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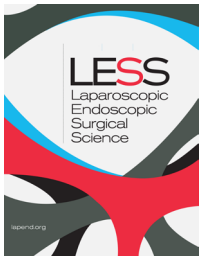

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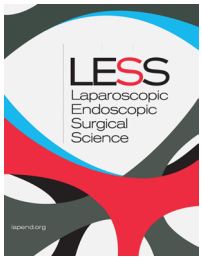

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RESEARCH ARTICLES

LETTER TO THE EDITOR

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Original Article

Learning total extraperitoneal (TEP) herniorrhaphy without supervision: A study on proficiency, efficiency, and safety

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ABSTRACT

Introduction: This study investigated the learning curve (LC) of TEP herniorrhaphy performed without supervision and with telescopic dissection.

Materials and Methods: This study was a retrospective data analysis. Patients who underwent inguinal hernia repair via the TEP method between April 2009 and December 2012 were included. Data from patient records, such as demographic information, hernia type, surgical details, intraoperative and postoperative complications, conversion to other surgical techniques, and early hernia recurrence, were collected and analyzed.

Results: A total of 141 patients were included in the study. The mean age was 48.5±14.7 years, and 131 (92.9%) patients were male. The mean surgery duration was 66.7±15.3 minutes. After performing 75 TEP herniorrhaphy surgeries, a significant reduction in operative time was observed ($p<0.001$). The study also reported that 9.2% of surgeries required conversion to other techniques, such as transabdominal preperitoneal (TAPP) or open hernia repair, with the conversion rate decreasing after the 75th surgery. Of the 12 conversions, 9 occurred during the first 75 cases, whereas only 3 were recorded afterward.

Postoperative complication rates remained consistently low throughout the study. Hematoma was observed in only 1.4% of patients, seroma in 4.3%, and mesh infection in 0.7%. There was no significant difference in complication rates before and after the 75-case threshold, suggesting that the safety of the procedure was maintained throughout the learning process. Early recurrence of hernia occurred in one patient (0.79%) within the first month.

Conclusion: This study demonstrated that surgeons with sufficient laparoscopic experience can effectively and safely learn TEP herniorrhaphy without the need for supervision or the use of a balloon dissector, a tool that typically increases procedural costs. However, more complex cases should be approached cautiously until the LC is fully established.

Keywords: Complication rates, hernia repair, laparoscopic surgery, learning curve, operative time. TEP herniorrhaphy, unsupervised surgery

Introduction

The process of inguinal hernia surgery, which began in the 16th century with the Italian anatomist Gabriele Fallopio, advanced with the tissue repair method introduced by Bassini in 1887. To date, more than 100 different techniques described for the repair of inguinal or femoral hernias can be categorized into open (tissue and mesh repair) and laparoscopic mesh repair.[1–4]

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The latest international guidelines from the Hernia Surge Group now recommend the TEP and TAPP techniques (laparoscopic), the Lichtenstein method (open mesh repair), and, with some limitations, the Shouldice technique (mesh-free).[5,6]

In the last guidelines, laparo-endoscopic techniques result in less chronic pain and faster recovery than Lichtenstein repair. If the surgeon is sufficiently experienced with the technique, laparo-endoscopic procedures do not require longer operative times. The high cost can decrease across open techniques, and no significant differences are observed in terms of perioperative complications requiring reoperation between the laparo-endoscopic and Lichtenstein techniques.[6]

Compared with open surgery, laparoscopic surgery is generally considered more challenging because of its unique anatomy and limited workspace, particularly in TEP repair.[6] Additionally, the learning curve for the TEP technique is longer and steeper due to the "inside-out anatomical view" that the surgeon is not accustomed to.

Several studies have been conducted to describe the LC for the TEP and TAPP techniques, and the LC varies between 20 and 250 cases.[7–10] However, there is no consensus in the literature regarding the exact number of cases that a surgeon must perform to determine the LC.[7] LC assessment is generally evaluated through parameters such as operative time, intraoperative and postoperative complications, patient outcomes, and technical difficulty.[11]

This retrospective study was conducted to estimate the number of cases required for the LC in TEP herniorrhaphy without supervision and without using a balloon dissector.

Materials and Methods

Patients who were diagnosed with inguinal hernia and admitted to our clinic between April 2009 and December 2012 were evaluated retrospectively. They underwent elective surgery by a single surgeon, using the TEP herniorrhaphy method for the first time, without a supervisor and without the use of a balloon dissector.

Inclusion Criteria

- Unilateral and primary hernias.
- Aged between 18 and 75 years.
- Body mass index (BMI) under 35.

Exclusion Criteria

- Patients with bilateral and/or recurrent hernias and large scrotal hernias.
- Patients presenting in emergencies (irreducible, incarcerated).
- Patients with infraumbilical incisions, colostomy, or ileostomy performed or applied.

Out of a total of 195 patients who underwent TEP herniorrhaphy, 24 patients with bilateral and/or recurrent hernias and 30 patients with unilateral recurrent hernias were excluded. One hundred forty-one patients who had unilateral and primary hernias were included in the study.

The diagnosis was made through physical examination and was necessitated with ultrasonography. Patients were discharged with an oral analgesic and maintained without the need for IV analgesics, as indicated by their visual analog scale (VAS) score. When the drainage volume from the drain fell below 20 cc, it was removed either in the hospital or during the follow-up appointment. Patients were called for follow-up after 7 days and 30 days post-discharge.

The hernias were classified as follows: direct (D), indirect (ID), femoral (F), and combined hernia. Patients' demographic characteristics, hernia type, surgery duration, intraoperative complications (vascular and organ injury, bleeding), peritoneal injury, use of a Veress needle, fixation and conversion to different methods, drain use and duration, length of stay, and postoperative complications (bleeding, hematoma, seroma, mesh infection, and early recurrence at the one-month mark) were evaluated.

The surgery duration was defined as the time from the first skin incision until the camera port was removed. Intraoperative complications were defined as vascular injuries (epigastric or testicular artery, etc.), damage to the ductus deferens, and organs. Postoperative complications such as hematoma or seroma were defined as the accumulation of blood or fluid in any subcutaneous tissue area up to the scrotal region. Early recurrence was defined as recurrence occurring within the first 4 weeks.

All patients were operated on by the same surgeon, who was experienced in laparoscopy (more than 300 laparoscopic cholecystectomies) and had performed more than 400 Lichtenstein inguinal hernia repairs but had no experience in laparoscopic TEP herniorrhaphy. All surgeries were performed via the same technique.

The LC evaluation parameters included surgery duration, conversion from TEP to TAPP or open surgery, intraoperative complications, and postoperative complications.

All procedures were conducted in accordance with the 1964 Helsinki Declaration and subsequent guidelines on ethical principles, and informed consent was obtained from all patients included in the study. The Ethics Committee approved this study (Date: 13.06.2024; No: 2024/96).

Surgical Technique

The surgeries were performed under general anesthesia. Three infraumbilical trocars or two infraumbilical trocars and one trocar on the hernia side were placed in the region of the anterior superior iliac spine. A 0° telescope was used to perform blunt dissection up to the pubic bone under CO2 insufflation, while the medial side of the rectus muscle was dissected, and the camera was changed to a 30° telescope. Blunt dissection was initiated without a balloon expander.

If there was any rupture in the peritoneum that hindered work, a Veress needle was sent into the abdomen through the camera port area. If it could not be controlled with Veress, repair was performed. When conversion was needed, the procedure was switched to open surgery or TAPP in favor of the patient. In direct large hernias, the hernia sac on the anterior wall was fixed to the pubic bone.

After controlling for bleeding, a 15x15 cm polypropylene mesh was cut to fit the patient's physical dimensions and was placed in this area, covering indirect and direct femoral hernia areas. Especially for large hernias, the mesh was fixed with absorbable tacks. If deemed necessary, a drain was placed. The surgical technique was performed as previously described.[12]

Statistical Analysis

The descriptive statistics of the data included mean, standard deviation, median, minimum, maximum, frequency, and percentage values. The distribution of variables was measured via the Kolmogorov–Smirnov and Shapiro–Wilk tests. The Mann–Whitney U test was used for the analysis of non-normally distributed quantitative independent data. The chi-square test was used for the analysis of qualitative independent data, and Fisher's test was used when the conditions for the chi-square test were not met. The effect level and cutoff value were investigated with ROC curves. The SPSS 27.0 program was used for the analyses.

Results

A total of 141 patients who underwent laparoscopic TEP repair were included in the study. The patients' mean age was 48.5±14.7 years, with 131 (92.9%) being male and 10 (7.1%) being female. The mean BMI was 24.8±2.2 kg/m². Among the patients, 46 (32.6%) were classified as ASA I, 71 (50.04%) as ASA II, and 24 (17.0%) as ASA III. The mean duration of surgery was 66.7±15.3 minutes.

There was no isolated femoral hernia, and the femoral hernia detected in 5 (3.5%) patients was accompanied by other hernias. Hernia-related information is comprehensively listed in Table 1.

The number of surgeries that required conversion because of technical difficulties with different methods during the operation was 12 (8.5%). In the last three of these cases, TAPP herniorrhaphy was also applied, which is why it was preferred over open surgery. The initial nine procedures were performed via the open method.

In terms of complications, two patients (1.4%) had hematomas that did not require intervention, six patients (4.3%) had seromas, and one patient (0.7%) had a mesh infection that was removed because it could not be controlled with medical treatment.

The average length of hospital stay was 1.21±0.41 days. A total of 111 patients (78.7%) were discharged on the first postoperative day, whereas 30 patients (21.3%) required a two-day stay. No patients needed to stay longer than two days.

When ROC curve analysis was performed, the number of surgeries significantly distinguished between patients with operation times of 60 minutes or more and those with operation times of less than 60 minutes. At a cutoff value of 75 surgeries, the sensitivity for predicting longer operation times was 73.3%, with a specificity of 65.6% (Table 2), (Fig. 1).

The mean surgery duration after the 75th patient was significantly shorter than that before (59.5±11.8 minutes vs. 73.1±15.3 minutes, $p<0.05$). There was no difference in patient age, sex distribution, ASA score, hernia type, length of hospital stay, drain rate and duration, rate of use, complication rates (hematoma, seroma, and mesh infection rates) or fixation rates between the groups with ≤75 and >75 surgeries ($p>0.05$). The BMI value was significantly ($p<0.05$) greater in the surgery duration >75 group than in the surgery duration ≤75 group. In the first group of 75 patients, conversion to a different method was required

Table 1. Demographic and surgical findings of patients

	Min–Max	Median	Mean±SD/n-%
Total number of patients, n			141
Age	18.0-73.0	49	48.5±14.7
Gender			
Female			10-7.1%
Male			131-92.9%
BMI (kg/m^2)	21.2-35.5	24.5	24.8±2.2
ASA score			
I			46-32.6%
II			71-50.4%
III			24-17.0%
Hospitalization day	1	2	1.21±0.41
Hospitalization day			
I day			111-78.7%
II day			30-21.3%
Operation Time (minute)	40.0-115.0	65.0	66.7±15.3
Veres Needle			
(-)			121-85.8%
(+)			20-14.2%
Drain			
(-)			81-57.4%
(+)			60-42.6%
Duration of drain use (number of days)	2.0-7.0	2.0	3.1±1.7
Fixation			
(-)			100-70.9%
(+)			41-29.1%
Type of hernia			
Direct			42-29,78%
Indirect			74-52,48%
D-ID			25-17,73%
D/ID-F			5-3,54%
Side of hernia			
Right			74-52.5%
Left			67-47.5%
Femoral (F)			
(-)			136-96.5%
(+)			5-3.5%
Complications			
(-)			132-93.6%
(+)			9-6.4%
Hematoma			
(-)			139-98.6%
(+)			2-1.4%
Seroma			
(-)			135-95.7%
(+)			6-4.3%

Table 1. Demographic and surgical findings of patients (Cont.)

	Min–Max	Median	Mean±SD/n-%
Mesh Infection			
(-)			140-99.3%
(+)			1-0.7%
Conversion to another method			
(-)			128-90.8%
(+)			13-9.2%
Operation Time			
≥60 minutes			96-68.1%
<60 minutes			45-31.9%

SD: standard deviation; Min–Max: minimum-maximum; BMI: body mass index; ASA score: American Society of Anesthesiologists.

Table 2. ROC Curve

	Area Under Curve	95% Confidence Interval	p
Number of Surgeries	0.747	0.663-0.832	0.000
Number of Surgeries (75 Cut-Off)	0.695	0.602-0.788	0.000

	Surgery Time≥60	Surgery Time< 60		%
Number of Surgeries				
≤ 75	63	12	Sensitivity	73.3
> 75	33	33	Positive Predictive Value	50.0
			Specificity	65.6
			Negative Predictive Value	84.0

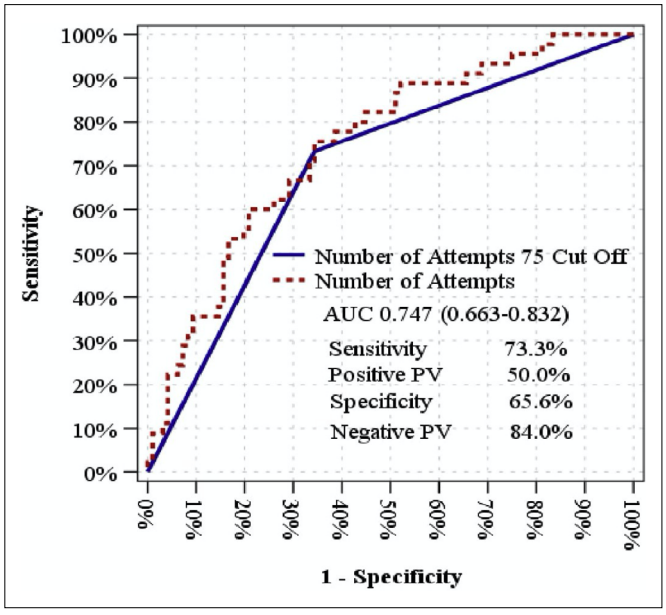

Figure 1. Sensitivity graph for distinguishing patients with ≥60 and <60 surgeries at the cutoff value of 75 surgeries.

in 9 patients, whereas in the group after 75 patients, conversion was required in 3 patients. Despite the higher proportion, the difference was not statistically significant (p>0.05) (as described in Table 3).

When patients were divided into groups of 25, the duration decreased to less than 60 minutes as it approached the upper level of the 25 groups. (Fig. 2).

Discussion

Traditionally, surgical training in surgical disciplines has been conducted based on the master–apprentice relationship according to the fundamental training principles of the specialties. However, when minimally invasive surgery was defined, even instructors with master qualifications were not fully adept in this area. In surgery, the term "learning curve" is used to describe the acquisition of surgical skills necessary to perform a surgical procedure safely, adequately, and effectively.[13]

Table 3. Comparison of patients below and above the cutoff value of 75

	Number of Surgeries ≤75 (Mean±SD/n-%)	Number of Surgeries >75 (Mean±SD/n-%)	p
Total Number of Patients	75	66	
Age	47.7±15.5	49.4±13.9	0.592[m]
Gender			
Female	7 (9.3)	3 (4.5)	0.269[X²]
Male	68 (90.7)	63 (95.5)	
BMI (kg/m^2)	24.4±2.4	25.2±1.9	0.002[m]
ASA Score			
I	28 (37.3)	18 (27.3)	0.301[X²]
II	37 (49.3)	34 (51.5)	
III	10 (13.3)	14 (21.2)	
Side of hernia			
Right	42 (56.0)	32 (48.5)	0.373[X²]
Left	33 (44.0)	34 (51.5)	
Direct hernia (D)	20 (26.7)	22 (33.3)	0.304[X²]
Indircet Hernia (ID)	39 (52.0)	35 (53.0)	0.808[X²]
D-ID	10 (13.3)	15 (22.7)	0.073[X²]
Femoral hernia			
(-)	73 (97.3)	63 (95.5)	0.547[X²]
(+)	2 (2.7)	3 (4.5)	
Fixation			
(-)	58 (77.3)	52 (78.8)	0.054[X²]
(+)	17 (22.7)	14 (21.2)	
Veres needle			
(-)	62 (82.7)	59 (89.4)	0.253[X²]
(+)	13 (17.3)	7 (10.6)	
Hospitalization Day			
I Day	56 (74.7)	55 (83.3)	0.210[X²]
II Day	19 (25.3)	11 (16.7)	
Operation Time (minute)	73.1±15.3	59.5 ±11.8	0.000[m]
> 60 Minute	63 (84)	33 (50)	
≤ 60 Minute	12 (16)	33 (50)	
Drain			
(-)	41 (54.7)	40 (60.6)	0.477[X²]
(+)	34 (45.3)	26 (39.4)	
Duration of drain use (number of days).	3.2±1.8	2.9±1.3	0.978[m]
Conversion to another method			
(-)	66 (88)	63 (95.45)	
(+)	9 (12.0)	3 (4.55)	0.20[X²]
Complications			
(-)	70 (93.3)	63 (93.9)	0.883[X²]
(+)	5 (6.7)	4 (6.1)	
Hematoma			
(-)	74 (98.7)	65 (98.5)	1.000[X²]
(+)	1 (1.3)	1 (1.5)	
Seroma			
(-)	71 (94.7)	64 (97.0)	0.499[X²]
(+)	4 (5.3)	2 (3.0)	
Mesh Infection			
(-)	75 (100.0)	65 (98.5)	0.468[X²]
(+)	0 (0.0)	1 (1.5)	

[X²], Ki-square test (Fischer test); [m]Mann-Whitney U test; SD: standard deviation; BMI: body mass index; ASA: American Society of Anesthesiologists.

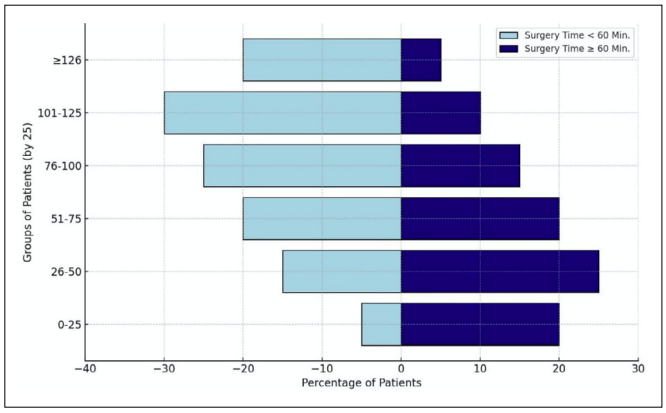

Figure 2. Distribution of surgery times <60 and ≤60 minutes when patients were divided into groups of 25.

The European Hernia Society (EHS) guidelines advocate open Lichtenstein and laparoscopic techniques (TEP and TAPP) as the best evidence-based treatment options for primary unilateral inguinal hernia repair, provided that the surgeon has sufficient experience and that the necessary resources for the specific procedure are available.[6,14]

TEP and TAPP are superior in terms of recovery, postoperative pain, and chronic pain. Additionally, laparoscopic techniques appear to be safe and cost-effective in high-volume centers and skilled hands. However, the guidelines note a well-documented difference in favor of Lichtenstein concerning the LC and initial costs.[5] In our study, we attempted to evaluate a surgeon's TEP performance learning curve using neither supervision control nor a balloon dissector.

According to the EHS guidelines, the LC for laparoscopic-endoscopic repair, especially TEP, appears to be longer than that of the Lichtenstein technique, varying between 50 and 100 procedures, with the first 30–50 being the most critical.[5] Owing to the rarity yet seriousness of complications reported, laparoscopic techniques should be learned under proper supervision if possible.[6] Nevertheless, publications suggest that surgeons with sufficient laparoscopic experience can successfully perform laparoscopic TEP repair unsupervised by observing a supervisor.[15]

Publications indicate that the LC for laparoscopic TEP repair reflects that the operative time decreases to less than one hour or reaches a stable plateau after 65 or more than 100 repairs.[16,17] In different series, the operative time was found to be between 58 and 89 minutes.[4,18,19] Moreover, the average operative time varies from surgeon to surgeon, independent of the timeline for reaching a plateau in the surgeon's learning curve. Indeed, in a study comparing the learning curves of three surgeons in the same clinic, the operative time decreased below the plateau level of 40 minutes after 51, 71, and 81 surgeries, respectively.[20] In our study, 75 surgeries were found to be significant in differentiating patients with operative times of ≥60 and <60 minutes. In the group with more than 75 surgeries, the operative time was significantly ($p<0.05$) lower than that in the group with 75 surgeries or fewer (Table 3).

When evaluated in terms of early recurrence, recurrence was observed in one patient within the first month among the patients in the LC. There was a total of 141 patients, with a recurrence rate of 0.79%. No early recurrences were observed in subsequent patients. When patients with early recurrence were questioned, they reported pain and swelling after lifting heavy weight. In a study comparing TEP and TAPP hernias, only one recurrence was detected among 325 TEP surgeries, which corresponds to 0.28%.[21]

Surgeons who frequently perform the procedure have different LC and complication rates than those who operate sporadically and medical residents.[22] There is evidence that even after 400 cases, the operative time, conversion rate, and short-term complication rates continue to decrease.[23] In a published study, as the surgeon's experience increased, the transition rates to open or TAPP significantly decreased; the rate was 17% in the first 100 cases and decreased to 2.2% in the last 500 cases.[24] In our study, the rate decreased from 12% to 6.1%. In the ≤75 surgeries group, 9 patients transitioned to a different method, whereas in the >75 surgeries group, 3 patients transitioned to a different method ($p>0.05$). Although not statistically significant, a clear decrease was observed in the transition to different methods.

Patients in the LC period were noted to have a BMI below 25 and to be in line with the recommendations for patient selection. Literature reviews indicate that having a BMI >25 not only increases the likelihood of complications but also introduces technical difficulties.[25,26] In one study, it was suggested that younger patients be selected during the LC stage, whereas females were shown to have a high risk of recurrence.[25] Surgical procedures for direct hernias are easier and shorter in duration.[18] In our study, there was no difference in patient age, sex distribution, ASA score, or hernia type between the groups with ≤75 and >75 surgeries, and both groups were homogeneous. Only the BMI value was significantly ($p<0.05$) greater in the group with a surgery duration >75 than in the group with a surgery duration ≤75 (Table 3). However, the com-

pletion of the LC and the fact that the threshold of 25 in the literature has not been significantly exceeded may have reduced its negative effects on the outcomes. No significant (p>0.05) differences were observed in the complication rates (hematoma, seroma, and mesh infection rates) between the ≤75 and >75 surgeries groups.

The LC stage can be evaluated significantly in terms of risk. The total complication rate was lower for those under 60 years of age, whereas when evaluated separately for hematoma, seroma, and mesh infection, no statistically significant difference was found. The need for drains and the number of drain days were found to be greater in relation to the duration of surgery.

TEP herniorrhaphy, performed without a supervisor and without a balloon dissector, resulted in a decrease in the average operative time after the 75th repetition and then stabilized, with no additional difference in terms of complications detected.

Limitations

The study is retrospective and was conducted by a single surgeon; thus, it is worthwhile to note that technical capabilities may vary among surgeons. Multicenter studies comparing a diverse range of surgeons and socioeconomically heterogeneous populations are necessary to provide a more comprehensive and precise analysis of the development of the LC.

Conclusion

Surgeons with sufficient laparoscopic experience can safely learn TEP hernia repair without a supervisor and without the use of a balloon dissector, which contributes to increased costs. In our study, a stable plateau was reached at or below the 60th minute in 75 patients.

Disclosures

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The role of bronchoscopic lavage culture monitoring in affecting the length of stay in intensive care unit in lung transplant patients

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ABSTRACT

Introduction: The aim of this study was to investigate whether bacterial growth detected in bronchial lavage is related to the length of stay in the intensive care unit (ICU).

Materials and Methods: A single-center retrospective cohort study was conducted, including patients who underwent lung transplantation for end-stage lung disease at a tertiary hospital between January 2017 and December 2022. Data were collected from the hospital database, comprising 86 patients admitted to the ICU for at least 24 hours postoperatively. The study focused on the first 30 days in the ICU after transplantation. Seventeen patients were excluded due to early transfer to the ward, infection developed in the ward, intraoperative mortality, or missing data.

Results: The final cohort consisted of 69 patients, with 81.2% male and a median age of 47 years (range: 32–56 years). The average waiting list duration was 3 months (range: 1–5 months). Among the patients, 44% had interstitial lung disease (ILD), followed by other conditions. Comorbidity indices showed that 30.4% had a score of 1, 46.4% had a score of 2, and 23.2% had a score of 3. No significant differences were detected in bronchoscopic lavage samples taken on days 0–3, 7, 14, and 30 post-transplantation. Additionally, bacterial culture positivity did not affect the length of stay in the ICU.

Conclusion: Postoperative mortality is highest in the months following transplantation, primarily due to complications and infections. This study found no significant relationship between bacterial culture growth and ICU stay length, likely due to effective prophylactic antibiotic strategies and diligent patient monitoring. Further multicenter studies are needed to explore potential relationships between bacterial positivity and ICU stay duration.

Keywords: Bronchial lavage culture, intensive care, lung transplantation

Introduction

Lung transplantation is an effective treatment method that improves survival and quality of life in patients with end-stage respiratory disease who do not respond to medical treatment despite optimal therapies. However, the survival rate of lung transplant recipients is the lowest among solid organ transplants, with an average of 6.5 years. This rate has been gradually improving with recent

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advancements compared to other solid organ transplants.[1] These patients are at risk of airway infections and microbial colonization due to continuous exposure to environmental factors through inhaled microorganisms, decreased ciliary transport, denervation, and a weakened cough reflex.

Although post-transplant mortality has decreased with new surgical techniques and pharmaceutical regimens, the 5-year mortality rate has been reported to be approximately 50%. Infections are the primary cause of death in the first year after lung transplantation, and among the many issues reported in the early postoperative phase, bacterial respiratory infections constitute major complications that significantly contribute to increased mortality in transplant recipients.[2–5] The etiologies of these infections are diverse, including both community-acquired and hospital-acquired microorganisms.[4–6]

After successful transplant surgery, recipients are typically transferred from the operating room to the intensive care unit (ICU). Often, recipients are still intubated, and some may require postoperative extracorporeal membrane oxygenation (ECMO) support.[7] The average duration of mechanical ventilation after lung transplantation is usually 2 to 3 days.[8] The approach to managing these patients in the early postoperative period may play an important role in their long-term morbidity and mortality.

The positive clinical outcomes of lung transplantation are increasingly threatened by the rising incidence of infections, which adversely affect both function and survival. Infections frequently occur as complications following lung transplantation, making them difficult to recognize; signs and symptoms can sometimes be misleading. Lifelong immunosuppression is necessary to prevent acute and chronic rejection, and the resulting impairment of the immune system increases patient susceptibility to infectious agents. Traditionally, recipients may host infections from a wide variety of microorganisms or become colonized by nosocomial organisms. Lung grafts can facilitate the transmission of infections from donors, and transplanted patients are prone to significant infections from agents that are relatively harmless in an immunocompetent host.[9]

Time is a determining factor in the development of infections after lung transplantation; although infections are the second leading cause of death in the first 30 days after transplantation (19.2%), they rise to first place (37.3%) between 30 days and 1 year.[10] Additionally, time affects the types of infections that can develop in the transplant patient: in the first month after surgery, the etiological cause of infection is usually associated with microbes present in the donor or recipient.[11] Perioperative deaths are correlated with longer recipient stays in the ICU. The mortality rate of patients after organ transplantation is highest in the initial months following surgery, with causes changing over time. Postoperative complications (e.g., acute rejection, bronchiolitis obliterans, and anastomotic leaks) and infections are the leading causes of death in the first year following lung transplantation.[12]

This study aims to clarify whether bacterial growth detected in bronchial lavage within the first 30 days after lung transplantation has an effect and relationship with the length of stay in the intensive care unit.

