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EFFECT OF LOW-PRESSURE PNEUMOPERITONEUM VERSUS STANDARD PRESSURE PNEUMOPERITONEUM IN LAPAROSCOPIC CHOLECYSTECTOMY ON POST-OPERATIVE PAIN

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Abstract

Objective: *To compare postoperative pain scores after laparoscopic cholecystectomy under low pressure versus standard pressure pneumoperitoneum.*

Study Design: *Quasi-Experimental Trial*

Place and duration: *Surgery Department Tertiary care Hospital, Kharian February 2024-July 2024.*

Methods: *Patients from either gender, aged 18-50 years, who had ASA grade I or II and were diagnosed with symptomatic cholelithiasis were included. After employing a non-probability consecutive sampling technique, 102 patients were recruited. Group A included 51 patients subject to low pressure pneumoperitoneum while 51 patients from Group B were subject to standard pressure pneumoperitoneum. The primary outcome was a pain score on the visual analogue scale while secondary outcomes included post-operative complications and duration of hospital stay.*

Results: *Gender distribution revealed a female predominance with a frequency of 80 (78.43%) as compared to 22(21.57%) males. Median age and BMI between the two groups were comparable. Pain assessment on a VAS at 02 hours, 06 hours, and 12 hours revealed significantly lesser pain scores in Group A as compared to Group B. Frequency of postoperative complications in Group A was 5 (9.8%) as compared to 17 (33.3%) in Group B (p-0.004). Rescue analgesia was administered more frequently in Group B as compared to Group A. Median length of Hospital stay in Group A was 38 (36-39) as compared to 41 (40-42) in Group B (p-0.000).*

Conclusion: *Laparoscopic cholecystectomy under low-pressure pneumoperitoneum offers superior analgesia post-operatively with significantly lesser complications post-operatively, decreased requirement of rescue analgesia and significantly reduced the length of hospital stay.*

INTRODUCTION

Cholelithiasis is a common biliary pathology that is characterized by the presence of stones in the gall bladder. The annual incidence of gallstones is around 0.75% with a higher female predisposition as compared to males which warrants prompt attention and effective treatment to reduce morbidity and mortality.[1]

Cholelithiasis manifests pain, nausea, and vomiting and the treatment is either a medical or a surgical intervention. Medical treatment includes bed rest, analgesics, antibiotics, and hydration while the surgical intervention includes open or laparoscopic cholecystectomy.[2] Advances in the field of medical science have led to better surgical approaches which may offer better analgesia, early recovery and reduction in the duration of hospital stay therefore in the present era laparoscopic techniques have gained popularity over the open technique for better patient outcomes in the postoperative period.[3]

Analgesia is one of the most crucial components of post-operative recovery and inadequate analgesia may lead to a surge in catecholamines leading to a wide range of multisystemic effects. Pneumoperitoneum pressure employed during laparoscopic cholecystectomy leads to an increase in abdominal pressure affecting the cardiovascular, and respiratory physiology and contributing to pain in the post-operative period.[4] Higher pressures may lead to better visibility of the abdominal contents intraoperatively but result in higher pain scores in the postoperative period. Similarly, low-pressure pneumoperitoneum may lead to lower pain scores post-operatively but limits the visibility of the surgeon.[5]

Several studies have been conducted to compare the laparoscopic technique with open cholecystectomy. However, the scarcity of studies comparing the pneumoperitoneum pressure in laparoscopic cholecystectomies addresses the existing gaps in research. This research aims to compare the effect of low-pressure pneumoperitoneum versus standard-pressure pneumoperitoneum in laparoscopic cholecystectomy on post-operative pain. The research will pave the way to further investigate the applications of low-pressure pneumoperitoneum in different laparoscopic procedures ensuring better patient outcomes.

Methodology:

This Quasi-experimental study was done at Tertiary care Hospital Kharian during a period of 06 months from Feb 2024 to Jul 2024. The ethical review board of the hospital approved the research work under ERC no A/24/23.

