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Mesh size may not affect recurrence in laparoscopic totally extraperitoneal repair of inguinal hernias

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Abstract

A mesh is usually employed to cover defects when performing laparoscopic totally extraperitoneal repair (TEP) of inguinal hernias. However, there is insufficient evidence for an appropriate mesh size. Therefore, we aimed to compare the recurrence rate between large- and medium-mesh laparoscopic TEP. Patients who underwent laparoscopic TEP for primary inguinal hernias from January 2012 to March 2020 were included. We retrospectively reviewed electric medical records. The primary outcome was the difference in recurrence rate between the large and medium meshes. The large mesh was 10.3 × 15.7 cm, and the medium mesh was 7.9 × 13.4 cm or 9 × 13 cm. In total, 446 patients were included in the study. Of these patients, 177 were in the large-mesh group, and 269 were in the medium-mesh group. The average ages of the large- and medium-mesh groups were 58.4 and 56.9 years, respectively (P = .361). In both groups (large vs medium), males were dominant (93.2% vs 93.6%, P = .850), and indirect hernias (87.0% vs 88.1%, P = .740) were dominant. There was no difference in body mass index (P = .883) or hernia side (P = .770). Peritoneal tearing as an intraoperative complication occurred frequently in the large-mesh group (13.6% vs 3.3%, P < .001). During the mean follow-up period of 28 months, recurrence occurred in 3 (1.7%) and 13 (4.8%) patients in the large- and medium-mesh groups, respectively. However, there was no statistical significance (P = .262). Mesh size may not affect recurrence after laparoscopic TEP of primary inguinal hernias.

Abbreviations: ASA = American Society of Anesthesiologists, BMI = body mass index, CI = confidence interval, EHS = European Hernia Society, HR = hazard ratio, IRB = institutional review board, MPO = myopectineal orifice, TAPP = transabdominal preperitoneal repair, TEP = totally extraperitoneal repair.

Keywords: inguinal hernia, laparoscopy, mesh, recurrence, TEP

1. Introduction

As a treatment method for inguinal hernia, the advantages of the laparoscopic approach are widely known. Although laparoscopic totally extraperitoneal repair (TEP) or transabdominal preperitoneal repair (TAPP) has no difference in recurrence rate compared to conventional Lichtenstein repair,[1,2] it has been a proven safe and feasible surgical technique because it reduces the frequency of wound infection, enables an early return to normal daily life, and reduces the frequency of chronic pain.[3] Most importantly, since the TEP technique is performed through an extraperitoneal approach, unlike TAPP, it has the advantage of less mesh exposure to the intraperitoneal organ after surgery and can reduce port-site hernia and visceral injury.[4]

When implementing TEP, it is common to use a mesh to cover defects. According to the European Hernia Society (EHS) guidelines in 2009,[5] it was recommended to use a mesh size of 10 × 15 cm for endoscopic repair. However, the grade of the recommendation was low (grade D), and there was little evidence regarding the mesh size for TEP. It is sometimes difficult to apply a large mesh depending on individual differences in the distance from the pubic bone to the anterior superior iliac spine or the distance from the umbilicus to the

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Code availability: Not applicable.

Ethics approval: This study was approved by the institutional review board (IRB) of the Catholic University of Korea (IRB number: UC21RISI0125). The study was performed in accordance with the relevant guidelines and regulations of the IRB. The investigation conformed with the principles outlined in the Declaration of Helsinki of 1964.

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pubic bone. In particular, according to a recently published paper, if the hernia size is <3 cm, it is not necessary to apply a 10 × 15 cm mesh, so there is no choice but to question the use of this mesh size.[6]

Therefore, we aimed to compare the recurrence rate between the case of using a mesh size of 10 × 15 cm and the case of using a smaller mesh for laparoscopic TEP of inguinal hernias.

2. Methods

This study was approved by the institutional review board (IRB) of our institution and was performed in accordance with the IRB's guidelines and regulations (IRB number: UC21RISI0125).

2.1. Patients

We retrospectively reviewed electric medical records. The inclusion criteria were patients who were diagnosed with primary inguinal hernia and underwent laparoscopic TEP from January 2012 to March 2020 at our hospital. The exclusion criteria were patients who did not undergo preoperative CT; patients who did not use a mesh or used a mesh of undetermined size; patients with open or TAPP conversion; patients with bilateral inguinal hernia; patients with the pantaloon type; and patients with combined femoral hernia.

