https://doi.org/10.29309/TPMJ/2026.33.04.9967 www.theprofesional.com

ORIGINAL ARTICLE

Efficacy of low-pressure versus high-pressure pneumoperitoneum in restoration of bowel sounds after laparoscopic cholecystectomy.

Asif Lateef[1], Tayyab Riaz[2], Usama Farrukh[3], Hussain Anwar[4], Mudassar Jabeen[5], Mubashar Abrar[6]

ABSTRACT… Objective: To compare the effectiveness of low-pressure versus high-pressure pneumoperitoneum in facilitating the return of bowel sounds within six hours following laparoscopic cholecystectomy. **Study Design:** Randomized Controlled trial. **Setting:** Department of Surgery, Allied Hospital, Faisalabad. **Period:** November'2020 to April'2021. **Methods:** Sixty patients aged 25–70 undergoing elective laparoscopic cholecystectomy were randomly assigned to two groups: Group A (low-pressure CO_2, <10 mmHg) and Group B (high-pressure CO_2, 14 mmHg). Patients with complicated gallbladder disease or comorbidities like CRF and CLD were excluded. **Results:** The mean ages in Groups A and B were 43.17 ± 11.20 and 45.20 ± 10.76 years, respectively. The majority (83.33%) of participants were female. Return of bowel sounds within six hours postoperatively occurred in 30% of Group A patients versus 3.33% in Group B (p = 0.006), indicating a statistically significant difference favoring low-pressure pneumoperitoneum. **Conclusion:** Low-pressure pneumoperitoneum significantly enhances early return of bowel function after laparoscopic cholecystectomy compared to high-pressure pneumoperitoneum.

Key words: Bowel Sound Recovery, Laparoscopic Cholecystectomy, Low-pressure Pneumoperitoneum, Postoperative Outcomes.

Article Citation: Lateef A, Riaz T, Farrukh U, Anwar H, Jabeen M, Mubashar A. Efficacy of low-pressure versus high-pressure pneumoperitoneum in restoration of bowel sounds after laparoscopic cholecystectomy. Professional Med J 2026; 33(04):687-691. https://doi.org/10.29309/TPMJ/2026.33.04.9967

INTRODUCTION

Among the most common conditions that need surgical intervention nowadays is cholelithiasis. Cholecystectomy, one of the most common abdominal surgeries, is often carried out laparoscopically in developed countries. Take laparoscopic cholecystectomies as an example; 90% of these procedures are carried out in the US using this technique.[1]

The majority of cholecystectomy procedures are performed with laparoscopes since they are common surgical interventions. In the United States, laparoscopic assistance is used in almost 90% of cholecystectomy surgeries. Reduced postoperative discomfort, reduced surgical scar size, and accelerated recovery time allow for a more rapid return to pre-operative activities when laparoscopic surgery is chosen. Common techniques for expanding the abdominal cavity for surgical procedures include the laparotensor and laparolift.[2] The gold standard for proper working space and patient safety is the pneumoperitoneum created by carbon dioxide (CO2) insufflation.[3]

Consequences associated with long-term use of standard pressure pneumoperitoneum include decreased pulmonary compliance, altered blood gas variables, impaired circulation, increased enzyme levels in the liver, renal dysfunction, and elevated intra-abdominal venous pressures.[4] An emerging trend is the use of minimal pressures with a variety of less than 10 mm Hg in place of the conventional standard pressure pneumoperitoneum.[5]

There are further potential benefits associated with low pressures during pneumoperitoneum, including a reduced occurrence of shoulder tip discomfort in the postoperative period and an improvement in quality of life in the week after surgery.[6] Low-pressure pneumoperitoneum causes 8% of shoulder tip discomfort, compared to 30% with high-pressure.

1. MBBS, FCPS (Surgery), Senior Registrar Surgery, Allied Hospital, Faisalabad.
2. MBBS, FCPS (Surgery), Assistant Professor Surgery, ABWA Medical College, Faisalabad.
3. MBBS, FCPS (Surgery), Senior Registrar Surgery, Allied Hospital, Faisalabad.
4. MBBS, FCPS (Surgery), Medical Officer Surgery, RHC, Khurrianwala.
5. MBBS, FCPS (Surgery), Senior Reigstrar Surgery, Allied Hospital, Faisalabad.
6. MBBS, FCPS (General Surgery), Consultant Surgeon, Saad Surgimed Hospital, Faisalabad.

