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Transabdominal Preperitoneal Repair *vs*. Open Lichtenstein Repair of Primary Unilateral Inguinal Hernias in Elderly Patients: A Single-Center Propensity Score Analysis

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Abstract

Background: Inguinal hernia repair is one of the most common general surgical operations worldwide. Although laparoscopic surgery for inguinal hernia is widespread, open repair is often selected in routine clinical practice for elderly patients because of its safety and ease. It is still controversial whether the laparoscopic or open surgical approach affects outcomes in elderly patients. In this study, we compared the surgical outcomes of Open Lichtenstein Repair (OLR) versus Transabdominal Preperitoneal (TAPP) repair of inguinal hernias in elderly patients.

Methods: A single-center, retrospective study of patients aged ≥ 75 years who underwent TAPP or OLR of an inguinal hernia between January 2012 and December 2018 was conducted (TAPP; n=27, OLR; n=140). To overcome selection bias, we performed 1:1 matching using 13 covariates to generate propensity scores.

Results: Twenty-five patients were analyzed *via* propensity score matching. TAPP repair was associated with a significantly shorter postoperative hospital stay (2.44 ± 0.65 *vs*. 2.96 ± 0.35 days; p=0.001) and less demand for additional analgesic prescriptions at the first postoperative outpatient visit (1/25; 4.0% *vs*. 6/25; 24.0%, p=0.049). The perioperative complication and recurrence rates did not differ between the two groups.

Conclusion: Although OLR for an inguinal hernia remains the most prevalent in the elderly population, TAPP repair for primary unilateral inguinal hernia is useful for properly selected elderly patients, and may reduce the demand for postoperative analgesics, and the hospital stay, compared with Lichtenstein repair.

Keywords: Inguinal hernia; Elderly patients; Laparoscopic surgery; TAPP; Lichtenstein

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Introduction

The lifetime occurrence of a groin hernia is 27% to 43% in men and 3% to 6% in women [1], and inguinal hernia repair is one of the most common surgeries worldwide, performed on more than 20 million people annually [1]. The Lichtenstein repair is the most frequently applied technique for inguinal hernia repair [2]. However, the use of laparoscopic inguinal hernia repair has been rapidly expanding since Watson et al. [3] first reported the technique in 1993. Although the open Lichtenstein and laparoscopic inguinal hernia techniques are recommended as the best evidence-based options for repair of primary unilateral hernias by the European Hernia Society Guidelines [4], it is still controversial whether laparoscopic or open preperitoneal repair should be the preferred technique for unilateral primary inguinal hernia [2]. A recent systematic review including 12 Randomized Controlled Trials (RCTs) concluded that there was no significant difference in recurrence rate between the laparoscopic and open groups, and the rates of acute and chronic pain were significantly less in the laparoscopic group [5]. However, whether the results of an RCT can be generalized to a practical setting, particularly for high-risk or elderly patients, is unclear. The advantages and disadvantages of open and laparoscopic hernia repair in elderly patients have been reported [6-8]. Previous studies have reported that elective laparoscopic inguinal hernia repair does

not raise the risk of surgery-related morbidity in patients aged ≥ 65 years [6,8]. However, not a few patients are older than 65 years, and the usefulness of laparoscopic surgery for such older populations is still controversial [7,8].

In this study, we assessed whether Transabdominal Preperitoneal (TAPP) repair is more effective than open Lichtenstein repair for treating inguinal hernias in elderly patients using Propensity Score (PS) matched analyses, which have been proven to reduce confounding bias in observational studies [9].

Methods

Patients and methods

Retrospective analyses based on data collected from an electronic database of 815 patients who underwent hernia repair between January 2012 and December 2018 was conducted. In total, 167 patients (Lichtenstein; n=140, TAPP; n=27) met our criteria and were enrolled. The inclusion criteria were patients aged ≥ 75 years, and patients with a primary unilateral hernia who underwent hernia repair surgery. The exclusion criteria were patients who underwent emergency surgery, had simultaneous surgery for other diseases, had surgery using the UltraPro Hernia System (UHS) method, and were surgically diagnosed with a femoral hernia. The patients underwent detailed laboratory examinations, including ultrasound of the inguinal region or computed tomography. The main preoperative demographics recorded were age, sex, Body Mass Index (BMI), American Society of Anesthesiologists (ASA) physical status, current smoking status, diabetes and coronary artery disease status, antiplatelet and anticoagulant use, steroid use, liver and renal status, and any history of malignant disease or abdominal surgery. Surgical details, including operating time, complications, length of hospital stay, and numbers of analgesics used during hospitalization, were recorded. We informed the patients to notify us of any postoperative problems and to visit the outpatient department any time for a clinical examination. A physical examination was performed 1 and 6 months after surgical repair, and the patients' complications were recorded.