A previous trial revealed that patients who underwent laparoscopic cholecystectomy under low-pressure pneumoperitoneum had a mean pain score of 0.09 ± 0.52 on the numerical pain rating scale as compared to 0.91 ± 1.91 in patients who underwent laparoscopic cholecystectomy under standard pressure pneumoperitoneum.[6] Employing a power of 90% with a 5% level of significance a sample size of n=46 was calculated using a WHO sample size calculator. Using a non-probability consecutive sampling technique assuming a 10% drop rate of the participants, a total of 102 patients were included in the trial. The participants were divided equally into Group A (n=51) which were subject to low-pressure pneumoperitoneum while Group B underwent laparoscopic cholecystectomy under standard pressure pneumoperitoneum.

Inclusion criteria: 18-50 years old patients of either gender diagnosed with uncomplicated cholelithiasis having American Society of Anesthesiologists grade I or grade II were included in the trial.

Exclusion criteria: Patients diagnosed with malignancies, history of stent placement, cardiovascular, respiratory, renal disorders, history of chronic use of analgesics, ASA III or ASA IV status or were excluded from the trial.

All patients who were admitted to the surgical department with a diagnosis of symptomatic cholelithiasis planned for laparoscopic cholecystectomy underwent a pre-anesthesia evaluation. After a detailed history, examination, and overview of the laboratory investigations, written informed consent was obtained and

patients were prepared for the surgical procedure. As per the surgical protocol, patients were kept nil per oral for 08 hours before surgery and shifted to the operation theatre on the day of surgery. Intravenous ceftriaxone 2g was given to each patient 30 minutes before the surgical procedure. Demographic characteristics and baseline hemodynamic readings of the participants were recorded on a Performa. All patients were reevaluated in the operation theatre by the attending anesthesiologist and general anesthesia was administered for the surgical procedure. Intravenous nalbuphine @ 0.1 mg/kg was administered as standard analgesia to all the patients. Noninvasive intraoperative monitoring was continuously done throughout the procedure. Under aseptic measures after incision of the skin, ports were inserted, and pneumoperitoneum was established using 8-10mm hg pressure in patients from Group A while 12-14mm hg pressure was kept in participants from Group B. At any point intraoperatively if visibility was difficult the pressure was changed, and the patients were excluded from the study. At the end of the surgical procedure, patients were extubated and shifted to recovery and analgesia with paracetamol 1g intravenously 08 hourly was prescribed to all patients. Postoperatively pain assessment was done using a visual analog scale (VAS) at intervals of 30 mins, 2 hours, 06 hours and 12 hours and a VAS of >4 was addressed by administration of intravenous tramadol @ 1mg/kg body weight if the planned paracetamol administration was later than 30 mins at any time interval. Complications of nausea and vomiting for 24 hours and hospital stay in hours were also recorded.

Data analysis was done using SPSS version 23. Frequencies and percentages were calculated for qualitative variables while the median (IQR) was calculated for quantitative variables. For analysis of significance between the groups chi-square test was used for qualitative variables and the Mann-Whitney U test was used for scale variables following a non-normal distribution. A p-value of ≤0.05 was considered as significant.