Microbiological Samples

Most patients underwent respiratory colonization sampling more than 6 months prior to transplantation. However, at our center, endobronchial swabs and respiratory tract samples are routinely collected from recipients just before transplantation. In the postoperative period, bronchial aspiration (BA) is performed using fiberoptic bronchoscopy every two to three days. Respiratory microbiological samples[13] obtained through BA and bronchoalveolar lavage (BAL) are processed using standard techniques. Susceptibility testing was conducted as previously described.[14]

Materials and Methods

This single-center retrospective cohort study was conducted in the Lung Transplantation Department of a tertiary hospital. Patient data were collected from the hospital database, and the identities of all patients were kept confidential. Due to the observational and retrospective nature of the study, informed consent was not required. The study received approval from the Local Ethics Committee (Date: 10.10.2023; Approval No: 2023/15/725). Between January 2017 and December 2022, 86 patients who underwent lung transplantation and were admitted to the intensive care unit (ICU) for at least 24 hours for postoperative care were included in the database. The study focused on the ICU stay during the first 30 days following transplantation. A total of 17 patients were excluded from the study: those who were transferred

from the ICU to the ward without infection, those who developed infections in the ward and were readmitted to the ICU, those who died intraoperatively, and those with missing data.

Perioperative Management

The surgical transplantation procedure was standardized according to our local policy.[15] Perioperative care, including postoperative management, followed a standardized protocol for all patients.[16] Immunosuppressive therapy consisted of a combination of a calcineurin inhibitor (tacrolimus), a cell cycle inhibitor (mycophenolate mofetil), and steroids (prednisolone),[1] with the target tacrolimus level set at 12–15 ng/mL. Antibacterial treatment was administered as perioperative prophylaxis for patients without previous respiratory tract colonization. In those with preoperative colonization, prophylaxis was tailored based on the isolated microorganisms. Antibiotic therapy is a fundamental component of postoperative care. However, there is a risk of emerging and exacerbating multidrug-resistant strains due to treatment of donors in the ICU and chronic colonization in recipients requiring frequent antibiotic use, which may lead to the selection of strains resistant to commonly used drugs. Antibiotic treatment should include broad-spectrum agents with diverse mechanisms of action. While there is no definitive recommendation for drug selection, the coverage should encompass both Gram-positive and Gram-negative bacteria, as well as methicillin-resistant Staphylococci and Pseudomonas aeruginosa.[17,18] Introducing MRSA-targeted antibiotics only after obtaining donor cultures is considered a sufficient precaution. Accordingly, patients in this study received antibiotic prophylaxis for a duration of 14 to 21 days.

Data Collection

Demographic data, including age, gender, and time of diagnosis, were extracted from patient records. In our center, diagnostic bronchoscopy is routinely performed on the 1st, 7th, and 14th days, as well as on the 1st month after lung transplantation. Additionally, bronchoscopy is conducted during other months based on clinical indications such as infection or rejection. Given the immunosuppressed status of the patients, a bacterial sample is collected during the bronchoscopy procedure as part of the microbiological testing panel, and a transbronchial biopsy is performed if necessary.

Bacterial Culture Evaluation

Bronchial lavage samples collected from patients were inoculated into solid media (5% sheep blood agar and MacConkey agar) using a quantitative method. After incubation at 37°C for 24 to 48 hours, identification and antibiotic susceptibility testing were conducted using VITEK® 2 Compact (bioMérieux, France) according to the guidelines set by the European Committee on Antimicrobial Susceptibility Testing.

The Comorbidity Index (CCI) was utilized to predict long-term survival in individuals with cancer by assigning weights to specific diseases. Comorbid conditions with a severity score of one included congestive heart failure, myocardial infarction, peripheral vascular disease, cerebrovascular disease, dementia, gastroesophageal reflux disease, diabetes, and mild liver disease.

Statistical Analysis

Data were collected from patient files and the hospital operating system and analyzed using IBM SPSS Statistics for Windows v.23.0. Descriptive statistics were used to present demographic and clinical characteristics of the patients. For nonparametric variables, median and interquartile range were reported, while mean±standard deviation was used for parametric variables. Culture and biopsy samples were routinely collected via bronchoscopy after transplantation. Results were compared using Chi-Square tests for categorical variables, and continuous variables were analyzed among three independent groups using Kruskal-Wallis analysis of variance. A statistical significance level of $p<0.05$ was set.

Results

The study cohort comprised a total of 69 patients, with a median age of 47 years (IQR, 32–56). The majority of the patients were male (81.2%, n=56). The median duration on the waitlist was 3.5 months (range: 1–6 months). When categorized by underlying disease, 44% (n=31) of the patients had interstitial lung disease (ILD), making it the predominant group. Other groups included obstructive airway disease (OAD) and cystic fibrosis (CF) at 14.5% (n=10) each, bronchiectasis at 13% (n=9), and idiopathic pulmonary arterial hypertension (IPAH) at 2.9% (n=2). The presence of a Comorbidity Index (CCI) of 1 was noted in 30.4% (n=21) of the study population, while 46.4% (n=32) had a CCI of 2, and 23.2% (n=16) had a CCI of 3. Table 1 summarizes the demographic results of the study.

Table 1. Descriptive Values of the study

Demograhic Parameters	Lung Transplant Canditates (n=69)
Age (median,%25-75)	47 (32-56)
Male (n, %)	56 (81.2)
Underlying Diseaseas (n, %)	
OLD	10 (14.5)
ILD	31 (44.9)
CF	9 (13)
Bronchiectasis	16 (23.2)
IPAH	2 (2.9)
Adenocarsinoma	1 (1.4)
Comorbidity Index (n, %)	
1	21 (30.4)
2	32 (46.4)
3	16(23.2)
Waiting List Time, month (median, %25-75)	3 (1-5)

OLD: obstructive lung diseases; ILD: interstisial lung diseases; CF: cystic fibrosis; IPAH: idiopathic pulmonary arterial hypertension.

A total of 276 bronchoscopic lavages were performed across the 69 patients. Positive bacterial growth was observed in 33.7% (n=93) of bronchoalveolar lavage (BAL) fluid samples. The three most commonly detected bacteria in BAL samples collected within the first 30 days post-transplantation were Klebsiella pneumoniae (34.7%, n=24), Pseudomonas aeruginosa (33.3%, n=23), and Acinetobacter baumannii (24.6%, n=17). Pre-transplant sputum culture positivity among recipient candidates was 21.7% (n=15) (Table 2).

The BAL culture positivity rates, categorized by days after transplantation, were as follows: 42% (n=29) on days 0 to 3, 26% (n=18) on day 7, 34.7% (n=24) on day 14, and 23.2% (n=16) on day 30. Notably, Pseudomonas putida (n=8; 11.6%) was the most frequently isolated bacterium in sputum cultures from recipient candidates prior to transplantation. The most common bacterial species detected in BAL samples from days 0 to 3 after transplantation was methicillin-sensitive Staphylococcus aureus (n=7; 10.1%). Following transplantation, the predominant infections were Acinetobacter baumannii (n=7; 10.1%) on day 7, Klebsiella pneumoniae (n=10; 14.5%) on day 14, and Pseudomonas

Table 2. Microorganisms detected in the recipient's respiratory tract before transplantation and on days 3, 7, 14, 30 after transplantation

Microorganism	Recipient Swabs-Sputum Pretransplant	Day 1 to 3	Day 7	Day 14	Day 30	Total after transplantation n,%
Gram-positive						
MSSA	2 (2.6)	7 (10.1)	0	0	2 (2.9)	9 (13)
MRSA	0	0	1 (1.3)	0	0	1 (1.4)
Streptococcus pneumonia	0	1 (1.3)	0	0	0	1 (1.4)
Coagulase-negative staphylococci	0	0	0	0	1 (1.3)	1 (1.4)
Gram-negative						
Escherichia coli	0	1 (1.3)	0	0	0	1 (1.4)
Proteus mirabilis	0	0	1 (1.3)	1 (1.3)	0	2 (2.9)
Enterobacter cloaca	1 (1.3)	0	0	3 (3.9)	0	3 (4.3)
Enterobacter aerogenes	0	2 (2.6)	0	0	0	2 (2.9)
Pseudomonas aeroginosa	0	6 (8.7)	4 (5.8)	6 (7.2)	7 (10.1)	23 (33.3)
Pseudomonas putida	8 (11.6)	0	0	0	0	0
Acinetobacter baumannii	2 (2.6)	5 (7.2)	7 (10.1)	4 (5.8)	1 (1.4)	17 (24.6)
Serratia rubidaea	0	0	1 (1.4)	0	0	1 (1.4)
Stenotrophomonas maltophilia	1 (1.4)	2 (2.8)	0	0	0	2 (2.9)
Klebsiella pneumonia	1 (1.4)	5 (7.2)	4 (5.8)	10 (14.5)	5 (7.2)	24 (34.7)
Total (n,%)	15 (21.7)	29 (42)	18 (26)	24 (34.7)	16 (23.1)	87

MSSA: methicillin-sensitive Staphylococcus aureus; MRSA: Methicillin-resistant Staphylococcus aureus.

aeruginosa (n=7; 10.1%) on day 30. There was no significant difference in the bronchoscopic lavage samples collected on days 0–3, 7, 14, and 30 post-transplantation.

Discussion

In this study, the predominant bacterial species detected within the first 30 days post-lung transplantation were Klebsiella pneumoniae, Pseudomonas aeruginosa, Acinetobacter baumannii, and methicillin-sensitive Staphylococcus aureus. Previous studies have also identified Enterobacteriaceae, Streptococcus spp., and Pseudomonas aeruginosa as dominant species in similar patient populations.[2,5] A key finding of our study was that bacterial culture positivity in bronchial lavage samples taken in the ICU after transplantation did not significantly correlate with the length of ICU stay. Notably, perioperative mortality is often linked to extended ICU stays, with the highest mortality rates occurring in the first months following transplantation. Postoperative complications, particularly infections, are leading causes of death within the first year, followed by chronic lung allograft dysfunction in subsequent years.[12]

Infectious complications contribute to significant morbidity and mortality at all stages post-transplantation and are responsible for the majority of deaths among lung transplant recipients.[19] Bacterial infections (BIs) represent the most common type of infectious complication. Despite advancements in immunosuppressive therapy and antimicrobial prophylaxis, opportunistic pathogens continue to pose a risk, particularly in the first year following solid organ transplantation, including lung transplants.[20] The Swiss Transplant Cohort Study reported that 55% of lung transplant recipients developed infections within the first year, with 63% of these infections being bacterial.[19] Another study indicated that 69% of lung transplant recipients experienced BIs, predominantly due to Gram-negative bacteria.[21] Generally, 50–85% of lung transplant recipients encounter at least one episode of BI,[22] with bacterial pneumonia accounting for a significant proportion of early infection-related deaths.[23]

In our center, we perform regular bronchoalveolar lavage in lung transplant patients during the first year post-transplantation to monitor for infections. This procedure is conducted every 2–3 days in the immediate post-transplant period to assess anastomotic healing and to collect samples for microbiological testing. The graft mucosa undergoes a healing process lasting about three weeks post-transplant, during which purulent discharge is a crucial indicator of infection. Consistent with our findings, Charlson et al.[24] reported that lung transplant recipients exhibit higher bacterial loads in BAL samples compared to healthy controls, regardless of the underlying indication for transplantation.

The landscape of bacterial infections has evolved with the introduction of routine postoperative antimicrobial therapy.[4,22,25] Recent studies have shown bacterial microbes isolated in up to 80% of transplant recipients.[4,22,25] A multicenter prospective Spanish study involving 236 lung transplant recipients with a mean follow-up of 180 days documented 72 pneumonia cases per 100 recipients annually, with two-thirds (57 cases) identified with microbiological etiology and 82% being bacterial infections. Notably, Pseudomonas aeruginosa was isolated in 24.6% (n=14) of cases, along with Acinetobacter baumannii and Staphylococcus aureus at 14% each, and various other bacteria at lower frequencies.[4]

In a study by Raviv et al.[26], 52 positive culture episodes for K. pneumoniae were reported among 136 recipients. The acquisition of carbapenem-resistant K. pneumoniae (CRKP) and extended-spectrum beta-lactamase K. pneumoniae (KP-ESBL) was linked to decreased survival rates among lung transplant recipients. Rodrigo-Troyano et al.[27] highlighted the significant threat posed by multidrug-resistant (MDR) Gram-negative bacteria in respiratory infections, underscoring a critical concern for managing these infections in solid organ transplant patients.

The early postoperative period, particularly the first three months post-surgery, has been identified as a critical timeframe for bacterial infections in lung transplant patients. The anatomical structure and functions of transplanted lungs may make them more susceptible to colonization than other organs. Secretions in the distal bronchi can serve as reservoirs for pathogenic flora, and mucus biofilm production can provide resistance against mechanical factors and antibiotics.[28] In our study, mucopurulent discharge was observed in 70% of recipients, yet positive culture rates were only 33.7%. Tanaka et al.[29] demonstrated that purulent discharge was present in 89% of pneumonia cases and 25% of tracheobronchitis cases.[29]

While our study found K. pneumoniae to be the most common bacterial species detected in the early postoperative period, it did not significantly affect the length of ICU stay.

Lung transplant recipients may be particularly vulnerable to severe K. pneumoniae infections due to multiple factors, including intense immunosuppression, limited ability to clear airway secretions, and potential malnutrition.[30,31] Pseudomonas aeruginosa was the second most frequently detected bacterium, yet it too did not significantly influence ICU length of stay.

It's important to note that our study did not classify bacteria by primary disease. Recipients with cystic fibrosis (CF) have a higher susceptibility to Pseudomonas aeruginosa colonization and infection compared to non-CF recipients.[3,32,33] The persistence of Pseudomonas colonization can be linked to chronic graft rejection and may increase the incidence of infection-related death.[34]

In conclusion, while our study identified significant bacterial infections, it did not find a substantial relationship between bacterial culture growth and the length of ICU stay. Frequent bronchoscopy and laboratory follow-ups are crucial for the early diagnosis of infections and for the development of effective antibiotic regimens. Due to the small sample size of our study, multicenter analyses with larger cohorts are recommended to further elucidate the impact of bacterial infections on ICU stay and patient outcomes. Limitations of our study include its retrospective nature, the preference for sputum sampling over BAL before transplantation, and the lack of evaluation of cold ischemia time, radiological findings, and parenchymal lesions.

Conclusions

The highest mortality rates following organ transplantation occur in the initial months after surgery, with postoperative complications and infections being the primary contributors. In our study, we found no significant correlation between bacterial culture growth and the length of ICU stay. This may be attributed to individualized preoperative prophylactic antibiotic treatments and the development of tailored antibiotic regimens. Additionally, regular bronchoscopy procedures, along with timely imaging and laboratory follow-ups based on the patients' clinical courses in the ICU, likely play a beneficial role in patient management.

To better understand the relationship between culture positivity and ICU length of stay, we advocate for multicenter studies with larger patient populations that compare different bacterial groups.

Disclosures

Ethichs Committee Approval: The study received approval from the Koşuyolu Higher Specialization Training and Research Hospital Local Ethics Committee (Date: 10.10.2023; Approval No: 2023/15/725).

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Challenges in total minimally invasive esophagectomy procedures; Our single center initial experiences

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ABSTRACT

Introduction: We aimed to retrospectively evaluate the first period patient portfolio and surgical outcomes, difficulties in operations, morbidity, and early mortality rates in minimally invasive esophagectomy procedures in a clinic with high experience in gastrointestinal minimally invasive surgery.

Materials and Methods: The records of fifteen esophageal cancer patients who underwent minimally invasive laparoscopic/robotic-thoracoscopic esophagectomy between November 2019 and July 2024 in our Gastroenterology Surgery Clinic were retrospectively reviewed.

Results: The mean age of the patients was 61.2 (42-74) years. Ten patients (66.6%) were male, and five patients (33.3%) were female. The tumor locations were 1 (6%) in the upper esophagus, 5(36%) in the middle esophagus, and 9 (60%) in the lower esophagus. Eleven (73.4%) patients were operated on laparoscopically-thoracoscopically, and four (16.6%) patients were operated on robotic-thoracoscopically. Total esophagectomy - cervical anastomosis (McKeown) was performed in 13 (86.6%) patients. Subtotal esophagectomy - intrathoracic anastomosis (Ivor Lewis) was performed in 2 (13.4%) patients. Two patients with intrathoracic anastomosis were in the laparoscopy group.

The mean operation time was 280.53(180-464) minutes. The mean intraoperative bleeding was 200.33 (50-550) ml. The mean intensive care unit (ICU) stay was 3.26(1-27) days, and the mean ward stay was 7.26 (0-11) days. One (6%) of our patients followed up in the ICU in the early postoperative period resulted in mortality.

Conclusion: We believe that in clinics experienced in gastrointestinal system (GIS) and minimally invasive surgery, sufficient experience can be achieved with smaller patient series in the transition to minimally invasive esophagectomy.

Keywords: Esophageal cancer, laparoscopic-robotic-thoracoscopic surgery, minimally invasive esophagectomy

Introduction

Esophageal cancer is an overwhelming disease, ranking 7th in cancer incidence worldwide and 6th in overall cancer-related mortality, and its incidence is increasing.[1] Although squamous cell carcinoma (SCC) of the esophagus is the most common histologic type worldwide, there has been an increase in the incidence of adenocarcinoma (AC) of the esophagus in Western countries in recent decades (partly due to the increasing prevalence of obesity).[2] In addition, in the United States, the in-

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cidence of adenocarcinoma (AC) arising from Barrett's esophagus (BE) has been increasing dramatically over the past few years.[3]

Multimodal therapies (chemotherapy, radiotherapy, immunotherapy, surgery) are often required to treat esophageal cancer patients. However, surgical resection remains the cornerstone in the management of early and locally advanced esophageal cancer.[4] Esophagectomy is a challenging operation that requires specific surgical techniques and extensive anatomical knowledge of the various surgical fields (abdomen, chest, and neck). Since its introduction in the early 1990s, minimally invasive esophagectomy (MIE) has been adopted by many centers due to its lower postoperative complication rates and better quality of life compared to the traditional open approach.[5] However, MIE is still technically complex (two-dimensional vision, flat non-articulating instruments, limited mediastinal surgical field, limited intracorporeal movements) and is associated with high morbidity rates.[6] Robotic surgery has well-known advantages over open and conventional MIE (laparoscopic and thoracoscopic surgery), facilitating more precise surgical dissection.

The choice of the type of surgery to be performed is decided by determining the extent of tumor resection and planned lymph node dissection depending on the location of the tumor. In addition, the performance of the patient and especially the experience of the surgeon are very important for esophageal tumor surgery. However, the randomized, controlled TIME study revealed that thoraco-laparoscopic total minimally invasive esophagectomy causes fewer pulmonary and cardiovascular complications than open surgery.[7]

Laparoscopic or robotic preparation of the gastric tube and thoracoscopic (laparoscopic-robotic) total or near-total esophagectomies are becoming increasingly common. In total esophagectomies, cervical anastomosis was performed through a cervical incision, while intrathoracic anastomosis was performed in near-total esophagectomies.

In this study, we aimed to share the first-term results of minimally invasive esophagectomy surgery performed in patients with esophageal tumors in our clinic, which is experienced in gastrointestinal surgery, the difficulties we encountered, and the management of complications in light of current literature.

Materials and Methods

We retrospectively analyzed the data of fifteen esophageal cancer patients operated on using the minimally invasive esophagectomy technique between November 2019 and July 2024 in our Gastroenterology Surgery Clinic.

Demographic and clinical characteristics were recorded for all patients (Table 1).

Patients were evaluated for treatment options by a multidisciplinary tumor board. The American Joint Committee on Cancer (AJCC) 8th edition TNM staging system by Amin et al.[8] was used for clinical staging. Patients with T2-4 and/or node-positive, M0 esophageal cancer were included in the study. Siewert type two patients and patients with previous esophageal surgery were excluded. The Group Performance Status Scale (ECOG PS) was used to evaluate the performance status of the patients,[9] and patients with ECOG PS 0, 1, or 2 were included. All patients received preoperative chemotherapy (CT) and/or radiotherapy (RT) treatment (patients with adenocarcinoma received CT, and patients with SCC received chemoradiotherapy (CRT). Thoracoabdominal triphasic

Table 1. Demographic parameters

	N	%
Age		
61.2 (42-74) mean	15	
Gender		
Male	10	66.6
Female	5	33.4
BMI		
28.26 (21-45) mean		
ASA score		
1	4	26.6
2	9	60
3	2	13
ECOG-PS		
0	6	40
1	7	46.6
2	2	13
Oncologic treatment protocol		
Definitive CRT	6	40
Neoadjuvant CRT	9	60

BMI: Body Mass Index; ASA: American Society of Anesthesiologists; ECOG-PS: Eastern Cooperative Oncology Group- Performance Status; CRT: Chemoradiotherapy.

computed tomography (CT), positron emission tomography (PET-CT), and endoscopic examination were performed before and after oncologic treatment to evaluate both localization and treatment response. Demographic characteristics, clinical and pathologic data, operative data, postoperative complications, and pathological data were retrospectively recorded. Six patients with partial tumor regression response who received definitive treatment and nine patients who received neoadjuvant treatment were operated on after waiting at least six weeks after treatment. Pathologic staging was performed using the American Joint Committee on Cancer (AJCC) 8th edition TNM staging system. All patients received anti-embolic stockings and prophylactic low molecular weight heparin and 2 grams of sulfamethoxazole for prophylaxis in preparation for surgery.

Surgical Technique

The operation was performed in three fields and in the following sequence:

Laparoscopy

The patient was placed in a supine position. After pneumoperitoneum was established, the abdomen was entered with a 12 mm trocar through a 1 cm vertical incision above the umbilicus. A thirty-degree scope was used. A 12 mm trocar was inserted from the left anterior axillary line, two 5 mm ports from the right and left pararectal region, a 5 mm port from below the xiphoid, and five ports in total were used. A Nathanson retractor was used for liver excision.

In all cases, the stomach was prepared for pull-up with an endoscopic stapler (Endo GIA 60-blue cartridge), celiac lymphadenectomy, and wide Kocher maneuver were performed. Pyloroplasty was not performed in any case. The right gastric artery and vein and the vascular arch with the right gastroepiploic artery and vein were preserved. A wide gastric tube was created using a linear tube with an endostapler through the greater curvature. No jejunostomy was opened in any patient for feeding.

Thoracoscopy

In the left lateral decubitus position, the right lung was collapsed with a double-lumen intubation tube, and three trocars were inserted from the right hemithorax. The first 10 mm trocar was inserted through the inferior right scapula with the open technique, one 10 mm trocar was inserted through the 7th intercostal space, and one 12 mm trocar was inserted through the 9th intercostal space under camera-guided direct vision. CO2 insufflation was not performed during thoracoscopy. A 30-degree camera was used. The thoracic esophagus was exposed by opening the mediastinal pleura over the esophagus. The esophagus was mobilized from the hiatus to the thoracic inlet and dissected together with the paraesophageal lymph nodes. The azygos vein was dissected and cut with (Endo GIA 45-white cartridge). A 32F thoracic drain was placed in the thoracic cavity for postoperative drainage.

Robotic

In the cases where we performed robotic surgery, four 8 mm device-specific trocars and one 12 mm assistant port were used both in the abdomen and thorax, and esophagectomy was completed by preparing the gastric pull-up and dissecting the esophagus thoracoscopically. McKeown esophagectomy and cervical anastomosis were performed in all robotic cases.

Cervical

An oblique incision was made at the anterior border of the left sternocleidomastoid muscle. The left recurrent laryngeal nerve was exposed following medial retraction of the thyroid. The prevertebral region was then entered. From here, the esophagus was dissected, suspended, and then continued dissection towards the mediastinum. In thirteen cases, the esophagus was removed through a cervical incision. The gastric tube was transected, and a 25 mm unvill was placed. Esophagogastric anastomosis was performed with a 25 mm circular stapler. The remaining gastric line was cut with Endo GIA 60 (blue cartridge). A closed absorbent drain was placed under the cervical incision, and the incision was closed.

In the early postoperative period, the lungs were evaluated by direct radiography. Patients with fully expanded lungs and no tube oscillation had a thoracic drain removed on the 2nd or 3rd day. On the 2nd day, patients were started on oral fluids. A routine leak test was not performed for patients with a normal course in terms of clinical and laboratory tests. Patients who did not develop problems in oral intake were discharged without complications by gradually increasing their feeding regimen.

Results

The mean age of the fifteen patients was 61.2 (42-74) years. Ten patients (71%) were male, and five patients (29%) were female. The female/male ratio was 0.50. The mean body mass index (BMI) was 28.26 (21-45). Tumor locations were in the lower esophagus in nine patients, the middle esophagus in five patients, and the upper esophagus in one patient. Tumor types were AC in eight cases and SCC in seven cases. Six SCC patients received definitive chemoradiotherapy (CRT), and one patient received neoadjuvant CRT. All of the AC patients received neoadjuvant CT. Cervical anastomosis (McKeown) or intrathoracic anastomosis (Ivor Lewis) was performed laparoscopically/robotically thoracoscopically in all operations (Table 2).

Gastric pull-up and cervical anastomosis were performed in thirteen cases of total esophagectomy. In two cases, subtotal esophagectomy and intrathoracic anastomosis were performed. Pyloromyotomy and feeding jejunostomy were not performed in any patient.

The mean operative time was 280.53 (180-464) minutes. The mean intraoperative bleeding was 200.33 (50-550) ml. The mean intensive care unit (ICU) stay was 3.26 (1-27) days; however, when the patient who resulted in mortality and was followed up in the ICU was excluded, our mean ICU stay was 1.57 (1-3) days. The mean ward stay was 7.26 (0-11) days. The mean hospital stay was 10.5 (ICU + ward) days. In the early postoperative period (<30 days), one case (0.06%) resulted in mortality. Histopathologic examination revealed ypTNM stage 1 in nine patients. Complete pathologic response was observed in five of these cases (T0N0M0). Of these five cases, two were AC and three were SCC. Two patients had ypTNM stage 2 disease, and four patients had ypTNM stage 3B disease (Table 3).

Table 2. Tumor type-location and type of surgery

	N	%
Tumor location		
Upper	1	6
Middle	5	33.3
Lower	9	60
Tumor type		
Adenocarcinoma	8	53.3
Squamous cell carcinoma	7	46.7
Operation type		
Laparoscopic-thoracoscopic		
Mc Keown	9	60
Ivor-Lewis	2	13
Robotic-thoracoscopic		
Mc Keown	4	26.6
Ivor-Lewis	0	0

Two patients with esophageal cancer with tumor localization in the distal esophagus underwent near-total esophagectomy and intrathoracic anastomosis (Ivor Lewis). Among these patients, the morbidly obese patient (BMI: 45) developed fever on the 10th postoperative day. Neck-thorax CT was performed, and anastomotic leakage was detected. Antibiotic revision was performed. A thoracic tube was available. A feeding jejunostomy was opened, and this leak was endoscopically verified. An intraluminal esophageal stent was then placed in the esophagus. The stent was replaced five days after stent placement due to stent migration. However, after clinical septicemia, the patient ended up with exitus on postoperative day twenty-seven due to sepsis.