The hernia orifice size was measured using CT at the level of the internal inguinal ring. The maximum diameter of the sac size was measured with the inferior epigastric vessel as the boundary (Fig. 1a, 1b).

2.2. Procedure

Multiport surgery was performed in 3 ports: one 12 mm port and two 5 mm ports. A transverse skin incision was made below the umbilicus, and a 12 mm trocar was inserted. A 12 mm trocar was used with a Spacemaker™ Plus Blunt Tip Trocar with Round Balloon Dissector (Covidien, USA) to create a peritoneal space. After preperitoneal space dissection below the rectus muscle, two 5 mm trocars were inserted. The first 5 mm trocar was inserted 2 finger positions cranially from the symphysis pubis, and the second 5 mm trocar was inserted between the 12 mm trocar and the first 5 mm trocar.

For the single port surgery, a single 2.5 cm infraumbilical skin incision was made, and the subcutaneous layer and the anterior rectus sheaths were opened by a monopolar energy device. Then, after performing a blunt dissection using a finger to form the preperitoneal space, the ONEPORT® (Tebahkorea, Inc., Republic of Korea) with one 12-mm and three 5-mm instrument access points was inserted into this space (Fig. 2).

Peritoneal space dissection was performed using a straight laparoscopic instrument. The indirect hernia sac was ligated with an absorbable loop or peritonealized without ligation.

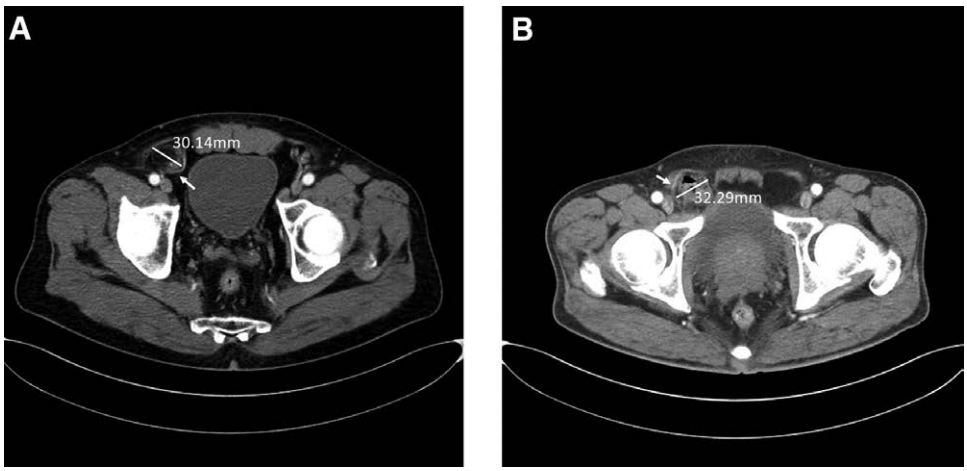

Figure 1. Measurement of hernia orifice size using CT in indirect hernia (a) and direct hernia (b). White arrows indicate inferior epigastric vessels.

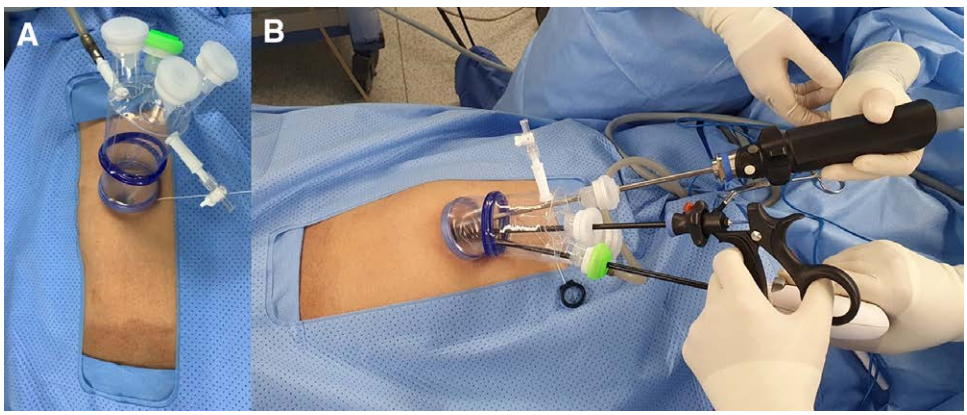

Figure 2. Port placement (a) and surgical instrument use (b) in single-incision laparoscopic totally extraperitoneal repair.

