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Comparison of Three-Port and Four-Port Laparoscopic Cholecystectomy: A Clinical Intervention Study

Three-Port vs Four-Port Laparoscopic Cholecystectomy

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Abstract: Objective: This study compares the outcomes of 3-port and 4-port laparoscopic cholecystectomy techniques, focusing on pain management, operative time, hospital stay, and recovery, within a clinical intervention framework.

Methods: This clinical intervention study was conducted at Van Başkale State Hospital, where data were retrospectively collected from 120 patients who underwent 3-port (n=60) or 4-port (n=60) laparoscopic cholecystectomy. Group allocation was performed prior to surgery based on clinical decisions, rather than a fully randomized process. Preoperative and postoperative management protocols were standardized. Key variables included gender, surgical priority, pain scores (VAS), operative time, hospital stay duration, and recovery time.

Results: Gender distribution differed significantly between groups (p=0.013), with more females in the 4-port group. No significant differences were observed in pain scores at 12 and 24 hours postoperatively, operative time, or recovery to normal activities. However, the 3-port group demonstrated a shorter hospital stay (p=0.003).

Conclusion: The findings suggest that the 3-port technique may offer advantages in reducing hospital stay duration. This clinical intervention study provides insights into optimizing laparoscopic techniques in resource-limited settings.

Keywords: Laparoscopic cholecystectomy, 3-port technique, 4-port technique, Postoperative recovery, Hospital stay duration

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Introduction

Cholecystectomy, especially laparoscopic cholecystectomy, is a common surgical procedure for treating symptomatic gallbladder diseases, including cholelithiasis and cholecystitis (1). Laparoscopic techniques have significantly reduced surgical morbidity and mortality compared to open cholecystectomy, offering faster recovery times, less postoperative pain, and shorter hospital stays (2). Among laparoscopic techniques, the number of ports used during surgery varies, with three-port and four-port approaches being widely applied. These variations primarily aim to improve patient outcomes by minimizing tissue trauma while maintaining procedural efficacy and safety (3).

The traditional four-port technique includes a standard port placement that allows optimal access to the gallbladder, enhancing visualization and instrument maneuverability (4). However, the three-port technique eliminates one port, theoretically reducing abdominal wall trauma, postoperative pain, and the risk of wound infection (5). Some studies suggest that fewer ports could decrease operative time, hospital stay, and postoperative recovery periods, although the evidence remains mixed and largely dependent on surgeon experience (6). Given the potential advantages of the three-port technique, further studies are needed to determine whether it offers distinct benefits over the four-port method in terms of pain management, recovery time, and overall efficiency (7).

Intraoperative and postoperative management in cholecystectomy patients often involves standard prophylactic antibiotic administration to reduce infection risk, although optimal protocols vary among institutions (8). In this study, all patients received preoperative cefazolin to maintain consistency and prevent infections associated with laparoscopic cholecystectomy. Additionally, postoperative analgesia, typically nonsteroidal anti-inflammatory drugs (NSAIDs), is essential for minimizing discomfort following surgery (9). Diclofenac sodium was selected as the sole analgesic agent for this study, administered twice on the first postoperative day, a protocol aligned with recommendations for effective and minimally invasive pain management in laparoscopic procedures (10).

This study is unique in that it was conducted as a randomized controlled trial by a single surgeon at xxx State Hospital. Data were collected retrospectively to compare the effects of three-port and four-port laparoscopic cholecystectomy on postoperative outcomes, including operative time, hospital stay, pain scores, and recovery duration. Randomization in the initial phase was crucial to minimize selection bias, ensuring comparability between the groups (11). The retrospective data analysis allowed for a comprehensive examination of postoperative outcomes, leveraging real-world data to assess each technique's efficacy in the context of a controlled clinical setting.

Although advanced techniques such as single-incision and robotic cholecystectomy are increasingly popular, they are often not feasible in small, resource-limited hospitals. This study was conducted in xxx Hospital, where limited resources necessitate an evaluation of the efficacy of widely applicable techniques such as 3-port and 4-port laparoscopic cholecystectomy. By focusing on a setting with constrained access to advanced technologies, this study aims to provide relevant insights into the optimization of laparoscopic procedures in such environments.

