from the previous operative trocar and 4 cm medially from midaxillary line. (D) Operation is performed at the patients' left side regardless of hernia location.

because of the need for access to both sides and a surgical dissection area from the symphysis pubis to the anterior superior iliac spine. However, this can be unergonomic and uncomfortable for some surgeons, especially those with a shorter reach. In this situation, it would be preferable to operate with two ipsilateral trocars. For this reason, we introduce the only left side approach TAPP (L-TAPP) procedure, which approach through an ipsilateral trocar position on the patient's left side, regardless of the side of the hernia, and discuss the initial results.

The goal of this study is not to demonstrate the superiority of only left side approach TAPP compared to conventional TAPP, but to confirm the possibility of L-TAPP as a new surgical technique to maximize the convenience of surgeon. To do this, we compare L-TAPP with TEP which is the most common surgical method now.

MATERIALS AND METHODS

We included patients who underwent laparoscopic inguinal hernia repair by a single surgeon between April 2016 and August 2017 in a single institution. The patients were divided into TEP and L-TAPP groups and compared with respect to clinical characteristics and surgical outcomes.

The patient characteristics included age, sex, body mass index (BMI), type and location of hernia, and recurrent hernia status. The operative time, postoperative complications, and early recurrence were documented. In addition, surgical outcomes were compared according to the location of hernia among L-TAPP group. This study was approved by institutional review board (IRB number: PC17REDI0055).

Operative procedure

With the patient supine, a 10-mm optical trocar was placed

Fig. 2. (A) The peritoneum was incised from anterior superior iliac spine level to median ligament. (B) Preperitoneal space was dissected with sharp and blunt dissection using electrocautery device with angled tip. (C) Preperitoneal dissection was done to expose pubic bone and inferior epigastric vessel. (D, E) Hernia sac was dissected, and vas deference and spermatic vessels were dissected from hernia sac. (F, G) Dissected hernia sac was ligated with endo-loop. (H) Measuring the mesh size with 5 cm ruler intra-corporeally.

in the umbilicus; a 5-mm operative trocar was placed at the left midaxillary line, 4 cm upward from the anterior superior iliac spine (ASIS) (Fig. 1A), and a 5-mm operative trocar was placed in 4~5 cm in a cephalic direction from the previous operative trocar and 4cm medially from midaxillary line (Fig. 1B & C). This trocar placement is most optimal position to avoid impingement between right and left-hand instruments (Fig. 1D).

The L-TAPP procedure commenced with the patient in Trendelenburg position. All the L-TAPP were performed at the patients' left side regardless of hernia type and location. Due to the angle between the operative trocars, there are no difficulties in repairing a right inguinal hernia. Although there was slight difficulty with a left inguinal hernia due to the angle between the trocars, careful crossing of the grasper will

permit completion of the surgical procedure without difficulty.

The operative procedure is as follows. First, the peritoneum was incised (Fig. 2A) in an up to down direction with repeated sharp and blunt dissection using electrocautery device with angled tip (Fig. 2B). While peritoneal dissection is performed, we could find inferior epigastric vessels, cooper ligament and external iliac vessels (Fig. 2C). The dissection was done until the symphysis pubis and pubic bone on the medial side, and the ASIS on the lateral side, were adequately exposed. After identifying the hernia sac and cord structure entering the internal ring (Fig. 2D), the hernia sac was isolated from the spermatic cord and vessels (Fig. 2E). And the hernia sac was resected and ligated using an endo-loop when sac is perforated (Fig. 2F & G).

After measuring the defect size using a ruler (Fig. 2H),

Fig. 3. (A) Designing mesh according to measured size. (B) Mesh fixation with tackers. (C) Peritoneum closure with unidirectional braided suture material. (D) Final view of operation site.

polypropylene mesh was designed (Fig. 3A) and inserted through the optical trocar. After placing the mesh to adequately cover the internal ring and Hesselbach's triangle, the medial side was fixed to Cooper's ligament, and the lateral side was fixed near the ASIS using a tackers (Fig. 3B). Then, the peritoneum was closed using V-loc suture (Medtronic, Minneapolis, MN, USA) (Fig. 3C & D).

Statistical analysis

Statistical analyses were performed with SPSS 18.0 (IBM, Chicago, IL). The collected data were expressed as median, frequency, percentage, and mean $\pm$ standard deviation (SD). The chi-square test or Fisher's exact test, and Student's t-test were used for comparisons. Statistical significance was set at $p < 0.05$.

