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Three-Port versus four-port laparoscopic cholecystectomy: a propensity score–matched retrospective cohort study of operative safety and short-term outcomes

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ABSTRACT

Introduction: The four-port technique is standard for laparoscopic cholecystectomy, but robust comparisons with the three-port technique that account for baseline differences are limited. We assessed whether three-port cholecystectomy achieves operative safety and short-term outcomes comparable to those of the four-port technique, using propensity score matching to account for confounding by indication.

Materials and Methods: We conducted a two-centre retrospective cohort study of 166 patients undergoing laparoscopic cholecystectomy (85 three-port, 81 four-port). The primary outcome was overall 30-day morbidity. Groups were compared before and after 1:1 nearest-neighbour propensity score matching based on age, sex, body mass index, ASA score, and comorbidity. The study was reported in accordance with the STROBE guideline.

Results: Patients selected for the four-port technique were older (median, 50 versus 42 years; p=0.003), had a higher body mass index (29 versus 26 kg/m²; p<0.001), and had higher rates of hypertension, cardiac disease, and anticoagulant use (all p<0.02). Operative time was longer with the four-port technique (44 versus 40 minutes; p=0.008); complications were rare in both groups, with no bile duct injury or mortality. Propensity score matching produced 54 well-balanced pairs (all SMD<0.10). In the matched cohort, operative time (40 versus 40 minutes; p=0.729) and length of stay (p=0.188) did not differ significantly. One patient in the four-port group required reoperation for bleeding; no conversions or mortality occurred in either group.

Conclusions: After adjustment for baseline risk, no statistically detectable differences in operative or short-term clinical outcomes were observed between the three-port and four-port techniques. The three-port technique could be used in selected patients with a low level of procedural difficulty.

Keywords: Cholelithiasis; laparoscopic cholecystectomy; propensity score matching; reduced-port surgery; surgical outcomes; three-port technique

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Introduction

Laparoscopic cholecystectomy is the gold standard for the surgical management of symptomatic gallstone disease and is among the most frequently performed general surgical operations worldwide. The conventional technique employs four trocars: an umbilical camera port, an epigastric working port, and two right-sided ports, the more lateral of which is used to retract the gallbladder fundus over the edge of the liver. This configuration has been refined over three decades and is supported by an extensive safety record.

The continued evolution of minimally invasive surgery has prompted interest in reduced-port approaches that aim to decrease abdominal wall trauma, postoperative pain, and the number of potential port-site complications. Among these, the three-port technique, first described by Slim et al.[1] in 1995, omits the lateral fundal retraction port while retaining conventional instrumentation. Since then, randomized trials, observational series, and several meta-analyses have suggested that the technique is feasible, offering modest reductions in postoperative pain and hospital stay while maintaining operative times and success rates comparable to those of the four-port approach.[2–5]

Important questions nonetheless remain. The main concern is whether omitting the fundal retraction port compromises exposure of Calot's triangle and attainment of the critical view of safety, thereby increasing the risk of bile duct injury.[6] Much of the existing literature is limited by small sample sizes, heterogeneous outcome reporting, and, in observational series, comparisons between groups that are not comparable at baseline.[7–9] In routine practice, the choice between techniques is rarely random: established preoperative predictors of a difficult cholecystectomy—including advanced age, obesity, and comorbidity—may lead surgeons to reserve the four-port approach for patients perceived to be more complex, introducing confounding by indication that naïve comparisons cannot resolve.[10,11]

We therefore undertook a retrospective cohort study comparing three-port and four-port laparoscopic cholecystectomy, with an emphasis on operative outcomes, morbidity, and mortality, using standardized complication grading and propensity score matching to adjust for baseline differences. Our aim was not to establish the novelty or superiority of the three-port technique but to determine whether it can be applied safely in appropriately selected patients without compromising the conduct or safety of the operation.

