

Is Laparoscopic Transabdominal Preperitoneal Hernia Repair more Invasive than Anterior Open Mesh Repair?

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ABSTRACT

Introduction: Tension-free open mesh repair is a popular surgical choice for an inguinal hernia. Laparoscopic Hernia Repair (LAHR) is gradually increasing, however, LAHR is considered more invasive than open mesh repair because the surgical time is longer and has a higher rate of postoperative complications.

Aim: To compare the invasiveness of laparoscopic Transabdominal Preperitoneal Hernia Repair (TAPP) with open mesh repair by evaluating surgical time, postoperative stay duration, postoperative complications, and inflammatory marker levels in patients with inguinal hernia.

Materials and Methods: This was a prospective comparative clinical study of 104 patients with inguinal hernia who were divided into two groups based on treatment type: TAPP and open mesh repair. Patient characteristics, surgery-related and postoperative factors, postoperative stay duration, and postoperative complications were analysed and compared

between the two groups. Continuous data were presented as mean±standard deviation and were compared using Student's t-test (two-tailed). Categorical data were compared using Fisher's-exact test.

Results: In total, 51 patients underwent TAPP and 53 open mesh repair. Surgical time and postoperative stay duration were not significantly different between the two groups. Similarly, White Blood Cells (WBC) (postoperative days 1 and 3) and C-Reactive Protein (CRP) (day 3) levels were not significantly different between the two groups; however, day 1 CRP levels were significantly lower in the TAPP group than in the open mesh repair group (1.12 ± 0.81 mg/dL and 2.22 ± 1.88 mg/dL, respectively; $p < 0.01$). Postoperative surgical complication rates were not significantly different between the two groups.

Conclusion: Both TAPP and open mesh repair are safe and feasible procedures. TAPP is comparable to open mesh repair in terms of surgical stress and is less invasive.

Keywords: Bilayer mesh, Inguinal hernia, Laparoscopic hernia repair, Mesh-plug

INTRODUCTION

Inguinal hernia repair is one of the most common surgical procedures performed worldwide [1]. Tension-free anterior open mesh repair is a popular technique used for inguinal hernia repair in Japan because it is relatively easy to perform; in addition, this technique has demonstrated a dramatic decrease in the rates of recurrence and postoperative complications when compared with the tension repair technique. On the other hand, laparoscopic inguinal hernia repair has been widely accepted due to several advantages such as less postoperative pain, shorter recovery period, earlier return to daily activities and work, and better cosmetic results [2-4]. Laparoscopic cholecystectomy, gastrectomy or colectomy is indisputably less invasive when compared with open surgery. Low levels of the systemic inflammatory markers CRP and WBC indicate that the procedure is less invasive or traumatic, thereby enhancing patient recovery [5-7]. However, some surgeons believe that laparoscopic herniorrhaphy is more invasive than open repair because it increases the risks of both recurrence and perioperative complications [8]. Adequate experience is required to be able to perform this procedure [9]. Furthermore, unlike anterior open repair, laparoscopic surgery needs to be performed under general anaesthesia and cannot be performed under local anaesthesia [10].

In the present study, authors compared laparoscopic TAPP and anterior open mesh hernia repair in terms of surgical time, length of postoperative stay, occurrence of postoperative complications, and presence of inflammatory markers. The purpose of this study was to demonstrate that TAPP if performed by reasonably experienced surgeons, is a safe, feasible, and less invasive procedure.

MATERIALS AND METHODS

Patients

This prospective, comparative, clinical study was conducted between April 2015 and August 2016 at the Saiseikai Shimonoseki General Hospital in Shimonoseki, Japan. The study was approved by the Ethics Committee of the institution, and written informed consent was obtained from all patients. Adult patients who were diagnosed with an uncomplicated inguinal hernia and who underwent elective herniorrhaphy were enrolled in this study. Patients with a recurrent hernia or incarceration or patients under the age of 18 years were excluded from the study. The sample size was calculated according to the analysis using the G*Power software and the findings of a previous report [4]. The ideal patients received explanations regarding anterior open repair (mesh-plug technique or bilayer mesh technique) and LAHR TAPP and their benefits as well as side effects following which, they were asked to select between the two methods of treatment.

All patients underwent standardised repairs performed by qualified surgeons who had performed a minimum of 50 open or laparoscopic repairs (laparoscopic, two surgeons; open, two surgeons). Data regarding patient characteristics (age, sex), surgery-related factors (hernia type, affected side, anaesthesia, operation time), and postoperative factors (WBC or CRP values on day 1 or day 3 post-procedure and postoperative complications) were collected from medical records and analysed. Blood samples on day 3 were obtained only from patients who remained at the hospital for three days or longer after the operation. Postoperative complications were evaluated from postoperative day 7 to 30 at the outpatient clinic. Conditions such as wound infection, seroma, and subcutaneous

haematoma, which required treatment (aspiration, incision, or irrigation), were classified as postoperative complications, whereas mild inguinal swellings or subcutaneous haematomas were not counted as complications. Pain was defined as a postoperative complication if the patient required a painkiller seven days after the surgical procedure.