Surgical technique

TAPP repair: This procedure was performed under general anesthesia. The abdomen was insufflated with CO_2. Three trocars were placed in total. A 12 mm diameter optic was placed through a periumbilical incision. A 12 mm diameter trocar was placed in the right or left hypochondrium (ipsilateral with an inguinal hernia), and a 5 mm diameter trocar was inserted at a position line-symmetrical with the port inserted into the hypochondrium with respect to a straight line connecting the lesion-sided inner inguinal ring and the navel. The peritoneum was incised at the level of the internal inguinal ring and the peritoneum was detached up to the anterior superior iliac spine on the outside, at the confluence of the medial umbilical cord and the vas deferens on the inside, and at a distance (about 3 cm) that was just enough for mesh deployment on the craniocaudal side. The Cooper ligament and dorsal side of the rectus abdominis were exposed through careful dissection of the preperitoneal parapubic adipose tissue to deploy the mesh. The peritoneum was sutured after deploying the mesh. We used a 15 cm × 10 cm Laparoscopic Self-fixating Mesh (ProGrip™) that was trimmed to fit the patient's physique.

Open Lichtenstein repair: The standard OLR technique was used with self-gripping mesh. During surgery, groin exploration was performed by making an incision at a point two-thirds of the distance between the anterior superior iliac spine and pubic tubercle. The tissues were then separated up to the aponeurosis of the external oblique muscle. After sharp dissection, the external oblique aponeurosis and internal oblique muscle were detached, and the iliohypogastric nerve was identified. If this nerve was expected to be a barrier to mesh deployment, it was cut with a scalpel from the central side, where the nerve penetrated the internal oblique muscle, and to the peripheral side where the nerve penetrated the external oblique aponeurosis. The spermatic cord was exposed and a Nelaton catheter was used for circumferential access. The cord structures were explored to identify the hernia sac in patients with indirect hernia, and to check the posterior wall of the inguinal canal in patients with direct hernia. Generally, the genital branch of the genitofemoral and ilioinguinal nerves were identified and preserved. The hernia sac was usually opened and ligated with "double transfixation". A 12 cm × 8 cm self-gripping polyester mesh (ProGrip™; Sofradim, Trévoux, France) was fixed to tissue over the pubic tubercle and inguinal ligament. Finally, the external oblique aponeurosis, Scarpa's fascia, and skin were sutured.

Final diagnosis and follow-up

The final diagnosis was made based on the surgical findings and classified in accordance with the European Hernia Society groin hernia classification [10]. In most instances, patients undergoing OLR were discharged 3 days after surgery, while those undergoing TAPP were discharged 2 days after surgery in accordance with the clinical pathway of our institution. Outpatient follow-up involved a physical examination to assess wound swelling, wound infection, the degree of pain, and hernia recurrence. At that time, additional analgesics were prescribed if requested by the patient. Puncture was performed for seroma with tension or pain. If subjective or objective re-swelling of the inguinal region was observed, the presence or absence of recurrence was confirmed by ultrasound or computed tomography. A minimum of 6 months of follow-up was required for all patients.

Statistical analyses

All statistical analyses were performed using the SPSS statistical software program (ver. 26.0; SPSS Inc., Chicago, IL, USA). Continuous variables are expressed as mean and standard deviation, and categorical variables are expressed as frequencies and percentages. The characteristics of patients who underwent TAPP or OLR inguinal hernia repair were compared using Student's t-test for continuous variables and Pearson's χ^2 test for categorical variables. A P-value <0.05 was considered significant. We performed PS matching to balance the observed characteristics between the two groups. We matched each patient in the TAPP group to one patient in the OLR group using the nearest-neighbor matching method with a caliper width of 0.25. The matching covariates included age, sex, BMI, ASA status, current smoking status, diabetes and coronary artery disease status, use of antiplatelet agents or anticoagulants, steroid use, liver and renal status, and any history of malignant disease and abdominal surgery.