Materials and Methods

Study Design and Setting

This was a two-center, retrospective, comparative cohort study conducted at Aktif International Hospital (Yalova) and Acıbadem Altunizade Hospital (İstanbul). The medical records of consecutive adult patients who underwent elective laparoscopic cholecystectomy between March 2025 and May 2026 were reviewed. Patients were grouped according to the surgical technique employed: three-port (exposure group) or four-port (comparator group). The choice of technique was based on surgeon preference and intraoperative conditions, reflecting real-world practice. The study was conducted in accordance with the Declaration of Helsinki and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline.[12] The study was approved by the Acıbadem Mehmet Ali Aydınlar University Medical Research Evaluation Board (ATADEK; approval no. 2026-11/127, dated June 25, 2026), and the requirement for individual informed consent was waived by the ethics committee because the study was a retrospective analysis of anonymized, routinely collected clinical records that entailed no additional intervention or risk to patients and no contact with participants. The study was not prospectively registered. Ethics approval was granted by the review board of one participating center (Acıbadem Mehmet Ali Aydınlar University Medical Research Evaluation Board (ATADEK) on 25 June 2026 (approval no. 2026-11/127), and institutional permission to access records was obtained from the other participating center (Aktif International Hospital).

Participants

Patients aged 18 years or older who underwent elective laparoscopic cholecystectomy for symptomatic cholelithiasis, chronic cholecystitis, or gallbladder polyps and had a complete operative record were eligible. Exclusion criteria were concurrent additional procedures, primary open cholecystectomy, single-incision or robotic procedures, incomplete records, and known gallbladder malignancy.

Surgical Technique

The three-port technique used a 10-mm umbilical camera port, a 5-mm epigastric working port, and a single 5-mm port in the right upper quadrant; fundal retraction was achieved through manipulation with the working instruments. The four-port technique added a second 5-mm right

upper quadrant port, placed approximately 10 cm lateral to the first, to provide dedicated fundal retraction over the edge of the liver. In both techniques, the critical view of safety was sought before division of the cystic duct and artery, and an additional port was inserted or conversion to open surgery was undertaken at the operating surgeon's discretion when safe dissection could not be achieved. The choice between techniques was made by the operating surgeon and was not governed by a written protocol; in practice, the three-port approach was preferentially used in patients judged to be at lower risk of difficult dissection, namely those with normal alkaline phosphatase and gamma-glutamyl transferase levels, no recent episode of acute cholecystitis, and no ultrasonographic features suggesting a difficult cholecystectomy, such as a thickened gallbladder wall, pericholecystic fluid, or an impacted stone.

Variables and Outcomes

Baseline variables comprised age, sex, body mass index, American Society of Anesthesiologists (ASA) physical status, comorbidities (diabetes, hypertension, cardiac disease, pulmonary disease, and anticoagulant use), previous abdominal surgery, and preoperative laboratory values. The primary outcome was overall 30-day morbidity. Secondary outcomes included operative time, attainment of the critical view of safety, need for an additional port, conversion to open surgery, drain placement, length of hospital stay, specific complications (bile duct injury graded according to the Strasberg classification, bile leak, postoperative bleeding, and surgical site infection), 30-day readmission, 30-day reoperation, and 30-day mortality. Complication severity was graded using the Clavien–Dindo classification.[13] Bile duct injuries were classified according to the Strasberg classification.[6] Outcomes and complications were ascertained from inpatient and outpatient hospital records. As part of standard institutional practice, all patients attended a clinical review on the 10th postoperative day and were contacted by telephone at one month to confirm their well-being; events occurring within 30 days were recorded.

Statistical Analysis

The primary outcome was overall 30-day morbidity. On the basis of morbidity rates of approximately 5–8% reported for four-port cholecystectomy, a sample of at least 100 patients per group was estimated to provide 80% power to detect an absolute difference of 8 percentage points at a two-sided alpha level of 0.05; therefore, all eligible consecutive patients between March 2025 and May 2026 were included. The achieved sample (85 three-port and 81 four-port patients) fell short of this target. More importantly, the observed overall morbidity rate (a single event among 166 patients, well below the assumed 5–8%) meant that the primary analysis was substantially underpowered in practice. At the observed event rate, detecting a between-group difference would have required approximately 300 patients per group, and the post hoc power of the achieved sample for the observed effect was below 35%. Overall morbidity is therefore reported descriptively, and the primary comparison—not only its rarer components—should be regarded as underpowered.