RESULTS

Of 44 patients who underwent laparoscopic herniorrhaphy, 33 underwent TAPP and 11 underwent TEP (Table 1). There were 31 males and 2 females in the TAPP group and 10 males and 1 female in the TEP group ($p = 0.730$). Patient ages ranged from 18 to 88, with a mean age of 67.5 in the TAPP group and 58.1 in the TEP group ($p = 0.068$). The mean BMI was similar between the two groups (TAPP group vs. TEP group = 23.7 ± 3.4 vs. 23.6 ± 2.7 , $p = 0.959$). Ten patients had prior abdominal surgery in TAPP group, six patients in TEP group and five patients had a prior herniorrhaphy (recurrent hernia) in the

TAPP group alone ($p = 0.170$). Five in the TAPP group and one in the TEP group had a bilateral hernia.

There were no differences in surgical outcomes between the two groups (Table 1). Mean operative time for TAPP was 71.4 ± 20.5 min, and 75.8 ± 17.4 min for TEP ($p = 0.522$). However, the mean operative time for a unilateral hernia repair only was 66.9 ± 17.9 min for TAPP and 72.9 ± 15.2 min for TEP ($p = 0.349$). The mean length of hospital stay for the TAPP group was 2.5 ± 0.7 days and 2.5 ± 0.5 days for the TEP group ($p = 0.797$). And the mean length of hospital stay for a unilateral hernia in the TAPP group was 2.5 ± 0.6 days and 2.5 ± 0.5 days for the TEP group ($p = 0.860$).

In the case of subgroup analysis divided into three groups according to the direction of the hernia in L-TAPP group, there was no significant difference about surgical outcome except for operation time ($p = 0.007$) (Table 2). However, it was meaningful only in the comparison of the left side and both sides ($p = 0.003$), right side and both side ($p = 0.004$), and there was no statistical meaning in the comparison of the left side and the right side ($p = 0.881$).

There was one postoperative scrotal hematoma and cord edema in the TEP group, but this was not statistically significant ($p = 0.219$). No complication was observed in the TAPP group. There were no early recurrences in either group.

DISCUSSION

Open inguinal hernia repair had been the standard treat-

Table 1. Clinicopathologic characteristics between L-TAPP and TEP

Variables	L-TAPP (n=33)	TEP (n=11)	p
Sex			
Male	31 (93.9)	10 (90.9)	0.730
Female	2 (6.1)	1 (9.1)	
Age (yr)	67.5±13.2	58.1±17.4	0.068
Body weight (kg)	64.6±10.6	66.2±11.1	0.964
Height (cm)	165.3±6.9	166.9±7.6	0.511
BMI (kg/m ²)	23.7±3.4	23.6±2.7	0.959
ASA classification			
1	8 (24.2)	5 (45.5)	0.294
2	22 (66.7)	6 (54.5)	
3	3 (9.1)	0 (0)	
Direction			
Both	5 (15.2)	1 (9.1)	0.862
Right	15 (45.5)	5 (45.5)	
Left	13 (39.4)	5 (45.5)	
Hernia type			
Direct	12 (36.4)	3 (27.3)	0.759
Indirect	19 (57.6)	8 (72.7)	
Femoral	1 (3.0)	0 (0)	
Pantaloon	1 (3.0)	0 (0)	
Recurrent hernia	5 (15.2)	0 (0)	0.170
Operation time (min)			
Include Bilateral	71.4±20.5	75.8±17.4	0.522
Except Bilateral	66.9±17.9	72.9±15.2	0.349
Hospitalization days			
Include Bilateral	2.5±0.7	2.5±0.5	0.797
Except Bilateral	2.5±0.6	2.5±0.5	0.860
Complication	0 (0)	1* (9.1)	0.219

L-TAPP = Left side approach transabdominal pre-peritoneal repair; TEP = Totally extraperitoneal repair; BMI = Body mass index; ASA = American society of the anesthesiologist classification.

