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Comparison of Intraperitoneal and Extraperitoneal Approaches in Laparoscopic Incisional Hernia Surgery

Laparoskopik Insizyonel Herni Cerrahisinde Intraperitoneal ve Ekstraperitoneal Yaklaşımların Karşılaştırılması

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ABSTRACT

Background: Incisional hernias (IHs) are one of the most important problems that can be seen after abdominal surgeries. In recent years, the application of minimally invasive techniques in the repair of these hernias has increased. Laparoscopic IH surgeries (LIHSs) can be performed with an intraperitoneal or extraperitoneal approach. In this study, we aimed at compare the approaches to LIHSs performed from these two different planes.

Materials and Methods: In our single-center and retrospective designed study, LIHSs performed by a hernia-specific general surgery team between January 2022 and December 2023 were scanned. They were evaluated in two groups as intraperitoneal and extraperitoneal. Demographic data, hernia findings, duration of surgery, postoperative pain score, duration of hospital stay, complications, and follow-up results were analyzed.

Results: A total of 79 laparoscopically operated IH cases were included in the study. Of these patients, 49 were operated on intraperitoneally and 30 were operated on extraperitoneally. No significant difference was observed between the groups in terms of age, gender, body mass index, anesthesia score, and smoking. The duration of surgery was significantly shorter in the intraperitoneal group ($p<0.001$). The pain score on the first postoperative day was lower in the extraperitoneal group ($p=0.001$). No significant difference was found between the groups in terms of seroma and recurrence in the follow-up.

Conclusion: In LIHS, both intraperitoneal and extraperitoneal techniques can be safely applied due to low complications and acceptable recurrence rates.

Keywords: Extraperitoneal, incisional hernia, intraperitoneal onlay mesh, laparoscopic hernia surgery

ÖZ

Amaç: İnsizyonel herniler (İH), abdominal cerrahilerden sonra görülebilen en önemli sorunlardan biridir. Son yıllarda bu hernilerin onarımında minimal invaziv tekniklerin uygulanması artmıştır. Laparoskopik İH cerrahileri (LİH) intraperitoneal veya ekstraperitoneal yaklaşımla gerçekleştirilebilir. Bu çalışmada, bu iki farklı plandan gerçekleştirilen LİHC yaklaşımları karşılaştırmayı amaçladık.

Gereç ve Yöntemler: Tek merkezli ve retrospektif olarak tasarlanmış çalışmamızda, Ocak 2022 ile Aralık 2023 arasında herniye özgü genel cerrahi ekibi tarafından gerçekleştirilen LİHC tarandı. İntraperitoneal ve ekstraperitoneal olmak üzere iki grupta değerlendirildi. Demografik veriler, herni bulguları, ameliyat süresi, postoperatif ağrı skoru, hastanede kalış süresi, komplikasyonlar ve takip sonuçları analiz edildi.

Bulgular: Çalışmaya laparoskopik olarak opere edilen toplam 79 insizyonel herni olgusu dahil edildi. Bu hastalardan 49'u intraperitoneal, 30'u ise ekstraperitoneal olarak opere edildi. Gruplar arasında yaş, cinsiyet, vücut kitle indeksi, anestezi skoru ve sigara kullanımı açısından anlamlı fark gözlenmedi. Ameliyat süresi intraperitoneal grupta anlamlı olarak daha kısaydı ($p<0,001$). Ameliyat sonrası birinci gün ağrı skoru ekstraperitoneal grupta daha düşüktü ($p=0,001$). Gruplar arasında takipte seroma ve nüks açısından anlamlı fark bulunmadı.

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ÖZ

Sonuç: LİHC hem intraperitoneal hem de ekstraperitoneal teknikler düşük komplikasyon ve kabul edilebilir nüks oranları nedeniyle güvenle uygulanabilir.

Anahtar Kelimeler: Ekstraperitoneal, insizyonel herni, intraperitoneal onlay mesh, laparoskopik herni cerrahisi

Introduction

Incisional hernias (IHs) are a common complication that can be seen especially after open abdominal surgeries, and have an incidence of 2-20% (1). IHs can be asymptomatic or can lead to serious complications such as incarceration and strangulation, and they can especially cause pain and problems that impair the quality of life of patients (2). Surgical repairs constitute the basis of hernia treatment. The importance of hernia surgery is increasing due to an increasing number of major surgical operations performed with laparotomy and the prevalence of risk factors such as obesity and an elderly population (3).

