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Original Research Article

COMPARATIVE STUDY OF STANDARD VERSUS LOW-PRESSURE PNEUMOPERITONEUM IN REDUCING POSTOPERATIVE COMPLICATIONS FOLLOWING LAPAROSCOPIC CHOLECYSTECTOMY

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Abstract: *Laparoscopic cholecystectomy is a widely used technique for managing gallstone disease, with pneumoperitoneum playing a critical role in procedural success and associated postoperative outcomes. However, conflicting evidence exists regarding the efficacy of standard versus low-pressure pneumoperitoneum in minimizing postoperative pain and nausea.* ***Objective:*** *To compare postoperative pain and nausea in patients undergoing laparoscopic cholecystectomy using standard pressure (12-15 mmHg) versus low-pressure (8-11 mmHg) pneumoperitoneum.* ***Methods:*** *A randomized controlled trial was conducted at the Department of Surgery, Benazir Bhutto Hospital, Rawalpindi. A total of 100 patients were randomly assigned to either the standard pressure (n=50) or low-pressure (n=50) pneumoperitoneum groups. Pain levels were measured using a Visual Analog Scale (VAS) at 0, 6, 12, and 24 hours post-surgery, while nausea frequency was assessed at corresponding intervals.* ***Results:*** *Patients in the low-pressure group experienced significantly reduced postoperative pain at 6, 12, and 24 hours ($p<0.05$) and lower rates of nausea at all time points assessed ($p<0.05$) compared to the standard pressure group.* ***Conclusion:*** *Low-pressure pneumoperitoneum significantly reduces postoperative pain and nausea, suggesting it may be preferable for patients undergoing laparoscopic cholecystectomy. Further research is needed to explore its long-term impact on recovery and potential complications.*

Keywords: Pneumoperitoneum, Laparoscopic Cholecystectomy, Postoperative Pain, Postoperative Nausea, Surgical Outcomes

Introduction

Laparoscopic cholecystectomy has become the gold standard for treating symptomatic gallstone disease due to its minimally invasive nature, shorter recovery periods, and reduced postoperative pain (1, 2). However, pneumoperitoneum—a crucial component in laparoscopic procedures used to create space for surgical access—can lead to complications, including shoulder pain, nausea, and, in some cases, more severe postoperative distress (3). Traditional laparoscopic cholecystectomy often utilizes a pneumoperitoneum pressure of 12-15 mmHg to maintain adequate visualization, yet recent studies suggest that lowering this pressure may reduce postoperative complications without compromising surgical efficacy (4).

The global prevalence of gallstone disease is rising, particularly in regions where obesity and related metabolic conditions are increasing (5). This growing burden underscores the need to optimize surgical techniques to improve patient outcomes and reduce postoperative discomfort. Studies indicate that low-pressure pneumoperitoneum may mitigate the adverse effects on hemodynamics and the peritoneal environment, which can contribute to postoperative pain and other complications (6). Furthermore, reducing intra-abdominal pressure during surgery has been associated with lower incidences of postoperative nausea and pain, facilitating faster recovery and higher patient satisfaction (7).

This study was designed to compare the effects of standard and low-pressure pneumoperitoneum on postoperative pain and nausea in patients undergoing laparoscopic cholecystectomy. By addressing this gap, the study aims to provide evidence that may inform surgical practices and enhance patient quality of care.

Methodology

This study is a randomized controlled trial conducted at the Department of Surgery, Benazir Bhutto Hospital, and Rawalpindi from February 2024 to August 2024. Ethical approval was obtained from the hospital's Ethics Committee, and written informed consent was collected from each participant.

A total of 100 patients scheduled for elective laparoscopic cholecystectomy for symptomatic cholelithiasis were recruited. Using a WHO calculator, the sample size was set at 90, adjusted to 100 to accommodate dropouts and ensure study power. Patients were randomly assigned to either the standard pressure (12-15 mmHg) or low-pressure (8-11 mmHg) pneumoperitoneum groups.

Participants included were aged 18 to 60 years, classified as ASA grade 1 or 2, and scheduled for elective laparoscopic cholecystectomy. Exclusions applied to those with diagnoses of mucocele gallbladder, empyema, acute cholecystitis, or choledocholithiasis, significant cardiac or pulmonary conditions, BMI outside 18.5–29.9, pregnancy or lactation, and chronic analgesic use.

Participants were assigned to groups by a lottery method. Standard pain management with intravenous paracetamol (1g TDS) was administered postoperatively. Pain levels were assessed at 0, 6, 12, and 24 hours using a Visual

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Analog Scale (VAS), and nausea frequency was recorded at corresponding intervals.

Data were analyzed using SPSS version 23. Continuous variables were presented as means ± standard deviations, and categorical variables as frequencies and percentages. Pain scores and nausea frequencies were compared between groups using the independent samples t-test and Chi-square test. A p-value ≤0.05 was considered statistically significant.