Continuous variables are presented as median (interquartile range). Normality was assessed using the Shapiro–Wilk test; because all continuous variables deviated from a normal distribution, they were compared using the Mann–Whitney U test throughout. Categorical variables are presented as frequencies (percentages) and were compared using Fisher's exact test. To address confounding by indication, 1:1 nearest-neighbor propensity score matching without replacement was performed using a caliper of 0.2 standard deviations of the logit of the propensity score. The propensity model was estimated by logistic regression incorporating age, sex, body mass index, ASA score, diabetes, hypertension, cardiac disease, pulmonary disease, anticoagulant use, and previous abdominal surgery. Balance was assessed using the standardized mean difference, with a value <0.10 considered negligible. Outcomes were compared in the matched cohort using the same tests. As a sensitivity analysis, a multivariable linear regression model was fitted to assess the independent effect of surgical technique on operative time after adjustment for all baseline covariates. A two-sided p value <0.05 was considered statistically significant. Patients with incomplete covariate data were excluded from the propensity model using a complete-case approach, and the extent and pattern of missing data are reported in the Results. As an additional sensitivity analysis, matched-cohort outcomes were compared using paired methods (Wilcoxon signed-rank test for continuous variables and McNemar's test for categorical variables) to account for the paired structure introduced by 1:1 matching.

Results

Study Population

During the study period, 166 patients met the inclusion criteria, of whom 85 (51.2%) underwent the three-port technique and 81 (48.8%) underwent the four-port technique. The co-

hort was predominantly female (104 patients, 62.7%). All procedures were completed laparoscopically except for a single conversion to open surgery in the four-port group. The flow of patients through the study is shown in Figure 1.

Baseline Characteristics

Baseline characteristics are summarized in Table 1. Patients selected for the four-port technique were significantly older (50, IQR 41 to 62 years vs 42, IQR 34 to 53 years, p=0.003) and had a higher body mass index (29, IQR 26 to 33 kg/m² vs 26, IQR 24 to 30 kg/m²; p<0.001). The four-port group also had significantly higher rates of hypertension (30.0% vs 14.1%; p=0.015), cardiac disease (21.2% vs 4.7%; p=0.002), and anticoagulant use (16.2% vs 3.5%; p=0.007). The direction of these differences mirrors the established preoperative predictors of a difficult cholecystectomy—older age, higher body mass index, and greater comorbidity—a pattern consistent with, although not proof of, surgeons preferentially reserving the four-port technique for patients perceived to be at higher operative risk. Because technique-selection criteria were not prospectively recorded, this remains an interpretation rather than a directly demonstrated finding.[10,11] This observed selection pattern provides the rationale for propensity score matching.

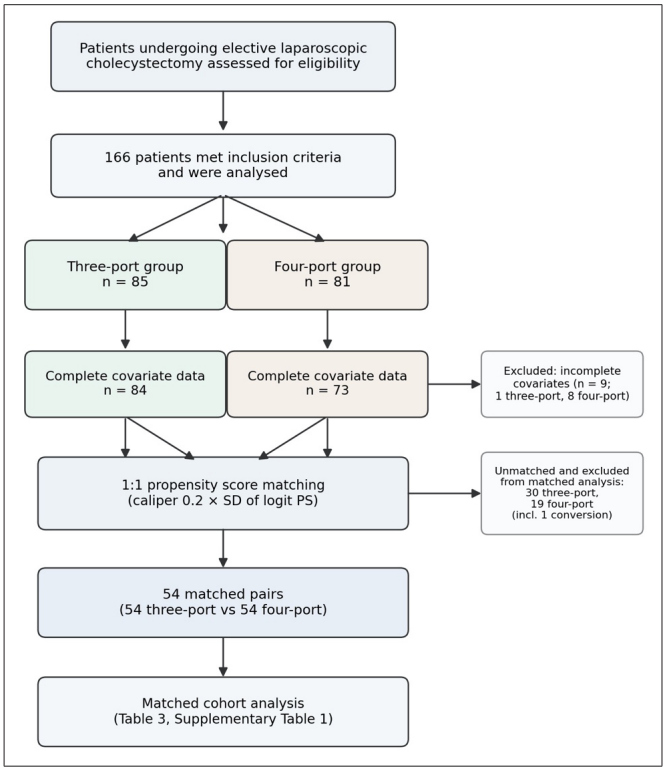

Figure 1. STROBE patient flow diagram.