Discussion

In the last two decades, a significant increase in surgical innovations aimed at improving patients' health care has been seen. Concerns about different complications that may occur in multiple anatomical sites have resulted in the use of different combinations in esophageal surgery to optimize technique. The use of some of these innovations requires a learning curve, and this has led to the creation of combinations such as minimally invasive esophagectomy (MIE) and robotic-assisted minimally invasive esophagectomy (RAMIE). The learning curve for MIE is largely determined by the technical challenges associated with the thoracoscopic approach. Technical complexity is reflected in a long learning curve.[10] The length of the learning curve for MIE ranges from 40 to 54 cases depending on the operative time.[11] It's been found that surgeons noticed a reduction in operative time in both thoracic and abdominal phases after twenty-three cases, reaching a plateau at case seventy. Pointer et al.[12] confirmed an improvement in surgery times with increasing experience, but this occurred after eighty cases.[13] It can be assumed that operative times decrease with more experience, which again emphasizes the importance of a learning curve.[14] As a clinic that actively uses minimally invasive surgical procedures in the upper GIS and actively performs open esophageal surgery, we aimed to share our first fifteen cases of total minimally invasive esophageal surgery and the difficulties we encountered in light of the literature.

Table 3. Intraoperative - postoperative data and complications

Operation time (min.)	280.53 (180-464) min. (mean)		
Intraoperative bleeding amount (ml)	200.33 (50-550) ml (mean)		
Duration of hospitalization (days)			
ICU	3.26 (1-27) (mean)	10.52 (overall average)	
Service	7.26 (0-11) (mean)		
		n	**%**
Pathological stage			
ypTNM stage1		9	60
ypTNM stage 2		2	13
ypTNM stage 3B		4	26.6
Postoperative complications			
Anastomotic leakage		1	6
Pulmonary complications (atelectasis)		2	13
Other		0	0
Early mortality (<30 days)		1	6

ICU: Intensive Care Unit; yp: post neoadjuvant (radiation or systemic) therapy—pathological; TNM: Tumour, Node, Metastasis.

It is very difficult to perform both MIE and RAMIE operations and to manage their complications (McKeown or Ivor Lewis operations). In this respect, especially laparoscopic and thoracoscopic Ivor Lewis esophagectomy and intrathoracic anastomosis have technical difficulties. Mini-thoracotomies have been added in some series to facilitate the anastomosis technique, but the difficulties increase even more, especially in obese patients.[15] A potentially fatal complication following esophageal surgery is anastomotic leakage. The incidence of this complication ranges from 0% to 12% and is similar between MIE and OE.[16] In cancer diagnosed as SCC, the surgical margin should be a minimum of 10-12 cm,[17] and therefore, neck anastomoses after total esophagectomy are often preferred in these patients.[18] However, anastomotic leakage in anastomoses performed into the thoracic cavity causes more frightening outcomes.[19] In our series, 7 (46.7%) of fifteen patients were diagnosed with SCC, and 9 (60%) of these fifteen patients were localized in the lower esophagus. However, in our surgical procedures, only 2 (13.3%) of fifteen patients underwent the Ivor Lewis procedure, whereas the number of Ivor Lewis esophagectomies should have been higher. Thirteen (86.7%) patients underwent McKeown esophagectomy. One of these two patients was discharged after uneventful recovery, while the other patient had anastomotic leakage, and mortality could not be prevented despite subsequent stenting. We believe that this patient's mortality due to the complication of the first minimally invasive esophagectomy and thoracic anastomosis performed with the Ivor Lewis procedure in our clinic has increased our tendency to perform McKeown esophagectomy in other cases. Another problem we encountered in these two patients was the difficulty in removing the pathological specimen from the 12 mm trocar area that we placed to use the endostapler. This area was enlarged during pathological specimen extraction, and we encountered the difficulty of suturing this area. Pulmonary complications in this patient group are among the most important concerns of us surgeons. In the TIME study, the reported incidence of pulmonary complications associated with MIE was 29%.[20] In our case series, postoperative atelectasis was detected in two of our patients (13%) and resolved with clinical medication. The mean duration of hospitalization after MIE was 10.53 days, which is consistent with the literature.

Robotic surgery has well-known advantages over MIE (laparoscopy and thoracoscopy) that facilitate more precise surgical dissection: improved visualization through high-resolution and magnified three-dimensional (3D) imaging, stable surgical field, tremor filtration, fingertip control of EndoWrist instruments, and better ergonomics/reduced fatigue, among others. The potential benefits of these technical advantages in esophageal cancer surgery have been explored in previous studies. A randomized trial comparing robot-assisted minimally inva-

sive esophagectomy (RAMIE) with open transthoracic esophagectomy found that RAMIE had lower rates of complications associated with surgery (59% vs. 80%, P=0.02), lower pulmonary complications (32% vs. 58%, P=0.005), lower cardiac complications (22% vs. 47%, P=0.006), lower postoperative pain, and better short-term quality of life. In oncologic outcomes, there was no difference between both approaches.[21] Another study showed that RAMIE was associated with less intraoperative blood loss, fewer pulmonary complications, and less overall morbidity.[22] Our high experience in robotic abdominal surgery and laparoscopic thoracic surgery has been a facilitating factor in our robotic thoracic interventions. We performed 4 (26.6%) of fifteen minimally invasive esophagectomy patients with the fully robotic McKeown procedure. In these patients, trocar placement difficulties, especially configuration according to tumor location, were the most important challenges we faced. In this first experience, none of the patients had complications and all were discharged in the usual course.

In the TIME study, mean operative times were 319 minutes: 299 minutes for MIE and 329 minutes for open esophagectomy.[23] In our current series, the mean operative time was 280.53 (180-464) minutes, which was shorter than the literature. The mean intraoperative blood loss was 200 ml in MIE in the TIME study.[23] In our current series, it was 200.33 (50-550) ml, which is consistent with the literature. We attribute this improvement to the current technological change and development (laparoscopy and robotic technological devices and equipment), specialization, and the fact that we have a lot of clinical experience in laparoscopy and robotic gastrointestinal cancer surgery.

When our first minimally invasive series of fifteen cases was evaluated, lower esophageal cancer surgical intervention was more common (60%) in line with our experience in minimally invasive total gastrectomy. As it is known, the rate of adenocarcinoma is higher in lower esophageal cancer,[24] and this was in parallel with our results (53-47%). In this first series, we used laparoscopic interventions more in the first cases because of our concern about controllability, and we included robotic thoracic surgery interventions more after laparoscopic experience (laparoscopic 73.3% - robotic 26.6%). The first selected group of patients had early-stage tumors, and the pathology results confirmed this (yp stage-1 60%).

When our case series is evaluated, we think that the ability of a team experienced in open esophageal surgery and minimally invasive abdominal surgery to perform minimally invasive esophagectomy while adhering to oncological principles in the treatment of robotic or laparoscopic esophageal cancer surgery can be achieved with a little experience. The small number of patients in this series, the preference for more McKeown esophagectomy surgery in patients, and the insufficient number of patients to separately evaluate the difficulties in differentiating between definitive and neoadjuvant therapy before esophagectomy are the most important shortcomings of our study. Studies with a higher number of cases are needed to evaluate the results of the study.

Conclusion

The widespread use of laparoscopic-thoracoscopic surgery in esophageal cancer surgery, the addition of the gains of robotic surgery technology to minimally invasive surgery, and increased experience have led to better early postoperative outcomes. In clinics experienced in gastrointestinal system and minimally invasive surgery, the thoracic surgery stage is considered to be the most worrisome step in minimally invasive esophagectomy procedures. We believe that adequate experience can be achieved with smaller patient series in the transition to minimally invasive esophagectomy, especially in clinics experienced with the open method in thoracic surgery. With the increase in laparoscopic-robotic thoracoscopic applications in esophageal cancer surgery, we think that neoadjuvant treatment may be preferred to definitive treatment in selected cases with a higher number of case results and sharing of experiences. However, more studies with larger series and long-term results are needed for this.

Disclosures

Ethichs Committee Approval: The study was approved by the Antalya Training and Research Hospital Ethics Committee. (No: 2024-320, Date: 10/10/2024).

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Outcomes of laparoscopic cholecystectomy in the elderly: A single-center study

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ABSTRACT

Introduction: The elderly population is at high risk for perioperative morbidity and mortality due to their disease profiles. This study aimed to evaluate the results of laparoscopic cholecystectomy (LC) performed in a single center in terms of young and elderly patients.

Materials and Methods: Patients who underwent LC between January 2022 and March 2023 were evaluated retrospectively. Two hundred and eighty-three patients were included in the study. Patients were divided into two groups: ≥65 years and <65 years, and perioperative findings were compared.

Results: Patients aged ≥65 had higher rates of heart disease, lung disease, kidney disease, and neurological disease; American Society of Anesthesiologists Score II–III; longer length of hospital stay (LOS); and longer length of intensive care unit (ICU) stay than patients aged <65. In addition, patients aged ≥65 had lower levels of hematocrit, hemoglobin, platelets, and albumin than patients aged <65, and patients aged ≥65 had higher levels of urea, creatinine, and total bilirubin than patients aged <65. High white blood cell count, C-reactive protein, aspartate transferase, and bilirubin values, as well as low hematocrit, hemoglobin, and albumin values, were associated with longer LOS and ICU stay. In addition, high aspartate transferase, alanine aminotransferase, alkaline phosphatase, direct bilirubin, and total bilirubin values were associated with increased development of complications. No mortality was observed during the study period.

Conclusion: LC is a safe method and has acceptable mortality and morbidity rates, even in patients with high comorbidities in elective conditions.

Keywords: Elderly, laparoscopic cholecystectomy, morbidity, mortality

Introduction

The population worldwide is rapidly aging, and the World Health Organization (WHO) estimates that the population over 60–65 will experience a significant increase, accounting for 22% of the world's population by 2050, outnumbering those under 15.[1] According to the March 2023 report of the Turkish Statistical Institute (TSI), there is a 22.6% increase in the population of people older than 65 years, from approximately 6.9 million in 2017 to 8.5 million in 2022. Projections estimate that the population of people over 65 will be around 25.6% of the total population.[2] Diseases such as cardiovascular, lung, and renal diseases, which affect surgical outcomes and lead to longer hospital stays, perioperative complications, and

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higher mortality rates, are more common in the elderly.[3,4] Understanding the specific challenges that occur with age in surgery can help improve perioperative care.[5,6] To achieve the best possible surgical outcomes, risks should be carefully assessed and managed, taking into account the health profiles and comorbidities of the elderly population.[7]

Gallbladder diseases, such as acute cholecystitis (AC) or biliary colic, are among the most common surgical indications for hospitalization and gastrointestinal diseases in developed countries. The most common cause of AC is gallstones.[8] With the aging of the population, the likelihood of gallstones and other gallbladder diseases is also increasing.[9] Ten percent of men and 25% of women aged 60–69 years, and 24% of men and 35% of women aged 90 years and older, have been reported to have gallstones.[10] Cholecystectomy, the preferred treatment for AC, continues to be one of the most commonly performed procedures in the United States.[11] Laparoscopic cholecystectomy (LC), which is considered the gold standard treatment for AC, still has a 6–9% risk of severe complications and a 0.1–0.3% mortality rate.[12-14] AC is associated with a higher risk of postoperative complications in the elderly due to the presence of more comorbidities, decreased functional reserve, and poorer general condition.[15] However, it has been documented that elective LC (ELC) is better than conservative treatment in elderly patients with AC.[16] The treatment strategy for gallbladder diseases in elderly patients remains controversial. This study aimed to compare LC results in patients aged ≥65 and <65 years.

Materials and Methods

This study was conducted between January 2022 and March 2023 at the Department of General Surgery, Faculty of Medicine, Trakya University. Ethical approval was obtained from the Faculty of Medicine Ethics Committee, Trakya University. The study protocol was prepared in accordance with the Declaration of Helsinki. Inclusion criteria for the study were being over 18 years old and having undergone cholecystectomy. Exclusion criteria for the study were being under 18 years old, having undergone cholecystectomy secondary to another gastrointestinal surgery, and being pregnant. Two hundred and ninety-five patients were evaluated retrospectively, and 283 were included in the study.

The patients were divided into two groups: ≥65 years and <65 years old. Demographic data of the patients, including age, gender, history of hepatobiliary disease, laboratory findings, American Society of Anesthesiologists Score (ASA), need for perioperative endoscopic retrograde cholangiopancreatography (ERCP) or preoperative percutaneous transhepatic gallbladder drainage (PTGBD), type (laparoscopic or open approach) and setting (elective or emergency) of cholecystectomies, duration of surgery, length of hospital stay (LOS) and intensive care unit (ICU) stay, post-cholecystectomy complications, and mortality were compared between the age groups of 65 years and older and under 65 years.

Statistical Analysis

Statistical evaluation was performed using SPSS 20 statistical software. The Kolmogorov-Smirnov test was used to evaluate the conformity of the measured data to the normal distribution. Mean, standard error, median, minimum, and maximum values of continuous variables, as well as frequency and percentage values of categorical variables, were given. Fisher's Exact test was used for categorical data and the Mann-Whitney U test for continuous data in the comparison of data for patients under 65 and over 65 years of age. For statistical analysis results, a p-value of less than 0.05 was considered significant.

Results

Demographic and clinical data of the patients included in the study are presented in Table 1. One hundred and eighty-two (64.3%) of the patients were female and 101 (35.7%) were male, and the mean age was 57.50±14.14 (19–88) years. The mean length of stay in the ICU was 0.25±1.07 (0–12) days, and the mean LOS was 3.62±3.31 (0–28) days. The preoperative diagnosis was cholelithiasis in 231 (81.6%) patients, acute cholecystitis in 22 (7.8%) patients, and acalculous cholecystitis in 15 (5.3%) patients. When their clinical histories were examined, 164 (58.8%) patients had cholelithiasis, 48 (17%) patients had acute cholecystitis, and 32 (11.3%) patients had cholelithiasis + choledocholithiasis. Eighty-one (28.6%) of the patients had heart disease, 76 (26.9%) had hypertension, 39 (13.8%) had lung problems, 15 (5.3%) had kidney comorbidities, 14 (4.9%) had neurological comorbidities, and 14 (4.9%) had hematological comorbidities.

One hundred and seventeen (41.3%) patients were ASA I, and 140 (49.5%) were ASA II. Seventeen (5.5%) patients underwent PTGBD, 29 (10.2%) patients underwent preoperative ERCP, 6 (2.1%) patients underwent postoperative

Table 1. Demographic and clinical data of the patients participating in the study

Variables	Mean±SD Median (Min-Max)
Age, years	57.50±14.14 59 (19-88)
Surgery Time, minutes	82.32±33.35 75 (30-240)
ICU Stay, days	0.25±1.07 0 (0-12)
Hospital Stay, days	3.62±3.31 3 (0-28)
	n (%)
Gender	
Female	182 (64.3)
Male	101 (35.7)
Preoperative Diagnosis	
Cholelithiasis	231 (81.6)
Acute Cholecystitis	22 (7.8)
Acalculous Cholecystitis	15 (5.3)
GB Perforation	9 (3.2)
GB Polyp	5 (1.8)
Cholelithiasis + Choledocholithiasis	1(0.4)
Clinical History	
Cholelithiasis	164 (58.0)
Acute Cholecystitis	48 (17)
Cholelithiasis + Choledocholithiasis	32 (11.3)
Acalculous Cholecystitis	12 (4.2)
Acute Cholecystitis + Choledocholithiasis	7 (2.5)
Cholelithiasis+ Abdominal Wall Hernia	5 (1.8)
Cholecystitis + Choledocholithiasis	4 (1.4)
Cholelithiasis + Inguinal Hernia	3 (1.1)
Cholecystitis	2 (0.7)
GB polyp	2 (0.7)
Acalculous Cholecystitis + Umbilical Hernia	1 (0.4)
Cholelithiasis + Umbilical Hernia	1 (0.4)
GB polyp + Abdominal Wall Hernia	1 (0.4)
GB polyp + Umbilical Hernia	1 (0.4)
Cardiovascular Disease	
No	202 (71.4)
Yes	81 (28.6)
Hypertension	
No	207 (73.1)
Yes	76 (26.9)
Lung Disease	
No	244 (86.2)
Yes	39 (13.8)

Table 1. CONT.

Variables	n (%)
Renal Disease	
No	268 (94.7)
Yes	15 (5.3)
Neurological Disease	
No	251 (95.1)
Yes	14 (4.9)
Hematological Disease	
No	269 (95.1)
Yes	14 (4.9)
PTGBD	
No	266 (94.5)
Yes	17 (5.5)
Complication	
No	272 (96.1)
Biliary Drainage	10 (3.5)
Subhepatic Hematoma	1 (0.4)
ASA	
0	3 (1.1)
I	117 (41.3)
II	140 (49.5)
III	22 (7.8)
4	1 (0.4)
Surgical Method	
Laparoscopy	264 (93.3)
Laparotomy	19 (6.7)
ERCP	
No	244 (86.2)
Preop	29 (10.2)
Postop	6 (2.1)
Preop+Postop	4 (1.4)
Surgery	
Emergency	21 (7.4)
Elective	262 (92.6)

ASA; American Society of Anaesthesiologists Score; ERCP; Endoscopic Retrograde Cholangiopancreatography; GB; Gallbladder; ICU; Intensive Care Unit; PTGBD; Preoperative Percutaneous Gallbladder Drainage.

ERCP, and 4 (1.4%) patients underwent both preoperative and postoperative ERCP. Two hundred and sixty-two (92.6%) patients underwent elective surgery, while 21 (7.4%) underwent emergency surgery. Laparoscopic surgery was initiated in 272 patients; eight patients were converted to open surgery, while 264 (93.3%) underwent laparoscopic surgery. No complications were observed in 272 patients. Biliary drainage was observed in 10 (3.5%) patients, and subhepatic hematoma was observed in 1 (0.4%) patient. Postoperative ERCP was applied to 10 patients with biliary drainage, and percutaneous drainage was applied to one patient with subhepatic hematoma.

The comparison of data for patients aged ≥65 years and <65 years is presented in Table 2. When clinical history

Table 2. Comparison of data of patients over 65 years of age and under 65 years of age

	Age <65 (n:182)	Age ≥65 (n:101)	
Gender, n (%)			
Female	120 (65.9)	62 (61.4)	X2= 0.585
Male	62 (34.1)	39 (38.6)	p= 0.444
Clinic History, n (%)			
Cholelithiasis	104 (57.1)	60 (59.4)	X2= 21.225
Acute Cholecystitis	32 (17.6)	16 (15.8)	p= 0.021
Cholelithiasis + Choledocholithiasis	16 (8.8)	16 (15.8)	
Acalculous Cholecystitis	12 (6.6)	0 (0)	
Acute Cholecystitis + Choledocholithiasis	5 (2.7)	2 (2)	
Cholelithiasis+ Abdominal Wall Hernia	3 (1.6)	2 (2)	
Cholecystitis + Choledocholithiasis	4 (2.2)	0 (0)	
Cholelithiasis + Inguinal Hernia	1 (0.5)	2 (2)	
Cholecystitis	2 (1.1)	0 (0)	
GB polyp	0 (0)	2 (2)	
Acalculous Cholecystitis + Umbilical Hernia	1 (0.5)	0 (0)	
Cholelithiasis + Umbilical Hernia	1 (0.5)	0 (0)	
GB polyp + Abdominal Wall Hernia	0 (0)	1 (1)	
GB polyp + Umbilical Hernia	1 (0.5)	0 (0)	
Preop Diagnosis, n (%)			
Cholelithiasis	144 (79.1)	87 (86.1)	X2= 14.656
Acute Cholecystitis	16 (8.8)	6 (5.9)	p= 0.005
Acalculous Cholecystitis	15 (8.2)	0 (0)	
GB Perforation	4 (2.2)	5 (5.0)	
GB Polyp	2 (1.1)	3 (3.0)	
Cholelithiasis + Choledocholithiasis	1 (0.5)	0 (0)	
Cardiovascular Disease, n (%)			
No	142 (70.3)	60 (49.4)	X2= 11.018
Yes	40 (29.7)	41 (50.6)	p= 0.001
Hypertension, n (%)			
No	137 (75.3)	70 (69.3)	X2= 1.178
Yes	45 (24.7)	31 (30.7)	p= 0.278
Lung Disease, n (%)			
No	166 (91.2)	78 (77.2)	X2= 10.686
Yes	16 (8.8)	23 (22.8)	p= 0.001
Renal Disease, n (%)			
No	176 (96.7)	92 (91.1)	X2= 4.079
Yes	6 (3.3)	9 (8.9)	p= 0.043
Neurological Disease, n (%)			
No	169 (92.9)	82 (81.2)	X2= 8.819
Yes	13 (7.1)	19 (18.8)	p= 0.003
Hematological Disease, n (%)			
No	170 (93.4)	99 (98.0)	X2= 2.940
Yes	12 (6.6)	2 (2)	p= 0.086

Table 2. CONT.

	Age <65 (n:182)	Age ≥65 (n:101)	
PTGBD, n (%)			
No	172 (94.5)	94 (93.1)	X2= 0.233
Yes	10 (5.5)	7 (6.9)	p= 0.629
ASA, n (%)			
I	112 (61.5)	8 (7.9)	X2= 77.236
II	62 (34.1)	78 (77.2)	P<0.001
III	8 (4.4)	15 (8.2)	
Complication, n (%)			
No	174 (95.6)	98 (97)	X2= 0.353
Yes	8 (4.4)	3 (3.0)	p= 0.552
Surgery, n (%)			
Emergency	11 (6.0)	10 (9.9)	X2= 1.407
Elective	171 (94.0)	91 (90.1)	p= 0.236
ERCP, n (%)			
No	161 (88.5)	83 (82.2)	X2= 7.328
Preop	13 (7.1)	16 (15.8)	p=0.062
Postop	4 (2.2)	2 (2.0)	
Preop+postop	4 (2.2)	0 (0.0)	
Surgery Duration, minutes	83.59±2.36	80.08±3.56	Z= -1.848
	75 (30-240)	75 (35-230)	p= 0.065
ICU Stay, days	0.07±0.03	0.59±0.16	Z= -4.656
	0 (0-5)	0 (0-12)	P<0.001
Hospital Stay, days	3.09±0.21	4.57±0.37	Z= -6.999
	2 (0-28)	3 (1-25)	P<0.001

X^2: Fischer's exact test, Z Mann-Whitney U test, ASA: American Society of Anaesthesiologists Score, ERCP: Endoscopic Retrograde Cholangiopancreatography, GB: Gallbladder, ICU: Intensive Care Unit, PTGBD: Preoperative Percutaneous Gallbladder Drainage.

was evaluated, acalculous cholecystitis was significantly more common in patients <65 years of age than in patients ≥65 years of age, and cholelithiasis accompanied by choledocholithiasis was significantly more common in patients ≥65 years of age than in patients <65 years of age (p=0.021). Heart disease (p=0.001), lung disease (p=0.001), kidney disease (p=0.043), and neurological diseases (p=0.003) were significantly more common in patients aged ≥65 years compared to patients aged <65 years. The number of ASA II and ASA III patients in the group aged ≥65 was significantly higher than in the group aged <65 (p<0.001). The length of ICU stay and LOS were significantly longer in patients aged ≥65 years compared to patients aged <65 years (p<0.001). No significant differences were observed between the two groups in terms of other data.

The comparison of laboratory results of patients aged ≥65 years and <65 years is given in Table 3. Hematocrit (Hct) (p=0.025), hemoglobin (Hb) (p=0.008), platelet (PLT) (p=0.021), and albumin (p<0.001) levels of patients aged ≥65 years were significantly lower than those of patients aged <65 years. However, urea (p<0.001), creatinine (p=0.003), and total bilirubin (p=0.033) levels of patients aged ≥65 years were significantly higher than those of patients aged <65 years. No significant differences were observed between the two groups in terms of other laboratory results.

The relationship between the clinical information of the patients and the LOS, the length of stay in the ICU, and complications is presented in Table 4. No relationship was observed between comorbidities and LOS, ICU stay, and complications. High WBC count, CRP, AST, total biliru-

Table 3. Comparison of laboratory results of patients under the age of 65 and those aged 65 and over.

Variables	Age < 65 (n:182)	Age ≥ 65 (n:101)	Test Statistics
WBC	8.01±0.16	8.71±0.53	Z= -0.096
	7.81 (3.39-17.59)	7.80 (3.17-50.88)	p= 0.923
HCT	40.19±0.33	39.02±0.511	Z= -2.242
	41 (26-51)	39 (26-55)	p=0.025
Hb	13.38±0.12	12.78±0.18	Z= -2.671
	13.35 (8.10-18.0)	12.90 (8.0-17.40)	p=0.008
PLT	283.74±6.05	263.98±8.40	Z= -2.308
	274 (82-678)	254 (107-630)	p= 0.021
CRP	9.95±1.91	14.80±3.79	Z= -1.550
	3.55 (0.2-200)	4.35 (0.3-313.2)	p= 0.121
Urea	29.00±0.88	35.06±1.43	Z= -4.125
	27 (12-128)	33 (11-89)	P<0.001
Creatinine	0.88±0.06	0.93±0.04	Z= -3.013
	0.75 (0.44-9.05)	0.82 (0.54-4.05)	p= 0.003
Albumin	4.48±0.03	4.11±0.05	Z= -6.608
	4.55 (2.70-5.30)	4.15 (2.10-5.00)	P<0.001
AST	23.28±1.53	26.65±1.76	Z= -1.438
	18 (2-169)	19 (9-99)	p= 0.150
ALT	28.40±1.96	21.45±1.49	Z= -1.872
	18 (6-163)	18 (4-79)	p= 0.061
ALP	102.49±7.66	87.76±4.55	Z= -0.757
	82 (25-920)	79 (30-343)	p= 0.449
GGT	52.46±4.49	44.26±6.34	Z= -0.937
	27 (8-386)	26.5 (10-437)	p= 0.349
Total Bilirubin	0.57±0.08	0.65±0.07	Z= -2.131
	0.5 (0.1-14.8)	0.5 (0.1-7.2)	p= 0.033
Direct Bilirubin	0.24±0.03	0.32±0.07	Z= -1.183
	0.2 (0-6.5)	0.2 (0- 6.9)	p= 0.237

Z Mann-Whitney U test; WBC: White Blood Cell; HCT: Hematocrit; Hb: Hemoglobin; PLT: Platelet; CRP; C-Reactive Protein; AST: Aspartate Transferase; ALT: Alanine Aminotransferase; ALP. Alkaline Phosphatase; GGT: Gamma-Glutamyl Transferase.

bin, and direct bilirubin values, and low Hct, Hb, and albumin values were associated with longer LOS and ICU stays (p<0.001). High AST (p=0.011), ALT (p=0.005), ALP (p=0.008), direct bilirubin (p=0.026), and total bilirubin (p=0.036) values were associated with the development of complications. The patients who needed PTGBD had longer hospital stays (p<0.001).