This study was conducted with the approval of the Institutional Review Board of the Hiratsuka City Hospital (No. 31-007).

Results

Background characteristics

In all, 815 patients underwent inguinal hernia surgery during the study period, and 195 were aged ≥ 75 years with primary unilateral inguinal hernia. Patients who underwent emergency surgery, had

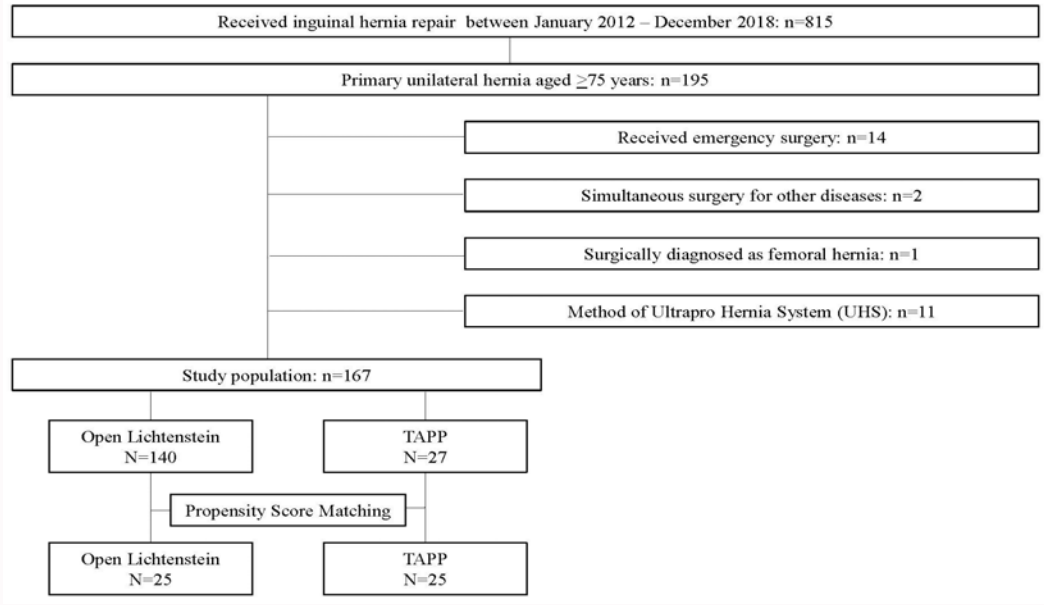

Figure 1: Study flow for the 815 patients who underwent surgery for inguinal hernia between January 2012 and December 2018.

Table 1: Baseline characteristics for elderly patients who underwent laparoscopic or open inguinal hernia repair.

	Unmatched			Matched		
	OLR n=140	TAPP n=27	*p* value	OLR n=25	TAPP n=25	*p* value
Age ≥ 80, n (%)	64 (45.7%)	5 (18.5%)	0.009	9 (36.0%)	5 (20.0%)	0.208
Sex M/F	140 / 0	26 / 1	0.162	25/0	25/0	-
BMI	22.6 ± 2.64	22.4 ± 2.70	0.726	22.5 ± 2.3	22.3 ± 2.8	0.782
ASA ≥ III, n (%)	46 (32.9%)	2 (7.4%)	0.007	6 (24.0%)	2 (8.0%)	0.123
Current smoking, n (%)	18 (12.9%)	0	0.037	2 (8.0%)	0	0.245
Diabetes mellitus, n (%)	22 (15.7%)	2 (7.4%)	0.209	3 (12.0%)	2 (8.0%)	0.500
Antiplatelet and anticoagulant, n (%)	36 (25.7%)	3 (11.1%)	0.101	6 (24.0%)	3 (12.0%)	0.232
Coronary artery disease, n (%)	10 (7.1%)	1 (3.7%)	0.442	1 (4.0%)	1 (4.0%)	0.755
Steroid use, n (%)	1 (0.7%)	0	0.838	0	0	-
Liver function disorder, n (%)	7 (5.0%)	1 (3.7%)	0.619	1 (4.0%)	1 (4.0%)	0.755
Renal function disorder, n (%)	25 (17.9%)	3 (11.1%)	0.293	2 (8.0%)	3 (12.0%)	0.500
History of malignant disease, n (%)	43 (30.7%)	1 (3.7%)	0.004	4 (16.0%)	1 (4.0%)	0.174
History of abdominal surgery, n (%)	67 (47.8%)	5 (18.5%)	0.005	5 (20.0%)	5 (20.0%)	1.000