The mesh was placed in the preperitoneal space and was either attached to the pubis or fixed with fibrin glue (Greenplast®, Q prefilled syringe kit (2 ml), Green Cross, Korea). The attending surgeon determined the size and type of mesh based on preference and defect size.

After fixing the mesh, the air in the preperitoneal space was removed. Next, the anterior rectus sheath below the umbilicus was sutured with 2-0 absorbable sutures, and all skin incisions were subcuticularly closed with 4-0 absorbable sutures.

2.3. Mesh size

The large-size mesh was the 3DMax™ light mesh (10.3 × 15.7 cm, Bard Davol, USA), and the medium-size mesh was the 3DMax™ light mesh (7.9 × 13.4 cm, Bard Davol, USA) or Parietex™ Hydrophilic Anatomical Mesh (9 × 13 cm, Sofradim, France).

2.4. Follow-up

For patients who regularly visited the attending physicians, the date of the last visit was the last follow-up day. For patients who did not visit the hospital regularly, the researcher contacted each patient by telephone to confirm recurrence. For these patients, the date of telephone contact was the last follow-up day.

2.5. Outcomes

The primary outcome was the difference in recurrence rate between the large-size and medium-size meshes. Secondary outcomes were factors affecting recurrence.

2.6. Statistical analysis

In the comparison of the 2 groups according to mesh size, Student t test was performed for continuous variables, and the X^2-test was performed for categorical variables. As a primary outcome, recurrence was compared using the Kaplan–Meier curve with the log-rank test. As a secondary outcome, univariable analysis was performed with a Cox regression test to analyze factors affecting recurrence, and multivariable analysis was performed for factors with $P < .1$ in univariable analysis.

According to the research results of Hiratsuka et al, which showed that it is not necessary to use a mesh size of 10 × 15 cm when the hernia orifice is <3 cm,[6] subgroup analysis was conducted only for patients with a hernia orifice size <3 cm. The statistical analysis method mentioned above was used for subgroup analysis.

For statistical analysis, SPSS v.21 (IBM, NY, USA) was used, and differences were considered statistically significant when $P < .05$.

3. Results

3.1. Patient selection

Among 610 consecutive patients who underwent laparoscopic TEP for primary inguinal hernia, 164 patients were excluded according to the exclusion criteria, and a total of 446 patients were included in the study. Of the 446 patients, 177 were in the large-mesh group, and 269 were in the medium-mesh group (Fig. 3).