Outcomes in the Unmatched Cohort

Operative and 30-day outcomes are presented in Table 2. Operative time was modestly longer in the four-port group (median 44, IQR 40 to 50 min vs 40, IQR 35 to 45 min; p=0.008). A critical view of safety was documented in the operative record more frequently in the four-port group (77.8% vs 47.1% in the unmatched cohort; 75.9% vs 44.4% in the matched cohort), as was drain placement, consistent with the selection of more complex cases. Because this variable reflects documentation rather than verified intraoperative attainment, the lower rate in the three-port group may partly reflect less consistent operative-note recording rather than a true difference in achieving the critical view. An additional port was required in one three-port patient (1.2%), and one four-port patient (1.2%) was converted to open surgery. There were no bile duct injuries, bile leaks, or deaths in either group. A single four-port patient developed postoperative bleeding requiring readmission and reoperation. This complication was graded Clavien–Dindo IIIb; all other patients in both groups were Clavien–Dindo grade 0. Complete covariate data were available for 157 of 166 patients; the nine excluded patients (one three-port, eight four-port) were missing data predominantly for previous abdominal surgery (n=4) and pulmonary disease (n=2), with single missing values for other covariates. Because these variables, such as sex, body mass index, and comorbidity, are routinely assessed before surgery, the missing values reflect incomplete transcription into the study dataset rather than information that was never obtained; a missing-at-random mechanism is therefore plausible, supporting the complete-case approach. A complete-case sensitivity analysis did not alter the direction of the findings. Length of stay was similar (p=0.142).

Propensity Score–Matched Analysis

Propensity score matching produced 54 well-balanced pairs (Supplementary Table 1). All ten covariates achieved a standardized mean difference <0.10, with the mean standardized mean difference decreasing from 0.33 before matching to 0.04 after matching. In the matched cohort (Table 3), operative time no longer differed between techniques (median 40 minutes in both groups; p=0.729), and length of stay remained comparable (p=0.188). Matching was performed on the 157 patients with complete covariate data (84 three-port, 73 four-port); 54 four-port patients were paired with three-port counterparts, while 19 four-port patients—including the single patient who required

Table 1. Baseline demographic and clinical characteristics before PSM

Characteristic	Three-port (n=85)	Four-port (n=81)	p
Demographics			
Age (years), median (IQR)	42 (34–53)	50 (41–62)	0.003
Male sex, n (%)	29 (34.1)	33 (40.7)	0.424
BMI (kg/m²), median (IQR)	26 (24–30)	29 (26–33)	<0.001
ASA score, median (IQR)	2 (2–2)	2 (1–2)	0.218
Comorbidities			
Diabetes mellitus, n (%)	4 (4.7)	11 (13.6)	0.059
Hypertension, n (%)	12 (14.1)	24 (30.0)	0.015
Cardiac disease, n (%)	4 (4.7)	17 (21.2)	0.002
Pulmonary disease, n (%)	0 (0.0)	4 (5.1)	0.052
Anticoagulant use, n (%)	3 (3.5)	13 (16.2)	0.007
Previous abdominal surgery, n (%)	6 (7.1)	4 (5.2)	0.749
Preoperative ERCP, n (%)	3 (3.5)	5 (6.2)	0.488
Preoperative laboratory			
WBC (×10³/μL), median (IQR)	7 (5–8)	7 (6–9)	0.053
ALT (U/L), median (IQR)	26 (19–37)	30 (21–52)	0.067
AST (U/L), median (IQR)	20 (15–28)	28 (20–40)	<0.001

Data are median (interquartile range) or n (%). P values from Mann–Whitney U test (continuous) and Fisher exact test (categorical). BMI: Body mass index; ASA: American Society of Anesthesiologists; ERCP: Endoscopic retrograde cholangiopancreatography; WBC: White blood cell count; IQR: Interquartile range. Sex coded 0=female, 1=male.