Material and Methods

This clinical intervention study was conducted at Van Başkale State Hospital to compare the outcomes of 3-port and 4-port laparoscopic cholecystectomy. Group allocation was based on clinical decisions rather than randomization, and data were retrospectively collected from patient records. Patients were included if they met the clinical criteria for laparoscopic cholecystectomy, and exclusions were made for patients with incomplete records or contraindications for surgery.

All patients received a prophylactic dose of 1 gram of cefazolin preoperatively. Postoperative pain management was standardized across groups, with 75 mg diclofenac sodium administered intramuscularly every 12 hours for the first postoperative day only. No additional analgesics or antibiotics were given unless clinically indicated.

The following parameters were collected from medical records: patient age, gender, operative time, hospital stay duration, time to return to normal activities, and pain scores (VAS) at 12 and 24 hours postoperatively. Operative times, duration of hospital stay, and recovery data were carefully documented to assess the effectiveness and patient outcomes associated with each cholecystectomy technique. Statistical analyses were then applied to compare these parameters between the 3-port and 4-port groups.

Results

In this study, we compared the outcomes of 3-port and 4-port cholecystectomy techniques across various patient characteristics and postoperative clinical parameters. In terms of gender distribution, 53% of patients in the 3-port group were female and 47% male, while in the 4-port group, 75% were female and 25% male. This difference in gender distribution was statistically significant (p=0.013), indicating that gender may influence the choice of surgical technique, with a preference for the four-port approach in female patients. However, further investigation is required to determine whether this association is related to gender-independent advantages or specific patient characteristics.

Regarding surgical priority, the proportion of patients requiring emergency surgery was 23% in the 3-port group and 27% in the 4-port group. Elective surgeries were performed on 67% of patients in the 3-port group and 63% in the 4-port group, showing no significant difference (p=0.673). This finding suggests that both techniques are similarly applicable in emergency or elective scenarios, and surgical priority does not significantly impact the choice of technique.

Pain management was assessed using VAS scores at 12 and 24 hours postoperatively. The 12-hour VAS score averaged 4.57 ± 2.13 in the 3-port group and 4.75 ± 2.07 in the 4-port group, with no statistically significant difference (p=0.788). Similarly, 24-hour VAS scores were 1.90 ± 1.08 in the 3-port group and 1.92 ± 1.08 in the 4-port group, with no significant difference (p=0.532). These results indicate that both surgical techniques provide comparable effectiveness in postoperative pain management.

When comparing operation times, the 3-port group had an average surgical duration of 33.90 ± 9.35 minutes, while the 4-port group had an average of 32.53 ± 8.32 minutes, a difference that was not statistically significant (p=0.299). This suggests that both techniques are equally efficient regarding operative time, allowing surgeons flexibility in technique choice without major differences in time requirements.

In terms of hospitalization duration, the average hospital stay was 1.27 ± 0.45 days for the 3-port group and 1.40 ± 0.49 days for the 4-port group, with this difference being statistically significant (p=0.003). The longer hospital stay observed in the 4-port group may imply that this technique could extend postoperative recovery time, indicating a potential advantage for the 3-port technique, especially in settings where shorter hospitalization is prioritized.

Finally, for the time to return to normal activity, patients in the 3-port group resumed daily activities within an average of 3.58 ± 0.77 days, while those in the 4-port group took an average of 3.85 ± 0.92 days, with no statistically significant difference (p=0.279). This finding suggests that neither surgical technique offers a distinct advantage in terms of recovery time to resume normal activities(table-1).