Until the recent past, IHs were treated with open mesh repair methods. In recent years, laparoscopic hernia surgeries have become increasingly preferred due to advantages such as fewer wound complications and shorter hospital stay, as well as the ability to detect additional hernias with a wide field of view during surgery (4). In laparoscopic IH surgery (LIHS), the first intraperitoneal onlay mesh (IPOM), which is based on the principle of intraperitoneal mesh placement, and later the IPOM Plus technique, which is modified by closing the hernia defect, was applied (5). With the concern that the intraperitoneal approach carries some complication risks, the enhanced-view totally extraperitoneal (e-TEP) technique was developed for LIHS, based on the totally extraperitoneal (TEP) technique in inguinal hernia surgery (6). After these techniques became increasingly widespread, LIHS expanded its scope. In particular, the definition of various technical modifications and the introduction of different mesh types led to the lack of a general standard approach for LIHS (7).

In this study, we aimed to compare our surgical results using the intraperitoneal (IPOM Plus) and extraperitoneal (e-TEP) techniques, which are the most commonly applied techniques in LIHS and are studied in different anatomical planes.

Materials and Methods

Case Selection and Data Collection

After the establishment of a hernia-specific surgery unit within the general surgery clinic of our hospital, data from LIHS performed by the hernia team between January 2022 and December 2023 were retrospectively scanned for inclusion in the study. The classifications of the European Hernia Society (EHS) were used for both midline and non-midline IHs (8). Age, gender, body mass index (BMI, kg/m^2), presence of comorbidity, smoking, American Society of Anesthesiology (ASA) score, location of hernia (according to EHS), hernia diameter (4 cm = W1, 4-10 cm = W2), surgical technique (intraperitoneal/extraperitoneal), surgical duration, Visual Analog Scale (VAS) score on the first postoperative day (pain grading as "0" points for no pain and "10" points for the most severe pain), hospital stay (days), complications (seroma, hematoma) within the first three months of postoperative surgery, unexpected re-admissions within the first 30 days of postoperative surgery, and recurrence status within at least one year of follow-up were retrospectively recorded and analyzed. Cases that started with laparoscopic surgery and were converted to open surgery, and patients who did not continue their postoperative follow-up were not included in the study.

Surgical Techniques

The decision on which technique to apply to the patients was made according to patient factors and surgeon preference. Very large hernias (diameter 10 cm and above) and complex volume hernias (presence of loss of domain) were not included in this study because different protocols were conducted.

Intraperitoneal Technique

Trocar sites were determined so that the monitor was placed opposite the surgeon, and the sites formed a triangular position relative to the hernia area (Figure 1). The abdomen was explored under 12 mmHg pressure using a 10 mm camera trocar, with the help of a Veress needle and an optical trocar. At least two 5 mm working trocars were inserted into the abdomen. If the hernia content was not reducible, it was reduced and adhesiolysis was performed (Figure 2). Even if the hernia defect was small, the defect was first closed with barbed suture. The measurement was then made, and the appropriate-sized composite mesh was laid from the abdomen to the hernia area and fixed with an absorbable tacker (IPOM Plus).

Figure 1. Port placement positions according to hernia location for intraperitoneal approach

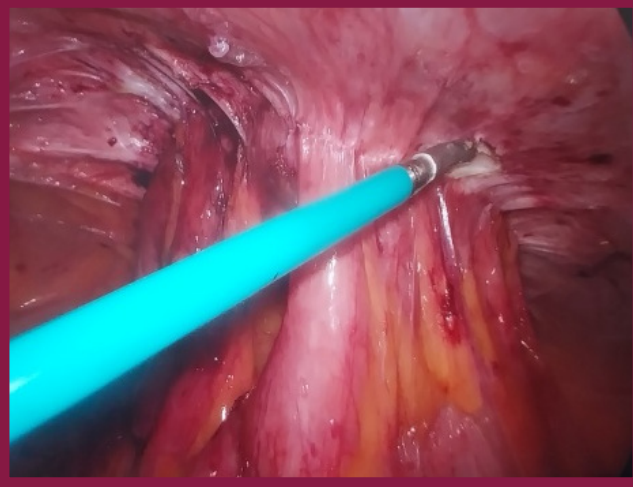

Figure 2. Visualization of hernia contents from the intraperitoneal area and initiation of adhesiolysis process

Figure 3. Placement of ports for extraperitoneal technique

Figure 4. Placement of polypropylene mesh in the extraperitoneal space

Extraperitoneal Technique

The monitor was positioned opposite the surgeon to be worked with effectively. Depending on the location of the hernia, an incision was made close to the costal arch in the right or left upper quadrant of the abdomen, through which the anterior rectus sheath and rectus muscle were accessed using an optical trocar (Figure 3). After entering the retromuscular area and opening it with optical dissection, at least two more 5 mm trocars were inserted into the site. After completing the hernia sac dissection through passing from the linea alba plane to the contralateral retrorectus plane, the posterior and anterior defects were closed with a barbed suture. After measuring the mesh area, the prolene mesh was prepared and laid in the retromuscular area, and the surgery was terminated with desufflation and trocar removal (e-TEP Rives-Stoppa, Figure 4). In large defects, a transversus abdominis release modification was added to allow tension-free closure of the hernia area.