Table 2. Operative and 30-day postoperative outcomes before PSM

Outcome	Three-port (n=85)	Four-port (n=81)	p
Operative			
Operative time (min), median (IQR)	40 (35–45)	44 (40–50)	0.008
Critical view of safety, n (%)	40 (47.1)	63 (77.8)	<0.001
Additional port required, n (%)	1 (1.2)	0 (0.0)	1.000
Conversion to open, n (%)	0 (0.0)	1 (1.2)	0.488
Drain placement, n (%)	0 (0.0)	43 (53.1)	<0.001
Postoperative (30-day)			
Length of stay (h), median (IQR)	25 (21–26)	23 (20–26)	0.142
Any complication, n (%)	0 (0.0)	1 (1.3)	0.494
Bile duct injury, n (%)	0 (0.0)	0 (0.0)	1.000
Bile leak, n (%)	0 (0.0)	0 (0.0)	1.000
Postoperative bleeding, n (%)	0 (0.0)	1 (1.3)	0.494
30-day readmission, n (%)	0 (0.0)	1 (1.3)	0.494
30-day reoperation, n (%)	0 (0.0)	1 (1.3)	0.494
30-day mortality, n (%)	0 (0.0)	0 (0.0)	1.000

Data are median (interquartile range) or n (%). The higher rate of drain placement and documented critical view of safety in the four-port group reflects preferential use of that technique in more complex disease. The postoperative bleeding, 30-day readmission, and 30-day reoperation events refer to the same single four-port patient, not three independent events.

Table 3. Outcomes after 1:1 propensity score matching (54 pairs)

Outcome	Three-port (n=54)	Four-port (n=54)	p
Operative time (min), median (IQR)	40 (35–45)	40 (36–45)	0.729
Length of stay (h), median (IQR)	25 (21–26)	23 (20–25)	0.188
Critical view of safety, n (%)	24 (44.4)	41 (75.9)	0.002
Additional port required, n (%)	1 (1.9)	0 (0.0)	1.000
Conversion to open, n (%)	0 (0.0)	0 (0.0)	1.000
Any complication, n (%)	0 (0.0)	1 (2.0)	1.000
30-day mortality, n (%)	0 (0.0)	0 (0.0)	1.000

conversion to open surgery, who lay outside the region of common support—remained unmatched and were excluded from the matched analysis. No conversions to open surgery or deaths occurred in either matched group; the single postoperative complication in the cohort (bleeding requiring reoperation in a four-port patient) occurred within the matched cohort, whereas no three-port patient experienced a complication. An additional port was required in one three-port patient. These findings indicate that, among patients with comparable baseline risk, no statistically detectable differences in these operative or short-term outcomes were observed between the techniques.

In a multivariable linear regression adjusting for all baseline covariates, surgical technique had no independent effect on operative time (four-port vs three-port, +1.4 minutes; 95% confidence interval, –3.4 to +6.2; p=0.566), corroborating the matched analysis. Because only a single postoperative complication occurred across the entire cohort, formal multivariable modeling of morbidity was not feasible.