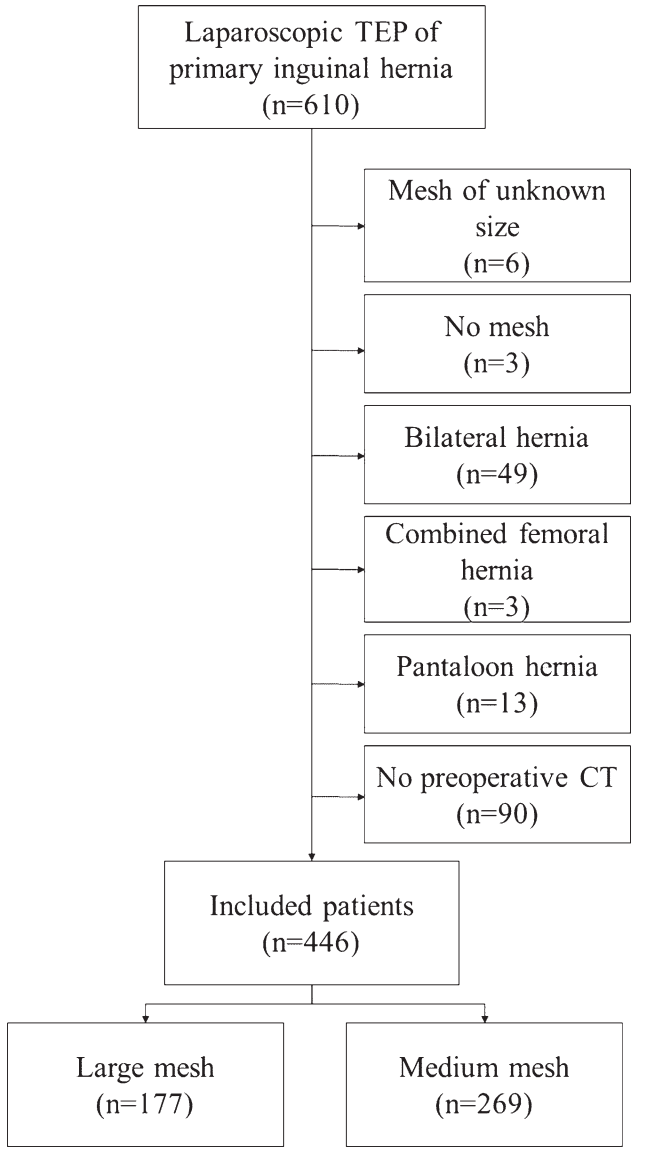

Figure 3. Flow diagram of patient selection.

3.2. Clinical characteristics of the 2 groups

The average ages of the large- and medium-mesh groups were 58.4 and 56.9 years, respectively ($P = .361$). In both groups, males were dominant, and indirect hernias were dominant. There was no difference in BMI (body mass index) ($P = .883$), hernia side ($P = .770$), or American Society of Anesthesiologists (ASA) classification ($P = .077$) (Table 1).

There was also no difference in operating time between the 2 groups, but intraoperative complications included a higher frequency of peritoneal tearing in the large-mesh group (13.6% vs 3.3%, $P < .001$). Postoperative complications did not differ between the 2 groups ($P = .648$).

3.3. Primary and secondary outcomes

As a primary outcome, during the mean follow-up period of 28 months, recurrence occurred in 3 (1.7%) and 13 (4.8%) patients in the large-mesh group and the medium-mesh group, respectively. However, there was no statistical significance ($P = .262$) (Fig. 4).

As secondary outcomes, BMI (hazard ratio (HR) 1.25, 95% confidence interval (CI) 1.07–1.47), direct hernia (HR 2.84, 95% CI 1.03–7.83) and postoperative urinary retention (HR 10.73, 95% CI 2.39–48.24) were statistically significant factors affecting recurrence in the univariable analysis. However, mesh size did not appear to be a factor affecting recurrence (HR 2.04, 95% CI 0.57–7.30). In the multivariable analysis, BMI (HR 1.26, 95% CI 1.06–1.51) and direct hernia (HR 3.07, 95% CI 1.06–8.93) were statistically significant factors affecting recurrence. (Table 2)

Table 1

Clinical characteristics of the 2 groups.

	Large mesh (n = 177)	Medium mesh (n = 269)	*P* value
Age (yr)	58.4 ± 16.4	56.9 ± 17.4	0.361
Sex			0.974
Male	167 (94.4%)	254 (94.4%)	
Female	10 (5.6%)	15 (5.6%)	
Height (cm)	167.0 ± 7.3	166.7 ± 6.9	0.629
Weight (kg)	65.9 ± 9.1	65.6 ± 9.6	0.692
BMI (kg/m^2)	23.6 ± 2.5	23.6 ± 2.7	0.883
BPH history			0.054
None	150 (84.7%)	208 (77.3%)	
Present	27 (15.3%)	61 (22.7%)	
ASA classification			0.077
1	53 (29.9%)	108 (40.1%)	
2	116 (65.6%)	153 (56.9%)	
3	8 (4.5%)	8 (3.0%)	
Hernia side			0.770
Right	111 (62.7%)	165 (61.3%)	
Left	66 (37.3%)	104 (38.7%)	
Hernia type			0.680
Indirect	142 (80.2%)	220 (81.8%)	
Direct	35 (19.8%)	49 (18.2%)	
Mesh fixation			<0.001
Tacker	15 (8.5%)	145 (52.9%)	
Fibrin glue	122 (68.9%)	62 (23.0%)	
Tacker + fibrin glue	40 (22.6%)	62 (23.0%)	
Surgery time (min)	56.1 ± 28.8	54.2 ± 22.8	0.466
Hernia orifice size (cm)	2.0 ± 0.9	2.0 ± 0.8	0.500
Intraoperative complication			
None	153 (86.4%)	259 (96.3%)	<0.001
Bleeding*	0	1 (0.4%)	>0.999
Peritoneal tearing	24 (13.6%)	9 (3.3%)	<0.001
Postoperative complication			
None	154 (87.0%)	233 (86.6%)	0.906
Seroma	16 (9.0%)	23 (8.6%)	0.858
Hematoma	4 (2.3%)	6 (2.2%)	>0.999
Urinary retention	3 (1.7%)	8 (3.0%)	0.538

ASA = American Society of Anesthesiologists, BMI = body mass index, BPH = benign prostate hyperplasia.