Postoperative Follow-up Protocol

A respiratory exercise ball was used for postoperative respiratory physiotherapy. Postoperative outpatient clinic follow-ups are routinely performed in our hernia-specific unit in the first week, first month, third month, sixth month,

Table 1. Demographic data and preoperative clinical characteristics of groups

n		IPOM Plus		e-TEP		Total		p-value
		%	n	%	n	%		
Gender	Female	29	59.2	19	63.3	48	60.8	0.714
	Male	20	40.8	11	36.7	31	39.2	
Age	Mean ± SD	52.84±11.34		49.87±11.44		51.71±11.40		0.266[b]
BMI (kg/m²)	Mean ± SD	30.75±4.13		30.90±3.88		30.81±4.02		0.872[b]
ASA score	ASA 1	8	16.3	5	16.7	13	16.5	0.137[a]
	ASA 2	27	55.1	22	73.3	49	62	
	ASA 3	14	28.6	3	10	17	21.5	
Comorbidity	No	26	53.1	24	80	50	63.3	**0.016[a]**
	Yes	23	46.9	6	20	29	36.7	
Smoking	No	26	53.1	15	50	41	51.9	**0.792[a]**
	Yes	23	46.9	15	50	38	48.1	

[a]Pearson chi-square test, [b]Independent samples t-test
ASA: American society of anesthesia, BMI: Body mass index, IPOM: Intraperitoneal onlay mesh, e-TEP: Enhanced-view totally extraperitoneal, SD: Standard deviation

and first year. In case of hematoma, seroma, or recurrence findings in physical examination, radiological examinations are used. Follow-up examination information is recorded in the hospital information management system.

Statistical Analysis

The statistical analyses of this study were performed using the IBM SPSS Statistics program for Windows, Version 29.0.2.0 (IBM Corp., Armonk, NY, USA). The conformity of continuous variables with a normal distribution was assessed with Kolmogorov-Smirnov and Shapiro-Wilk tests. In comparisons between groups, the Pearson chi-square test or the Fisher's exact test was used for categorical variables under appropriate conditions. An independent samples t-test was applied when continuous variables showed a normal distribution, or a Mann-Whitney U test was applied when they did not show a normal distribution. Categorical data were reported as frequency and percentage [% (n)], normally distributed continuous data as mean ± standard deviation, and non-normally distributed continuous data as median [interquartile range (IQR)]. In all tests, $p<0.05$ was considered statistically significant.

Ethical Approval

This single-center and retrospective study followed the "Strengthening the Reporting of Observational Studies in Epidemiology" guidelines. The study protocol was developed in accordance with the ethical principles of the current Declaration of Helsinki. Ethical approval for the study was obtained from the Başakşehir Çam and Sakura City Hospital Clinical Research Ethics Committee (approval number: 2023-624, dated: 13.12.2023). All patients were informed about the surgical procedures before surgery and signed an informed consent form.

Results

A total of 79 patients who underwent LIHS during the study period and met the study criteria were included. Of these patients, 49 were operated on intraperitoneally with the IPOM Plus technique (62%) and 30 were operated on extraperitoneally with the e-TEP technique (38%). Gender and age distribution was similar between the groups, and no statistical difference was found (p=0.714/p=0.266). No significant difference was found between the groups in terms of mean body mass index and ASA scores (p=0.872/p=0.137).

A total of 29 patients (36.7%) had at least one additional disease. The rate of additional diseases was significantly lower in the e-TEP group (p=0.016). No significant difference was found between the groups in terms of smoking (p=0.792); a total of 38 patients (48.1%) were smokers, and 41 patients (51.9%) were non-smokers (Table 1).

The most common location in the midline (M-midline) distribution was the umbilical region (M3). It was detected in 54 patients (68.4%). Lateral (L) localizations were observed in 14 patients (Table 2).