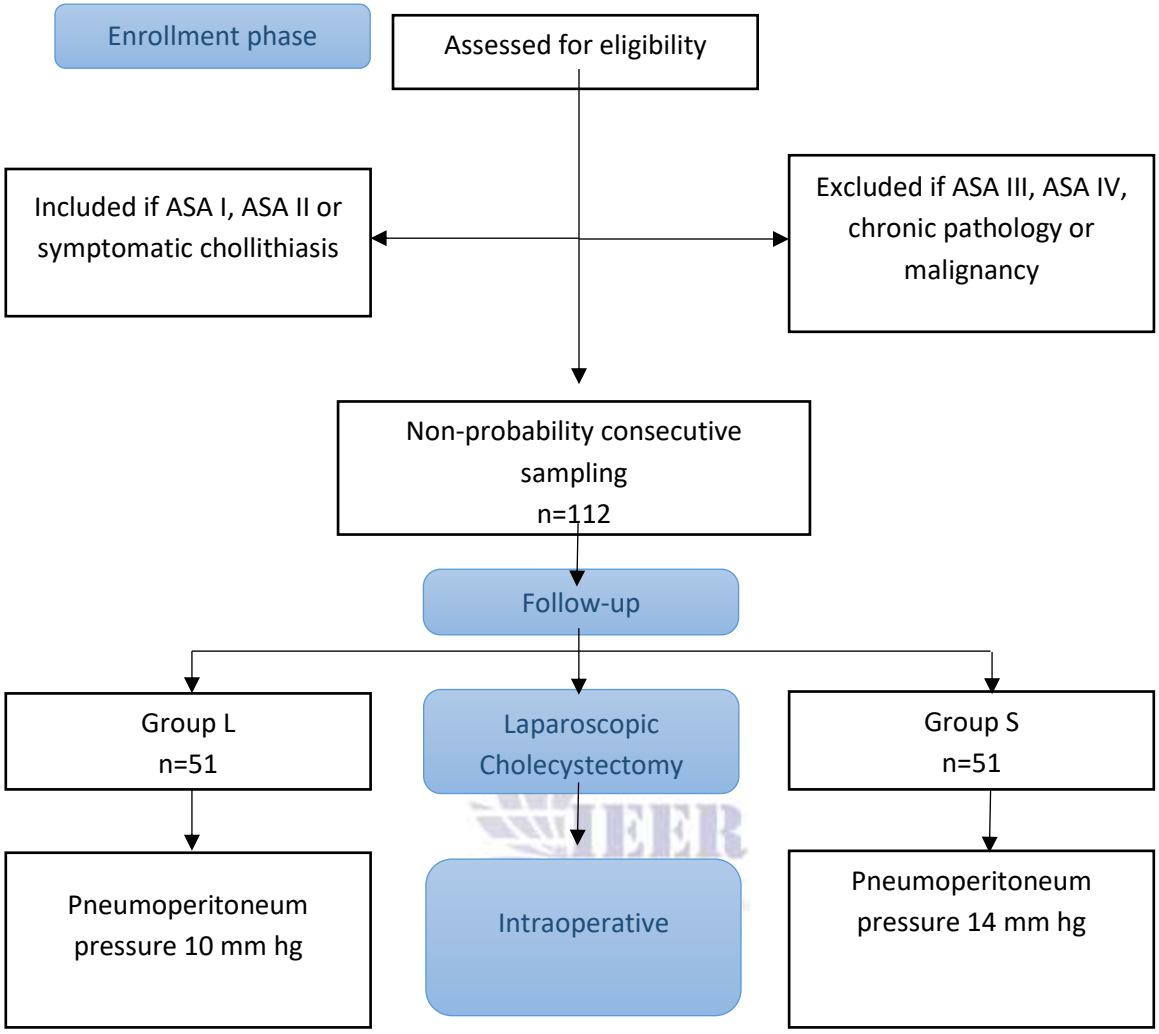

Figure-1

Results:

We recruited 102 patients in the trial with 22(21.57%) males and 80 (78.43%) females. The median age in years of the participants from Group A was 33 (26-39) as compared to 35(28-41) years in Group B. Recorded BMI in Group A vs Group B was 25 (23-26) vs 24 (23-25). Demographic characteristics of patients are shown in Table I. Pain score on a VAS scale was significantly lesser in Group A at 02 hours and 06 hours as compared to Group B. At an interval of 12 hours, the VAS score in Group A was 4 (4-5) as compared to 5 (5-6) in Group B (p-0.000). A comparison of postoperative pain scores between groups is shown in Table II. The frequency of complications recorded in Group A was significantly lower in Group A 5 (9.8%) as compared to 17 (33.3%) in Group B. Patients from Group B required rescue analgesia more frequently as observed in 15 (29.4%) compared to 5 (9.8%) in Group A (p-0.013). The median duration of hospital stay recorded in hours was 41 (40-42) hours in Group B as compared to 38 (36-39) in Group A with a p-value of 0.000. Post-operative outcomes between groups are shown in Table III.