Results

A total of 100 patients participated in this study, with 50 assigned to each of the pneumoperitoneum pressure groups (standard and low-pressure). The demographic characteristics, including age, gender distribution, ASA classification, and body mass index (BMI), are summarized in Table 1. The mean age of participants was 41.3 ± 15.1 years, with the majority (86%) being female. The distribution of ASA grades was fairly balanced, with 58% classified as ASA grade 1 and 42% as ASA grade 2. The mean BMI was 24.3 ± 3.0 kg/m² across both groups.

Pain scores measured at 0, 6, 12, and 24 hours postoperatively using the Visual Analog Scale (VAS) are presented in Table 2. Initial pain scores (0 hours) showed no significant difference between the groups (p=0.084). However, significant differences emerged at 6, 12, and 24 hours postoperatively, with the low-pressure group reporting lower pain scores compared to the standard pressure group. At 6 hours, the standard pressure group had a mean pain score of 8.48 ± 2.16, while the low-pressure group reported a mean score of 5.76 ± 1.44 (p<0.001). (Table 2).

Table 3 presents the incidence of nausea at various time intervals postoperatively. Nausea frequency was significantly lower in the low-pressure group compared to the standard pressure group at all time points. At 6 hours postoperatively, nausea was observed in 36% of patients in the standard pressure group versus only 10% in the low-pressure group (p<0.001). This trend continued through the 24-hour mark, highlighting the advantages of low-pressure pneumoperitoneum in reducing nausea.

Table 1: Baseline Demographic and Clinical Characteristics of Patients

Variable	Standard Pressure Group (n=50)	Low Pressure Group (n=50)	Total (n=100)
Mean Age (years)	42.2 ± 14.9	40.4 ± 15.3	41.3 ± 15.1
Gender			
- Male	7 (14%)	7 (14%)	14 (14%)
- Female	43 (86%)	43 (86%)	86 (86%)
ASA Grade			
- ASA 1	30 (60%)	28 (56%)	58 (58%)
- ASA 2	20 (40%)	22 (44%)	42 (42%)
Mean BMI (kg/m²)	24.5 ± 3.1	24.1 ± 2.9	24.3 ± 3.0

Table 2: Postoperative Pain Scores at Different Time Intervals

Time Post-Op	Standard Pressure Group (Mean ± SD)	Low Pressure Group (Mean ± SD)	p-value
0 hours	5.24 ± 1.06	4.88 ± 1.00	0.084
6 hours	8.48 ± 2.16	5.76 ± 1.44	<0.001
12 hours	7.84 ± 1.80	4.16 ± 1.60	<0.001
24 hours	6.24 ± 2.01	3.08 ± 1.46	<0.001

Table 3: Frequency of Postoperative Nausea in Both Groups

Time Post-Op	Standard Pressure Group (%)	Low Pressure Group (%)	p-value
0 hours	26%	16%	0.043
6 hours	36%	10%	<0.001
12 hours	30%	6%	<0.001
24 hours	18%	4%	0.001

Discussion

This study demonstrates that low-pressure pneumoperitoneum (8-11 mmHg) in laparoscopic cholecystectomy significantly reduces postoperative pain and nausea compared to standard pressure (12-15 mmHg). Our findings are consistent with recent studies that highlight the advantages of low-pressure pneumoperitoneum in minimizing postoperative discomfort and improving patient outcomes.

Postoperative pain, especially in the early hours following surgery, is a major concern in laparoscopic procedures,

Often linked to the pressure exerted by pneumoperitoneum on intra-abdominal structures. In this study, patients subjected to low-pressure pneumoperitoneum reported

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significantly lower pain scores at 6, 12, and 24 hours postoperatively. These findings support those of (8). Who found that reducing pneumoperitoneum pressure decreases visceral and shoulder pain without compromising operative visibility or increasing complications. Similarly, Rosenberg and (9). Suggest that lower intra-abdominal pressure limits inflammatory responses, which correlates with the decreased pain observed in our low-pressure group.

The incidence of nausea, a common postoperative symptom exacerbated by pneumoperitoneum, was also significantly lower in the low-pressure group. This is consistent with (10). Who found that low-pressure pneumoperitoneum is associated with a lower incidence of nausea and vomiting, likely due to reduced mechanical and chemical irritation of the peritoneum. Nausea reduction can improve patient comfort, reduce the need for antiemetic medications, and facilitate faster recovery and discharge, which can also alleviate hospital burden. From a physiological standpoint, lower pneumoperitoneum pressure is associated with fewer hemodynamic changes, which may further reduce the discomfort experienced by patients postoperatively. (11). observed that high-pressure pneumoperitoneum significantly influences hemodynamic stability, leading to increased risks for patients with comorbid conditions. Our study population, although generally healthy, still showed a clear benefit in terms of reduced complications at lower pressures, supporting the potential safety benefits of low-pressure settings for broader patient demographics.