Discussion

This study compared the clinical data of patients aged ≥65 who underwent cholecystectomy between January 2022 and March 2023 with those aged <65. Acalculous cholecystitis was more common in patients aged <65, while cholelithiasis accompanied by choledocholithiasis was more common in patients aged ≥65. In patients aged ≥65, heart disease, lung disease, kidney disease, neurological disease, the number of ASA II and ASA III patients, the LOS, and the length of ICU stay were higher than in patients aged <65. In addition, Hct, Hb, and PLT levels of patients aged ≥65 were significantly lower than those in patients aged <65, while urea, creatinine, and total bilirubin levels were significantly higher. Lower Hct, Hb, and albumin levels; higher WBC, CRP, AST, total bilirubin, and direct bilirubin values; and higher ASA were associated with LOS and the length of ICU stay.

Table 4. Relationship of clinical information of patients with length of hospital stay, length of stay in intensive care unit, and complications

	Hospital Stay		ICU Stay		Complication	p
	r	p	r	p	OR (95% CI)	
Cardiovascular Disease	0.074	0.215	0.001	0.990	1.447 (0.412-5.084)	0.564
Hypertension	0.030	0.615	0.107	0.073	1.564 (0.278-8.786)	0.612
Lung Disease	0.051	0.389	0.114	0.055	1.621 (0.228-11.546)	0.630
Renal Disease	0.032	0.598	0.002	0.974	3.141 (0.305-32.350)	0.336
Hematological Disease	-0.009	0.885	-0.024	0.682	2.048 (0.219-19.122)	0.529
PTGBD	0.235	<0.001	0.113	0.058	5.157 (0.886-30.007)	0.068
ASA	0.138	0.20	0.132	0.026	1.045 (0.116-9.388)	0.968
WBC	0.257	<0.001	0.365	<0.001	1.037 (0.631-1.157)	0.507
HCT	-0.209	<0.001	-0.215	<0.001	0.877 (0.778-0.989)	0.032
Hb	-0.173	0.003	-0.217	<0.001	0.749 (0.533-1.052)	0.095
PLT	0.163	0.006	-0.008	0.894	1.004 (0.998-1.010)	0.211
CRP	0.245	<0.001	0.299	<0.001	1.009 (0.997-1.020)	0.137
Urea	-0.054	0.369	0.033	0.578	1.187 (0.799-0.961)	0.875
Creatinine	0.016	0.790	0.014	0.821	1.113 (0.616-2.009)	0.723
Albumin	-0.295	<0.001	-0.256	<0.001	0.505 (0.180-1.414)	0.193
AST	0.220	<0.001	0.189	0.001	1.022 (1.005-1.039)	0.011
ALT	0.076	0.271	0.009	0.876	1.022 (1.007-1.038)	0.005
ALP	0.111	0.062	0.053	0.377	1.004 (1.001-1.008)	0.008
GGT	0.047	0.434	0.032	0.599	1.003 (0.995-1.010)	0.461
Total Bilirubin	0.448	<0.001	0.396	<0.001	1.409 (1.022-1.943)	0.036
Direct Bilirubin	0.409	<0.001	0.466	<0.001	1.642 (1.062-2.538)	0.026

WBC: White Blood Cell; HCT: Hematocrit; Hb: Hemoglobin; PLT: Platelet; CRP: C-Reactive Protein; AST: Aspartate Transferase; ALT: Alanine Aminotransferase; ALP: Alkaline Phosphatase; GGT: Gamma-Glutamyl Transferase; ICU: Intensive Care Unit.

Bile duct disorders are among the most common reasons for surgical intervention in elderly patients, who more often seek emergency medical observation for diseases such as AC.[17] LC, the gold standard treatment for symptomatic gallstones, has several advantages compared to open cholecystectomy, such as a shorter recovery time, less postoperative pain, and a rapid return to normal activities.[18,19] However, caution should be exercised in LC in certain patient groups, such as those with morbid obesity, immunocompromised patients, and the elderly, due to risks of morbidity and mortality.[20,21]

The incidence of AC increases with advancing age. Therefore, the average age of patients undergoing cholecystectomy is higher, and increasing age raises the risk of complications related to gallstones.[22] Moreover, elderly patients may present with more severe forms of gallbladder disease, such as AC, cholangitis, common bile duct stones, and gallbladder carcinoma.[23,24] However, there is no consensus on the definition of patient groups at high surgical risk, which scales should be used for risk assessment, and whether age is important. No well-defined indications and contraindications exist for treatment choices, especially in the older age group. In these cases, the choice depends on the expertise and preference of the treating surgeon.[25]

According to the WHO recommendation, patients aged ≥65 are considered elderly in developed countries.[1] Therefore, in this study, patients aged ≥65 were considered elderly, and the demographic data of patients aged <65 were compared with those aged ≥65.

It is known that advanced age is significantly associated with an increased risk of surgical complications. Serban et al.[26] reported an increased rate of postoperative complications in patients over 50 years of age, while Bass et

al.[27] and Kamarajah et al.[28] reported higher postoperative complications in patients over 65 years of age. Escartín et al.[29] and Lorenzon et al.[6] reported that increased AC severity was associated with higher comorbidities and increasing complications. Elderly patients exhibit more comorbidities compared to younger patients, and these comorbidities are associated with a higher frequency of complications. The most common comorbidities observed in elderly patients are cardiovascular disease, lung disease, and diabetes.[30]

Serban et al.[26] performed a comparative analysis of patients who underwent LC for AC according to age groups. They determined that patients aged <50 years had no significant comorbidities, short postoperative stays, and no significant complications. Patients aged 50–64 years also had a low anesthesia-surgery risk, though those with diabetes and chronic kidney disease were at risk of major cardiovascular complications in the early postoperative period. Patients aged 65–79 years exhibited increased anesthesia-surgery risk, a significant increase in biomarkers of inflammation, and more severe cases according to the Tokyo Guidelines criteria compared to patients aged <50. Patients aged >80 years demonstrated clinical features similar to those aged 65–79 years but had late presentation, increased anesthesia-surgery risk with comorbidities, a higher frequency of severe forms, a higher conversion rate, and major postoperative systemic complications compared to patients aged <50.

Elderly patients exhibit a higher ASA score distribution, and the number of patients with ASA III and above is higher in the elderly group.[26] Ramirez-Giraldo et al.[31] observed that patients with benign biliary tract disease and ASA classifications III–IV had higher mortality rates than those with ASA classifications I–II. Kubat et al.[32] determined that patients aged ≥65 years had a longer length of hospital stay, a greater need for open surgery, and a greater need for emergency surgery. Coelho et al.[33] showed that LC in the elderly was associated with longer operative times, higher rates of acute cholecystitis, more conversions, and higher postoperative complications.

Kamarajah et al.[28] documented that advancing age was associated with conversion to open cholecystectomy in a systematic review and meta-analysis of 53 studies with 59,173 patients. Researchers found that increasing age raised overall complication rates by 2.37 times, significant complication rates by 1.79 times, conversion rates to open cholecystectomy by 2.17 times, bile leak rates by 1.50 times, length of hospital stay by 2.21 times, and postoperative mortality rates by 7.20 times.[28]

In a recent study that included 567 patients and compared those over 75 years of age with those under 75 years of age, patients over 75 had more comorbidities, such as diabetes, hypertension, and ischemic heart disease, and more ASA III–IV patients. However, no differences were observed between the groups in terms of intraoperative and postoperative complications. The study reported that no patients required reoperation, and no deaths were recorded.[34]

Lee et al.[16] demonstrated that elective laparoscopic cholecystectomy (ELC) after percutaneous transhepatic gallbladder drainage (PTGBD) is a safe option for managing acute cholecystitis (AC). In a retrospective study involving 202 octogenarian patients treated with PTGBD for AC without common bile duct stones, patients were categorized into three groups: those who underwent ELC after PTGBD, those managed conservatively with PTGBD maintained for more than three weeks (PTGBD-M), and those with PTGBD removed within three weeks after decompression (PTGBD-R). While no significant difference in mortality was observed between the ELC and conservative management groups, the incidence of biliary events (e.g., cholecystitis and cholangitis) was markedly higher in the conservatively managed groups compared to the ELC group. The ELC group had a postoperative major complication (POMC) rate of 8.5%, while the cumulative incidence of biliary events in the PTGBD-R group was 22.2%. Furthermore, PTGBD-related complications were notably frequent in the PTGBD-M group, with a cumulative incidence of 70.8%.

In our study, cardiovascular, lung, renal, and neurological comorbidities, as well as the number of ASA II–III patients, were significantly higher in patients aged ≥65 years than in those aged <65 years. In addition, the LOS and length of ICU stay were higher in patients aged ≥65 years compared to those aged <65 years. This study also determined that as age increased, cardiovascular, lung, and hematological comorbidities, LOS, length of ICU stay, and the number of ASA II–III patients increased significantly. The LOS and length of ICU stay for ASA II patients were considerably longer than those for ASA I patients, but there was no significant difference between ASA III and ASA I patients. This may be due to the more careful perioperative evaluation of ASA III patients.

Although comorbidities were observed more frequently in patients aged ≥65 years, comorbidities were not associated with LOS, length of ICU stay, or complications, contrary to previous studies. We preferred to treat the patients conservatively in the acute setting, using PTGBD to decompress the inflamed or perforated gallbladder and antibiotics to relieve the inflammation where possible, in order to postpone the surgery to a time when the inflammation had decreased to ease the surgery. Therefore, patients who needed PTGBD were those with acute inflamed gallbladders, and they had significantly higher LOS after the postponed surgery ($p<0.001$). Since mortality was not observed in our study, the effect of age and other data on mortality could not be evaluated.

Investigating preoperative predictive factors for LC is essential to identify high-risk procedures and optimize the surgical plan and efficiency of the operating room. Regarding the inflammatory process, WBC, neutrophil, and CRP values may be observed to be higher than normal in AC patients. CRP is the most important inflammatory marker for conversion to advanced AC and open surgery.[35] Kubat et al.[32] determined that AC patients had higher WBC, neutrophil, and immature granulocytes at presentation. Moreover, they documented that these values were higher in patients requiring delayed emergency cholecystectomy. Nidoni et al.[36] noted a WBC count >11,000/mm³ as a predictive factor for difficult LC. Bourgouin et al.[37] determined a statistically significant relationship between ALP, ALT, and bilirubin values and difficult LC. On the contrary, Di Buono et al.[38] did not observe a relationship between ALP, ALT, and bilirubin values and difficult LC.

In our study, WBC, CRP, AST, ALT, ALP, and GGT values in patients aged ≥65 years were not different from those in patients aged <65 years. However, Hct, Hb, PLT, albumin, urea, and creatinine values of patients aged ≥65 years were different from those of patients aged <65 years. This difference is likely due to the comorbidities of patients aged ≥65 years. High WBC, PLT, CRP, AST, and bilirubin levels, as well as high ASA scores, and low Hct, Hb, and albumin levels were associated with longer LOS and longer ICU stays. High AST, ALT, ALP, and bilirubin levels increased the risk of complications.

The current study had several limitations. First, the study was retrospective, single-center, and had a small sample size due to the short time period. Therefore, the generalizability of the results may be limited. Second, there was selection bias, as only patients who underwent surgical treatment were included in the study. Third, the study evaluated only the short-term outcomes of surgery. Therefore, prospective studies with longer durations, larger sample sizes, and assessments of patients' quality of life are needed.

Conclusion

In this study, data from patients with gallbladder disease aged over 65 years were compared with those from patients aged under 65 years. Comorbidities were higher in patients over 65 years of age, the numbers of ASA II and ASA III patients were greater, and hospital stay and intensive care unit stay were longer in patients over 65 years of age, depending on comorbidities. However, no mortality was observed during the study period, and the total complication rate was only 4%. Laparoscopic cholecystectomy is a safe method with acceptable mortality and morbidity rates, even in patients with high comorbidities under elective conditions.

Disclosures

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The role of video-assisted thoracoscopic lung biopsy in the diagnosis of interstitial lung disease

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ABSTRACT

Introduction: Interstitial lung diseases (ILDs) are a heterogeneous group of disorders characterized by fibrosis and inflammation of the lung parenchyma. Early and accurate diagnosis is crucial for effective management and prognosis. Video-assisted thoracoscopic surgery (VATS) has emerged as a minimally invasive technique that provides sufficient tissue for histopathological diagnosis, particularly in cases where non-invasive methods, like high-resolution computed tomography (HRCT), are inconclusive.

Materials and Methods: This retrospective observational study was conducted on patients with suspected ILD who underwent VATS lung biopsy between January 1, 2014, and January 1, 2024. Demographic data, clinical symptoms, imaging results, biopsy sites, and histopathological findings were collected and analyzed. The study aimed to evaluate the diagnostic role of VATS and the relationship between biopsy locations and diagnostic success.

Results: A total of 39 patients were included, with a median age of 51 years (range: 21–69). Of the patients, 59% were male, and 41% were female. Biopsies were performed on 85% of the right lung and 15% of the left lung. Specific diagnoses were achieved in 87% of cases, with idiopathic pulmonary fibrosis (30%), non-specific interstitial pneumonia (20%), and cryptogenic organizing pneumonia (15%) being the most common. Surgical complications were observed in 3.4% of patients, including prolonged air leakage in two cases.

Conclusion: VATS is a reliable and minimally invasive method for diagnosing ILD, providing high diagnostic accuracy and a low rate of complications. This study demonstrates the clinical utility of VATS in obtaining accurate histopathological diagnoses in patients with interstitial lung diseases.

Keywords: Interstitial lung disease, lung biopsy, video-assisted thoracoscopy

Introduction

Interstitial lung diseases (ILDs) are a heterogeneous group of disorders characterized by fibrosis and inflammation of the lung parenchyma. Clinically, these diseases can present with symptoms such as dyspnea, dry cough, and shortness of breath, though there are significant variations in etiological factors and disease progression.[1–3] Early and accurate diagnosis of ILDs is crucial for disease management and prognosis. Timely diagnosis is necessary to prevent advanced fibrotic changes and to guide treatment options.

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High-resolution computed tomography (HRCT), a widely used non-invasive imaging method in the diagnosis of ILDs, plays a crucial role in distinguishing fibrotic from non-fibrotic patterns.[4,5] However, the diagnostic accuracy of HRCT is not always sufficient, and histopathological examination may be required in certain cases. In this context, video-assisted thoracoscopic lung biopsy (VATS), a minimally invasive surgical technique, is commonly employed to obtain sufficient tissue samples for the diagnosis of ILDs.[6–8]

VATS biopsy is preferred due to its lower morbidity and mortality rates compared to open lung biopsy. Additionally, its high diagnostic accuracy makes it a valuable tool in distinguishing between specific and non-specific subtypes of ILDs. The effectiveness of VATS biopsy in diagnosing diseases such as idiopathic pulmonary fibrosis (IPF), non-specific interstitial pneumonia (NSIP), and cryptogenic organizing pneumonia (COP) is well established.[9,10]

The aim of this study is to evaluate the role of VATS biopsy in the diagnosis of interstitial lung diseases.

Materials and Methods

This study has a retrospective observational design and includes patients diagnosed with ILD who underwent VATS in the thoracic surgery clinic of Kartal Dr. Lütfi Kırdar City Hospital between January 1, 2014, and January 1, 2024. The study was conducted with the approval of the local ethics committee (Ethics Committee Approval: 2024/010.99/6/38; Date: 26/07/2024).

Patients included in the study were selected from cases that underwent VATS biopsy due to suspected ILD. The inclusion criteria were: being over 18 years old, having been diagnosed with ILD based on computed tomography (CT) and HRCT imaging, and having clinical findings necessitating biopsy. Patients with missing data were excluded from the study.

Patient data were retrospectively obtained from hospital records. Demographic data (age, gender), clinical symptoms, laboratory results, biopsy sites, and histopathological diagnoses were thoroughly analyzed. Specific and non-specific diagnoses were classified according to clinical and histopathological findings. Additionally, diagnostic success rates were evaluated based on the biopsy regions.

All patients underwent biopsies using the standard VATS technique. During the surgical procedure, biopsies were generally taken from different lobes of both the right and left lungs. The adequacy of biopsy samples was assessed macroscopically during the operation. Post-surgery, chest tube follow-up was conducted, and cases with complications were treated with conservative methods.

Statistical Analysis

The statistical analyses were carried out using IBM SPSS version 29.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the data. Continuous variables were reported as medians and ranges due to their non-parametric distribution, while categorical variables were presented as counts and percentages. Diagnostic accuracy percentages were calculated for specific and non-specific diagnoses across different lung biopsy sites. The analyses considered the distribution of biopsy regions, histopathological diagnoses, and associated complications.

Results

In this study, a total of 39 patients who underwent VATS were analyzed. The median age of the patients was 51 years (range: 21–69), with 23 being male (59%) and 16 female (41%). The distribution of lung biopsy sites is shown in Table 1. Biopsies were performed on 85% of the right lung and 15% of the left lung. The biopsy sites included the right upper lobe (25%), right lower lobe (26.6%), left upper lobe (21.8%), left lower lobe (18.8%), and right middle lobe (2.5%).

Histopathological evaluation resulted in a specific diagnosis for 87% of the patients (Table 2). The most common specific diagnoses were idiopathic pulmonary fibrosis (30%), non-specific interstitial pneumonia (20%), cryptogenic organizing pneumonia (15%), and sarcoidosis (10%). Additionally, rarer diagnoses included squamous cell carcinoma, Langerhans cell histiocytosis, and Aspergillus infection.

Table 1. Distribution of lung biopsy sites

Lung Region	Number of Patients	Percentage (%)
Right Upper Lobe	10	25
Right Lower Lobe	11	26.6
Left Upper Lobe	9	21.8
Left Lower Lobe	8	18.8
Right Middle Lobe	1	2.5

Table 2. Specific and non-specific histopathological diagnoses

Diagnosis	Number of Patients	Percentage (%)
Interstitial Fibrosis	7	18
Usual Interstitial Pneumonia (UIP)	6	15
Hypersensitivity Pneumonitis	6	15
Squamous Cell Carcinoma	3	7.5
Granulomatous Pathologies	5	12.5
Langerhans Cell Histiocytosis	3	7.5
Aspergillus Infection	2	5
Sarcoidosis	3	7.5
Non-Specific Interstitial Pneumonia	4	10

Table 3. Complications and length of hospital stay

Parameter	Median	Range
Chest Tube Duration	3 days	1-7 days
Length of Hospital Stay	4 days	2-7 days
Prolonged Air Leak	2 patients	3.4%

Table 4. Diagnostic accuracy of specific and non-specific diagnoses by biopsy site

Biopsy Region	Specific Diagnosis (%)	Non-Specific Diagnosis (%)
Right Upper Lobe	85	15
Right Lower Lobe	90	10
Left Upper Lobe	88	12
Left Lower Lobe	92	8
Right Middle Lobe	80	20

Surgical complications and hospital stay durations are summarized in Table 3. The complication rate following VATS biopsies was 3.4%, with two patients experiencing prolonged air leaks. The median duration of chest tube placement was 3 days (range: 1–7 days), and the median length of hospital stay was 4 days (range: 2–7 days). The diagnostic success rates by biopsy site are presented in Table 4. The specific diagnostic success rate was 85% for biopsies from the right upper lobe, 90% for the right lower lobe, 88% for the left upper lobe, 92% for the left lower lobe, and 80% for the right middle lobe. The rates of non-specific diagnoses ranged from 7% to 20% depending on the biopsy site.

Discussion

In this study, the clinical and surgical outcomes of patients with ILD who underwent VATS were retrospectively analyzed. Our findings demonstrate that VATS biopsy is a minimally invasive method with high diagnostic accuracy in the diagnosis of ILDs. Additionally, when the proportions of specific and non-specific diagnoses were examined, it was found that specific diagnoses were more common compared to non-specific ones.

ILDs represent a complex and heterogeneous group of disorders that affect the lung parenchyma, leading to fibrosis, inflammation, and subsequent deterioration of lung function. These conditions can be challenging to diagnose due to the variability in clinical presentation and the overlap of radiographic features with other pulmonary diseases. Early and accurate diagnosis is essential for determining the appropriate therapeutic strategies and for improving patient outcomes, as delayed treatment can lead to irreversible fibrosis and respiratory failure.[11,12] Non-invasive imaging techniques, such as HRCT, are crucial in the initial assessment of ILD. However, in many cases, radiological findings alone are insufficient to provide a definitive diagnosis. This is especially true in cases where there is a need to differentiate between various subtypes of ILD, such as IPF, NSIP, or COP. In such instances, a histopathological examination obtained through lung biopsy remains the gold standard for diagnosis. Lung biopsy not only aids in accurate disease classification but also helps in ruling out other potential etiologies, such as malignancies or infections, that can mimic ILD.[13]

VATS has revolutionized the diagnostic approach to ILD by providing a minimally invasive method for obtaining lung tissue samples.[14] Compared to traditional open lung biopsy, VATS offers several significant advantages, including reduced postoperative pain, shorter hospital stays, and a lower risk of complications. Its ability to provide high-quality tissue samples while minimizing surgical trauma has made it the preferred technique for lung

biopsy in ILD patients. Moreover, the diagnostic accuracy of VATS in ILD is well-established, with studies consistently demonstrating its success in differentiating specific subtypes of interstitial lung disease.[15] This success is attributed to VATS's ability to obtain larger and deeper lung tissue samples compared to less invasive methods, such as transbronchial biopsy, which often yield smaller and less representative samples. The precise localization of biopsy sites using VATS further enhances its diagnostic yield, particularly in patients with diffuse or heterogeneous lung involvement. Additionally, VATS has been shown to have a relatively low complication rate, making it a safer alternative for patients who require tissue diagnosis for ILD. Its widespread clinical use has proven effective in guiding treatment decisions and improving the prognosis of patients with various forms of ILD.[16]

Several studies in the literature highlight the clinical value of VATS in the diagnosis of ILDs. Sugino et al.[17] reported that surgical lung biopsy plays a pivotal role in the accurate diagnosis of ILDs, with high diagnostic concordance across multiple biopsies, reinforcing our study's findings on the utility of VATS in obtaining sufficient tissue samples for histopathological evaluation. Additionally, the work by Demiröz et al.[18] emphasizes that a single VATS biopsy, when carefully planned through multidisciplinary discussion, can achieve diagnostic accuracy comparable to multiple biopsies while minimizing the length of hospital stay. Furthermore, Otsuka et al.[19] highlighted the low complication rate of surgical lung biopsy in patients with ILD, underlining the procedure's safety and efficacy. Our findings corroborate these results, as we reported a similarly low complication rate, particularly regarding prolonged air leaks. Jeon et al.[20], in their comparison of intubated and non-intubated VATS procedures, found that non-intubated VATS yielded fewer postoperative complications. Although our study did not explore non-intubated techniques, the overall safety of VATS, as demonstrated by both studies, supports its continued use as a minimally invasive diagnostic tool in patients with ILDs.

Limitations

This study has several limitations. First, the retrospective nature of the research introduces potential biases, such as incomplete or missing data. Second, the sample size is relatively small, which may limit the generalizability of the findings to broader populations. Third, the study was conducted in a single center, which may restrict the applicability of the results to other clinical settings. Lastly, while VATS is considered a minimally invasive technique, its availability and use may be limited in facilities lacking the necessary surgical expertise or resources.

Conclusion

VATS is a valuable and minimally invasive diagnostic tool for interstitial lung diseases (ILD). This study demonstrates that VATS provides high diagnostic accuracy, especially in differentiating specific from non-specific ILD subtypes, while maintaining a low complication rate. Despite the limitations, the findings support the use of VATS in clinical practice for accurate histopathological diagnoses in ILD patients.

Disclosures

Ethichs Committee Approval: This study was approved by the Ethics Committee of Kartal Dr. Lütfi Kırdar City Hospital (Ethics committee rulling number: 2024/010.99/6/38, Date: 26/07/2024).

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LESS

Original Article

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Impact of coronary artery disease on outcomes of video-assisted thoracoscopic surgery for non-small cell lung cancer: A retrospective analysis

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ABSTRACT

Introduction: Coronary artery disease (CAD) is a prevalent comorbidity among patients undergoing lung cancer surgery, posing significant perioperative challenges. Video-assisted thoracoscopic surgery (VATS) has gained prominence for its minimally invasive approach and reduced morbidity compared to open thoracotomy. This study investigates the outcomes of VATS in patients with non-small cell lung cancer (NSCLC) and concomitant CAD.

Materials and Methods: This retrospective study analyzed 42 patients with NSCLC who underwent VATS anatomical resections at Kartal Kosuyolu High Specialization Education & Research Hospital from April 2020 to August 2024. Patients were divided into two groups: the study group included those with a history of percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG), while the control group comprised patients without such histories. All patients underwent preoperative cardiac evaluations and tailored antithrombotic management. Outcomes were assessed in terms of perioperative complications, postoperative recovery, and pathological findings.

Results: The study group (n=20) and control group (n=22) were comparable in terms of demographics and tumor characteristics. The mean operative time was 312 minutes for the study group and 330 minutes for the control group. Drain removal time and hospital stay were slightly longer in the study group. Postoperative cardiovascular complications were minimal, with no significant differences between groups. Pathological evaluation revealed similar tumor histology and staging, predominantly adenocarcinoma in both groups. VATS demonstrated low conversion rates and acceptable outcomes, even in high-risk patients with CAD.

Conclusion: VATS is a feasible and safe surgical option for NSCLC patients with concomitant CAD. With appropriate preoperative evaluations and individualized management, perioperative risks can be minimized, enabling effective surgical treatment for this complex patient population.

Keywords: Coronary artery disease, non-small cell lung cancer, perioperative outcomes, video-assisted thoracoscopic surgery

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Introduction

Lung cancer remains the leading cause of cancer-related mortality worldwide, representing a major global health challenge.[1-3] In Türkiye, the burden of lung cancer is similarly substantial, contributing to a significant number of cancer-related deaths annually.[4] According to the National Comprehensive Cancer Network (NCCN) Guidelines, surgical intervention is the cornerstone of treatment for stage 1 and stage 2 lung cancer and may also be indicated for certain subgroups of patients with stage 3 disease.[2,3] While open thoracotomy has long been the standard surgical approach, the past three decades have seen a growing shift toward minimally invasive techniques, driven by advances in surgical technology and the pursuit of improved patient outcomes.[1,5]

Video-assisted thoracoscopic surgery (VATS) has emerged as a prominent minimally invasive approach for the management of lung cancer.[6] Compared to open thoracotomy, VATS is associated with several advantages, including reduced perioperative complications, shorter hospital stays, and lower surgical morbidity. These benefits are particularly pronounced in high-risk patients, such as those with significant comorbidities, who were previously considered unsuitable for surgery. Despite these advantages, the role of VATS remains a subject of debate, with some studies reporting comparable outcomes between VATS and open thoracotomy. Nevertheless, the global adoption of VATS has steadily increased, with notable variability in its utilization across countries and healthcare institutions.[6] In Türkiye, the technique has gained traction, reflecting broader international trends in minimally invasive thoracic surgery.[7]

Coronary artery disease (CAD) is a common comorbidity in patients undergoing lung cancer surgery, posing unique challenges for perioperative management.[8] Large-scale institutional databases estimate the prevalence of CAD in resectable lung cancer patients to be between 7% and 16%. Furthermore, the risk of major adverse cardiac events (MACE) following anatomic lung resection is approximately 3%. Studies from Japan and other cohorts have highlighted the intersection of lung cancer and cardiovascular disease, reporting that up to 26.5% of lung cancer patients have concomitant coronary heart disease, with perioperative cardiovascular event risks as high as 4.2%. These findings underscore the importance of optimizing surgical strategies and perioperative care to mitigate cardiovascular risks while ensuring effective oncologic outcomes.[8]

In this study, we aimed to investigate the perioperative and postoperative outcomes of lung cancer patients undergoing video-assisted thoracoscopic surgery (VATS) with coexisting CAD, focusing on the incidence of MACE and the feasibility of VATS in this high-risk population.