Table–I: Demographic characteristics between groups (n=102)

Variables		Group A (n = 51)	Group B (n = 51)	p-value
Gender n (%)	Male	12 (23.5%)	10 (19.6%)	0.630
	Female	39 (76.5%)	41 (80.4%)	
Age in years Median (IQR)		33 (26-39)	35(28-41)	0.214
BMI in kg/m^2 Median (IQR)		25 (23-26)	24 (23-25)	0.455

Table–II: Comparison of postoperative pain scores between groups (n=102)

Variables	Group A (n = 51)	Group B (n = 51)	p-value
VAS at 30 mins Median (IQR)	2 (2-2)	2 (2-2)	0.844
VAS at 02 hours Median (IQR)	3 (3-4)	4 (3-4)	0.010
VAS at 06 hours Median (IQR)	4 (4-5)	5 (4-5)	0.15
VAS at 12 hours Median (IQR)	4 (4-5)	5 (5-6)	0.000

Table–III: Post-operative outcome between groups (n=102)

Variables		Group A (n = 51)	Group B (n = 51)	p-value
Nausea or vomiting n (%)	Yes	5 (9.8%)	17 (33.3%)	0.004
	No	46 (90.2%)	34 (66.7%)	
Rescue Analgesia	Yes	5 (9.8%)	15 (29.4%)	0.013
	No	46 (90.2%)	36 (70.6%)	
Length of hospital stay in hours Median (IQR)		38 (36-39)	41 (40-42)	0.000

Discussion:

The quasi-experimental trial was conducted to observe the effects of low-pressure versus standard-pressure pneumoperitoneum employed during laparoscopic cholecystectomy. Our results revealed symptomatic cholelithiasis was more common in females with a female-to-male ratio of 1: 0.275. Similarly, another study revealed that cholelithiasis was more predominant in females as compared to males with an odds ratio of 1.4 (C.I 95%, 1.1-1.7).[7] In another research the incidence of cholelithiasis among women was as high as 20% among the population of Poland and approximately 45000 cholecystectomies were required to address such high incidence of cholelithiasis.[8] We observed that the median age of the patients recruited in our study was 34 (27-40) years in the Pakistani population and a similar study conducted at Rawalpindi revealed

that patients with cholelithiasis were from the age group of 30-40 years.[9] Similarly another prospective trial conducted by Sajjan SC et al revealed that the most common age group with cholelithiasis was 31-40 years having a frequency of 49(26.5%) followed by 41-50 years age group having a frequency of 44 (22.2%).[10] Increased amounts of adipose tissue may predispose to the formation of gallstones.[11] Median BMI (kg/m^2) recorded in our patients was 24 (23-26) however several trials revealed that higher BMI is one of the risk factors leading to increased chances of cholelithiasis.[12,13]