*Inferior epigastric vessel injury during space making.

3.4. Subgroup analysis

According to the research results of Hiratsuka et al, which showed that it is not necessary to use a mesh of 10 × 15 cm when the hernia orifice is <3 cm,[6] the analysis was conducted only for patients with a hernia orifice size <3 cm.

There were 146 and 236 patients in the large-mesh group and the medium-mesh group, respectively, and there was no difference in age, sex, BMI, ASA classification, hernia side or hernia type between the 2 groups (Supplement Table 1, Supplemental Digital Content 1, http://links.lww.com/MD/H70).

In the large-mesh group and medium-mesh group, recurrence occurred in 3 patients (2.1%) and 8 patients (3.4%), respectively, and there was no statistically significant difference (*P* = .639) (Fig. 5).

4. Discussion

Our study demonstrated that mesh size did not affect recurrence when laparoscopic TEP was performed for primary inguinal hernia. In particular, when the hernia orifice size was <3 cm, this did not affect recurrence. In particular, when a large mesh was applied, intraoperative peritoneal tearing occurred more frequently.

Compared with Lichtenstein repair, laparoscopic TEP does not show a difference in 5-year recurrence rates (1.2% (Lichtenstein repair) vs 2.4% (laparoscopic TEP), *P* = .109)[2]; however,

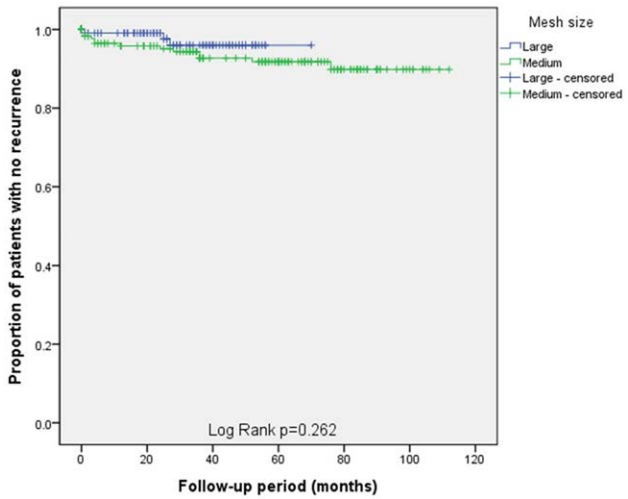

Figure 4. Kaplan–Meier curves for recurrence between the large and medium mesh groups.

laparoscopic TEP has the advantage of decreasing postoperative chronic pain (risk ratio = 0.36, 95% CI 0.21–0.54) and facilitating early return to work/activities (Weighted Mean Difference = −3.6; 95% CI −4.9; −2.4).[7] Most importantly, laparoscopic TEP has the advantage of less visceral injury because it takes an extraperitoneal approach compared to that of TAPP; therefore, our institute mainly uses laparoscopic TEP as a surgical method for inguinal hernias.[5]

In open inguinal hernia surgery, according to the 2009 EHS guidelines, it has been recommended to use a mesh with a size of 7 × 14 cm,[5] and Anitha et al stated that an appropriate mesh size is 9 × 15 cm.[8] On the other hand, the recommendation for an appropriate mesh size for laparoscopic TEP was mentioned as 15 × 15 cm or 10 cm in the 2009 EHS guideline. Furthermore, the International Endohernia Society recommended that the ideal size of mesh for laparoscopic hernia repair be 10 × 15 cm.[9] However, these recommendations were only based on retrospective studies. Therefore, Hiratsuka et al reported that the mesh size can be tailored according to the hernia orifice size.[6] According to Hiratsuka et al, the myopectineal orifice (MPO) size and hernia orifice size were measured together for Asian patients, and through the correlation between MPO size and hernia orifice size, a mesh with a size of 10.4 × 13.2 cm for hernia orifices <3 cm and a mesh with a size of 13 × 15.6 cm for hernia orifices of 3 cm or more were recommended. As a follow-up to that investigation, our study demonstrated that there was no difference in recurrence according to the mesh size, especially in cases with a hernia orifice <3 cm in size.