When evaluated for W-width, the defect width was measured at less than 4 cm (W1) in 8 patients (10.1%). The defect width of all e-TEP patients was between 4 and 10 cm (W2) (p=0.021).

The operation time was found to be significantly longer, with a median of 155 minutes (IQR: 120-188.7) in the e-TEP group and 95 minutes (IQR: 75-142.5) in the IPOM Plus

Table 2. Comparison of perioperative and postoperative outcomes of groups

		IPOM Plus		e-TEP		Total		p-value
		n	%	n	%	n	%	
Hernia locations (according to EHS)	M2: Epigastric	10	20.4	1	3.3	11	13.9	NA
	M3: Umbilical	33	67.3	21	70	54	68.4	
	M4: Infraumbilical	2	4.1	2	6.7	4	5.1	
	M5: Suprapubic	0	0.0	3	10	3	3.8	
	L1: Subcostal	2	4.1	1	3.3	3	3.8	
	L2: Flank	1	2.0	0	0.0	1	1.3	
	L3: Iliac	1	2.0	1	3.3	2	2.5	
	L4: Lumbar	0	0.0	1	3.3	1	1.3	
Width (cm)	W1:<4	8	16.3	0	0.0	8	10.1	**0.021**[a]
	W2:4-10	41	83.7	30	100	71	89.9	
Surgery time (minutes)	Median (IQR)	95	75-142.5	155	120-188.7	115	85-160	**<0.001**[b]
VAS score (po day 1)	Median (IQR)	4	3-6	3	3-4	4	3-5	**0.001**[b]
Length of stay (days)	Median (IQR)	3	2-3.5	3	2-3	3	2-3	0.944[b]
Complication	No	43	87.8	25	83.3	68	86.1	0.582[a]
	Yes	6	12.2	5	16.7	11	13.9	
Seroma	No	44	89.8	26	86.7	70	88.6	0.671[a]
	Yes	5	10.2	4	13.3	9	11.4	
Hematoma	No	47	95	28	93.3	75	94.9	0.611[a]
	Yes	2	4.1	2	6.7	4	5.1	
Unexpected readmission (first 30 days)	No	46	93.9	27	90	73	92.4	0.528[a]
	Yes	3	6.1	3	10	6	7.6	
Recurrence (at least 1 year)	No	46	93.9	29	96.7	75	94.9	0.583[a]
	Yes	3	6.1	1	3.3	4	5.1	

[a]Fisher's exact test, [b] Mann-Whitney U test
NA: Not applicable, EHS: European Hernia Society, e-TEP: Enhanced-view totally extraperitoneal, IQR: Interquartile range, IPOM: Intraperitoneal onlay mesh, Po: Postoperative, VAS: Visual Analog Scale

group (p<0.001). Postoperative first day pain scores were higher in the IPOM Plus group, with a median of 4 (IQR: 3-6) compared to the e-TEP group, with a median of 3 (IQR: 3-4) (p=0.001) (Table 2).

The number of patients who developed complications was 11 (13.9%) in total, with 6 patients (12.2%) in the IPOM Plus group and 5 patients (16.7%) in the e-TEP group (p=0.582). Seroma development was observed in 9 patients (11.4%). Five of these patients were in the IPOM Plus group and four in the e-TEP group (p=0.671). The number of patients with hematoma was 4 (5.1%); 2 cases were detected in both groups (p=0.611). The number of patients who were re-admitted to the hospital within the first 30 days after surgery was 3 (6.1%) in the IPOM Plus group and 3 (10.0%) in the e-TEP group, totaling 6 (7.6%) (p=0.528). The reasons for these applications were subileus and abdominal pain in the IPOM Plus group and nonspecific abdominal pain in the e-TEP group. All patients were followed up as outpatients with symptomatic treatment. During the follow-up period, a total of 4 patients (5.1%) developed recurrence. Three of them were in the IPOM Plus group and one in the e-TEP group (p=0.583) (Table 2). No intraoperative complications developed in any patient. No hernia-related mortality was observed during the hospitalization and follow-up periods.

Discussion

Yet, there is no consensus in the literature on which technique is superior in LIHS (9). In this study, the results of IPOM Plus and e-TEP methods were compared in the context of LIHS in our hernia-specific general surgery unit.

Although the e-TEP procedure seemed to be advantageous in terms of postoperative pain, longer operative times were a disadvantage.