Discussion

In this comparative cohort of 166 patients undergoing elective laparoscopic cholecystectomy, no statistically detectable differences in operative or short-term clinical outcomes were observed between the three-port and conventional four-port techniques. The two groups were not comparable at baseline: the four-port approach was preferentially used in older patients with higher body mass index and greater cardiac, hypertensive, and anticoagulant-related comorbidity. After propensity score matching produced 54 well-balanced pairs, no statistically detectable differences in operative time, length of stay, complications, conversion, or mortality were found, indicating that, among patients with comparable baseline risk, no statistically detectable differences in these outcomes were observed between the techniques; however, the very low event rate precludes any conclusion of equivalent safety. Repeating the matched comparisons using paired methods yielded consistent results (operative time, p=0.951; length of stay, p=0.172; critical view of safety, p=0.006). The unmatched patients differed systematically: unmatched four-port patients were older and had a higher body mass index than their matched counterparts (mean age 65 vs 47 years; body mass index 37 vs 29 kg/m²), whereas unmatched three-port patients were younger and leaner (mean age 39 vs 48 years; body mass index 24 vs 29 kg/m²); their characteristics are provided in the supplementary material.

Our results are consistent with an established and growing body of evidence. The three-port technique was first described by Slim et al.[1] in 1995, and numerous randomized and observational studies have since examined its safety and efficacy.[2] Several randomized controlled trials have directly compared the two techniques: Trichak[3]; Ku-mar et al.[4] in a community hospital in eastern Nepal:, and Cerci et al.[5] in a Turkish cohort each reported that three-port cholecystectomy was feasible and safe, with compa-rable operative times and, in some series, reduced port-site pain.[3–5] The most comprehensive synthesis to date, a systematic review and meta-analysis of 18 randomized trials encompassing 2085 patients by Nip et al.,[7] found shorter hospital stays and reduced analgesic requirements with the three-port technique and no differences in operative duration, procedural success, or adverse events. Earlier meta-analyses reported comparable operative times and success rates, with mixed findings regarding analgesic requirements and, in a trial-sequential analysis, lower early pain scores and shorter hospital stays.[8,9] Despite the growing evidence supporting three-port cholecystectomy, the four-port technique is still re-

garded as the gold standard. Our finding of no detectable difference in operative outcomes after adjustment for baseline risk is consistent with this body of evidence.

Comparative cohort studies provide the closest methodological parallel to our work. In a retrospective series of 495 patients with acute and chronic cholecystitis, Al-Azawi et al.[14] found no differences between three-port and four-port cholecystectomy in complications, conversion to open surgery, or operative time, while the three-port group required less opioid analgesia. Mayir et al.,[15] comparing 100 three-port with 50 four-port procedures, likewise reported similar operative time, length of stay, complication, and conversion rates, with a fourth port required in 9% of three-port cases. Our additional-port rate of 1.2% compares favorably with these figures and reflects careful intraoperative selection.

A central concern with reduced-port surgery is whether the loss of the lateral fundal retraction port compromises exposure of Calot's triangle and increases the risk of bile duct injury. The absence of any bile duct injury in our cohort, including among higher-risk four-port patients, is reassuring. The largest single-technique experience supports this finding: in a 10-year review of 1878 three-trocar cholecystectomies, Tuveri et al.[16] reported a 94% success rate, an overall morbidity rate of 1.5%, only two minor (Strasberg type D) bile duct injuries, and no mortality. These data indicate that, at scale and in experienced hands, omission of the fourth port is not associated with an excess of biliary injury. In a prospective series of 102 patients, Chatterjee et al.[17] similarly managed 99 cases using three ports without any bile duct injury, requiring conversion to four ports in only three patients, and extended the technique even to anticipated difficult gallbladders. In our cohort, only one three-port patient required an additional port, and no biliary injury occurred; while reassuring, this small sample cannot establish comparative biliary safety and demonstrates only technical feasibility, provided that the decision to omit the fourth port does not compromise safe dissection.[7]