Post-operative pain assessment on a VAS revealed that when low-pressure pneumoperitoneum was used in laparoscopic cholecystectomy median pain scores at 02 hours was 3 (3-4) as compared to 4 (3-4) in patients with standard pressure pneumoperitoneum (p-0.010). Similarly, pain scores recorded on VAS at 06 hours and 12 hours were significantly lower in Group A as compared to Group B. Similar to the effects of low-pressure pneumoperitoneum on postoperative pain another study revealed that better and more significant pain control was achieved when a low level of pressure was employed in patients undergoing laparoscopic cholecystectomy.[14] In our study we could not measure the level of satisfaction in terms of difficulty or visibility of the surgical field however previous studies reveal that low pressure might obscure the visual field of surgery and may increase the level of difficulty in operating.[15] Similarly another meta-analysis conducted to compare low-pressure versus standard-pressure pneumoperitoneum concluded that post-operative pain on VAS was significantly reduced up to 48 hours after surgery with low-pressure pneumoperitoneum as compared to standard-pressure pneumoperitoneum. Similarly, the same study revealed that multiple trials favor low-pressure pneumoperitoneum in terms of reducing the length of hospital stay.[16] We observed that in the post-operative period frequency of complications was observed in 5 (9.8%) patients from Group A as compared to 17 (33.3%) patients from Group B with a p-value of 0.004. Similarly, another locoregional trial concluded that low-pressure pneumoperitoneum is a superior and favorable alternative in terms of postoperative pain and complications as compared to standard pressure pneumoperitoneum in patients undergoing laparoscopic cholecystectomy.[17] In our study we kept low pressure pneumoperitoneum at a level of 8-10mmhg and a standard pressure at 12 -14 mm hg however there is no standardized pressure level that explains the low-pressure pneumoperitoneum. However, a similar study conducted by et al revealed that when the pressures were kept similar to those as in our study, post-operative outcomes in terms of pain and hospital stay were significantly better with low pressure as compared to high-pressure pneumoperitoneum during laparoscopic cholecystectomy.

Our study concludes that better pain control and early hospital discharge may be possible when the low-pressure pneumoperitoneum technique is employed as compared to high-pressure pneumoperitoneum in patients undergoing laparoscopic cholecystectomy.

Conclusion:

Laparoscopic cholecystectomy under low pressure pneumoperitoneum offers superior analgesia post-operatively with significantly lesser complications post-operatively, decreased requirement of rescue analgesia and significantly reduced the length of hospital stay.

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Limitations of the Study: We could not record the effect on the return of bowel activity postoperatively. Pain assessment was done up to 12 hours which could have been extended. The level of surgical difficulty in low-pressure and standard-pressure pneumoperitoneum might have been more informative.