Table 1: Analysis based on laparoscopic port counts				
Variables		3 Port	4 Port	p †
		(n=60)	(n=60)	
Gender	Female	32 (53%)	45 (75%)	0.013
	Male	28 (47%)	15 (25%)	
Surgical Priority	Emergency	14 (23%)	16 (27%)	0.673
	Elective	46 (67%)	44 (63%)	
		Mean ± sd		p ‡
VAS Score 12 Hour		4.57 ± 2.13	4.75 ± 2.07	0.788
VAS Score 24 Hour		1.90 ± 1.08	1.92 ± 1.08	0.532
Surgery Time		33.90 ± 9.35	32.53 ± 8.32	0.299
Hospitalization Time		1.27 ± 0.45	1.40 ± 0.49	0.003
Days to Return Normal Activity		3.58 ± 0.77	3.85 ± 0.92	0.279

Discussion

This study evaluates the outcomes of 3-port versus 4-port laparoscopic cholecystectomy within the context of a clinical intervention study. Unlike fully randomized controlled trials, this study allocated patients based on clinical decisions and retrospectively analyzed their outcomes. While this design may introduce inherent biases, it reflects real-world clinical practices, particularly in resource-limited settings where advanced randomization processes may not be feasible.

The shorter hospital stay observed in the 3-port group highlights its potential for reducing healthcare costs and optimizing resource utilization. These findings are particularly relevant for facilities where efficiency and cost management are priorities. Future research involving prospective, randomized designs may help further validate these results.

Gender distribution was notably different between the two groups, with a higher percentage of female patients undergoing the 4-port technique. This result aligns with some recent studies suggesting that female patients may be more likely to undergo certain surgical techniques due to anatomical or physiological considerations; however, the literature remains divided on whether gender should influence technique choice (12). Some studies have suggested that factors such as the severity of cholecystitis or BMI might also influence technique selection in different patient demographics, potentially impacting recovery and postoperative pain (13). Our data align with findings that suggest female patients may exhibit slightly different responses to laparoscopic interventions, but larger studies are needed to confirm whether such differences hold clinical significance (14).

The postoperative pain scores (VAS) at 12 and 24 hours showed no significant differences between the groups, supporting recent findings that both techniques yield similar pain outcomes when postoperative analgesia is carefully managed (15). Minimally invasive approaches, regardless of the number of ports, have been shown to reduce postoperative pain, a result corroborated by our findings, emphasizing the efficacy of standardized pain management protocols in ensuring patient comfort (16). Given the increased emphasis on early postoperative pain management in laparoscopic procedures, our findings suggest that the choice of port number may not substantially influence pain levels (17). Studies have indicated that other factors, such as intra-abdominal pressure during the procedure, may also contribute to postoperative pain, which could explain the lack of difference between 3-port and 4-port approaches in this study (18).

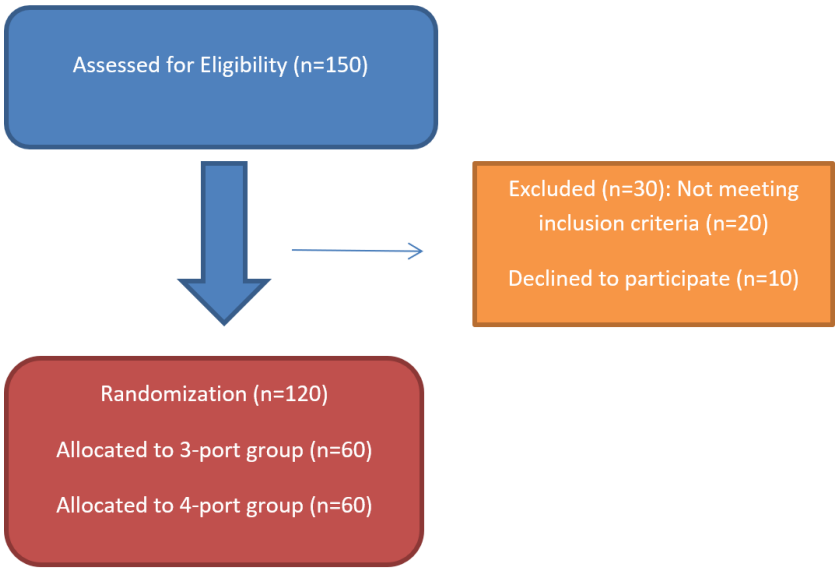

Figure 1: CONSORT Flow Diagram Depicting Patient Enrollment, Randomization, Follow-up, and Analysis