The methodological core of this study is its use of propensity score matching to address confounding by indication. The marked baseline differences between groups reflect a real and clinically meaningful phenomenon: surgeons intuitively selected the four-port technique for more complex patients. By matching on age, body mass index, ASA score, and comorbidity, we compared patients with comparable baseline risk and found no evidence that the technique itself influenced the measured outcomes. This distinguishes our analysis from much of the existing literature, which has frequently compared unbalanced groups or relied on small randomized samples.[4,5] Recent work defining the factors that render reduced-port cholecystectomy more difficult underscores the importance of patient selection. A key limitation, however, is that propensity score matching can balance only measured covariates. Several important determinants of operative difficulty and technique selection—gallbladder wall thickening, pericholecystic adhesions, impacted or large stones, prior acute cholecystitis, inflammation around Calot's triangle, and individual surgeon experience—were not captured in our dataset and therefore could not be incorporated into the model. Residual confounding by these unmeasured factors cannot be excluded and may account for part of the observed differences. Because our cohort comprised consecutive, unselected patients treated in routine practice across two centers rather than a trial population subject to protocol-driven eligibility, it reflects how technique selection and outcomes actually unfold in everyday surgical care. The contribution of this study lies less in validating a novel technique than in providing real-world evidence that three-port cholecystectomy, as currently applied to appropriately selected patients, does not compromise safety.[18]

Rather than validating a novel technique, our study contributes evidence that, within real-world practice, the three-port technique is a safe option for patients at lower baseline risk, while the four-port technique remains a prudent choice for more complex cases. The specific contribution of this study is therefore threefold: it quantifies the substantial real-world treatment-selection bias between the two techniques, demonstrates what remains after adjustment for measured baseline differences, and illustrates the limits of propensity score matching when operative complexity and surgeon-related variables are unavailable. Notably, this selection occurred through routine surgical judgment rather than any predefined protocol; the baseline differences we observed indicate that surgeons were already directing lower-risk patients to the three-port approach. This pragmatic, practice-based pattern accords with the prevailing recommendation that three-port cholecystectomy be reserved for lower-risk patients in experienced hands.[7,17]

Limitations

This study has several limitations. Its retrospective, two-center design introduces potential selection and in-

formation bias, and residual confounding by unmeasured variables cannot be excluded despite propensity score matching. The overall complication rate was very low in both groups, so the study was underpowered to detect differences in individual complications such as bile duct injury; the absence of a detectable difference should be understood as an absence of demonstrable harm rather than proof of identical safety. Allocation to technique was not randomized. Follow-up was limited to 30 days, so late outcomes such as port-site hernia may have been underestimated. Preoperative transaminases (ALT and AST), available for all patients, are reported in Table 1 and were higher in the four-port group, consistent with more complex biliary disease; alkaline phosphatase, gamma-glutamyl transferase, and total bilirubin were recorded for only a minority of patients (65, 79, and 55 of 166, respectively) and could not be tabulated. Liver enzymes were not incorporated into the propensity model, so unmeasured markers of biliary disease complexity may persist as residual confounders. Finally, matching reduced the analyzable sample to 54 pairs, with some higher-risk four-port patients remaining unmatched; the matched conclusions therefore apply chiefly to the region of covariate overlap.

Conclusion

In conclusion, within a real-world cohort in which technique selection reflected patient risk, no significant differences in the evaluated short-term outcomes were observed between three-port and four-port laparoscopic cholecystectomy among matched patients. The very low event rate precludes reliable conclusions regarding comparative morbidity or rare complications such as bile duct injury, and longer-term outcomes such as port-site hernia and chronic pain were not assessed. Within these limitations, our findings are consistent with three-port cholecystectomy being a feasible option in carefully selected, lower-risk patients rather than a universal replacement for the four-port approach. Prospective, adequately powered studies are warranted to define explicit selection criteria and confirm these findings in higher-risk patients.

Disclosures

Ethics Committee Approval: The study was approved by the Acıbadem Mehmet Ali Aydınlar University Medical Research Evaluation Board (ATADEK) on 25 June 2026 (approval no. 2026-11/127). The requirement for individual informed consent was waived owing to the retrospective design.

Peer-review: Externally peer-reviewed.

Informed Consent: Waived owing to the retrospective design.

Conflict of Interest: The authors declare no conflict of interest.

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Authorship Contributions: Concept – E.O., E.B.; Design – E.O., E.B., S.S.; Data collection – E.O., S.S.; Analysis/interpretation – E.O., E.B.; Literature search – E.O. S.S; Writing – E.O., S.S., E.B.; Critical review – E.B, E.O, S.S.

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