OLR: Open Lichtenstein's Repair; TAPP: Transabdominal Preperitoneal Approach

simultaneous surgery for other diseases, had surgery by the UHS method, and those who were surgically diagnosed with femoral hernia were excluded. A total of 167 patients (Lichtenstein; n=140, TAPP; n=27) met the eligibility criteria and were enrolled in this study, as shown in Figure 1.

Table 1 shows the baseline characteristics before and after matching. Undergoing open surgery was associated with older age ≥ 80 years (45.7% *vs.* 18.5%; P=0.009), ASA status ≥ III (32.9% *vs.* 7.4%: p=0.007), current smoking (12.9% *vs.* 0%, P=0.037), history of malignant disease (30.7% *vs.* 3.7%, P=0.004), and history of abdominal surgery (47.8% *vs.* 18.5%, P=0.005). However, these differences disappeared after PS matching.

The surgical outcomes are shown in Table 2. After PS matching, TAPP was associated with a shorter postoperative length of stay (2.44 ± 0.65 *vs.* 2.96 ± 0.35 days; P=0.001) and less demand for additional analgesic prescriptions at the first postoperative outpatient visit (4.0% *vs.* 24.0%, P=0.049). Lichtenstein repair was associated with a shorter operating time (101.6 ± 28.9 min *vs.* 138.7 ± 30.2 min; P<0.001). No significant differences were observed in postoperative complications between the groups.

Discussion

We assessed whether TAPP repair for primary unilateral inguinal hernia repair is more feasible than Lichtenstein repair in elderly patients using PS-matched analyses. TAPP was associated with a shorter postoperative length of stay and less demand for additional analgesic prescriptions at first postoperative outpatient visit, compared with Lichtenstein repair. No significant differences in postoperative complications were observed between the two groups. These findings suggest that TAPP can be safely performed with less pain and a shorter hospital stay in tolerable elderly patients.

Table 2: Surgical outcomes for elderly patients who underwent laparoscopic or open inguinal hernia repair before matching.

	Unmatched			Matched		
	OLR n=140	TAPP n=27	*p* value	OLR n=25	TAPP n=25	*p* value
Operative time (min)	96.3 ± 24.7	137.6 ± 30.6	<0.001	101.6 ± 28.9	138.7 ± 30.2	<0.001
Postoperative hernia classification L1/L2/L3/M1/M2/M3/combined type	3/74/30/6/3/12/12	0/15/4/3/0/1/4	0.754	1/11/6/0/0/1/6	0/13/4/3/0/1/4	0.876
Surgical site infection, n (%)	1 (0.7%)	0	0.838	0	0	-
Inguinal seroma requiring puncture, n (%)	0	0	-	0	0	-
Recurrence, n (%)	2 (1.4%)	0	0.702	0	0	-
Postoperative length of stay	3.46 ± 1.12	2.44 ± 0.64	<0.001	2.96 ± 0.35	2.44 ± 0.65	0.001
Number of analgesics used during hospitalization	1.63 ± 2.10	1.48 ± 2.15	0.740	1.88 ± 2.39	1.28 ± 1.77	0.317
Demands for additional analgesics prescriptions at the first postoperative outpatient visit, n (%)	18 (12.9%)	1 (3.7%)	0.147	6 (24.0%)	1 (4.0%)	0.049
Unexpected consultation, n (%)	3 (2.1%)	1 (3.7%)	0.510	2 (8.0%)	1 (4.0%)	0.500