Materials and Methods

This retrospective study included 42 patients diagnosed with non-small cell lung cancer (NSCLC) who underwent consecutive VATS anatomic resections at the Department of Chest Surgery, Kartal Kosuyolu High Specialization Education & Research Hospital, between April 2020 and August 2024. Ethical approval was obtained from the local ethics committee (No: 2024/19/955), and the study was conducted in accordance with the principles of the Helsinki Declaration. Written informed consent was obtained from all participants, and patient privacy was strictly maintained.

Patients were categorized into two groups based on their cardiovascular history. The study group comprised patients with a history of percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) for acute coronary syndrome. The control group consisted of patients without such a history. Only patients with a confirmed diagnosis of NSCLC were included; those with other diagnoses were excluded.

Preoperative Assessment and Management

All patients underwent a comprehensive preoperative cardiac evaluation, including resting electrocardiogram (ECG) and ultrasound echocardiography (ECHO). The management of antithrombotic agents was guided by cardiologists. Antiplatelet agents were discontinued seven days before surgery, while warfarin therapy was stopped five to seven days prior and replaced with bridging therapy using unfractionated heparin (UFH). UFH was resumed postoperatively as soon as hemostasis was confirmed.

Surgical Procedure

VATS was performed under single-lung intubation anesthesia with the patient positioned in the lateral decubitus position (Fig. 1). The surgical team, including the primary surgeon and assistant, was positioned anterior to the patient, while the camera operator was placed posteriorly.

Thoracic access was achieved using a 10 mm thoracoport inserted at the seventh intercostal space along the midclavicular line, and a 30 mm utility incision made at the

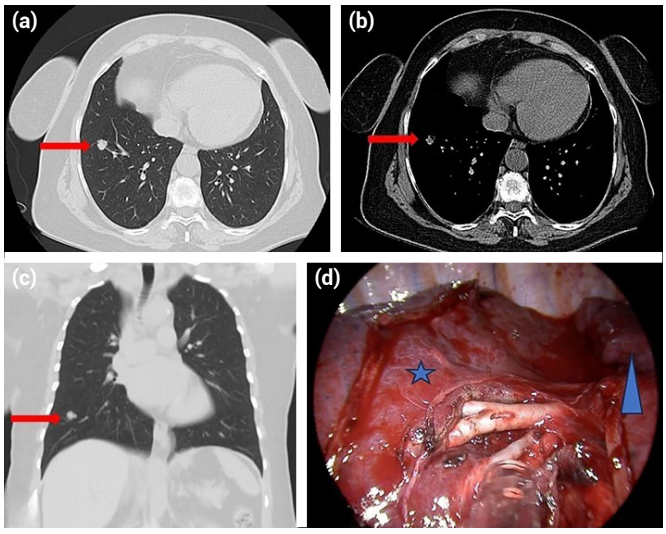

Figure 1. Thoracic computed tomography; right lung lower lobe fissure neighbor anteriorly lobulated parenchymal nodule with 12.5 mm diameter (arrow) **(a)** In sections in the parenchymal window **(b)** In sections in the mediastinal window **(c)** In sections in the coronary section parenchymal window **(d)** Surgical image, lower lobe (star) upper lobe (triangle).

fourth intercostal space along the preaxillary line. A 10 mm, 30-degree thoracoscope was used for visualization.

Adhesions were carefully separated using sharp dissection or energy devices, depending on their density. Anatomical resection involved sequential ligation and division of the artery, vein, and bronchus of the affected lobe using sharp and blunt dissection techniques. Conversion to thoracotomy was performed in cases of significant bleeding, dense adhesions preventing safe dissection, or inability to achieve an R0 resection via VATS.

Postoperative Care

Patients were closely monitored in the surgical intensive care unit for the first postoperative night. Vital signs, drainage output, chest X-rays, and laboratory parameters were assessed on the first postoperative day before transferring the patients to the thoracic surgery ward.

Statistical Analysis

Data were analyzed to compare the study and control groups across various demographic, clinical, and surgical parameters. Categorical variables were analyzed using Chi-square tests, with Fisher's exact test employed for comparisons where cell counts were less than five. Continuous variables were compared using the Mann-Whitney U test due to the non-normal distribution of the data. Statistical significance was defined as $p<0.05$ for all analyses.

Results

A total of 42 patients with NSCLC were included in the analysis, comprising 20 individuals in the study group and 22 in the control group. The study group consisted of patients with a history of percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG), while the control group included those without such a history.

Demographics and Clinical Characteristics

The study group had 18 males (90%), and the control group included 16 males (72.7%), yielding an overall male prevalence of 80.9%. The mean age was 66.5 years (range: 57–82) in the study group and 65 years (range: 50–83) in the control group, with an overall mean of 66 years. Smoking was reported by 14 participants (70%) in the study group and 14 (63.6%) in the control group, resulting in an overall smoking prevalence of 66.6% (Table 1).

Comorbidities varied between groups: hypertension was present in 40% of the study group and 31.8% of the control group, chronic obstructive pulmonary disease (COPD) in 10% and 13.6%, and diabetes mellitus (DM) in 45% and 13.6%, respectively. Overall, DM was the most prevalent comorbidity, affecting 28.5% of participants (Table 1).

Operative and Postoperative Data

The VATS approach was used for 75% of the study group and 72.7% of the control group, while hybrid VATS was employed for the remaining participants. Lobectomy was the predominant surgical technique, performed in 80% of the study group and 86.3% of the control group. The mean operative time was 312 minutes (range: 150–630) for the study group and 330 minutes (range: 190–440) for the control group.

Postoperative recovery metrics showed a mean drain removal time of 5 days (range: 1–54) in the study group and 3.5 days (range: 1–25) in the control group. The average hospital stay was 6 days (range: 3–52) for the study group and 5 days (range: 1–14) for the control group (Table 1).

Pathological Findings and Staging

In the study group, 85% of participants had N0 lymph node status, 5% had N1, and 10% had N2. Similarly, in the control group, 86.3% had N0, 9% had N1, and 4.5% had N2 status. Adenocarcinoma was the most common tumor

Table 1. Demographic, clinical, postoperative and histopathological data of patients who treatment with video-assisted thoracoscopic surgery (VATS)

Parameter	Total (n=42)	Study group (n=20)	Control group (n=22)
Gender (male), N (%)	34 (80.9)	18 (90)	16 (72.7)
Age (years; mean)	66 (50-83)	66.5 (57-82)	65 (50-83)
Smoker, N (%)	28 (66.6)	14 (70)	14 (63.6)
Comorbidity, N (%)			
HT	15 (35.7)	8 (40)	7 (31.8)
COPD	5 (11.9)	2 (10)	3 (13.6)
DM	12 (28.5)	9 (45)	3 (13.6)
PCI, N (%)	18 (42.8)	18 (90)	0 (0)
CABG, N (%)	4 (9.5)	4 (20)	0 (0)
Antithrombotic agents, N (%)			
None	16 (38)	1 (5)	15 (68.1)
One	19 (45)	13 (65)	6 (27.2)
Two	7 (16.6)	6 (30)	1 (4.5)
Resection type, N (%)			
Segmentegtomy	7 (16.6)	4 (20)	3 (13.6)
Lobectomy	35 (83.3)	16 (80)	19 (86.3)
Side of resection, N (%)			
R	20 (47.6)	8 (40)	12 (54.5)
L	22 (52.3)	12 (60)	10 (45.5)
Perative approach, N (%)			
VATS	31 (73.8)	15 (75)	16 (72.7)
Hybrid VATS	11 (26.1)	5 (25)	6 (27.2)
Operative time (min)	322.5 (150-630)	312 (150-630)	330 (190-440)
Drain removing time (days)	4 (1-54)	5 (1-54)	3.5 (1-25)
Length of stay in hospital (days)	6 (1-52)	6 (3-52)	5 (1-14)
Tumour size (mm, median)	25 (10-65)	24.5 (10-65)	25.5 (10-50)
Tumor subtype, N (%)			
Adenocarcinoma	26 (61.9)	14 (70)	12 (54.5)
Squamous carcinoma	13 (30.9)	3 (15)	10 (45.4)
Carcinoid	2 (4.76)	2 (10)	0 (0)
Sarcomatoid carcinoma	1 (2.38)	1 (5)	0 (0)
The extent of the tumor (T), N (%)			
T1a	3 (7.14)	2 (10)	1 (4.5)
T1b	15 (35.7)	7 (35)	8 (36.3)
T1c	14 (33.3)	5 (25)	9 (40.9)
T2a	4 (9.5)	2 (10)	2 (9)
T2b	2 (4.76)	-	2 (9)
T3	4 (9.5)	4 (20)	-
The extent of spread to the lymph nodes (N), N (%)			
N0	36 (85.7)	17 (85)	19 (86.3)
N1	3 (7.14)	1 (5)	2 (9)
N2	3 (7.14)	2 (10)	1 (4.5)

COPD: Chronic obstructive pulmonary disease; DM: Diabetes mellitus; HT: Hypertension; PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass grafting; VATS: Video-assisted thoracoscopic surgery.

histology in both groups, observed in 70% of the study group and 54.5% of the control group. Squamous carcinoma was present in 15% of the study group and 45.4% of the control group, with carcinoid and sarcomatoid carcinoma exclusively in the study group (Table 1).

Tumor staging revealed that in the study group, 10% of participants had T1a tumors, 35% had T1b, 25% had T1c, 10% had T2a, and 20% had T3 tumors. In the control group, 4.5% had T1a, 36.3% had T1b, 40.9% had T1c, 9% had T2a, and 9% had T2b tumors (Table 1).

Discussion

This study evaluated the perioperative and postoperative outcomes of patients with NSCLC undergoing VATS, with a particular focus on those with concomitant CAD. Our findings emphasize the unique challenges and complexities associated with managing this high-risk population while also underscoring the potential for safe and effective surgical interventions when appropriate precautions are taken.

Comparison with Existing Literature

The prevalence of CAD in our cohort (7%–16%) aligns with recent reports, which identify CAD as a common comorbidity among lung cancer patients undergoing resection.[9-12] CAD remains a significant determinant of perioperative risk, as also highlighted by Sandri et al.[9], who reported that CAD increases the likelihood of MACE during the postoperative period. However, consistent with findings by Li et al.[13], our study demonstrated that with thorough preoperative preparation and carefully managed perioperative protocols, VATS lobectomy can be safely performed in this challenging population. The relatively low incidence of postoperative cardiovascular events in our cohort supports the view that proactive and individualized perioperative management is key to mitigating risks.

As Maeda et al.[14] emphasized, robust preoperative cardiac evaluations are critical, particularly in patients with a history of cardiovascular interventions. Our study adopted a similar approach, incorporating resting ECG, echocardiography, and consultation with cardiologists to guide antithrombotic management. The use of tailored bridging protocols ensured both cardiovascular stability and surgical safety, likely contributing to the favorable outcomes observed in our study.

Surgical Outcomes and Technique

Our findings reaffirm the advantages of VATS over open thoracotomy, in line with the results of Laursen et al.[6], who highlighted reduced operative times, shorter hospital stays, and fewer complications with minimally invasive approaches. Importantly, this benefit extends to high-risk populations, as noted by Serna-Gallegos et al.[15], who demonstrated the safety of VATS even in patients with extensive surgical histories. The low conversion rate to thoracotomy in our study further supports the feasibility of VATS in complex cases, provided that the procedure is conducted by an experienced surgical team adept at managing intraoperative challenges, such as dense adhesions or unexpected bleeding.

Impact of CAD on Outcomes

CAD was associated with a slightly longer hospital stay and a higher prevalence of certain complications in our study. However, these findings are consistent with Kirk et al.[8], who emphasized that meticulous patient selection and perioperative care can significantly reduce complications in patients with CAD. Notably, our study demonstrated comparable N0 staging and similar histological profiles between the study and control groups, suggesting that the presence of CAD does not adversely impact tumor resectability or oncological outcomes. This finding underscores the importance of not excluding CAD patients from surgical consideration solely based on cardiovascular risk, as outcomes can remain favorable with adequate preparation.

Strengths and Limitations

This study provides valuable insights into the integration of VATS for NSCLC patients with CAD, contributing to the growing evidence of its safety and efficacy in high-risk populations. The inclusion of preoperative cardiac optimization protocols and the comprehensive analysis of perioperative outcomes strengthen the relevance of our findings. However, the single-center, retrospective design limits generalizability, and the relatively small sample size may not capture the full spectrum of potential outcomes. Future research should focus on larger, multicenter cohorts and prospective designs to validate these findings further and to develop standardized perioperative pathways for this unique patient population.

Conclusion

This study highlights the feasibility and safety of VATS in NSCLC patients with concomitant CAD. Despite the increased perioperative challenges, careful preoperative evaluation and individualized management strategies can minimize risks and improve outcomes. These findings emphasize the need for multidisciplinary collaboration and tailored perioperative protocols in high-risk patient populations.

Disclosures

Ethichs Committee Approval: The study protocol was approved by the Ethical Committee of Clinical Research of Kartal Kosuyolu High Specialization Education & Research Hospital (No: 2024/19/955). This study was conducted according to the Helsinki principles, patients signed informed consent for participation, and nothing invasive of patients' privacy was done.

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Conflict of Interest: The authors declare that they have no competing interests.

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Data availability: All data generated or analyzed during this study are included in this published article.

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LESS

Original Article

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Predictive factors of mortality and hospitalization in elderly patients undergoing laparoscopic cholecystectomy for acute cholecystitis

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ABSTRACT

Introduction: Gallstone disease is a prevalent condition, affecting over 10% of the population, and acute cholecystitis (AC) remains a frequent cause of emergency gastrointestinal admissions. The Tokyo Guidelines (TG18/TG13) provide criteria for assessing the severity of AC and guide treatment decisions. This study aims to identify factors associated with mortality and prolonged hospitalization in elderly patients undergoing laparoscopic cholecystectomy (LC) for AC.

Materials and Methods: This retrospective study included patients aged 70 and older who underwent LC for TG18/TG13 grade 1–2 AC between 2016 and 2023. Patients with recurrent AC, organ dysfunction, or a history of ERCP were excluded. Data on demographics, comorbidities (Charlson Comorbidity Index (CCI)), ASA (American Society of Anesthesiologists) scores, CRP/Albumin ratio (CAR), POSSUM (Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity) scores, postoperative outcomes, and length of hospital stay were collected. Statistical analyses were performed to evaluate the correlation between clinical factors and outcomes, including mortality and hospitalization duration.

Results: A total of 52 patients, with a mean age of 74 years, were included. Mortality occurred in 4 patients (7.6%). Higher ASA, CCI, and POSSUM scores were significant predictors of mortality. CAR and serum albumin levels showed borderline significance. The timing of surgery and Tokyo severity scores were not associated with mortality. A positive correlation was found between the timing of surgery and length of hospital stay. The POSSUM score had higher specificity and sensitivity compared to CCI in predicting mortality.

Conclusion: The POSSUM score was superior to CCI and ASA in predicting mortality in elderly patients undergoing LC for AC. The CAR ratio also showed potential as a predictive factor. These scores may help in optimizing treatment decisions and outcomes in this high-risk population.

Keywords: Acute cholecystitis, Charlson comorbidity index, elderly patients, laparoscopic cholecystectomy, POSSUM score

Introduction

Gallstone diseases affect more than 10% of the population and are one of the most common reasons for emergency gastrointestinal admissions.[1] Acute cholecystitis (AC) is a condition that requires thorough evaluation in terms of the need for hospitalization and emergency surgery. This condition involves a spectrum ranging from the severity of cholecystitis to the patient's comorbidities and current physical capacity. A multiparametric assessment of the disease is crucial for prognosis.[2]

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The Tokyo Guidelines (TG18/TG13) are widely used for disease severity evaluation and treatment planning.[3] According to these criteria, laparoscopic cholecystectomy (LC) is recommended for patients with grade 1 and grade 2 inflammation, while percutaneous cholecystostomy is prioritized for those with grade 3 AC associated with organ dysfunction.[4] Therefore, accurate assessment of disease severity is one of the key factors influencing the treatment plan.

Other factors affecting surgical decisions include the patient's overall condition. The Charlson Comorbidity Index (CCI) and the American Society of Anesthesiologists (ASA) score are crucial in evaluating general health status. Surgery can be recommended if the patient is expected to tolerate the procedure based on these criteria.[3] In some studies, additional scoring systems such as the CRP/albumin ratio (CAR) and POSSUM (Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity) have also been investigated for their predictive value.[5,6] Furthermore, studies examining the impact of surgical timing on outcomes are also available.[7]

The aim of this study is to predict the factors affecting mortality and hospitalization in elderly patients who underwent LC due to AC.

Materials and Methods

This retrospective study includes patients who underwent laparoscopic cholecystectomy for acute cholecystitis between January 2016 and June 2023 at a tertiary hospital. Approval was obtained from the hospital's ethics committee for this study. Patients aged 70 years and older with TG18/TG13 grade 1–2 AC were included. Patients with multiple episodes of acute cholecystitis, a history of endoscopic retrograde cholangiopancreatography (ERCP), or organ dysfunction were excluded. The diagnosis of acute cholecystitis and the decision for surgery were made according to the TG18/TG13 criteria (3,4). All patients received intravenous (IV) hydration and IV antibiotics upon admission and were kept nil per os (NPO) until surgery. The timing of surgery was left to the surgeon's discretion.

Demographic characteristics, comorbidities, duration of symptoms, blood test results, POSSUM, CCI, and ASA scores, postoperative outcomes, and length of hospital stay were recorded. Postoperative complications classified as Clavien-Dindo grade 2 and above were considered complications. Patient data were obtained from the hospital's information system. The CAR was calculated as the serum CRP/serum albumin ratio. Surgical timing was defined as the number of days from the onset of symptoms to surgery.

Statistical Analysis

The Kolmogorov-Smirnov test was used to test the assumption of normal distribution. The Mann-Whitney U test was applied to compare mean differences between groups. The chi-square test was used to compare categorical variables. Spearman correlation analysis was used to evaluate the correlation between the length of hospital stay and blood test results and scores. ROC analysis was performed to assess the relationship between CCI, POSSUM scores, and mortality. Data analysis was conducted using IBM SPSS 25. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 52 patients were included in the study, with an average age of 74 years. The gender distribution was similar. The mean POSSUM score was 17.0, while the mean CCI score was 4.9. The average length of hospital stay was 7.7 days. The average symptom duration at emergency admission was 2.2 days. A total of 3 patients experienced complications, and 4 patients had mortality. The demographic and clinical data of the patients are shown in Table 1.

Table 1. Demographic data and clinical features

	n=52
Age, mean (SD), year	74.5±4.2
Gender (Male/Female), n	27/25
POSSUM	17.0±3.1
CCI	4.9±1.5
CAR	2.66±3.28
WBC (×10^9/L)	10.4±5.1
Platelet (10^3 /μl)	269.1±70.5
CRP (mg/dL)	8.6±8.7
Albumin (g/dL)	3.7±0.6
Hospital stay (days)	7.7±4.5
Symptom duration at emergency admission (days)	2.2±0.6
Complication (yes/no)	3/49
Mortality (yes/no)	4/48

POSSUM: Physiological and Operative Severity Score for the enumeration of Mortality and morbidity; CCI: Charlson Comorbidity Index; CAR: CRP/albumin ratio; WBC: White blood cell; CRP: C-reactive protein.

Table 2. Relationship between mortality and parameters

	No Mortality (n=48)	Mortality present (n=4)	p
POSSUM	16 (13-21)	25 (23-27)	0.001
CCI	4 (3-9)	7.5 (7-8)	0.003
CAR	2.35±2.93	5.55±5.40	0.064
Albumin (g/dL)	3.9 (2.1-4.7)	3.3 (3.1-3.6)	0.071
WBC (×10^9/L)	9.2 (4.5-27.0)	12.7 (9.3-16.2)	0.169
CRP (mg/dL)	5.5 (0.5-28.7)	17.4 (3.1-31.7)	0.219
Day of surgery (from symptom onset)	5 (1-16)	4 (2-5)	0.171
ASA			
2	26	0	0.009
3	22	4	
Tokyo 2018 severity grade			
1	15	0	0.185
2	33	4	

POSSUM: Physiological and Operative Severity Score for the enumeration of Mortality and morbidity; CCI: Charlson Comorbidity Index; CAR: CRP/albumin ratio; WBC: White blood cell; CRP: C-reactive protein; ASA: American Society of Anesthesiologists classification.

Table 3. Correlation of length of stay and parameters

	R value	P value
Day of surgery (from symptom onset)	0.834	<0.001
CCI	0.328	0.024
POSSUM	0.236	0.111
CAR	-0.021	0.897
ASA	0.284	0.041
Age, mean (SD), year	0.232	0.117
Albumin (g/dL)	-0.557	<0.001

CCI: Charlson Comorbidity Index; POSSUM: Physiological and Operative Severity Score for the enumeration of Mortality and morbidity; CAR: CRP/albumin ratio; ASA: American Society of Anesthesiologists classification.

A total of 4 patients experienced mortality. A comparison of clinical data between patients with and without mortality is shown in Table 2. ASA, CCI, and POSSUM were found to be significant predictors of mortality. CAR and serum albumin levels were near-significant in predicting mortality. The timing of surgery and Tokyo severity score were not associated with mortality.

The correlation between length of stay and clinical parameters is shown in Table 3. A positive correlation was found between the timing of surgery and length of stay. CCI, ASA, and albumin levels had a moderate to low correlation with the length of stay. The POSSUM score was associated with mortality but was not related to the length of stay.

The ROC analysis results for POSSUM and CCI scores in predicting mortality are shown in Table 4. A POSSUM

Table 4. ROC analysis of the effects of CCI and POSSUM on mortality

	AUC (95% CI)	Cutoff points	P-value	Sensitivity (%)	Specificity (%)
POSSUM	1.000 (1.000-1.000)	20.5	0.001	100	95.8
CCI	0.948 (0.887-1.000)	6.5	0.003	100	91.7

ROC: receiver operating characteristic; AUC: area under the curve; CI: confidence interval, CCI: Charlson Comorbidity Index; POSSUM: Physiological and Operative Severity Score for the enumeration of Mortality and morbidity.

score of 20.5 and a CCI score of 6.5 had 100% sensitivity, with POSSUM having higher specificity at this cutoff. The area under the curve was also higher for POSSUM at a score of 20.5.

The ROC curve analysis of POSSUM and CCI scores in predicting mortality is shown in Figure 1.

Discussion

While LC is the primary treatment for AC, percutaneous cholecystostomy (PC) is an important treatment option in high-risk patients. Studies have shown that LC is superior to PC even in high-risk patients.[8] However, it should not be overlooked that LC can be a procedure prone to complications in AC. In patients with a CCI score of 5 and above, the mortality rate exceeds 3%.[9] Therefore, it is essential to be cautious when making surgical decisions, especially in elderly patients with AC.

Various scoring systems have been developed to predict mortality and morbidity in patients with AC. ASA and CCI are the most commonly used.[3] The POSSUM score and inflammation-based CAR are also parameters with high prognostic value.[5] In patients aged 80 years and older undergoing LC for AC, mortality rates can range from 4% to 40%.[10,11] In our study, the mortality rate in patients aged 70 and older was 7.6%.

In the S.P.Ri.M.A.C.C. study, the POSSUM score was found to be more effective than CCI in predicting mortality both at admission and at 30 days.[12] Similarly, in our study, we found that the POSSUM score had a higher area under the curve and specificity compared to CCI. In the S.P.Ri.M.A.C.C. study, the cutoff for POSSUM was 25, while in our study, it was 20. This difference was attributed to the mean age of 59 years in the S.P.Ri.M.A.C.C. study compared to 74 years in our study. We concluded that, due to the older patient group, smaller physiological impairments had more mortal effects in our patients. In the study by Yılmaz et al.[5], CAR was found to be a significant predictor of mortality. Similarly, in our study, the CAR ratio was borderline significant.

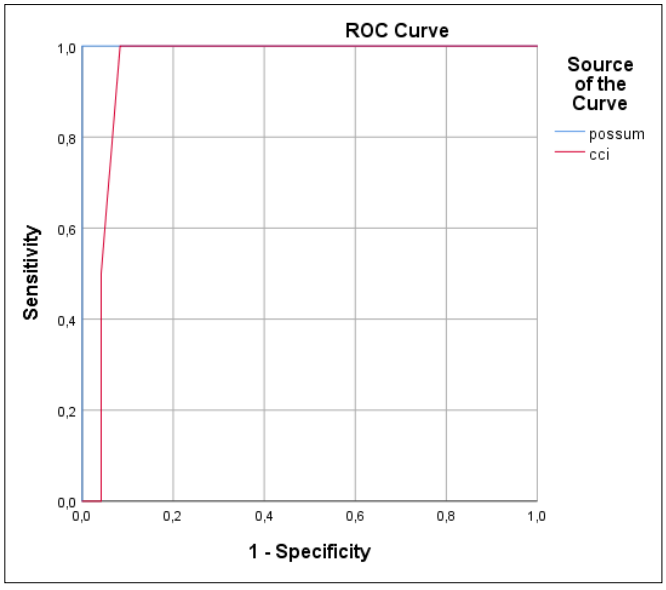

Figure 1. ROC curve graph of the mortality relationship between CCI and POSSUM score.

In our study, the most important factors determining the length of hospital stay were the timing of surgery and albumin levels. Similar to our study, Lucocq et al.[13] found that early surgical timing was associated with early discharge. The average hospital stay in our study was 7.7 days. In the study by Osterman et al.[14], patients with an ASA score of 3 had a 2-day longer hospital stay after LC compared to those with ASA scores of 1–2. Another study found a correlation between CCI and prolonged hospital stay.[15] In our study, CCI and ASA scores were also correlated with the length of stay. Although the POSSUM score was associated with mortality, it was not significantly related to the length of stay. This was thought to be due to the POSSUM score reflecting the patient's immediate condition, which might improve during the hospital stay.

The limitations of our study are the retrospective design and the small number of patients spread over a long period of time. Another bias of the study is that the surgeries were performed by multiple surgeons. The strength of the study is that it is focused on a specific subgroup of patients aged 70 and over.

Conclusion

In conclusion, we found that the POSSUM score was superior to the CCI and ASA scores in predicting mortality in patients undergoing LC for AC. Additionally, the CAR ratio was also useful in predicting mortality. We believe these scores can be beneficial in planning appropriate treatment approaches for AC.