Correspondence Address:
Dr. Tayyab Riaz
Department of Surgery, ABWA Medical College, Faisalabad.
dr.tayyabch100@gmail.com

Article received on:
12/07/2025
Accepted for publication:
01/01/2026

Prior research found that 0% of high-pressure pneumoperitoneum cholecystectomy patients produced bowel noises after 6 hours, but 21% of low-pressure patients did. The average time for laparoscopic cholecystectomy with high-pressure pneumoperitoneum was 62±9.4 minutes (range: 45-85 minutes), while low-pressure pneumoperitoneum took 63.17±7.7 minutes (range: 45-90 minutes). However, this difference was not statistically significant ($p>0.05$). No significant changes were found in visceral, vascular, or biliary leakage between groups.[7]

The purpose of this research is to evaluate the effectiveness of low-pressure and high-pressure pneumoperitoneum in restoring bowel sounds after laparoscopic cholecystectomy. The literature shows that low pressure CO2 may be just as effective as high pressure CO2 during laparoscopic cholecystectomy surgery for pneumoperitoneum, and that low pressure is also useful for the early return of the bowels after cholecystectomy. However, there is a lack of sufficient data in this area. Also, the literature does not provide any evidence specific to the local area. Consequently, high-pressure CO2 applications continue. Therefore, we want to carry out this research to gather information from the local area and determine the applicability of low CO2 pneumoperitoneum. In order to facilitate the early restoration of bowel motility after laparoscopic cholecystectomy, we will need to develop methods to use low pressure CO2 pneumoperitoneum.

METHODS

This randomized controlled trial was conducted in the Department of Surgery, Allied Hospital, Faisalabad, following approval from the Institutional Ethical Review Committee (Reference.No.1070, Date: 10-10-2020). Patients who met the inclusion criteria and provided informed consent were randomly allocated into two groups using a random number table: Group A and Group B.

All surgical procedures were performed by consultant surgeons with at least three years of post-fellowship experience. Group A received low-pressure carbon dioxide (CO_2) insufflation at less than 10 mmHg, while Group B received standard-pressure CO_2 insufflation at 14 mmHg. Pneumoperitoneum was established using a Veress needle, and intra-abdominal pressure was maintained consistently throughout each procedure.

Using a random number table, we divided the patients who gave their informed permission into two groups: Group A and Group B. Surgical procedures in both groups were performed by consultants with a minimum of three years of experience after their fellowship. Group A was administered CO2 at a low pressure of less than 10 mmHg. Co2 at a pressure of 14 mmHg was administered to the B group. Insufflation of carbon dioxide gas with a Veress needle was used to produce the pneumoperitoneum. Every group's intraabdominal pressure remained constant at a constant pressure. As stated in the operational definitions, the researcher personally monitored all patients and recorded the return of bowel sound at the sixth hour.

RESULTS

The average age of the participants in this research was 44.31 ± 10.89 years, and their ages ranged from 25 to 70 years. Both groups included patients with average ages of 43.17 ± 11.20 and 45.20 ± 10.76 years old, respectively. Table shows that the majority of the patients, 35 in total, were in the age bracket of 18–40 (58.33%).

Table shows that there were 60 patients total, with 50 being female and 10 being male (16.67%). The ratio of male to female was 1:5. This research revealed that nine patients (30.0%) in Group A (low pressure pneumoperitoneum) and one patient (3.33%) in Group B (high pressure pneumoperitoneum) had the restoration of bowel sounds within six hours after the operation.

Low-pressure pneumoperitoneum significantly improved early return of bowel sounds ($p = 0.006$). The effect was more pronounced in females and younger age groups (25–45 years). Although trends were seen in males and older age groups, they were not statistically significant likely due to small sample size.