Operative times were also similar between the 3-port and 4-port groups, consistent with recent findings that the number of ports does not significantly impact the duration of laparoscopic procedures (19). This may be due to advances in surgical technique and technology, which have made multi-port and reduced-port approaches equally feasible in terms of operative efficiency (20). Another study highlighted that skill and experience of the surgeon have a greater impact on operative times than the number of ports used (21). The lack of significant difference in operative time in our study implies that surgeons may choose either technique without compromising surgical time, focusing instead on patient-specific factors and surgical expertise (22).

One of the most notable findings was the shorter hospital stay for patients in the 3-port group. Previous studies have suggested that fewer ports may reduce abdominal wall trauma, leading to faster recovery and shorter hospital stays, which is in line with our findings (23). Shorter hospital stays are particularly relevant in modern healthcare systems where reducing healthcare costs and bed occupancy are prioritized (24). Thus, the 3-port technique may offer economic benefits without compromising patient safety or outcomes. However, it is worth considering that this advantage may vary based on institutional protocols, and further research in different healthcare settings is necessary to validate this finding (25). Hospitalization costs and the associated resource allocation remain a critical concern in many healthcare systems, and shorter stays have been shown to contribute positively to resource management (26).

In terms of time to return to normal activities, no statistically significant difference was observed between the groups. This is consistent with studies showing that recovery timelines are often comparable across different laparoscopic techniques as long as postoperative pain and mobility are managed effectively (27). Both 3-port and 4-port techniques provide minimally invasive options that allow for rapid recovery and early resumption of daily activities, aligning with the enhanced recovery protocols commonly employed in laparoscopic surgery (28). However, some reports suggest that even minor differences in recovery time may be significant in patients with active lifestyles or jobs that require early physical activity (29). Our findings suggest that, despite the technical differences, both techniques enable patients to achieve postoperative recovery with similar timelines, which is advantageous in reducing postoperative recovery

periods (30).

Overall, our study suggests that the 3-port technique may offer some advantages in terms of hospital stay while maintaining comparable pain management, operative time, and recovery outcomes with the 4-port approach. Additionally, advancements in laparoscopic tools and the growing experience with reduced-port techniques may further enhance the feasibility and desirability of the 3-port approach, particularly in facilities focused on cost-effective care (31). The findings of this study contribute to the ongoing debate on the optimal laparoscopic approach in cholecystectomy, supporting the notion that fewer ports may confer specific benefits without significant compromises. Nevertheless, the final decision on the choice of technique should always account for patient-specific factors, surgeon experience, and institutional resources (32). This study demonstrates that both 3-port and 4-port laparoscopic cholecystectomy techniques produce comparable results in most postoperative outcomes. The significantly shorter hospital stay in the 3-port group may reflect reduced surgical trauma associated with fewer incisions, supporting findings from previous research that fewer ports can enhance recovery and reduce complications.

This study was conducted in a resource-limited hospital where advanced surgical techniques, such as robotic and single-incision laparoscopic surgery, were not available. Consequently, the findings are specific to conventional laparoscopic methods and may not directly apply to settings with access to advanced technologies.

Future randomized controlled trials with larger sample sizes, multicenter designs, and extended follow-up periods could provide further clarity on the comparative advantages of each technique. Additionally, incorporating quality-of-life metrics and patient satisfaction scores in future studies would provide a more comprehensive evaluation of the true impact of these surgical approaches on patient-centered outcomes (33). By evaluating outcomes from multiple dimensions, future research could enable more individualized surgical planning and further refine laparoscopic cholecystectomy protocols.

These findings may be applicable to other healthcare systems, particularly in low-resource settings. However, further research is needed to confirm their generalizability across diverse patient populations and healthcare contexts.

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