Conflict of Interest: None

References

1. Kratzer W, Klysik M, Binzberger A, Schmidberger J, EMIL-Study group. Gallbladder stone incidence and prevalence in Germany: A population-based study. Zeitschrift für Gastroenterologie. 2021 Aug;59(08):859-64. https://doi.org/10.1055/a-1401-2170
2. Mannam R, Narayanan RS, Bansal A, Yanamaladoddi VR, Sarvepalli SS, Vemula SL et al. Laparoscopic cholecystectomy versus open cholecystectomy in acute cholecystitis: a literature review. Cureus. 2023 Sep;15(9). https://doi.org/10.7759/cureus.45704
3. Chattopadhyay K, Das R. Laparoscopic and open cholecystectomy: a comparative study. International J Surg Sci. 2020;4(1):427-30. https://doi.org/10.33545/surgery.2020.v4.i1h.375
4. Saway JP, McCaul M, Mulekar MS, McMahon DP, Richards WO. Review of outcomes of low versus standard pressure pneumoperitoneum in laparoscopic surgery. The American Surgeon. 2022 Aug;88(8):1832-7. https://doi.org/10.1177/00031348221084956
5. Umano GR, Delehaye G, Noviello C, Papparella A. The "dark side" of pneumoperitoneum and laparoscopy. Minimally Invasive Surgery. 2021;2021(1):5564745. https://doi.org/10.1155/2021/5564745
6. Mandal A, Ghosh A, Bakshi S. Low pressure versus standard pressure pneumoperitoneum in laparoscopic cholecystectomy: a comparative study. International Surgery Journal. 2020 Apr 23;7(5):1551-61. https://doi.org/10.18203/2349-2902.isj20201868
7. Baddam A, Akuma O, Raj R, Akuma CM, Augustine SW, Hanafi IS, et al. Analysis of Risk Factors for Cholelithiasis: A Single-Center Retrospective Study. Cureus. 2023 Sep;15(9). https://doi.org/10.7759/cureus.46155
8. Lazarchuk I, Barzak B, Wozniak S, Mielczarek A, Lazarchuk V. Cholelithiasis–a particular threat to women. A review of risk factors. Medical Journal of Cell Biology. 2023;11(1):20-7. https://doi.org/10.33545/surgery.2020.v4.i4a.529
9. Ashraf S, Khan MS, Wattoo NM, Rashid AR, Zia SA. Gender-Based Differences in the Outcome of Laparoscopic Cholecystectomy in Patients with Gall Stones. Pakistan Armed Forces Medical Journal. 2024 Aug 31;74(4):961. https://doi.org/10.51253/pafmj.v74i4.9627
10. Sajjan SC, Javali S, Madhusudhan BV, Ramya B. Clinical profile of patients with cholelithiasis at a tertiary care hospital. International Journal of Surgery Science. 2021;5(2):244-6. https://doi.org/10.33545/surgery.2021.v5.i2e.697
11. Hendarto H, Akbar FN, Muzakki JB, Amri RA, Nugraha SN, Adlani H. Obesity, dyslipidemia, and diabetes mellitus as risk factors in cholelithiasis. Electronic Journal of General Medicine. 2023 Nov 1;20(6). https://doi.org/10.29333/ejgm/13814
12. Bansal D, Rattan A, Bhangu GS, Singh R. Cholelithiasis and its relation to body mass index and waist to hip ratio: an observational study. International Surgery Journal. 2021;8(1):150-4. https://doi.org/10.18203/2349-2902.isj20205818
13. Baddam A, Akuma O, Raj R, Akuma CM, Augustine SW, Hanafi IS, et al. Analysis of Risk Factors for Cholelithiasis: A Single-Center Retrospective Study. Cureus. 2023 Sep;15(9). https://doi.org/10.7759/cureus.46155

14. Morey T, Phalgune D, Shah S. A Randomized Trial of Low-Pressure (08–10 mm Hg) vs. Standard-Pressure (13–15 mm Hg) Pneumoperitoneum in Laparoscopic Cholecystectomy. Indian Journal of Surgery. 2022 Feb;84(1):117-23. https://doi.org/10.1007/s12262-021-02846-7
15. Neogi P, Kumar P, Kumar S. Low-pressure pneumoperitoneum in laparoscopic cholecystectomy: A randomized controlled trial. Surgical Laparoscopy Endoscopy & Percutaneous Techniques. 2020 Feb 1;30(1):30-4. https://doi.org/10.1097/SLE.0000000000000719
16. Ortenzi M, Montori G, Sartori A, Balla A, Botteri E, Piatto G et al. Low-pressure versus standard-pressure pneumoperitoneum in laparoscopic cholecystectomy: a systematic review and meta-analysis of randomized controlled trials. Surgical Endoscopy. 2022 Oct;36(10):7092-113. https://doi.org/10.1007/s00464-022-09201-1
17. Ali I, Naz G, Sayyed S, Rasheed Z, Rizwan M, Hameed F, et al. Low-Pressure Laparoscopic Surgery is a Viable and Risk-Free Alternative to Standard Pressure for the Treatment of Benign Gall Stone. Pakistan Journal of Medical & Health Sciences. 2023 Apr 21;17(03):301. https://doi.org/10.53350/pjmhs2023173301
18. Wali S, Shah SD, Khan MA, Tareen N, Siddiqa A. SHORT TERM OUTCOMES IN PATIENTS UNDERGOING NORMAL PRESSURE PNEUMOPERITONEUM IN PATIENTS OF LAPROSCOPIC CHOLECYSTECTOMY VERSUS CHOLELITHIASIS USING LOW PRESSURE PNEUMOPERITONEUM: A COMPARISON STUDY. https://doi.org/10. 20959/wjpr202212-25122