Disclosures

Ethichs Committee Approval: Approval was obtained from the Ethics Committee Gaziantep City Hospital Non-Interventional Clinical Researches on 18/09/2024, with reference number 33/2024.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors declare that they have no conflicts of interest or financial ties to disclose.

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Authorship Contributions: Concept – E.T., B.G., B.T.; Design – E.T., S.Y.; Supervision – M.M., Z.S.; Fundings – B.G., S.Y.; Materials – M.M., Z.S., B.T.; Data Collection and/or Processing – S.Y., M.M.; Analysis and/or Interpretation – E.T., B.G., Z.S.; Literature Review – E.T., S.Y., B.G.; Writing – E.T., B.G.; Critical Review – S.Y., B.G., B.T.

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LESS

Original Article

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Colorectal foreign body due to aspiration in children: The experience of a tertiary-level hospital

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ABSTRACT

Introduction: Foreign bodies resulting from aspiration are seen in children, especially those aged <5 years. Colorectal foreign bodies must be removed by colonoscopy because they may cause complaints or complications in children. This study aims to evaluate the clinical characteristics of children treated in a tertiary-level hospital for a diagnosis of colorectal foreign body.

Materials and Methods: The study included 12 children (50% male, 50% female), aged median 5 years (range, 0.6–17.0 years), who were diagnosed with a colorectal foreign body due to aspiration. The demographic data, clinical findings, and operation notes of the cases were examined retrospectively from the hospital records.

Results: The time from aspiration to presentation was a median of 15 days (range, 5 days–3 years). Colonoscopy was performed in 7 cases. The localization of the foreign body was the base of the cecum in 4 cases, the hepatic flexure in 2, and the descending colon in 1. The foreign body was removed with colonoscopy in 7 cases, with surgical intervention in 3, and with forceps in 2 where the localization was the distal rectum. In one case, an open-ended safety pin embedded in the appendix was surgically removed. In another case, a sewing needle had passed the right hepatic flexure, leading to subcapsular bleeding in the liver. The needle was removed with a surgical procedure. No complications were observed in any of the cases during or after colonoscopy or surgical procedures.

Conclusion: Pediatric cases with colorectal foreign bodies can be treated successfully and without serious complications with colonoscopy.

Keywords: Child, colonoscopy, colorectal, foreign body

Introduction

Colorectal foreign bodies can be seen in both children and adults. These foreign bodies include knife blades, food, bottles, rubber objects, sex toys, lamps, and glass pieces.[1] In recent years, colorectal foreign bodies have been reported to be seen more often in children. In the elderly, mentally retarded individuals, and children, foreign bodies are usually aspirated unintentionally.[2] Of the foreign bodies swallowed by children, 80–90% emerge spontaneously from the gastrointestinal system, but 20% may need to be removed with endoscopic methods. Surgical intervention to remove a foreign body or treat complications is required in 1% of cases.[3] Foreign bodies stuck in the colon and rectum can cause complaints or complications in children, such as abdominal pain, perianal region pain, lower gastrointestinal system bleeding, perforation, penetration, or intestinal obstruction.[4] Colorectal foreign bodies can be removed through endoscopic or surgical routes.[5]

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The aim of this study was to retrospectively evaluate the clinical characteristics of pediatric cases treated in our clinic for a diagnosis of colorectal foreign body.

Materials and Methods

The study included cases who presented with the complaint of foreign body aspiration and were diagnosed with a colorectal foreign body in the Pediatric Gastroenterology, Hepatology, and Nutrition Polyclinic of Firat University Medical Faculty Hospital between 2010 and 2022. The files of the cases were examined in detail. The clinical, laboratory, radiological, and colonoscopic data obtained together with the treatment method applied were recorded on a study form.

To determine the localization of the foreign body, abdominal radiographs and abdominal tomography were taken. It was planned to perform colonoscopy on the cases determined to have a foreign body in the colon or rectum. Colon cleaning with enema and oral laxatives was performed for 2 days before the colonoscopy procedure. Before the colonoscopy procedure, informed consent was obtained from the parents of all the children. During the procedure, midazolam was used for sedation, and pethidine hydrochloride for analgesia. Pediatric colonoscopes (Olympus Lucera CV-260, Tokyo, Japan) were used during the colonoscopy procedure. Rat tooth forceps, crocodile forceps, and mesh forceps were used to remove the foreign bodies. After the procedure, sedation was terminated using flumazenil, and the patients were monitored for 6 hours. Cases that did not develop any complications were permitted to start oral feeding. Foreign bodies that could not be removed with colonoscopy were removed with a surgical method.

Data obtained in the study were analyzed statistically using IBM SPSS v.22 software. Percentages, mean values, and the Chi-square test were used in the statistical evaluations of the variables. Continuous variables were stated as mean±standard deviation (SD), (minimum–maximum) values, and categorical variables as number (n) and percentage (%). A value of $p<0.05$ was accepted as the level of statistical significance.

Results

Evaluation was made of 12 cases, comprising 6 (50%) males and 6 (50%) females with a median age of 5 years (range, 0.6–17.0 years). The provinces from which the cases presented were 4 from Elazığ, 4 from Van, 2 from Bingöl, 1 from Tunceli, and 1 from Malatya. The mean duration of the complaints was 15 days (range, 5–1000 days).

The demographic characteristics of the cases, localization of the foreign body, and the treatments applied are shown in Table 1. The foreign body was removed with

Table 1. Demographic characteristics of the cases, localisation of the foreign body, and treatment applied

Case no	Age (years)	Gender	City of residence	Foreign body	Localisation of foreign body	Status of foreign body removal with colonoscopy	Other tools used in foreign body removal
1	0.75	Male	Van	Safety pin	Distal rectum	Not performed	Forceps
2	17	Female	Elazığ	Straight pin	Sigmoid colon	Yes	
3	5	Female	Van	Drawing pin	Cecum base	Yes	
4	0.75	Male	Van	Safety pin	Rectum	Not performed	Forceps
5	15	Female	Bingöl	Sewing needle	Hepatic capsule	Not performed	Surgical intervention
6	8	Male	Malatya	Fecaloma	Rectum	Not performed	Surgical intervention
7	15	Male	Bingöl	Safety pin	Cecum base	Yes	
8	5	Male	Elazığ	Nail	Cecum base	Yes	
9	8	Female	Elazığ	Coin	Cecum base	Yes	
10	5	Female	Van	Hair clip	Distal hepatic flexura	Yes	
11	1	Female	Elazığ	Safety pin	Appendix	Not performed	Surgical intervention
12	5	Male	Tunceli	Watch battery	Cecum base	Yes	

colonoscopy in 7 cases, with surgical intervention in 3, and with forceps from the distal rectum in 2. During colonoscopy, the foreign body localization was observed to be at the base of the cecum in 4 cases, in the hepatic flexure in 2, and in the descending colon in 1. A nail was determined in the base of the cecum in 1 case during the colonoscopy procedure (Fig. 1). A fecaloma 8 × 6 cm in size was determined in the rectum of 1 case (Fig. 2), and this was removed surgically under general anesthesia. In 1 case, an open-ended safety pin was observed to be embedded in the appendix, and this was removed surgically. In another case with a history of having swallowed a sewing needle 3 years previously, axial non-contrast CT showed that the needle had passed from the right hepatic flexure to be located in the liver parenchyma, and this laceration was causing subcapsular bleeding (Fig. 3). The needle was removed with a surgical procedure. No complications were seen in any of the cases during or after the colonoscopy or surgical procedures.

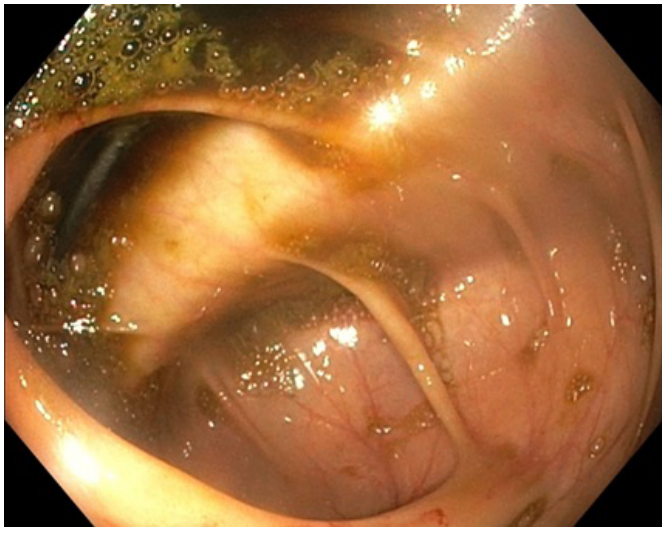

Figure 1. A nail observed at the base of the cecum during colonscopic examination.

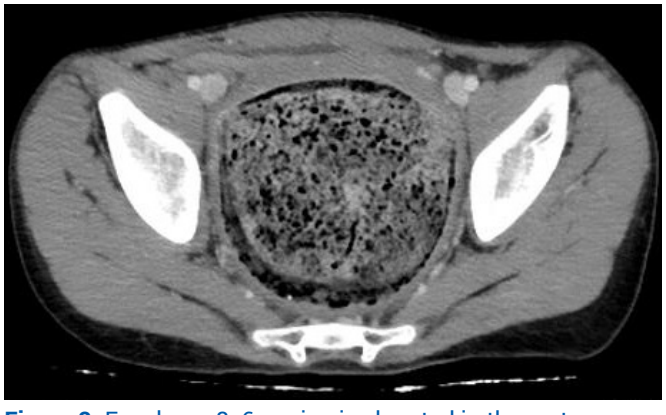

Figure 2. Fecaloma 8x6 cm in size located in the rectum.

Figure 3. Axial non-contrast computed tomography slice showing a needle passed from the right hepatic flexura and located in the liver parenchyma, and subcapsular bleeding caused by this laceration.

Discussion

The aim of this study was to evaluate the clinical, radiological, and colonoscopy findings together with the treatment methods and outcomes in pediatric cases determined to have a colorectal foreign body. The swallowing of a foreign body is seen more often in children younger than 5 years.[6] Previous studies have reported that children who swallow a foreign body are more often male.[6–8] However, there was no difference in the gender distribution of the cases in the current study. Most aspirated foreign bodies pass through the gastrointestinal system without any complications, but some may require removal with colonoscopy or a surgical procedure.[5]

Foreign bodies stuck in the colon and rectum can cause complaints or complications in children, such as abdominal pain, perianal region pain, lower gastrointestinal system bleeding, perforation, penetration, or intestinal obstruction.[4] Foreign bodies stuck in the colon can be easily and safely removed with colonoscopy.[5] Unnecessary surgical interventions can be avoided with the use of colonoscopy.[9] In addition, foreign bodies in the rectum can be removed with a rigid proctoscope or sigmoidoscope.[10] In the current study, colonoscopy was performed on 7 cases after colon cleaning. During colonoscopy, the foreign body localization was observed to be at the base of the cecum in 4 cases, in the hepatic flexure in 2, and in the descending colon in 1. These foreign bodies were removed with “foreign body forceps,” and those in the distal rectum with forceps. No complications were observed in any of the cases.

Sharp objects such as sewing needles can sometimes advance as far as the liver and can lead to bleeding and pain.[11] One of the current study cases had a history of having swallowed a sewing needle 3 years previously, and despite no previous complaints, presented with the complaint of pain in the upper right quadrant for the last 15 days. As a result of the examination and tests, it was determined that the aspirated needle had passed through the intestinal wall in the right hepatic flexure and had pierced the liver. This sewing needle was removed with a laparoscopic surgical procedure. As open-ended safety pins can become embedded in the cecum, these may require surgical removal.[12] In one of the cases in this study, an open-ended safety pin was stuck in the cecum, and this was removed surgically. No complications were observed during this procedure. Foreign bodies in the rectum can lead to constipation and rectal leakage.[10] Similarly, one of the current study cases had complaints of constipation and rectal leakage that had been ongoing for 2 years. On pelvic tomography, it was determined that there was a fecaloma 8×6 cm in size located in the rectum. This fecaloma was removed with a surgical procedure under general anesthesia. After the intervention, the complaints of constipation and rectal leakage completely recovered.

Conclusion

Foreign body aspirations can be frequently seen in children. As the aspirated foreign body can be spontaneously expelled with the feces, these children must be closely monitored. With radiological and endoscopic methods, early diagnosis and treatment can be made of foreign bodies with colorectal localization, thereby preventing morbidity and mortality. In selected cases that cannot be treated with endoscopic methods, surgical intervention may be necessary.

Disclosures

Ethichs Committee Approval: Approval for this retrospective cohort study was granted by the Firat University Non-Interventional Research Ethics Committee (decision no: 2022/16-25, dated: 29.12.2022).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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Informed Consent: This was a retrospective study with no requirement for informed consent.

Authorship Contributions: Concept - U.D., Y.D.; Design - U.D., Y.D.; Supervision - U.D., Y.D.; Fundings - U.D., A.M.K., Ş.A., F.A.; Materials - U.D., A.M.K., Ş.A., F.A.; Data Collection and/ or Processing – U.D., Y.D.; Analysis and/ or Interpretation – U.D., Y.D.; Literature Review – U.D., Y.D.; Writer – U.D.

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LESS

Original Article

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Effect of sleeve gastrectomy on histopathological changes in the gastric mucosa

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ABSTRACT

Introduction: This study aimed to evaluate the impact of weight loss on the histopathological findings of gastric mucosa in patients who underwent laparoscopic sleeve gastrectomy (LSG).

Materials and Methods: Patients who underwent LSG for morbid obesity in our clinic between January 2019 and December 2023 were included in the study. The LSG specimen data were recorded as the surgical group (SG), and the postoperative 6-month endoscopic gastric biopsy data from the same patients were recorded as the biopsy group (BG). The two groups were compared in terms of body mass index (BMI) and histopathological observations of Helicobacter pylori (HP), chronic active gastritis (CAG), chronic inactive gastritis (CIG), and intestinal metaplasia (IM).

Results: A total of 86 patients were included in the study. The median BMI was 44.00 (6.05) in the SG and 34.80 (6.00) in the BG, indicating a statistically significant difference between the groups in terms of BMI ($p<0.001$). Histopathological examination revealed no significant differences between the groups in terms of CAG, CIG, and IM ($p>0.05$). However, a significant difference was observed between the groups regarding HP ($p<0.001$).

Conclusion: It was observed that weight loss did not lead to significant changes in histopathological findings such as CAG, CIG, and IM in the gastric mucosa, but it did result in significant differences in terms of HP.

Keywords: Endoscopic gastric biopsy, histopathological findings, laparoscopic sleeve gastrectomy

Introduction

Laparoscopic sleeve gastrectomy (LSG) is the most commonly performed surgical procedure worldwide for obesity.[1] In the literature, studies on LSG outcomes predominantly focus on the weight loss process, prevention of obesity-related comorbidities, and postoperative complications.[1,2] Due to the limited number of studies examining gastric specimens obtained after LSG, data on this topic are scarce.[3] While some studies suggest that histopathological findings do not provide significant data and consider this examination unnecessary,[4] other studies emphasize the necessity of such examination due to unexpected histopathological results that may require follow-up.[5,6]

Although the prevalence of Helicobacter pylori (HP) is lower in developed countries, approximately half of the world's population is infected with HP.[7,8] It is well known

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that HP is associated with gastrointestinal diseases such as chronic gastritis, intestinal metaplasia (IM), gastric cancer, and mucosa-associated lymphoid tissue lymphoma.[9-11] According to recent studies, HP infection is also closely linked to various diseases outside the digestive system, such as diabetes and nonalcoholic fatty liver disease.[12] Recent studies on the relationship between HP infection and obesity have reported conflicting results. While some studies have indicated a positive correlation,[13,14] others have reported no relationship or even a negative correlation.[15,16]

This study aimed to evaluate the impact of obesity on histopathological findings in the gastric mucosa by comparing the histopathological findings of surgical specimens from patients who underwent LSG with those from gastric biopsy materials obtained 6 months after the surgery.

Materials and Methods

Study Design and Patient Population

This retrospective study included patients who underwent LSG in our clinic between January 2019 and December 2023 and had biopsies taken at their 6-month follow-up. Histopathological data obtained from these patients during LSG were compared with data obtained from the same patients in the 6th postoperative month. The parameters compared between these two different time points were body mass index (BMI) as well as the rates of HP, IM, chronic active gastritis (CAG), and chronic inactive gastritis (CIG) observed in the surgical specimens and postoperative 6-month biopsies. Ethical approval for the study was obtained from the institutional committee (Date: 22.07.2024, decision number: 10).

Exclusion Criteria

Patients who had undergone LSG in our clinic but had a history of previous abdominal surgery, did not wish to participate in the study, developed complications secondary to the surgery, underwent additional surgical interventions alongside LSG, were active alcohol and tobacco users, had a history of chronic medication use, patients with incomplete data, patients with malignancies detected in the histopathological examination, and patients who had received treatment for HP eradication prior to surgery were excluded from the study.

Statistical Analysis

Statistical analyses were conducted using SPSS for Windows, version 25.0 (IBM SPSS Inc., Chicago, IL, USA). The Shapiro-Wilk test assessed the normality of data distribution. Numerical variables were presented as medians with interquartile ranges (IQR), while categorical variables were reported as counts (n) and percentages (%). The Wilcoxon signed-rank test was used to compare dependent variables before and six months after surgery, and the Chi-square test was employed for categorical variables. A 95% confidence interval was applied, and a two-tailed p-value of <0.05 was considered statistically significant.

Results

A total of 86 patients were included in the study. Of these patients, 74 (86.05%) were female and 12 (13.95%) were male. The mean age of the patients was 35.25±9.94 years. The median preoperative BMI was 44.00 (Interquartile range: 6.05) kg/m², while the median BMI at the time of biopsy performed 6 months after surgery was 34.80 (Interquartile range: 6.00) kg/m². A statistically significant difference was observed between the preoperative and pre-biopsy BMI values (p<0.001).

HP was detected in 32 (37.20%) LSG specimens, while HP positivity was observed in 43 (50%) biopsy samples. This difference was found to be statistically significant (p<0.001) (Fig. 1). IM was seen in 6 (6.97%) patients in LSG specimens. In biopsy materials, IM was present in a total of 5 (5.81%) patients, and no statistically significant difference was observed between the groups (p=0.528).

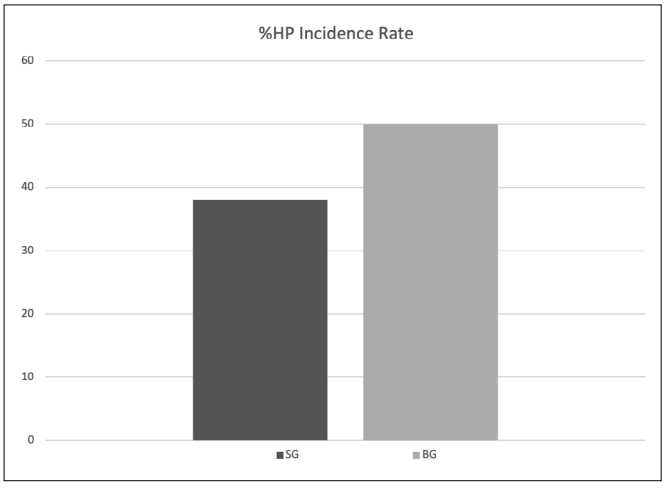

Figure 1. Percentage of Helicobacter pylori positivity between groups.
HP: Helicobacter pylori; SG: Surgical group; BG: Biopsy group.

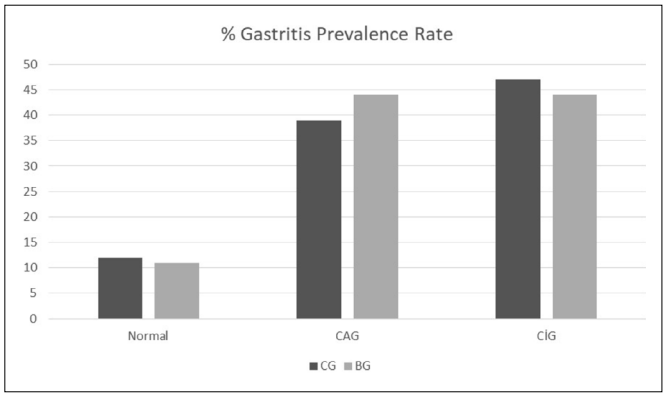

Figure 2. Percentages of gastritis incidence between groups.
CAG: Chronic active gastritis; CIG: Chronic Inactive gastritis; SG: Surgical group; BG: Biopsy group.

In the LSG specimens, normal mucosa was reported in 11 (12.79%) patients, while CAG was reported in 34 (39.53%) cases and CIG in 41 (47.67%) cases. In the biopsy samples, 10 (11.62%) patients had normal mucosa, while CAG and CIG were reported in 38 (44.18%) cases each (Fig. 2). There was no statistically significant difference in the rates of gastritis between the two groups (p=0.350) (Table 1).

Table 1. Comparison of BMI and histopathological findings

	SG	BG	p
BMI*	44.00 (6.05)	34.80 (6.00)	*<0.001
Intestinal metaplasia			
Yes	6	5	¥ 0.528
No	80	81	
Helicobacter pylori			
Yes	32	43	¥ <0.001
No	54	43	
Gastric mucosa			
Normal	11	10	¥ 0.350
CAG	34	38	
CIG	41	38	

SG: Surgical group; BG: Biopsy group; BMI: Body mass index; LSG: Laparoscopic sleeve gastrectomy; * Wilcoxon Signed Ranks Test—Median value (interquartile range); ¥ Chi Square test, bold p value indicates significance.

Discussion

In recent years, there has been an increase in studies focusing on the histopathological findings of specimens obtained after LSG.[3,17,18] However, studies evaluating the long-term postoperative follow-up of these histopathological findings remain limited.

In their study, Safaan et al.[19] identified advanced age, female gender, and HP infection as significant risk factors for abnormal histopathological findings (CAG, CIG, follicular gastritis, and lymphoid aggregates) following LSG. In a study conducted in Romania, Mocian et al.[5] reported an HP prevalence of 27.2% in LSG specimens. Similarly, Sabbah et al.[20] indicated an HP prevalence of 35.3% in LSG specimens in their study from Lebanon. In a study by Akbulut et al.,[21] HP positivity was found to be 61.1% in preoperative endoscopic biopsies. In the same study, patients did not receive treatment for HP eradication postoperatively, and routine endoscopies performed due to dyspeptic complaints revealed an HP positivity rate of 30.2%. In this study, the mean time to postoperative endoscopy was 17.1±8.51 months, and a statistically significant difference was reported between preoperative and postoperative HP detection rates. In contrast to the study of Akbulut et al.,[21] our findings showed HP positivity in 37.2% of cases in the surgical group (SG), which increased to 50% in the biopsy group (BG). This difference may be related to the relatively earlier timing of postoperative endoscopy in the present study.

In the present study, normal mucosa was observed in 12.79% of the SG patients, CAG in 39.53%, and CIG in 47.67%. In the BG patients, normal mucosa was observed in 11.62% of the patients, CAG in 44.18%, and CIG in 44.18%, with no significant difference between the two groups. In a study by Demirpolat et al.[17] in Türkiye, histopathological examination of LSG specimens revealed that 20.2% of gastric mucosa samples were normal, 37.1% had CIG, and 41.2% had CAG. In a study by Mocian et al.,[5] 33.7% of the mucosa samples were reported as normal, 39% as CAG, and 27.2% as CIG. In a study by Onzi et al.,[22] which compared preoperative and 6-month postoperative endoscopic biopsy results in patients who underwent LSG, no significant difference was observed in terms of IM and gastritis, consistent with our findings.

In the present study, the IM detection rate was 6.97% in SG patients and 5.81% in BG patients, which is consistent with the literature. Regarding the detection rate of IM in LSG specimens, Sabbah et al.[20] reported a rate of 1.66%, Aljerian et al.[23] reported 1%, Tomasiccio et al.[18] reported 3.15%, and Mocian et al.[5] reported 11.6%.

The present study has certain limitations. These include the relatively small sample size, the short dura-

tion between surgery and postoperative endoscopy, the single-center design, and the retrospective nature of the study. These limitations hinder the generalizability of our findings.

Conclusion

In conclusion, despite these limitations, the present study comparing the histopathological findings of LSG specimens with biopsy materials obtained at the 6-month postoperative follow-up did not reveal any significant histopathological differences between the groups. We believe that future studies with larger sample sizes and extended biopsy timing could be conducted to verify the accuracy of our current findings.

Disclosures

Ethichs Committee Approval: Ethical approval for the study was obtained from the Harran University Ethical Committee (Date: 22.07.2024, decision number: 10).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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LESS

Original Article

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Evaluation of changes in posterior segment parameters and cardiovascular risk score following laparoscopic sleeve gastrectomy in obese patients

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ABSTRACT

Introduction: To investigate the effects of laparoscopic sleeve gastrectomy (LSG) on body mass index (BMI), visceral adipose index (VAI), waist circumference (WC), cardiovascular risk score, and retinal microvascular and neurogenic changes in obese patients.

Materials and Methods: This retrospective study included 30 obese patients and 40 age- and sex-matched control subjects. Comprehensive systemic and ophthalmic examinations, including posterior segment parameters preoperatively and at six months postoperatively, were obtained for all participants. Data on BMI, VAI, and WC were collected from patient records. The Framingham Risk Score (FRS) was calculated both preoperatively and six months postoperatively.

Results: The study indicated a significant reduction in BMI, VAI, WC, and FRS post-surgery (p=0.015, p=0.001, p=0.035, p<0.001, respectively). Retinal assessments revealed thinner temporal quadrant central macular thickness (CMT) and nasal quadrant peripapillary retinal nerve fiber layer (RNFL), as well as reduced vascular densities in all quadrants of the superficial capillary plexus (SCP), except for the fovea, and in the superior, temporal, and nasal quadrants of the deep capillary plexus (DCP) compared to the control group preoperatively, with improvements noted in temporal quadrant RNFL and nasal quadrant SCP post-surgery. Significant negative correlations were observed between VAI and subfoveal choroidal thickness (SCT), between WC and both superior quadrant MT and SCT, and between FRS and both temporal quadrant RNFL and nasal choriocapillaris vascular density.

Conclusion: These findings suggest that LSG not only facilitates weight loss but also positively impacts retinal neurogenic and microvascular health, highlighting potential predictive markers for future cardiometabolic risks in obese patients.

Keywords: Body mass index (BMI), laparoscopic sleeve gastrectomy, optic coherence tomography, optic coherence tomography angiography, the framingham risk score (FRS), visceral adipose index (VAI), waist circumference (WC).