Surgical Techniques

TAPP: TAPP was performed as described by Fitzgibbons RJ Jr et al., [11]. Briefly, after inducing general anaesthesia, a 12-mm trocar was inserted through the umbilicus using the open trocar method. The pneumoperitoneum was established by insufflation with Carbon Dioxide (CO₂) gas to an abdominal pressure of 10 mmHg, and a 10-mm laparoscope was inserted through the trocar. A second 12-mm trocar was placed in the right lateral abdominal region, and a 5-mm trocar was placed in the left lateral abdominal region. After determining the type of hernia, the peritoneum was circularly incised around the hernia orifice using an ultrasonically activated energy device. The peritoneum was separated to expose the Hesselbach triangle, internal inguinal ring, and femoral ring, and a peritoneum flap was created. Myopectineal Orifice (MPO) was fully covered with mesh, which was fixed to the transverse abdominal muscle aponeurosis and Cooper ligament, away from the triangle of doom, using absorbable tacks. The peritoneum was closed with continuous sutures.

Anterior open mesh repair: Anterior open mesh repair was performed using the mesh-plug for an indirect hernia or bilayer mesh for direct hernia as described previously [12]. Open mesh repair was administered with lumbar anaesthesia. General anaesthesia or local anaesthesia was selected according to patient's preference in consultation with an anaesthesiologist. Open mesh repair by local anaesthesia was performed in conjunction with transversus abdominis plane block. An oblique skin incision (approximately 5 cm in length) was made in the inguinal region, and the inguinal canal was opened. In indirect hernias, the hernia sac was separated from the spermatic cord and transected at the neck level; the central side was ligated or closed via a purse-string suture. A plug was inserted into the internal ring, and the mesh was placed on the anterior surface of the posterior wall of the inguinal canal. In the case of direct hernias, the preperitoneal space was adequately dissected. The underlay patch of the bilayer mesh was inserted into the preperitoneal space and extended over the entire MPO, whereas the only patch was spread like mesh as in the mesh-plug technique.

STATISTICAL ANALYSIS

Continuous data were presented as mean±standard deviation and were compared using Student's t-test (two-tailed). Categorical variables were compared using the Fisher's-exact test. Data analysis was performed using EZR version 1.36 (Saitama Medical Center, Jichi Medical University, Saitama, Japan) [13]. A p-value<0.05 was considered as statistically significant.

RESULTS

The preoperative data are summarised in [Table/Fig-1]. No significant differences in gender were observed between the two groups; however, patients who underwent TAPP were significantly younger than those in the open repair group [Table/Fig-1]. No significant difference in the type of hernia or the side of the patient

affected by it was noted between the two groups [Table/Fig-1]. All patients in the TAPP group required general anaesthesia, whereas 42 (79%) patients in open repair group were operated under spinal anaesthesia; only 9 (17%) patients required general anaesthesia. Two patients (4%) in the open repair group underwent the procedure under local anaesthesia (p<0.01, [Table/Fig-2]).

Variables	TAPP	Open mesh repair	p-value
	(n=51)	(n=53)	
Age (years) (mean±SD)	65.2±13.5	71.1±14.3	<0.05
Sex (M/F)	48/3	46/7	0.32
Affected side (right/left/bilateral)	28/19/4	28/21/4	0.97
Classification			0.13
Indirect	43	37	
Direct	11	20	
Femoral	1	0	

[Table/Fig-1]: Clinicopathological characteristics of the patients.

TAPP: Transabdominal preperitoneal; SD: Standard deviation
(Using Student's t-test and Fisher's exact test)

Variables	TAPP	Open mesh repair	p-value
	(n=51)	(n=53)	
Anaesthesia (general/lumbar/local)	51/0/0	9/42/2	<0.01
Operating time (minutes)	61.3±16.7	60.1±20.1	0.74
Postoperative stay (days)	3.1±1.1	3.4±1.0	0.24
Postoperative complications			
Seroma	4	1	0.21
Wound infection	1	0	0.31
Continued pain	1	5	0.21
Haematoma	0	1	0.32

[Table/Fig-2]: Summary of perioperative data.