When laparoscopic TEP is performed, parietalization must be performed to apply the mesh appropriately. The range of parietalization may vary depending on the mesh size; however, there may be differences in the distance from the pubic bone to the anterior superior iliac spine or from the umbilicus to the pubic bone for each patient, which may lead to unnecessary parietalization. Because peritoneal tearing may occur during wide parietalization, it is necessary to reduce unnecessary peritonealization by using an appropriate mesh for the hernia orifice or size of the trunk. According to the mean height and waist circumference in adults reported by Cheryl D. Fryar in 2018, the average height of nonHispanic Asian men was approximately 7 cm smaller than that of nonHispanic white or nonHispanic black men.[10] Furthermore, the waist circumference of nonHispanic Asian men is also 8–12 cm smaller than that of nonHispanic white or nonHispanic black men.[10] Given that the majority of the patients included in our study were male of nonHispanic Asian descent, the umbilacal-pubic and pubic-iliac distances are bound to be smaller than those of other races.

Table 2

Univariate and multivariate analysis for factors affecting recurrence.

			Univariate			Multivariate		
	No recurrence (n = 430)	Recurrence (n = 16)	HR	95% CI	*P* value	HR	95% CI	*P* value
Age (yr)	57.5 ± 17.1	58.4 ± 12.7	1.01	0.97–1.04	0.760			
Sex					0.591			
Male	405 (94.2%)	16 (3.6%)	21.43	0.00–1553466.21				
Female	25 (100%)	0	1 (ref)					
BMI (kg/m^2)	23.5 ± 2.6	25.5 ± 2.8	1.25	1.07–1.47	0.006	1.26	1.06–1.51	0.009
BPH history					0.162			
None	347	11 (3.1%)	1 (ref)					
Present	(96.9%)	5 (5.7%)	2.13	0.74–6.12				
	83 (94.3%)							
ASA classification					0.790			
1	156 (96.9%)	5 (3.1%)	1 (ref)					
2	259 (96.3%)	10 (3.7%)	1.25	0.43–3.67	0.686*			
3	15 (93.8%)	1 (6.2%)	2.06	0.24–17.67	0.510*			
Hernia side					0.641			
Right	267 (96.7%)	9 (3.3%)	1 (ref)					
Left	163 (95.9%)	7 (4.1%)	1.27	0.47–3.41				
Hernia type					0.043			0.040
Indirect	352 (97.2%)	10 (2.8%)	1 (ref)			1 (ref)		
Direct	78 (92.9%)	6 (7.1%)	2.84	1.03–7.83		3.07	1.06–8.93	
Hernia orifice size (cm)	2.0 ± 0.8	2.4 ± 0.9	1.52	0.90–2.57	0.117			
Mesh size					0.273			
Large	174 (98.3%)	3 (1.7%)	1 (ref)					
Medium	256 (95.2%)	13 (4.8%)	2.04	0.57–7.30				
Mesh fixation					0.321			
Tacker	151 (94.4%)	9 (5.6%)	1 (ref)					
Fibrin glue	178 (96.7%)	6 (3.3%)	0.95	0.322–2.82	0.953†			
Tacker + fibrin glue	101 (99.0%)	1 (1.0%)	0.21	0.03–1.65	0.137†			
Intraoperative Cx					0.500			
None	396 (96.1%)	16 (3.9%)	1 (ref)					
Peritoneal tearing	33 (100%)	0	0.05	0.00–373.36				
Postoperative Cx								
Seroma or hematoma								
None	385 (97.0%)	12 (3.0%)	1 (ref)					
Present	45 (91.8%)	4 (8.2%)	2.05	0.66–6.38	0.214			
Urinary retention								
None	421 (97.9%)	14 (3.2%)	1 (ref)			1 (ref)		0.059
Present	9 (81.8%)	2 (18.2%)	10.73	2.39–48.24	0.001	4.63	0.94–22.72	

*Versus ASA classification 1.

†Versus Tacker.