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Introduction

Obesity is a significant public health challenge, currently affecting approximately 650 million adults worldwide, with its prevalence on the rise.[1] Obesity is associated with numerous chronic conditions, including diabetes, hypertension, and various cancers, and is responsible for high levels of morbidity and mortality.[2,3] Moreover, obesity plays a direct and indirect role in the development of cardiovascular diseases (CVD), including atherosclerotic and vasospastic coronary heart disease, arrhythmias, cardiomyopathy, and congestive heart failure, by causing endothelial dysfunction, changes in the microvascular structure, and cardiomyocyte toxicity.[4] It has been shown that approximately 29–40% of patients with heart failure are overweight (body mass index [BMI] 25.0–29.9 kg/m²), and 30–49% are obese (BMI ≥ 30 kg/m²).[5] Although BMI has long been considered the gold standard for defining obesity and evaluating associated cardiovascular risk, recent studies indicate that risk may differ across various obesity phenotypes. As a result, visceral adipose tissue (VAT) is increasingly acknowledged as a critical indicator of obesity, complementing the information provided by BMI.[5,6] The visceral adipose index (VAI), which is calculated using BMI, waist circumference (WC), triglycerides (TG), and high-density lipoprotein (HDL), is a straightforward, cost-effective, and practical method for assessing VAT compared to magnetic resonance imaging (MRI) and computed tomography (CT).[7]

Laparoscopic sleeve gastrectomy (LSG) is an increasingly utilized and effective treatment option for obesity that significantly reduces the prevalence of obesity-related morbidity and mortality.[8] In their review, Kwok et al.[9] found that among 29,208 patients who underwent bariatric surgery, there was a 50% reduction in cardiovascular risk compared to a control group of 166,200 patients who did not undergo surgery. It is believed that bariatric surgery reduces cardiovascular risk by improving certain vascular biomarkers associated with weight loss.[10,11] Habib et al.[12] demonstrated a reduction in carotid intima-media thickness and an increase in flow-mediated brachial artery dilation in 50 obese patients following bariatric surgery. Meanwhile, Backdahl et al.[13] reported significant improvements in aortic elasticity and left ventricular diastolic function during a 36-month postoperative follow-up in 60 obese patients.

Weight loss resulting from bariatric surgery can induce changes in various tissues, including the eye. Studies have demonstrated alterations in retinal and choroidal thickness, as well as retinal microvascular perfusion, in obese patients undergoing bariatric surgery.[14,15] Microvascular dysfunction is an early indicator of CVD, and there is a well-established significant association between retinal microvascular changes and the risk of CVD.[16,17]

Optical coherence tomography angiography (OCTA) is a non-invasive and practical technique that provides detailed morphological imaging and allows for the quantitative assessment of changes in the microvascular structure of the macula and choroid.[18]

This study aimed to evaluate the changes in BMI, WC, and VAI in obese patients who underwent LSG, along with alterations in neurogenic and vascular parameters in the posterior segment, in relation to changes in CVD risk.

Materials and Methods

This retrospective study comprised obese patients who were monitored at the Obesity Unit and referred for laparoscopic bariatric surgery indications in collaboration with the General Surgery Clinic between January 2022 and January 2024. Additionally, control subjects were recruited from the Ophthalmology Clinic, presenting with minor symptoms, such as refractive disorders, and without any concomitant systemic diseases. The study was conducted following the principles of the Helsinki Declaration, and ethical approval was obtained from the local ethics committee of our hospital (Protocol No: 010.99/12). Given the retrospective nature of the research, obtaining informed consent from patients was not required. However, all patients who underwent LSG received comprehensive information and signed consent forms before the procedure.

The study included patients aged 30 to 60 years with a BMI of ≥40, as well as those with a BMI of ≥35 who had obesity-related comorbidities (such as hypertension, diabetes mellitus, or severe musculoskeletal disorders), all of whom underwent LSG. Patients with endogenous obesity diagnoses, such as Cushing's syndrome, as well as those suffering from retinal and choroidal diseases—including diabetic retinopathy, hypertensive retinopathy, central serous chorioretinopathy, and macular degeneration—were excluded from the study. Additionally, individuals with uveitis, optic nerve disorders, glaucoma, a history of ocular trauma, or refractive errors of +6 or -6 D (high hyperopia and myopia) were not included. Furthermore, patients with media opacities due to cataracts, corneal

disorders, or vitritis, as well as those unable to cooperate with optical coherence tomography (OCT) and optical coherence tomography angiography (OCTA) imaging, were also excluded from the study.

Patient data, including age, sex, presence of systemic diseases, medications used, smoking status, height, weight, BMI, WC, systolic and diastolic blood pressure, hemoglobin A1c (HbA1c), total cholesterol, low-density lipoprotein (LDL), and HDL levels, were collected. Additionally, best-corrected visual acuity (BCVA) measured using the Snellen chart, intraocular pressure (IOP) assessed with a non-contact tonometer, pachymetry measurements, anterior and posterior segment examinations performed using slit-lamp biomicroscopy, central macular thickness (CMT), peripapillary retinal nerve fiber layer (RNFL), subfoveal choroidal thickness (SCT) evaluated by OCT, and superficial and deep macular vascular densities, foveal avascular zones, and choriocapillaris vascular densities assessed with OCTA, were recorded from patient files.

The preoperative examination findings of patients who underwent LSG were compared with the findings obtained during the postoperative assessment at six months. Based on the collected data, BMI was calculated as weight (kg) divided by height² (m^2), and the Framingham cardiovascular risk scores (FRS) and VAI scores were determined. The VAI serves as a clinical index that combines anthropometric and metabolic parameters to provide a better assessment of visceral fat. In men, the visceral adiposity index (VAI) is calculated using the formula:

VAI (Men) = [WC (cm)/39.68 + (1.88 × BMI)] × (TG (mmol/L)/1.03) × (1.31/HDL (mmol/L))

In women, VAI is calculated as:

VAI (Women) = [WC (cm)/36.58 + (1.89 × BMI)] × (TG (mmol/L)/0.81) × (1.52/HDL (mmol/L)) [19]

Data from one randomly selected eye of each participant were included in both the obese patient group and the control group.

All patients diagnosed with obesity underwent LSG. This surgical procedure entailed the vertical resection of the stomach, initiated 4 cm from the pylorus and 2 cm from the esophagogastric junction. A tri-stapler was utilized as a stabilizing device, and the site was subsequently reinforced with omentopexy.[20]

The Framingham Risk Score (FRS)

The Framingham Risk Score (FRS) is a widely used cardiovascular risk assessment tool developed by the Framingham Heart Study, which calculates the 10-year risk of cardiovascular events based on sex-specific factors.[21] In this study, the FRS for each participant was calculated using data such as age, sex, total cholesterol, HDL, systolic blood pressure, hypertension status, and smoking habits. For patients who underwent LSG, FRS scores were computed based on preoperative data and results obtained at the six-month postoperative follow-up. In the control group, individuals were included if their medical records contained the necessary blood parameters within the last three months.

Optical Coherence Tomography and Optical Coherence Tomography Angiography

The CMT and peripapillary RNFL parameters measured with the Swept Source Optical Coherence Tomography (SS-OCT) device (Topcon, Japan), were recorded for all participants. In the measurement of central macular thickness (CMT) in accordance with the ETDRS study, macular thickness was evaluated at central (1 mm, foveal) and parafoveal (3 mm) areas. For assessing peripapillary retinal nerve fiber layer (RNFL) thickness, average measurements were calculated within a 3.45 mm diameter scanning circle surrounding the optic disc, at 90-degree intervals across the four quadrants (superior, inferior, temporal, and nasal) (Fig. 1). Only those imaging results with a signal strength of ±7 were included in the study. Furthermore, SCT was assessed by manually measuring the distance from the retinal pigment epithelium to the choroid-sclera junction in the foveal area using cross-sectional OCT scans. En face OCTA images were obtained from a 3×3 mm^2 central macular area using OCTA (DRI OCT Triton Plus, Topcon, Japan). The superficial capillary plexus (SCP), deep capillary plexus (DCP), and choriocapillary vascular plexus were measured using the IMAGEnet software developed by Topcon. The area of the foveal avascular zone (FAZ) was manually delineated and measured by two different researchers (UK, ÖFB), and the average was calculated. All measurements were conducted between 10:00 and 12:00 to minimize the effects of diurnal variation. Vessel density was defined as the percentage of the area occupied by large and microvessels. Images with a signal strength index (SSI)<45 or those exhibiting segmentation errors and motion artifacts were excluded from the analysis.

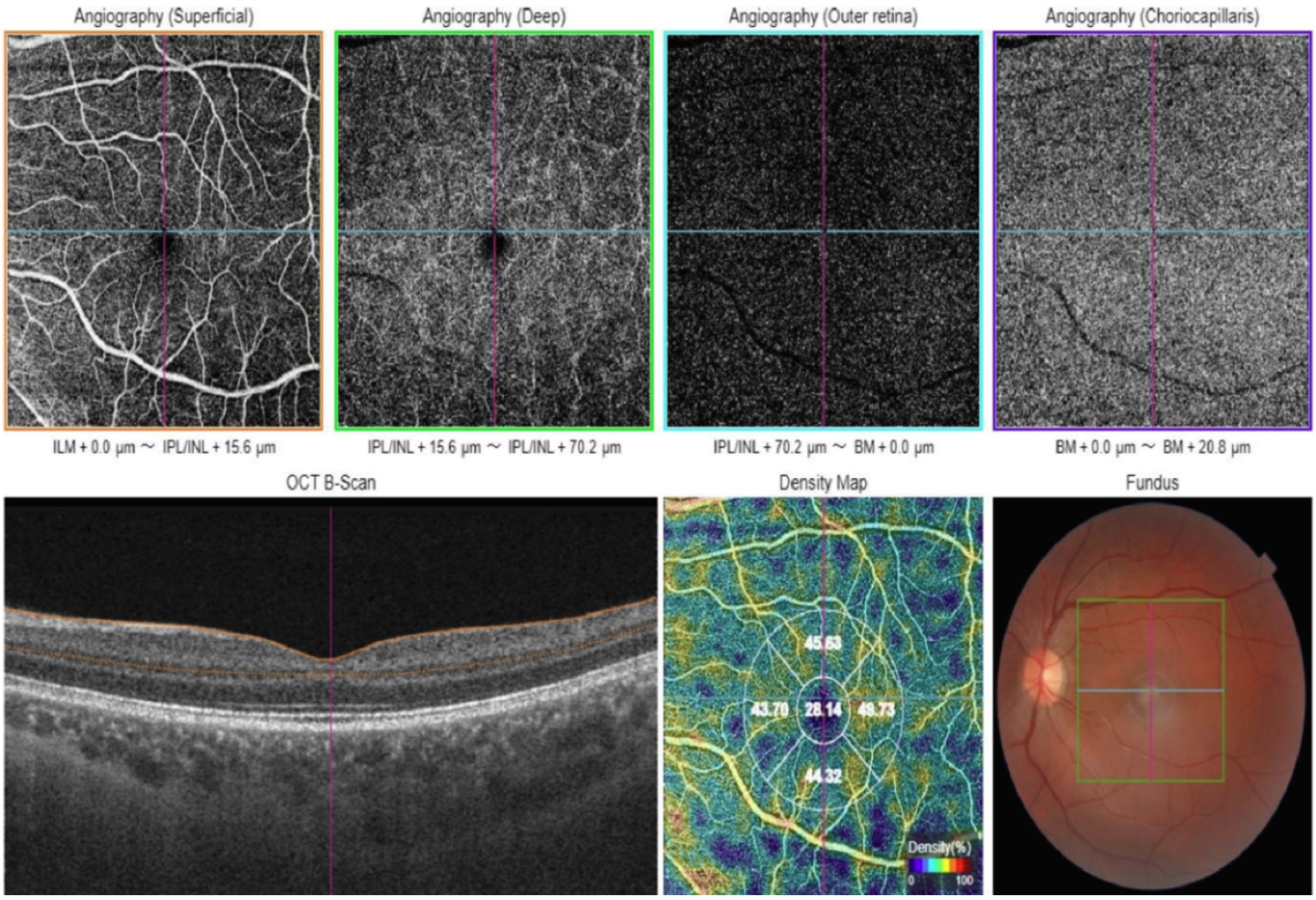

Figure 1. Optical coherence tomography angiography images of the macula.

Statistics

Statistical analyses were conducted using IBM SPSS Statistics (version 26). Descriptive statistics included percentages and frequencies for grouped data, while continuous data were summarized using mean, standard deviation, median, and interquartile ranges (25^{th} to 75^{th} percentiles). The Shapiro-Wilk test indicated that continuous data did not meet the criteria for normal distribution. For comparisons between independent groups, the Mann-Whitney U test and Student's t-test were employed, while paired groups were analyzed using the paired t-test and Wilcoxon signed-rank test. The Spearman rank correlation coefficient was utilized to assess relationships between continuous variables. The Chi-square test was applied to compare the distributions of grouped data. A significance level of $p<0.05$ was established.

Results

The study included 30 obese patients who underwent LSG and 40 healthy controls. The mean age of the obese patients was 37.30±7.75 years, while the control group had a mean age of 40.33±9.97 years (p=0.079). Table 1 presents the clinical and demographic characteristics of all participants.

In obese patients, the preoperative body mass index (BMI) was 45.57±4.85 kg/m², whereas the control group had a BMI of 21.78±1.76 kg/m², indicating a statistically significant difference between the two groups ($p<0.001$). In the analysis of posterior segment parameters, subfoveal choroidal thickness (SCT) and central macular thickness (CMT) were found to be reduced in the obese patients compared to the control group; however, these differences did not reach statistical significance (p=0.164 and p=0.200, respectively). Furthermore, while macular thickness was consistently thinner in all four quadrants among obese patients relative to controls, a statistically significant difference was identified specifically in the temporal quadrant (p=0.011). Analysis of peripapillary retinal nerve fiber layer (RNFL) values revealed that the average RNFL measurements, along with those assessed in each of the four quadrants, were significantly reduced in obese patients. Notably, the decrease in RNFL in the nasal quadrant was statistically significant (p=0.004).

Table 1. Demographic and clinic features of all study participants

	Patients with Obesity (n=30)	Control Group (n=40)	p
Age, (Mean±SD)	37.30±7.75	40.33±9.97	0.079
Gender, Female, n (%)	24 (80%)	30 (75%)	0.622
IOP (mm Hg), (Mean±SD)	15.1±3.3	15.4±3.1	0.294
Corneal Pachymetry, (μm) (Mean±SD)	556±55	550±48	0.135
DM, n (%)	17 (56.7%)	9 (22.5)	0.035
HT, n (%)	7 (23.3%)	6 (15%)	0.124
BMI (kg/m^2)	45.57±4.85	21.78±1.76	<0.001

IOP: Intraocular pressure; DM: Diabetes Mellitus; HT: Hypertension; BMI: Body Mass Index; FRS: Framingham Risk Score.

In the evaluation of the macular vascular plexus, it was observed that vascular densities in the superficial capillary plexus (SCP) were significantly reduced in obese patients across all quadrants outside the fovea (p=0.004, p=0.07, p=0.001, p=0.005 for the superior, inferior, temporal, and nasal quadrants, respectively). In the deep capillary plexus (DCP), notable reductions in vascular densities were detected in the superior, temporal, and nasal quadrants of the obese cohort (p=0.007, p<0.001, p=0.008 for the superior, temporal, and nasal quadrants, respectively). However, no statistically significant differences were identified between the two groups concerning the superior and deep foveal avascular zone (FAZ) areas (p=0.136 and p=0.196, respectively).

In the choriocapillaris, vascular densities in the foveal and superior quadrants were significantly lower in obese patients, whereas no significant reductions were observed in the other quadrants (p<0.001 and p=0.004 for the fovea and superior quadrant, respectively). Furthermore, the FRS was found to be significantly higher in the obese patients compared to the control group (p=0.049) (Table 2).

In obese patients, the BMI decreased significantly from a preoperative value of 45.57±4.85 kg/m² to 29.65±6.01 kg/m² at six months postoperatively (p=0.015). The VAI also showed a statistically significant reduction, changing from 2.52±1.28 preoperatively to 1.52±1.14 at the six-month follow-up (p=0.001). Additionally, WC decreased significantly from 133.0±11.31 cm preoperatively to 103.63±13.09 cm at six months post-surgery (p=0.035).

Upon analyzing the posterior segment parameters, it was observed that there was an increase in SCT, CMT, and macular thickness across all four quadrants in the postoperative period compared to the preoperative period; however, this increase was not statistically significant (p>0.005 for all measures). In the peripapillary RNFL, only the increase in the temporal quadrant was found to be statistically significant (p=0.020).

In the evaluation of macular vascular densities, a statistically significant increase was observed in the nasal quadrant of the SCP (p<0.001). Conversely, in the DCP, there was a statistically significant increase in both the foveal and temporal quadrants in the postoperative period compared to the preoperative period (p=0.044 and p=0.046, respectively). However, the differences in the superficial and deep FAZ area values were not statistically significant (p>0.005 for all). In the assessment of vascular densities within the choriocapillaris, no statistically significant changes were observed across all quadrants during the postoperative period when compared to the preoperative period (p>0.005).

In the obese patients, the preoperative FRS risk score was recorded at 6.21±5.28, while the postoperative score exhibited a marked reduction to 2.51±1.28, reflecting a statistically significant decrease in FRS (p<0.001) (Table 3).

In examining the correlations between changes in posterior segment parameters postoperatively and variables such as BMI, VAI, WC, and FRS values in obese patients, a significant negative correlation was found between VAI and SCT (rho=-0.446, p=0.009). Additionally, a significant negative correlation was noted between WC and both superior quadrant MT and SCT (rho=-0.497, p=0.005; rho=-0.363, p=0.048). Furthermore, a significant negative correlation was observed between FRS and both temporal quadrant RNFL and nasal choriocapillaris vascular density (rho=-0.456, p=0.011; rho=-0.356, p=0.044) (Table 4).

Table 2. Comparison of posterior segment parameters and cardiovascular risk scores between patients with obesity and the control group

	Patients with Obesity	Control Group	p
Central MT (μm)	242.57±28.52	251.07±26.20	0.200
Superior quadrant MT (μm)	303.95±21.15	308.43±13.45	0.313
Inferior quadrant MT (μm)	296.53±18.60	303.15±21.68	0.184
Nasal quadrant MT (μm)	301.47±14.95	307.87±13.99	0.073
Temporal quadrant MT (μm)	292.47±16.37	302.68±15.84	0.011
SCT (μm)	307.93±59.17	326.63±51.63	0.164
Average RNFL (μm)	107.05±11.02	108.20±9.70	0.651
Superior quadrant RNFL (μm)	134.00±17.31	138.85±15.94	0.599
Inferior quadrant RNFL (μm)	135.00±20.65	136.03±13.35	0.801
Nasal quadrant RNFL (μm)	80.80±11.99	91.46±18.25	0.004
Temporal quadrant RNFL (μm)	72.17±8.79	74.03±13.50	0.489
SCP (%)			
Foveal	17.86±3.55	18.37±4.38	0.601
Superior	40.49±4.18	43.53±4.39	0.004
Inferior	38.71±4.49	41.78±4.67	0.007
Temporal	41.22±4.09	44.20±3.03	0.001
Nasal	39.73±4.33	42.66±3.98	0.005
DCP (%)			
Foveal	16.54±3.84	16.71±4.57	0.875
Superior	44.09±4.41	46.29±5.19	0.007
Inferior	44.43±5.26	50.86±6.42	0.586
Temporal	42.39±4.25	48.34±3.38	<0.001
Nasal	42.37±4.77	45.49±4.65	0.008
FAZ (μm^2)			
Superficial	332.75±409.24	313.242±362.114	0.136
Deep	375.585±426.443	325.722±411.502	0.196
Choriocapillaris (%)			
Foveal	49.28±5.08	52.80±2.38	<0.001
Superior	49.39±2.71	51.49±3.12	0.004
Inferior	50.23±3.81	50.85±2.09	0.424
Temporal	52.16±3.07	52.89±2.23	0.269
Nasal	52.55±1.81	52.59±2.15	0.938
FRS	6.21±5.28	1.5±4.40	<0.001

Mean±standard deviation values are shown. MT: Macular Thickness; SCT: Subfoveal Choroidal Thickness; RNFL: Retinal Nerve Fiber Layer; SCP: Superficial Capillary Plexus; DCP: Deep Capillary Plexus; FAZ: Foveal Avascular Zone; FRS: Framingham Risk Score.

Discussion

Obesity is a multifactorial disease characterized by the abnormal increase and distribution of adipose tissue.[22] In addition to inducing various hormonal, inflammatory, and metabolic changes in the body, obesity can lead to significant microvascular alterations in multiple organs.[23] Obesity is also an independent risk factor for CVD, particularly in relation to coronary heart disease and stroke. It is also associated with other CVD risk factors, including systemic hypertension, metabolic dyslipidemia, inflammation, and thrombosis.[24,25] It is well established that central obesity plays a significant role in the risk of developing CVD.[26] To the best of our knowledge, this study is the first to comparatively assess the changes in BMI, VAI,

Table 3. Comparison of posterior segment parameters and cardiovascular risk scores in obese patients who underwent LSG in the preoperative period and in the 6th month postoperatively.

	Preoperative period	Postoperative period	p
Central MT (µm)	242.57±28.52	243.03±27.19	0.915
Superior quadrant MT (µm)	303.95±21.15	306.90±21.78	0.635
Inferior quadrant MT (µm)	296.53±18.60	299.33±18.20	0.292
Nasal quadrant MT (µm)	301.47±14.95	303.17±15.44	0.545
Temporal quadrant MT (µm)	292.47±16.37	293.10±17.60	0.347
SCT (µm)	307.93±59.17	310.93±59.50	0.590
Average RNFL (µm)	107.05±11.02	107.87±8.31	0.775
Superior quadrant RNFL (µm)	134.00±17.31	139.50±16.14	0.100
Inferior quadrant RNFL (µm)	135.00±20.65	139.17±12.32	0.222
Nasal quadrant RNFL (µm)	80.80±11.99	91.46±18.25	0.004
Temporal quadrant RNFL (µm)	72.17±8.79	78.13±10.44	0.020
SCP (%)			
Foveal	17.86±3.55	18.01±5.63	0.539
Superior	40.49±4.18	41.42±6.54	0.096
Inferior	38.71±4.49	39.69±5.92	0.110
Temporal	41.22±4.09	43.13±6.65	0.104
Nasal	39.73±4.33	44.49±4.65	<0.001
DCP (%)			
Foveal	16.54±3.84	19.92±8.21	0.044
Superior	44.09±4.41	47.30±4.19	0.052
Inferior	44.43±5.26	46.74±6.95	0.239
Temporal	42.39±4.25	45.63±7.57	0.046
Nasal	42.37±4.77	43.03± 7.44	0.797
FAZ (μm^2)			
Superficial	332.75±409.24	342.20 ±395.552	0.509
Deep	375.585±426.443	327.50±419.432	0.070
Choriocapillaris (%)			
Foveal	52.21±5.03	52.80±2.39	0.540
Superior	51.41±4.14	51.49±3.12	0.896
Inferior	50.85±2.09	50.93±3.72	0.912
Temporal	52.89±2.23	53.16±3.89	0.651
Nasal	51.49±3.37	52.56±1.81	0.069
BMI (kg/m^2)	45.57±4.85	29.65±6.01	0.015
VAI	2.52±1.28	1.52±1.14	0.001
Waist Circumference (cm)	133.0±11.31	103.63±13.09	0.035
FRS	6.21±5.28	2.51±1.28	0.017

Mean±standard deviation values are shown. MT: Macular Thickness; SCT: Subfoveal Choroidal Thickness; RNFL: Retinal Nerve Fiber Layer; SCP: Superficial Capillary Plexus; DCP: Deep Capillary Plexus; FAZ: Foveal Avascular Zone; FRS: Framingham Risk Score; BMI: Body Mass Index; VAI: Visseral Adipose Index.

and WC due to obesity following LSG, in relation to the alterations in cardiovascular risk as reflected in retinal vascular and neurogenic structures.

Morbid obesity affects various tissues through multiple pathophysiological processes and also leads to several changes in the eye. Studies have reported that conditions

Table 4. Correlations between the differences in posterior segment parameters and BMI, VAI, waist circumference and cardiovascular risk score before and after LGS surgery in obese patients

	BMI (kg/m²)		VAI		Waist circumference (cm)		FRS	
	Spearman's rho	p	Spearman's rho	p	Spearman's rho	p	Spearman's rho	p
Central MT (µm)	-0.113	0.552	-0.071	0.707	-0.068	0.618	0.282	0.131
Superior quadrant MT (µm)	-0.211	0.263	-0.021	0.913	-0.497**	0.005	-0.278	0.136
Inferior quadrant MT (µm)	-0.107	0.575	-0.051	0.790	-0.229	0.224	-0.095	0.616
Nasal quadrant MT (µm)	-0.199	0.293	-0.212	0.262	-0.138	0.468	-0.003	0.985
Temporal quadrant MT (µm)	-0.014	0.940	-0.202	0.284	0.146	0.442	-0.153	0.421
SCT (µm)	-0.026	0.890	-0.446**	0.009	-0.363*	0.048	-0.215	0.253
Average RNFL (µm)	-0.008	0.967	0.059	0.757	-0.147	0.437	-0.149	0.432
Superior quadrant RNFL (µm)	-0.237	0.206	-0.197	0.297	0.052	0.785	-0.135	0.478
Inferior quadrant RNFL (µm)	-0.177	0.350	-0.078	0.681	-0.089	0.639	-0.301	0.106
Nasal quadrant RNFL (µm)	-0.092	0.629	-0.096	0.613	0-.108	0.570	-0.338	0.068
Temporal quadrant RNFL (µm)	-0.225	0.232	-0.239	0.204	-0.246	0.190	-0.456*	0.011
SCP (%)								
Foveal	-0.256	0.173	-0.198	0.295	-0.004	0.981	-0.140	0.461
Superior	-0.021	0.912	-0.115	0.545	-0.297	0.111	-0.094	0.622
Inferior	-0.238	0.206	-0.084	0.658	-0.022	0.873	-0.092	0.629
Temporal	-0.245	0.192	-0.074	0.698	-0.216	0.252	-0.088	0.642
Nasal	-0.217	0.249	-0.240	0.202	-0.087	0.647	-0.101	0.594
DCP (%)								
Foveal	-0.107	0.575	-0.133	0.483	-0.112	0.557	-0.004	0.982
Superior	-0.106	0.578	-0.024	0.902	-0.224	0.234	-0.171	0.365
Inferior	0-.216	0.252	-0.056	0.769	-0.021	0.912	0.096	0.615
Temporal	-0.066	0.729	-0.059	0.756	-0.096	0.615	-0.017	0.930
Nasal	-0.360	0.051	-0.170	0.370	-0.130	0.494	-0.053	0.781
FAZ (µm²)								
Superficial	-0.209	0.268	-0.092	0.627	0.100	0.597	-0.247	0.188
Deep	-0.135	0.477	-0.140	0.460	0.036	0.851	-0.086	0.653
Choriocapillaris (%)								
Foveal	-0.115	0.547	-0.047	0.805	-0.268	0.152	-0.113	0.551
Superior	-0.208	0.269	-0.009	0.963	-0.012	0.949	0.203	0.282
Inferior	-0.302	0.105	0.080	0.674	-0.149	0.433	-0.131	0.489
Temporal	-0.095	0.618	0.170	0.368	0.116	0.540	-0.157	0.406
Nasal	-0.038	0.843	-0.115	0.545	-0.022	0.907	-0.356*	0.044

MT: Macular Thickness; SCT: Subfoveal Choroidal Thickness; RNFL: Retinal Nerve Fiber Layer; SCP: Superficial Capillary Plexus; DCP: Deep Capillary Plexus; FAZ: Foveal Avascular Zone; FRS: Framingham Risk Score; BMI: Body Mass Index; VAI: Visseral Adipose Index.

such as age-related macular degeneration, optic neuritis, glaucoma, diabetic retinopathy, and hypertensive retinopathy occur more frequently in obese patients.[27-29] Throughout this process, it is believed that both vascular and mechanical etiologies associated with morbid obesity play a significant role.[30] Doğan et al.[31] conducted a

study involving 67 patients with morbid obesity, which revealed a thinning of the CMT that did not reach statistical significance. However, they found that the RNFL, retinal ganglion cell layer, and SCT were significantly thinner in comparison to the control group. Teberik et al.[32] observed that in patients with morbid obesity, the nasal and temporal CMT, temporal RNFL, and SCT were statistically significantly lower compared to the control group. In their study comparing retinal and optic disc vascular densities between 27 obese patients and a control group, Doğan et al.[33] found that both the SCP and DCP were statistically significantly thinner in all quadrants among the obese patients. They also observed a significant negative correlation between these vascular densities and BMI. Roland et al.[34] observed that in obese patients, both the central macular density and perfusion density were significantly lower compared to the control group. The neurogenic and vascular changes observed in the posterior segment of obese patients have been linked to the hyperinflammation and vasoconstrictive molecules associated with obesity.[31,32,34]

Weight gain and obesity contribute to the formation of visceral adipose tissue, which is characterized by immune cell infiltration and the presence of inflammatory, dysfunctional adipocytes. These adipocytes release both local and systemic pro-inflammatory cytokines. Additionally, the increased levels of leptin and the decreased levels of the anti-inflammatory hormone ghrelin further intensify this inflammatory process.[35,36] Furthermore, it has been observed that in obese patients, levels of nitric oxide (NO) are decreased, while vasoconstrictive molecules such as endothelin-1 and angiotensin-II are found to be elevated in association with higher BMI.[37] In our study, consistent with previous research, we found that in obese patients, the SCT, CMT, and RNFL were thinner compared to the control group. Notably, the CMT in the temporal quadrant and the RNFL in the nasal quadrant were statistically significantly lower. Additionally, we observed that vascular densities in all quadrants of the SCP, except for the fovea, as well as in the superior, temporal, and nasal quadrants of the DCP, were significantly reduced in the obesity group.