OLR: Open Lichtenstein's Repair, TAPP: Transabdominal Preperitoneal Approach

Although several studies have reported that elective laparoscopic inguinal hernia repair does not raise the risk of surgery-related morbidity in patients aged ≥ 65 years [6,8], the risk of postoperative complications of laparoscopic hernia repair in older populations is controversial. Mayer et al. [7] reported that the perioperative risk for conducting a laparoscopic hernia repair might increase at about 80 years of age. By contrast, Hernadez et al. [8] compared cohorts aged >80 years and found comparable morbidity and mortality rates between laparoscopic and open repair. However, all these reports included both unilateral and bilateral hernias, and some of those included the mixture of TAPP and Totally Extraperitoneal (TEP) hernia repair and did not describe the laparoscopic surgery or open procedure in detail. Ying et al. [11] applied PS matching and reported that TEP could be performed with similar perioperative outcomes, complication rates, and chronic pain between patients older and younger than 75 years, but did not directly compare laparoscopic and Lichtenstein repair in the elderly. Therefore, our study focused on the direct comparison of TAPP and Lichtenstein repair for primary unilateral inguinal hernias in patients aged ≥ 75years using PS analysis.

Postoperative pain is an important factor in patient quality of life after hernia surgery. A recent systematic review that included 12 randomized control trials with 3,966 patients comparing open *vs.* laparoscopic repair of primary unilateral inguinal hernia reported that laparoscopic hernia repair is associated with a reduced rate of acute and chronic pain compared with those of open surgery, and the recurrence rate is similar between the two approaches [5]. Kockerling et al. [12] reported PS-matched analyses using a large registry-based comparison on the outcome of the Lichtenstein and TAPP techniques and showed disadvantages of the Lichtenstein operation concerning the postoperative complication rate (3.8% *vs.* 3.3%), complication-related reoperations (1.2% *vs.* 0.9%), and pain at rest (5% *vs.* 4.5%) and upon exertion (10.2% *vs.* 7.8%). A common finding in many studies, including our study, laparoscopic surgery tends to be less painful than the open method. The Lichtenstein repair is thought to be more painful than laparoscopic surgery because the mesh is fixed to the tissue to prevent it from being pushed out by abdominal pressure, a large surgical incision is made, and the nerve and mesh are in close contact, which increases the risk of physical contact and involvement of the chronic inflammatory process with the mesh products. Our institutional Lichtenstein repair also requires a larger surgical incision than that of TAPP, and we fix mesh to tissue over the pubic tubercle and inguinal ligament and often deliberately cut the iliohypogastric nerve to deploy the mesh. Some or all of these procedures may have increased the demand for additional analgesic prescriptions after the first postoperative outpatient visit. Reducing the amount of analgesics is thought to be beneficial because such treatments, including non-steroidal anti-inflammatory drugs, increase the risk of peptic ulcer and acute renal events in elderly patients [13-15].

Lichtenstein repair has been established as a safe and easy surgical procedure that does not require general anesthesia; thus, it tends to be selected for elderly patients. Indeed, in our original cohort, the Lichtenstein group had a large proportion of patients who were aged ≥ 80 years, had an ASA status ≥ III, and had malignant diseases and a history of abdominal surgery. These results seem reasonable because there is no need to select TAPP in patients with a high risk for general anesthesia or difficulty with the intraperitoneal approach. Our findings imply that TAPP can be safely performed in elderly patients who can tolerate general anesthesia and have no history of complicated abdominal surgery, and may be superior to the Lichtenstein repair in terms of reducing analgesic use and shortening the hospital stay, which may minimize both the side effects of medication and the likelihood of a decline in the ability to perform activities of daily living. In addition, Bay-Nielsen et al. [16] reported a nationwide evaluation between the type of anesthesia and postoperative complications after groin hernia repair and found that patients aged ≥ 65 years undergoing regional anesthesia had a higher rate of medical complications, such as myocardial infarction, pneumonia, and thrombosis than those undergoing general anesthesia. Lichtenstein repair is often performed with the patient under regional anesthesia, as in our hospital, but it is also necessary to determine the surgical method assuming the types of complications that differ depending on the anesthesia method.

Some limitations of this study should be discussed. First, the main disadvantage of PS matching is that it only accounts for the observed covariates. Therefore, factors that affect the assignment to a treatment that cannot be observed are not be accounted for in the matching procedure. Second, small and minor clinical outcome differences might not be detectable due to the small sample size and single-center analyses. However, the significant differences detected are likely to be truly different.

Conclusion

Although OLR for inguinal hernia remains the most prevalent approach in the elderly population, TAPP repair for primary unilateral inguinal hernia could be useful for properly selected elderly patients

and may reduce the demand for postoperative analgesic prescriptions, and the length of hospital stay, compared with Lichtenstein repair.

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