*Scrotal hematoma and cord swelling.

ment of choice for over a century. After laparoscopic technique was introduced for cholecystectomy and appendectomy, TEP and TAPP procedures were also introduced. Since then, many comparative studies have been performed between laparoscopic and conventional open repair.⁶⁻⁸ In those studies, laparoscopic inguinal herniorrhaphy is preferred because

Table 2. Clinicopathologic characteristics of the three group according to direction

Variables	Left (n=13)	Right (n=15)	Both (n=5)	p
Sex				
Male	13 (100)	13 (86.7)	5 (100)	0.631
Female	0 (0)	2 (13.3%)	0 (0)	
Age (yr)	65.4±17.0	67.7±10.2	72.0±5.0	0.655
BMI (kg/m ²)	22.9±4.2	24.3±3.1	23.6±0.6	0.569
ASA classification				
1	3 (23.1)	3 (20.0)	2 (40.0)	0.852
2	8 (61.5)	11 (73.3)	3 (60.0)	
3	2 (15.4)	1 (6.7)	0 (0)	
Hernia type				
Direct	2 (15.4)	5 (33.3)	5 (100)	0.006
Indirect	11 (84.6)	8 (53.3)	0 (0)	
Femoral	0 (0)	1 (6.7)	0 (0)	
Pantaloon	0 (0)	1 (6.7)	0 (0)	
Recurrent hernia	1 (7.7)	2 (13.3)	2 (40.0)	0.262
Operation time (min)	66.3±12.1	67.3±22.2	96.6±16.1	0.007
Hospitalization days	2.5±0.7	2.5±0.5	2.2±1.3	0.639
Conversion	0 (0)	0 (0)	0 (0)	-
Complication	0 (0)	0 (0)	0 (0)	-

BMI = Body mass index; ASA = American society of the anesthesiologist classification.

of shorter hospitalization, rapid return to usual activity, less pain, and cosmetic benefits. In addition, there is no difference between open and laparoscopic repair regarding short-term recurrence.

Among laparoscopic inguinal hernia repair technique, TAPP and TEP are widely used surgical methods for inguinal hernia repair. TEP has a major advantage in not entering the peritoneal cavity, but TEP is technically difficult, with a longer learning curve. Moreover, the operator has difficulty due to the limitations of space and the unfamiliar anatomical structure especially for the patients underwent previous intra-abdominal surgery.⁹ In contrast, TAPP has a major disadvantage by entering the peritoneal cavity, with a risk of injury to abdominal organs and to inducing postoperative adhesions. However, operator can perform the surgery with sufficient and familiar space. In addition, pre-peritoneal adhesion induced by previous intra-abdominal surgery can be dealt with more

efficiently.

In general, the preferred method for TAPP placed the optical trocar in the umbilical position and the other two operative trocars in the contralateral midclavicular line. This is probably because of the need for access to both sides and a surgical dissection area from the symphysis pubis to the ASIS. However, this method can be inconvenient and unergonomic for some surgeons who have short reaches. For them, if it is possible to manage both side of inguinal hernia, the ipsilateral operative trocar placement could be more convenient and ergonomic procedure. In this study, we presented our new trocar placement and method for only left side TAPP approach. To the best of our knowledge, this is the first report to consider the usefulness of ipsilateral trocar position for laparoscopic TAPP.

To prove real benefit of only left side approach of TAPP, this new procedure had to be compared with conventional contralateral TAPP method. However, because previous TAPP procedures were mainly used for recurrent inguinal hernia, comparative study between L-TAPP and conventional TAPP was impossible. Instead, comparative analysis was done with TEP which is most widely performed laparoscopic hernia repair procedure.

Although the number of cases is low, there was no difference between the TAPP method and the TEP method in terms of complications, hospital days, and early recurrence. However, there were 5 (12.5%) bilateral and 5 (12.5%) recurrent cases in TAPP group. These difference in characteristics of two groups reflect advantage of TAPP regarding the recurrent inguinal hernia and bilateral hernia. All those surgeries were successfully performed by patients' left side ipsilateral approach. Conceptually, left inguinal hernia seem to be difficult to manage with left side ipsilateral approach. However, laparoscopic TAPP can be successfully done with proposed trocar placement and angled electrosurgery tip.

Recently, the number of reports related to robotic hernia repair has increased, probably because interest in robotic surgery has increased.^{10,11} Reasons to increase the number of robotic hernia repairs include not only the detailed movement and superior imaging, but also physical convenience.¹² Thus, we thought that this ipsilateral operative trocar method would be more convenient than the conventional contralateral operative trocar method; moreover, the surgical cost is much lower, compared to the cost of robotic hernia repair.

The limitation of this study is that the ergonomics of this procedure were not validated by other surgeons. We did not assess the comfort of this procedure using an objective scale. Only the operating surgeon perceived a feeling of comfort. For

this reason, further study and external validation are needed.

In conclusion, L-TAPP is a feasible and safe procedure compared with TEP. In addition, this procedure might be adopted with more comfort for surgeons who have short reaches.

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