Several limitations to our study should be acknowledged. Firstly, our analysis did not include long-term follow-up data, which limits the ability to assess whether low-pressure pneumoperitoneum has lasting impacts on recovery beyond the immediate postoperative period. This limitation is noted in the work of (12). Who advocate for multi-center trials to assess both short-term and long-term outcomes associated with different pneumoperitoneum pressures. Additionally, our study focused on uncomplicated cholelithiasis, excluding patients with more complex biliary pathologies, such as acute cholecystitis or choledocholithiasis, which may exhibit different responses to pressure settings. Further research should consider a broader range of cases to establish comprehensive guidelines for pneumoperitoneum pressures (14).

This study aligns with recent trends toward "patient-centered surgery," which prioritize minimizing invasive measures and reducing postoperative complications. As (13). highlighted, the benefits of low-pressure pneumoperitoneum in terms of patient comfort and reduced analgesic requirements make it a valuable option for laparoscopic procedures, particularly in resource-limited settings where reducing hospital stay and readmission rates is critical. Future studies should further explore the balance between surgical efficacy and patient comfort, especially with the advent of enhanced recovery protocols that emphasize minimally invasive strategies.

Conclusion

In conclusion, low-pressure pneumoperitoneum in laparoscopic cholecystectomy offers a safe and effective approach to reducing postoperative pain and nausea. These findings suggest that surgical protocols could benefit from considering lower pressure settings, particularly in patients with lower risk profiles or in cases where postoperative comfort is a priority. Further research, especially randomized controlled trials with diverse patient populations and extended follow-up periods, will be essential to establish low-pressure pneumoperitoneum as a standard practice in laparoscopic surgery.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-BSHR-29/23

Consent for publication

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Conflict of interest

The authors declared absence of conflict of interest.

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References

1. Galetin, T., & Galetin, A. (2022). Impact of pneumoperitoneum pressure on patient outcomes in laparoscopic surgery: A review. Surgical Endoscopy, 36(5), 1348-1362.
2. Rosenberg, J., & Fuchs-Buder, T. (2023). Low-pressure pneumoperitoneum—why and how. Laparoscopic Surgery, 7(1), 9-16.
3. Singh, P., Gupta, S.K., & Kumar, M. (2021). Patient-centered benefits of low-pressure pneumoperitoneum in laparoscopic surgery. International Surgery Journal, 8(3), 223-229.
4. Sta Clara, E.L., et al. (2022). Access, pneumoperitoneum, and complications in laparoscopic surgery. Journal of Minimal Access Surgery, 18(1), 102-110.

[Citation Ismail, T., Farooqi, H.A., Khan, A.D., Iqbal, M., Hassan, R., Ahmed, A. (2024 Comparative study of standard versus low-pressure pneumoperitoneum in reducing postoperative complications following laparoscopic cholecystectomy. *Biol. Clin. Sci. Res. J.*, **2024***: 1251*. doi: https://doi.org/10.54112/bcsrj.v2024i1.1251]

5. Di Ciaula, A., & Portincasa, P. (2021). Advances in understanding and managing cholesterol gallstones. F1000Research, 10(2), 789-798.
6. Mandal, A., et al. (2022). Comparative study of low-pressure vs. standard-pressure pneumoperitoneum in laparoscopic cholecystectomy. Indian Journal of Surgery, 84(2), 172-179.
7. Tanaja, J., Lopez, R.A., & Meer, J.M. (2023). Low-pressure pneumoperitoneum in laparoscopic procedures: Patient outcomes and safety. Clinical Surgery, 11(5), 201-209.
8. Galetin, T., & Galetin, A. (2021). Influence of gas type, pressure, and temperature in laparoscopy—a systematic review. Annals of Laparoscopic and Endoscopic Surgery, 7, 35-42.
9. Galetin, T., & Galetin, A. (2022). Impact of pneumoperitoneum pressure on patient outcomes in laparoscopic surgery: A review. Surgical Endoscopy, 36(5), 1348-1362.
10. Rosenberg, J., & Fuchs-Buder, T. (2023). Low-pressure pneumoperitoneum—why and how. Laparoscopic Surgery, 7(1), 9-16.
11. Mandal, A., et al. (2022). Comparative study of low-pressure vs. standard-pressure pneumoperitoneum in laparoscopic cholecystectomy. Indian Journal of Surgery, 84(2), 172-179.
12. Sta Clara, E.L., et al. (2022). Access, pneumoperitoneum, and complications in laparoscopic surgery. Journal of Minimal Access Surgery, 18(1), 102-110.
13. Singh, P., Gupta, S.K., & Kumar, M. (2021). Patient-centered benefits of low-pressure pneumoperitoneum in laparoscopic surgery. International Surgery Journal, 8(3), 223-229.
14. Jones, M.W., & Guay, E. (2022). Minimizing complications in laparoscopic cholecystectomy: Current best practices. Journal of Gastrointestinal Surgery, 18(11), 2128-2136.

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