Abbreviations: ASA = American Society of Anesthesiologists, BMI = body mass index, BPH = benign prostate hyperplasia, CI = confidence interval, Cx = complication, HR = hazard ratio, Ref = reference.

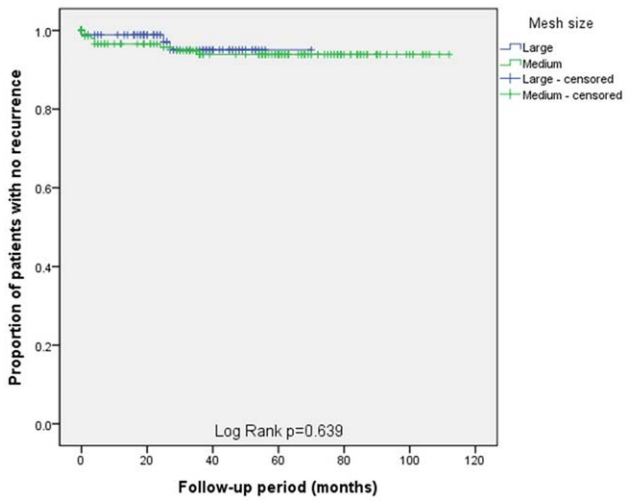

Figure 5. Kaplan–Meier curves for recurrence between the large- and medium-mesh groups in patients with a hernia orifice under 3 cm.

The MPO is known as a weak point in the lower abdomen where inguinal hernia can occur.[11] There are studies suggesting that it is better to measure the MPO during surgery for an inguinal hernia and apply a mesh to cover approximately 3–5 cm.[8,12] A group has published a 3D visualization program for measuring the actual MPO, so if this program is put into clinical practice, it would be better for applying a mesh size suitable for each patient.[13]

In our study, BMI (HR 1.26, 95% CI 1.06–1.51) and direct hernia (HR 3.07, 95% CI 1.06–8.93) were statistically significant factors affecting recurrence. These results were similar to the findings in previous literature. Schjoth-Iversen et al reported that the risk of recurrence was 3 times higher in the BMI > 30 group than in the BMI < 30 group.[14] In terms of the location of hernias, Schjoth-Iversen et al reported that direct hernias also had a higher recurrence rate than indirect hernias.[14] In addition, Burcharth et al demonstrated that direct hernia had a higher recurrence rate (HR: 2.37) than indirect hernia through a large-scale epidemiologic study.[15]

A limitation of our investigation is that it was a retrospective single-center study. Second, because it was a study conducted in Asia (specifically, Korea), it may be difficult to apply the findings to other races. Nevertheless, our study is significant in that it confirmed the effect of mesh size on hernia recurrence after

laparoscopic TEP in a large number of patients. Third, our study did not check for MPO, unlike other studies. However, it is significant that our clinical investigation proved that the general large-size mesh (10×15 cm) had no effect on recurrence in the group of patients with hernia size < 3 cm, as claimed by Hiratsuka et al Fourth, there was a difference in mesh fixation between the 2 groups because the anatomical mesh (9×13 cm) was mainly used until December 31, 2016, glue was not used for mesh fixation, and only a tacker was used until December 31, 2015. However, since the mesh fixation method was not found to be a factor influencing recurrence in 2 meta-analyses[16,17] and based on these documents, the 2018 International Guidelines for groin hernia management suggested that mesh fixation was not necessary when implementing TEP.[18] In our results, the mesh fixation method was found to have no effect on recurrence, so matching was not performed. Fourth, although the mean follow-up period of 28 months in our study seems sufficient to confirm early recurrence, there is a limitation in the detection of late recurrence. In addition, objective methods, such as ultrasonography or CT, were not used for all patients to check for recurrence. Therefore, long-term follow-up studies with a regular follow-up period of more than 3 years using ultrasonography are needed.

5. Conclusion

Mesh size may not be expected to affect recurrence when laparoscopic TEP is performed for primary inguinal hernias. In particular, when the hernia orifice size is <3 cm, it is seemingly not necessary to widen the range of parietalization for use of a 10×15 cm-sized large mesh. Further well-designed prospective studies are needed to corroborate our results.

Author contributions

KYL and JIL designed the study. KYL and JIL collected the data and performed the statistical analysis. KYL, JIL, YYP, HJK, and STO interpreted the results of the analysis and prepared the manuscript. All authors contributed extensively to the work presented.

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