TAPP: Transabdominal preperitoneal (Using Student's t-test and Fisher's exact test)

There were no significant differences in the mean length of time required for the procedure (TAPP: 61.3±16.7 minutes, open repair: 60.1±20.1 minutes) and mean length of postoperative stay (TAPP: 3.1±1.1 days, open repair: 3.4±1.0 days, [Table/Fig-2]). Blood samples were collected from all patients on postoperative day 1, whereas on postoperative day 3, the samples were collected from 44 (86%) and 47 (89%) patients in the TAPP and open mesh repair groups, respectively.

On post-procedure days 1 and 3, the mean WBC counts were 7.75±2.02×10³ per µL and 6.40±1.79×10³ per µL in the TAPP group and 8.17±1.95×10³/µL and 6.34±1.53×10³/µL in the open repair group, respectively. No significant differences in these values were noted between the two groups [Table/Fig-3]. The mean Day 1 and Day 3 post-procedure CRP measurements were 1.12±0.81 mg/dL and 2.46±3.40 mg/dL, respectively, in the TAPP group and 2.22±1.88 mg/dL and 3.88±3.40 mg/dL, respectively, in the open repair group. The mean Day 1 post-procedure CRP value was significantly lower in the TAPP group than in the open repair group (p<0.01, [Table/Fig-3]).

The postoperative surgical complication rate was 6/51 (12%) in the TAPP group (four seroma, one wound infection, and one continued pain) and 7/53 (13%) in open repair group (one seroma, five continued pain, and one haematoma) with no significant differences between the two groups [Table/Fig-2].

Variables	Mean WBC value				Mean serum CRP level		p-value	POD 3 (mg/dL)	p-value
	POD 1 (x10 ³ /µL)	p-value	POD 3 (x10 ³ /µL)	p-value	POD 1 (mg/dL)				
TAPP (mean±SD)	7.75±2.02	0.29	6.40±1.79	0.87	1.12±0.81		<0.01	2.46±3.40	0.06
Open mesh repair (mean±SD)	8.17±1.95		6.34±1.53		2.22±1.88			3.88±3.40	

[Table/Fig-3]: Mean values of WBC and CRP on postoperative days 1 and 3.

TAPP: Transabdominal preperitoneal; POD: Postoperative day; WBC: White blood cell; CRP: C-reactive protein (Using Student's t-test)

DISCUSSION

An inguinal hernia is one of the most common conditions in the world that require surgical intervention. Tension-free repair is the main procedure used for inguinal hernia, except for incarcerated inguinal hernia, and comprises of an anterior approach and laparoscopic surgery. The anterior approach for tension-free repair was reported by Lichtenstein IL et al., and has been a standard procedure ever since [14]. It has resulted in significant reductions in recurrence rates and early postoperative pain when compared with the tension repair method. LAHR was also undertaken in the 1990s [15]; nevertheless, the disadvantages of this procedure include the following: LAHR usually requires general anaesthesia, whereas anterior open hernia repair is often performed under spinal anaesthesia and sometimes under local anaesthesia [10]; surgical time of LAHR is often longer than that of open mesh repair [16]; it requires more time to master the laparoscopic technique when compared with the anterior approach [9]; complications and recurrence rates increase when LAHR is performed by inexperienced surgeons with poor anatomical knowledge [8].

However, the number of facilities performing LAHR is increasing as a result of chronic pain relief, lower recurrence rate, and prompt resumption of daily activities after the procedure [2-4]. Because both experts of anterior open mesh repair and LAHR are enrolled at the present hospital, patients were assigned to the open mesh repair group and laparoscopic repair group after we provided a full accounting of two operation methods, and patients made a choice between two operations themselves. Only two patients were classified into the open repair group independently of their wish; they received it under local anaesthesia because they had cardiac hypofunction, and authors determined that general or lumbar anaesthesia was involved with the risk for further increase in cardiac failure. Open mesh repair is extremely useful for patients with cardiac or respiratory failure because general anaesthesia and pneumoperitoneum using carbon dioxide affects cardiovascular and pulmonary system and might generate a harmful effect for their circulatory dynamics and cause lethal complications [17,18].

No significant difference in surgical time was noted between the two groups. LAHR is generally considered to be time-consuming when compared to open mesh repair because the laparoscopic approach is technically more difficult [16]. The learning curve for the laparoscopic method is longer than that of open approach. In other words, surgeons need a certain amount of experience to achieve a certain level of expertise in the laparoscopic technique for inguinal hernias [9]. Authors believe that adequate practice of the suturing or ligation process using a laparoscopic training box every day will contribute to the shortening of the surgical time in TAPP [19]. It is important for inexperienced surgeons to perform LAHR under the guidance of expert surgeons until their technique is stable and the plateau of the learning curve has been reached. Additionally, no significant differences in mean length of postoperative stay were noted between the two groups. It was considered that severe complications, which led to prolonged postoperative stays, did not occur in both groups and almost all patients had a defined clinical pathway.