Intraperitoneal approaches have a faster learning curve due to the wide field of view, but they are not preferred by some surgeons due to various associated risks. Since the procedures are operated in a narrower area, the learning curve of the e-TEP technique requires significant experience. Therefore, intraoperative times are longer in the e-TEP technique (10). Sholapur et al. (11) reported that in their prospective study comparing IPOM Plus and e-TEP in ventral hernias, the hospital stay (5.9±2.19 days) and the postoperative first day VAS score (3.2±1.11) were higher in the IPOM Plus group, while the surgery time (192.3±16.20 minutes) was higher in the e-TEP group.

The intraoperative success of intraperitoneal and extraperitoneal approaches is affected by demographic and personal factors to a minor extent. In a study comparing intraperitoneal and extraperitoneal techniques, no statistically significant difference was found between the groups in terms of age, gender, BMI, ASA score, and active smoking (12). In our study, no difference was found between the groups in terms of gender, age, ASA score, BMI, and smoking. The main determinant of patient comfort in the early period after hernia surgeries is the severity of pain. In the intraperitoneal technique, the use of absorbable or nonabsorbable tacker during the fixation of the mesh to the parietal peritoneum significantly shortens the operation time and is the main cause of postoperative pain (13). On the other hand, in the extraperitoneal technique, because the mesh placed in the retromuscular area does not need to be fixed most of the time, it eliminates an additional cause of pain. Although it is considered advantageous in terms of less postoperative pain, the longer operation time in the e-TEP technique has been identified as a disadvantage in many studies. In the same studies, VAS scores were found to be high due to significant postoperative pain in the intraperitoneal technique, and this was shown to be the cause of prolonged hospital stays (10-12).

Another undesirable situation after hernia surgery is unexpected re-admissions. Especially in the intraperitoneal technique, the direct contact of the mesh with the abdominal organs was associated with paralytic ileus attacks in the postoperative period (14). In our study, unexpected admissions occurred in the first month after both procedures. While non-specific abdominal pain was observed in the e-TEP group, subileus attacks were the main reason for admission in the intraperitoneal technique group. Wieland et al. (15) presented general and subgroup analyses regarding postoperative complications in their study comparing both techniques. The general postoperative complication rate was found to be higher in the IPOM group (e-TEP: 4.17%, IPOM: 25%, p=0.009). However, complications were more severe in the e-TEP group, and those that could be managed with symptomatic treatment were more prominent, in the IPOM group (15). There are also studies in the literature that provide different results, and a meta-analysis including 433 patients reported that there was no significant difference in the incidence of seroma, hematoma, intraoperative complications, and postoperative ileus between the e-TEP and IPOM groups (16). Similarly, the overall complication rate in our study was 13.9%. All of these were mild complications that could be treated symptomatically, and there was no significant difference between the groups.

Seromas, which are frequently observed after hernia surgery, are usually asymptomatic. Since most seromas regress spontaneously, it is recommended to wait unless they cause serious symptoms, and to avoid performing aspiration if possible due to the risk of infection (3,14). The overall seroma rate in our study was 11.4% and all seromas regressed completely within three months without the need for additional intervention.

In the literature, the recurrence rate after LIHS is reported to be between 1% and 7% (17-19). However, since publications reporting low recurrence rates include data from a six-month postoperative follow-up period, this period may not be sufficient to detect recurrences. Therefore, we planned the shortest follow-up period to be 12 months in our study.

This study has some limitations. The most important of these are the retrospective study design, single-center study nature, and the small number of patients included in the study. The limitations resulting from the small sample size and single-center design prevent the generalization of the study results. In addition, since laparoscopic procedures require technological infrastructure, these procedures may not be applicable in every hospital. Despite all these limitations, it should not be forgotten that the surgical team in the study was a general surgery team working specifically on hernias. This specialization may have prevented some additional problems caused by inexperience.

Conclusion

Since there are no major complications in LIHS, both techniques can be applied safely. The shorter operation time in the IPOM technique and less postoperative pain in the eTEP technique can be seen as advantages. Patient factors and surgeon experience come to the fore in the selection of the procedure based on current information.

Ethics

Ethics Committee Approval: Ethical approval for the study was obtained from the Başakşehir Çam and Sakura City Hospital Clinical Research Ethics Committee (approval number: 2023-624, dated: 13.12.2023).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: H.K., S.Y., M.D., F.G., İ.K., Concept: H.K., İ.K., Design: H.K., S.Y., M.D., Data Collection or Processing: H.K., S.Y., F.G., İ.K., Analysis or Interpretation: H.K., F.G., Literature Search: H.K., S.Y., M.D., F.G., Writing: H.K., M.D., F.G.

Conflict of Interest: No conflict of interest was declared by the authors.

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