LSG is a commonly preferred bariatric surgical procedure for obese patients, demonstrating successful outcomes in weight loss.[38] Additionally, it is believed to have beneficial effects on microvascular circulation.[39] Toptan et al.[40] demonstrated a significant increase in vascular density across all retinal layers, particularly in the DCP, in obese patients following bariatric surgery. They attributed this improvement to the enhanced retinal perfusion observed after the surgery. ElShazly et al.[41] observed a significant increase in CMT and DCP during the three-month follow-up after bariatric surgery. They attributed these changes to improvements in retrobulbar hemodynamic parameters. In our study, we observed a significant reduction in BMI, VAI, and WC in patients following LSG. Additionally, there was an increase in CMT, SCT, and RNFL, with the increase in temporal RNFL reaching statistical significance. We found a statistically significant increase in the nasal quadrant of the SCP and in the foveal and temporal quadrants of the DCP in the postoperative period compared to preoperative values. Furthermore, we identified significant negative correlations between VAI and SCT, as well as between WC and both superior quadrant macular thickness and SCT. This suggests that VAT has a notable impact on microvascular structures, indicating that the reduction of VAT after LSG may lead to decreased inflammation and a reduction in vasoconstrictive molecules, ultimately improving retinal perfusion.

In the Look AHEAD study, 5,145 obese patients with type 2 diabetes were randomized into an intensive lifestyle intervention (ILI) group and a routine care group, followed for an average of 9.6 years. The ILI group experienced a weight loss of 6.0%, while the routine care group lost 3.5%. Although improvements in CVD risk factors were observed, there were no significant changes in CVD risk or mortality between the two groups.[42] In contrast, the Swedish Obese Subjects (SOS) study demonstrated that weight loss following bariatric surgery is associated with a reduction in CVD risk.[43] In our study, we found a significant reduction in the FRS score following LSG. Additionally, a significant negative correlation was identified between the FRS score and both the temporal quadrant RNFL and nasal choriocapillaris vascular density.

This study had several limitations. The retrospective design, along with a relatively small sample size and limited follow-up duration, contributed to these constraints. Additionally, the obese patients in our study were not stratified or evaluated into groups based on the presence or absence of metabolic syndrome, which may have affected the results. Lastly, the potential confounding effects of diet, exercise, or other lifestyle factors alongside LSG were not accounted for in our analysis.

In conclusion, obesity-related retinal neurogenic and

microvascular structures are affected, with observed improvements in parameters such as BMI, VAI, and WC following LSG. This study suggests that VAT may play a particularly significant role in these improvements. Furthermore, the reduction in cardiovascular risk scores post-surgery, alongside associated microvascular and neurogenic changes in the retina, supports the hypothesis that retinal microvascular alterations could serve as predictive markers for future cardiometabolic diseases. Overall, these findings indicate that LSG may be a safe and effective method for weight loss in obese patients.

Disclosures

Ethichs Committee Approval: The study was conducted following the ethical approval obtained from the local ethics committee of Kartal Dr. Lütfi Kırdar City Hospital (No: 010.99/12, Date: 28/02/2024).

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Original Article

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A comparison of extracorporeal and intracorporeal anastomosis in patients undergoing laparoscopic right hemicolectomy for right colon tumors

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ABSTRACT

Introduction: Colorectal cancer is a global health concern, and laparoscopic right hemicolectomy is widely performed for right-sided colon tumors. The choice between intracorporeal and extracorporeal anastomosis in laparoscopic right hemicolectomy remains controversial. This study compares early outcomes of these techniques.

Materials and Methods: A retrospective analysis of 61 patients who underwent laparoscopic right hemicolectomy between 2019 and 2024 was conducted. The patients were divided into two groups: intracorporeal anastomosis (n=20) and extracorporeal anastomosis (n=41). The patients were evaluated in terms of their demographic characteristics, perioperative findings, and histopathological results. Statistical significance was defined as $p<0.05$.

Results: The operative time was significantly shorter in the extracorporeal anastomosis group (181.95±26.88 vs. 200.0±24.17 minutes, p=0.015). Hospital stay duration was similar between groups (6.10±1.14 vs. 6.50±0.89 days, p=0.165). The median number of dissected lymph nodes was comparable (24 vs. 25.5, p=0.742). Surgical site infection rates (12.2% vs. 5.0%, p=0.376), ileus (26.8% vs. 20.0%, p=0.561), and anastomotic leakage (7.3% vs. 5.0%, p=0.731) showed no significant differences. No mortality was observed.

Conclusion: Both intracorporeal and extracorporeal anastomosis are safe and effective techniques for laparoscopic right hemicolectomy, with no clear advantage regarding complications or oncological outcomes. The shorter operative time in the extracorporeal anastomosis group may favor its use in certain cases. Further randomized trials are needed to clarify long-term outcomes and support surgical decision-making.

Keywords: Colorectal cancer, extracorporeal anastomosis, intracorporeal anastomosis, laparoscopic right hemicolectomy

Introduction

Colorectal cancer is a significant global health issue, ranking as the second most lethal and the third most common cancer worldwide.[1] The incidence of colorectal cancer among adults aged 50 years and older has been decreasing due to increased awareness among the public and healthcare professionals, as well as the widespread adoption of early screening tests.[2] Surgical treatment remains the cornerstone of therapy for colorectal cancer.[3]

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Laparoscopic right hemicolectomy is now a commonly performed procedure in the treatment of right-sided colon cancer.[4] Since its introduction in 1991, laparoscopic right hemicolectomy has gained popularity, offering advantages such as faster recovery and fewer early postoperative complications compared to open right hemicolectomy.[5-7]

One of the controversial topics in the application of laparoscopic right hemicolectomy is determining whether the intracorporeal anastomosis technique is superior to the extracorporeal anastomosis technique. The impact of the chosen technique on both early and long-term patient outcomes remains a subject of ongoing debate and investigation.

In our study, we aimed to contribute to this discussion by analyzing the early outcomes of patients in our clinic who underwent laparoscopic right hemicolectomy for right-sided colon cancer with either intracorporeal anastomosis or extracorporeal anastomosis techniques.

Materials and Methods

Patients who underwent laparoscopic right hemicolectomy for right colon tumors in the general surgery clinic of our hospital between 2019 and 2024 were included in the study. A total of 41 patients who underwent extracorporeal anastomosis and 20 patients who underwent intracorporeal anastomosis were included in the study. Patient data were retrospectively reviewed from medical records.

Histopathological data, including grade, lymphovascular invasion (LVI), perineural invasion (PNI), the presence of a mucinous component (MC), disease stage, and tumor size, were obtained through pathological examination of the surgical specimens. Patients who underwent open surgery, were unable to complete laparoscopic surgery for any reason, had malignancies other than adenocarcinoma, were operated on for benign causes, or had incomplete data were excluded from the study.

The patient was positioned supine, and the surgery was initiated. A 10-mm camera trocar was placed through the umbilicus, and the abdominal cavity was insufflated with carbon dioxide (CO_2). Subsequently, two 5-mm working trocars were placed in the right and left lower quadrants, and a 10-12 mm working trocar was positioned in the epigastric region to proceed with the operation.

As a surgical technique, a standard mesocolic excision was performed using a medial-to-lateral approach. During this procedure, the ileocolic artery and vein, as well as the right colic artery and vein (if present), were ligated and divided.

For patients undergoing intracorporeal anastomosis, a side-to-side ileotransversostomy was performed intracorporeally using a laparoscopic Endo-GIA stapler. Subsequently, the specimen was removed through an incision in the epigastric region, and the operation was concluded.

For patients undergoing extracorporeal anastomosis, after the resection was completed, the specimen was extracted through an incision in the epigastric region, and a side-to-side ileotransversostomy was routinely performed manually through this incision. All surgeries were carried out by the same surgical team following consistent standards.

To compare surgical outcomes, patients who underwent extracorporeal anastomosis and intracorporeal anastomosis were retrospectively evaluated in terms of operation time, length of hospital stay, number of dissected lymph nodes, postoperative surgical site infection (SSI), ileus, anastomotic leakage, and mortality.

Statistical Analysis

All statistical analyses were performed using the SPSS (Statistical Package for Social Sciences) for Windows 25.0 software. Normality was tested using the Shapiro-Wilk test and graphical methods. For non-normally distributed data, we used mean and standard deviation for the expression of study data. For normally distributed variables, we expressed the data using the median and minimum-maximum values. Additionally, we added the numeric (n) values and percentages (%) for the data. The Chi-square test was employed for the comparison of two categorical variables. However, when we compared one categorical variable with a numeric value, we used the Independent Sample T-test for normally distributed data and the Mann-Whitney U test for the non-normally distributed data. All statistical calculations were two-sided, and $p<0.05$ indicated statistical significance at a 95% confidence interval.

Results

The study included 61 patients who met the inclusion criteria. Age, BMI, operative time, and length of hospital stay were not normally distributed, whereas the number of dissected lymph nodes and tumor size followed a normal distribution.

The mean age of the patients was 63.52±14.36 years, the mean BMI was 25.93±5.11 kg/m², the mean operative time was 187.87±27.19 minutes, and the mean hospital stay was 6.23±1.07 days. The median number of dissected lymph nodes was 25 (range: 10–48). Of the patients, 45.9% (n=28) were male. Regarding ASA (American Society of Anesthesiologists) classification, 59.0% (n=36) were ASA 2, 36.1% (n=22) were ASA 3, and 4.9% (n=3) were ASA 4. Comorbidities were present in 29.5% (n=18) of the patients, including hypertension (15 patients), diabetes mellitus (8 patients), chronic obstructive pulmonary disease (3 patients), and coronary artery disease (6 patients).

The pathological stage was Stage 1–2 in 60.7% (n=37) of the patients and Stage 3 in 39.3% (n=24). The tumors of the patients were 9.8% (n=6) T2, 82.0% (n=50) T3, and 8.2% (n=5) T4. Tumor differentiation was poor in 13.3% (n=8), moderate in 70.0% (n=42), and good in 16.7% (n=10) of the patients. Lymphovascular invasion (LVI) was detected in 34.4% (n=21), perineural invasion (PNI) in 21.3% (n=13), and mucinous components in 27.9% (n=17) of the cases. Mucinous adenocarcinoma was identified in 8.2% (n=5) of the patients.

Extracorporeal anastomosis was performed in 67.2% (n=41) of the patients, while intracorporeal anastomosis was performed in 32.8% (n=20). When intracorporeal anastomosis and extracorporeal anastomosis groups were compared regarding age, BMI, tumor size, ASA score, gender, presence of comorbidities, pathological stage, grade, LVI, PNI, and mucinous components, no statistically significant differences were found, and the groups were determined to be homogeneously distributed (Table 1).

In the comparison of intraoperative findings between the intracorporeal anastomosis and extracorporeal anastomosis groups, the operative time was significantly shorter in the extracorporeal anastomosis group compared to the intracorporeal anastomosis group (p=0.015). No statistical differences were observed between the two groups regarding hospital stay (6.10±1.14 vs. 6.50±0.89 days, p=0.165), the number of dissected lymph nodes (24 vs. 25.5, p=0.742), SSI rates (12.2% vs. 5.0%, p=0.376), ileus (26.8% vs. 20.0%, p=0.561), and anastomotic leakage (7.3% vs. 5.0%, p=0.731). Mortality was not observed in either group (Table 2).

Discussion

In our study, no significant differences were observed between the intracorporeal anastomosis and extracorporeal anastomosis groups, which were demographically homogeneous, regarding early postoperative complications, the number of dissected lymph nodes, and hospital stay. However, the operative time was found to be shorter in the extracorporeal anastomosis group.

The literature includes numerous studies comparing intracorporeal anastomosis and extracorporeal anastomosis. While studies comparing postoperative complications yield varying results, the majority suggest that intracorporeal anastomosis is superior in terms of early postoperative complications.

The incidence of postoperative anastomotic leakage was found to be similar in both groups across reviewed studies, and no superiority of intracorporeal anastomosis or extracorporeal anastomosis was demonstrated.[8-13] Consistent with these findings, our study also found no significant difference between the groups regarding anastomotic leakage.

Regarding the frequency of surgical site infections (SSI) in the early postoperative period, no significant differences were observed between the groups.[8-11] However, studies by Milone M. et al.[12] and Shapiro R. et al.[13] reported a lower incidence of SSI in the intracorporeal anastomosis group. In our study, no significant differences were found between the groups.

Some studies indicate that postoperative bowel function recovery is delayed in the extracorporeal anastomosis group, leading to a higher incidence of postoperative ileus.[9,11,12] Other studies found no significant difference between the groups.[8,10,13] Considering the greater manual traction on the intestines and more extensive abdominal manipulation in the extracorporeal anastomosis group, the higher frequency of postoperative ileus in this group is understandable. However, no significant differences were observed in our study.

Most studies in the literature report shorter operative times in favor of the extracorporeal anastomosis group.[9,11,13,14] Some studies, however, found no differences between the groups.[9,12] Interestingly, the CLIMHET study group reported shorter operative times for intracorporeal anastomosis, although no explanation was provided.

Table 1. Clinical and demographic features

	ECA n=41 (67.2%)	ICA n=20 (32.8%)	p
Age (years), Mean±SD	61.66±15.49	67.35±11.08	0.213
BMI (kg), Mean±SD	26.19±5.21	25.39±4.99	0.639
Tumor Size (cm), median (min-max)	5.0 (2.0-7.0)	5.0 (2.0-7.5)	0.657
Gender, n (%)			
Male	20 (48.8)	8 (40.0)	0.518
Female	21 (51.2)	12 (60.0)	
ASA Score, n (%)			
2	20 (48.8)	8 (40.0)	0.408
3	20 (48.8)	10 (50.0)	
4	1 (2.4)	2 (10.0)	
Comorbidity, n (%)			
No	28 (68.3)	11 (55.0)	0.310
Yes	13 (31.7)	9 (45.0)	
Stage, n (%)			
Stage 1-2	25 (61.0)	12 (60.0)	0.942
Stage 3	16 (39.0)	8 (40.0)	
T stage, n (%)			
T2	3 (7.3)	3 (15.0)	0.577
T3	35 (85.4)	15 (75.0)	
T4	3 (7.3)	2 (10.0)	
Grade, n (%)			
Well	6 (15.0)[a]	4 (20.0)	0.121
Moderate	31 (77.5)	11 (55.0)	
Poor	3 (7.5)	5 (25.0)	
LVI, n (%)			
No	26 (63.4)	14 (70.0)	
Yes	15 (36.6)	6 (30.0)	0.611
PNI, n (%)			
No	32 (78.0)	16 (80.0)	0.861
Yes	9 (22.0)	4 (20.0)	
MC, n (%)			
No	27 (65.9)	12 (60.0)	0.888
Yes	11 (26.8)	6 (30.0)	
Mucinous cancer	3 (7.3)	2 (10.0)	

[a]One missing case; ASA: American Society of Anesthesiologists Score; LVI: Lymphovascular invasion; PNI: perineural invasion; MC: mucinous components; BMI: Body mass index.

Consistent with the majority of the literature, our study found that operative time was shorter in the extracorporeal anastomosis group.

In oncological surgery, regardless of the technique chosen, adherence to oncological principles is paramount. Across all studies reviewed, the number of dissected lymph nodes was found to be similar between the intracorporeal anastomosis and extracorporeal anastomosis groups.[9,11,12]

While some studies suggest a shorter hospital stay for the intracorporeal anastomosis group,[9,10,14] others report no

Table 2. Perioperative and postoperative outcomes between extracorporeal anastomosis and ıntracorporeal anastomosis groups

	ECA n=41 (67.2%)	ICA n=20 (32.8%)	p
Operation Time (min), Mean±SD	181.95±26.88	200.0±24.17	0.015[a]
Lenght Of Hospital Stay (day), Mean±SD	6.10±1.14	6.50±0.89	0.165
Dissected Lymph Node, median (min-max)	24 (10-48)	25.5 (11-45)	0.742
SSI, n (%)	5 (12.2)	1 (5.0)	0.376
Ileus, n (%)	11 (26.8)	4 (20.0)	0.561
Anastomosis Leak	3 (7.3)	1 (5.0)	0.731
Mortality	-	-	-

[a]Statistically significant at the confidence level of 0.95; SSI: surgical site infection.

significant differences.[8,11,12] In our study, no significant difference in hospital stay was observed between the groups. Generally, the lower incidence of postoperative complications in the intracorporeal anastomosis group, as reported in the literature, may explain the shorter hospital stays for this group.

A 2023 meta-analysis that reviewed seven randomized controlled trials involving 750 patients reported a lower incidence of paralytic ileus in the intracorporeal anastomosis group compared to the extracorporeal anastomosis group, while operative times were longer for the intracorporeal anastomosis group. However, perioperative complications such as bleeding, wound infections, anastomotic leakage, hospital stay, and the number of dissected lymph nodes were found to be similar between the two groups.[15]

Many studies in the literature analyze the short- and long-term outcomes of intracorporeal anastomosis and extracorporeal anastomosis techniques in laparoscopic right hemicolectomy. Overall, no significant differences in early postoperative mortality or survival have been observed between intracorporeal anastomosis and extracorporeal anastomosis. Thus, both techniques have been proven to be reliable options.

Our study has certain limitations. First, it is a retrospective study. Additionally, the sample size, particularly in the intracorporeal anastomosis group, is limited because intracorporeal anastomosis is technically more challenging, and fewer surgeons are proficient in this technique. Consequently, achieving comparable group sizes was not possible. However, the demographic and pathological characteristics of the groups were homogeneous, allowing for valid comparisons. Furthermore, since the choice of technique was left to the surgeon's discretion, randomization was not feasible, which likely resulted in surgeons opting for the technique they were most skilled at. Lastly, our study focused solely on short-term outcomes.

Conclusion

The findings of our study are generally consistent with the literature. Both techniques appear to be viable options, particularly when considering oncological outcomes and complications such as anastomotic leakage that could increase mortality. Based on our findings, we conclude that both techniques are applicable depending on the surgeon's expertise, with no clear superiority of one technique over the other. However, considering the conflicting data in the literature, randomized controlled trials with larger patient populations are warranted.

Disclosures

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Letter to the Editor

Simultaneous laparoscopic management of acute appendicitis and an incidental gallbladder cystic lesion: A case report

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Introduction

Abdominal pain is one of the most common complaints among patients presenting to the emergency department and encompasses a wide range of potential etiologies. Acute appendicitis is a leading cause of right lower quadrant pain and is considered a common surgical emergency requiring prompt intervention.[1] Despite its prevalence, coexisting pathologies identified during the diagnostic workup of acute appendicitis are rare and may complicate both diagnosis and treatment.[2]

Gallbladder cystic lesions, on the other hand, are typically incidental findings discovered during imaging for unrelated conditions. These lesions are often asymptomatic, with a wide spectrum of potential etiologies ranging from benign conditions, such as biliary cysts, to malignant transformations like cystadenocarcinoma.[3,4] Although these lesions are generally considered indolent, their management may pose a challenge when encountered in emergent surgical settings.

The simultaneous occurrence of acute appendicitis and gallbladder cystic lesions is exceedingly rare, and the decision to address both pathologies in a single surgical session requires careful consideration of patient factors, including clinical stability and access to follow-up care.[5] In emergent cases, such as when patients may not return for further evaluation or treatment, a combined surgical approach could be warranted to prevent potential complications.

Here, we present a case of a 17-year-old female who presented to the emergency department with right lower quadrant pain. She was diagnosed with acute appendicitis and, incidentally, a 15-mm cystic lesion in the gallbladder Hartmann's pouch. The management of this rare clinical scenario, including the decision for simultaneous laparoscopic appendectomy and cholecystectomy, is discussed in the context of available literature.

Case Report

A 17-year-old female presented to the emergency department with a complaint of right lower quadrant abdominal pain. Laboratory investigations revealed leukocytosis with a white blood cell count of 15,000/μL, while other hematologic parameters were within normal limits. Liver function tests, including ALT, AST, ALP, GGT, total bilirubin, and direct bilirubin, were also within normal ranges.

Abdominal ultrasound and CT demonstrated findings consistent with acute appendicitis. Additionally, a 15-mm cystic lesion was identified in the gallbladder Hartmann's pouch (Fig. 1). A subsequent computed tomography scan

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confirmed the presence of acute appendicitis and a 15-mm cystic lesion in the gallbladder without evidence of additional pathologies (Figs. 2, 3, 4).

The patient was taken to the operating room for laparoscopic appendectomy. (Fig. 5) Given the patient's reluctance for future follow-up and her limited access to healthcare services, informed consent was obtained for concurrent laparoscopic cholecystectomy during the same session. The surgical procedures were uneventful, and the patient was discharged with appropriate postoperative care and follow-up recommendations.

Figure 1. Cystic lesion identified in the gallbladder Hartmann's pouch.

Figure 2. Operaton material.

Figure 3. Pathology macroscopy.

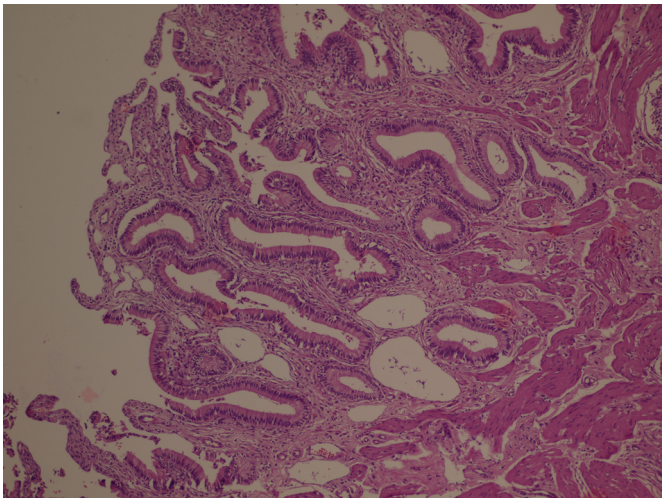

Figure 4. Computed tomography scan of acute appendicitis and a 15-mm cystic lesion in the gallbladder.

Discussion

The simultaneous occurrence of acute appendicitis and a cystic lesion in the gallbladder, as seen in this case, is an uncommon clinical scenario that poses unique diagnostic and therapeutic challenges. Acute appendicitis is one of the most common surgical emergencies, while gallbladder cystic lesions are generally incidental findings during imaging for unrelated conditions.[1,2] The rarity of these conditions presenting together necessitates a tailored approach to diagnosis and management.

Gallbladder cystic lesions encompass a wide spectrum of pathologies, including congenital cysts, pseudocysts, and neoplastic conditions such as biliary cystadenomas and cystadenocarcinomas.[3] Although asymptomatic in

Figure 5. Operating room for laparoscopic appendectomy ports.

most cases, these lesions carry potential risks such as infection, rupture, or malignant transformation, which necessitate vigilant assessment.[4,5] The decision to proceed with cholecystectomy during an acute surgical event must consider the lesion's characteristics, the patient's clinical context, and access to follow-up care.

In the present case, the patient exhibited leukocytosis and right lower quadrant pain typical of acute appendicitis. The incidental finding of a 15-mm gallbladder cystic lesion during imaging raised important questions regarding its clinical significance and the optimal timing for surgical intervention. Given the lesion's size and location in Hartmann's pouch, its management was integrated into the operative plan due to the patient's limited healthcare access and reluctance to return for follow-up.[6]

Simultaneous laparoscopic appendectomy and cholecystectomy is increasingly recognized as a safe and effective approach in select cases where concurrent pathologies are identified. This combined approach minimizes the risks associated with a second anesthesia and surgical procedure while addressing both conditions during the same session.[7] Previous studies have demonstrated the feasibility of this strategy, particularly in young, otherwise healthy patients with no significant comorbidities.[8]

However, the decision for simultaneous surgery must also account for potential intraoperative complications. Laparoscopic cholecystectomy, while considered the gold standard for gallbladder surgery, carries inherent risks such as bile duct injury or hemorrhage.[9] The surgeon's expertise and intraoperative assessment of the patient's stability are critical in ensuring favorable outcomes.

In our case, the absence of signs of infection or malignancy in the gallbladder cystic lesion, along with the patient's stable clinical condition, supported the decision for concurrent surgery. Histopathological examination of the resected specimens confirmed the diagnosis of acute appendicitis and a benign gallbladder cyst, further validating the surgical approach.

This case underscores the importance of individualized patient management in emergency settings. Factors such as the availability of imaging modalities, patient preferences, and healthcare access must all be carefully weighed in the decision-making process. Additionally, the case highlights the value of multidisciplinary collaboration in addressing complex presentations involving coexisting pathologies.

Future studies are needed to establish clear guidelines for the management of incidental gallbladder lesions identified during acute surgical interventions. While simultaneous surgery offers significant benefits, further research is required to refine patient selection criteria and optimize surgical outcomes.

Conclusion

In conclusion, this case demonstrates the successful management of acute appendicitis and an incidental gallbladder cystic lesion through a simultaneous laparoscopic approach. The decision to perform concurrent procedures should be guided by clinical judgment, patient-specific factors, and the expertise of the surgical team. Early recognition and management of such rare clinical scenarios are essential for ensuring favorable patient outcomes.

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