Surgical stress is an iatrogenic trauma, which accompanies the surgical procedure. The degree of surgical stress depends on the size of the surgical wound, surgical site, volume of the resected organs, operative procedure, amount of bleeding during the operation, and the type of anaesthesia used; less surgical stress means less invasive procedure. Less invasive surgery results in lower amount of pain at the site, fewer surgical complications, and decreased length of postoperative hospital stay, thus proving advantageous for the patients. Laparoscopic surgery is less invasive when compared with open surgery during gastrectomy [5], colectomy [6] or cholecystectomy [7] leading to fewer perioperative

complications, early recovery, and decreased postoperative pain. Furthermore, the inflammatory markers WBC and CRP are used to evaluate damage or stress after various surgical procedures owing to ease in obtaining the measurements and the cost effectiveness of the process. Lower values of these inflammatory markers have often been correlated with lower rates of postoperative complications and less invasive surgery. Sakuramoto S et al., revealed a significant decrease in the use of analgesics by the patients after laparoscopic distal gastrectomy along with fewer postoperative complications and number of days at the hospital when compared with open distal gastrectomy for early gastric cancer [5]. In addition, significantly lower levels of WBC and CRP were reported in their study on postoperative day 7 after laparoscopic surgery [5]. Janež J et al., showed a considerably lower postoperative systemic inflammatory response, including WBC and CRP levels, in patients who underwent laparoscopic surgery when compared to those who underwent open surgery for colorectal cancer; moreover, the patients who underwent the laparoscopic procedure demonstrated significantly less blood loss during surgery, earlier resumption of oral food intake, and shorter postoperative hospital stay [6]. Similar findings were reported by Kohli R et al., among patients who underwent laparoscopic cholecystectomy when compared with those who received open surgery [7]. Some studies have compared inflammatory responses between open hernia repair and LAHR [20-22]. Takahara T et al., mentioned that the CRP level on postoperative day 1 was higher with LAHR than that with open hernia repair [20]. These authors concluded that LAHR offered no advantage over the open approach from the standpoint of immunological and inflammatory responses. Bender O et al., compared systemic inflammatory responses after open hernia repair (Kugel method) and LAHR (total extraperitoneal repair; TEP repair), and they found that the serum cortisol, high-sensitivity C-reactive protein (hs-CRP), and interleukin (IL)-6 levels before surgery and at 1 and 24 hours after surgery were not significantly different between the two groups [21]. They also mentioned that Kugel repair has the advantages of TEP repair and is less costly. Kokotovic D et al., performed a systematic review and found that inflammatory responses were greater with open mesh repair than with LAHR [22]. In the present study, authors measured WBC and CRP on postoperative days 1 and 3 as markers of surgical stress. No significant differences in mean WBC values (days 1 and 3) and CRP values (day 3) were observed between the two groups post-procedure. Furthermore, the mean day 1 post-procedure CRP value was significantly lower in the TAPP group; these findings indicated that TAPP is less invasive when compared with open mesh repair.

No significant differences in the rate of postoperative complications and length of postoperative stay were noted between the two groups in this study. Similar to previous reports, authors also encountered patients with seroma, subcutaneous haematoma, constant pain, and wound infection. Only one patient required painkillers on postoperative day 7 in the TAPP group as compared to the seven patients who needed additional painkillers in the open repair group, thus indicating that TAPP might allow for earlier social rehabilitation when compared to the open repair procedure. Seroma formation is a known postoperative complication after TAPP. The sizes of the seroma in all cases of postoperative seroma in the TAPP group were ≥ 3 cm in the present study. Köckerling F et al., reported that mesh fixation with tacks or glue, large hernia defect, and medial defect localisation were some of the risk factors for seroma development in TAPP inguinal hernia repair [23]. Many cases of postoperative seroma disappeared with time without the need for any surgical procedure. Nonetheless, prevention of seroma is important because puncture or drainage of large or prolonged seromas is considered as a risk factor for mesh infection. In a recent study, the fixation of the residual distal sac high and lateral to the inguinal wall was associated with a lower risk of developing large seromas [24]. This technique may be adopted for large inguinal hernias.

LIMITATION

The present study had its limitations of a small sample size and short duration of study period.

CONCLUSION

Both Transabdominal Preperitoneal Hernia Repair (TAPP) and open mesh repair are considered as safe and feasible surgical procedures. Although TAPP requires general anaesthesia, it is comparable to open repair with regard to surgical stress, which indicates that it is a less invasive procedure that can facilitate earlier social rehabilitation when compared with anterior open mesh repair. Open mesh repair can be performed under local anaesthesia and is a candidate for patients with cardiac or respiratory failure whose clinical conditions might be exacerbated by general anaesthesia or pneumoperitoneum.

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