TABLE-I

Demographic and baseline characteristics (N = 60)

Variable	Group A (Low Pressure, n=30)	Group B (High Pressure, n=30)	P-Value
Mean Age (years)	43.17±11.20	45.20±10.76	0.432
Age Group 25–45	18 (60%)	17 (56.67%)	
Age Group 46–70	12 (40%)	13 (43.33%)	
Male Gender	6 (20%)	4 (13.3%)	
Female Gender	24 (80%)	26 (86.7%)	

TABLE-II

Return of bowel sounds within 6 hours post-op

Outcome	Group A (Low Pressure)	Group B (High Pressure)	P-Value
Return of Bowel Sounds	9 (30%)	1 (3.33%)	0.006

TABLE-III

Stratified analysis of return of bowel sounds by age and gender

Stratification	Sub-group	Return in Group A	Return in Group B	P-Value
Age 25–45		6/18 (33.3%)	1/17 (5.9%)	0.042
Age 46–70		3/12 (25.0%)	0/13 (0%)	0.055
Gender Male		2/6 (33.3%)	0/4 (0%)	0.197
Gender Female		7/24 (29.2%)	1/26 (3.8%)	0.015

DISCUSSION

Abdominal surgery has been transformed by laparoscopic operational methods. Among its many benefits include a quicker recovery time, less blood loss, and a less noticeable incision. The preferred method of treating symptomatic cholelithiasis is laparoscopic cholecystectomy. Postoperative discomfort following Laparoscopic cholecystectomy is still a concern, despite the obvious advantages compared to open surgery. Extended hospital stays and higher rates of morbidity may be caused by pain.[8,9]

Visceral discomfort is more common after laparoscopic cholecystectomy for a number of reasons, including intraabdominal cavity stretching, inflammation in the peritoneum, and stimulation of the phrenic nerves due to leftover carbon dioxide.[10] The most common kind of pain experienced after an open cholecystectomy is parietal discomfort.[11]

How to effectively manage pain after surgery is a topic on which there is no consensus. Gas drainage, hot gas, low-pressure gas, nitrous oxide pneumoperitoneum, intraperitoneal saline, intraperitoneal anaesthetics, local wound anaesthetics, intraperitoneal saline, and laparoscopic surgical pain relief regimens have been suggested.[12] While high-pressure pneumoperitoneum during laparoscopy does alter organ system performance and induce postoperative discomfort, low-pressure offers major benefits in reducing postoperative pain, analgesic use, pulmonary function preservation, and length of hospital stay. The use of low pressure pneumoperitoneum during laparoscopy improves postoperative outcomes in several ways, but it makes tissue dissection more challenging for surgeons.[13]

By measuring the recurrence of bowel sounds six hours after laparoscopic cholecystectomy with both low-pressure and high-pressure pneumoperitoneum, I want to draw some conclusions about the relative merits of these two techniques. The results showed that in Group A (low pressure pneumoperitoneum), 9% of patients returned bowel sounds within six hours after surgery, but in Group B (high pressure pneumoperitoneum) only 3% did so (pvalue=0.006).

Research shows that low pressure pneumoperitoneum is associated with an 8% incidence of shoulder tip discomfort, compared to a 30% incidence in high pressure pneumoperitoneum. Six hours after surgery, a comparable author found that 0% of patients undergoing high-pressure pneumoperitoneum cholecystectomy heard bowel sounds again, but 21% of patients undergoing low-pressure pneumoperitoneum experienced the same. In the identical study, there was no discernible variation in the average duration needed for laparoscopic cholecystectomy when using high-pressure regions pneumoperitoneum (62±9.4 minutes, range 45-85 minutes) or low-pressure pneumoperitoneum (63.17±7.7 minutes, range 45-

90 minutes) (p>0.05). Bile spillage and visceral/vessel damage were not significantly different across the groups.[14]

Historically, postoperative ileus has been acknowledged as a typical reaction to tissue damage. Research suggests that even exposing the peritoneum might reduce gastrointestinal motility, and that the severity of surgical damage is associated with the risk of postoperative ileus after abdominal surgeries. Neuronal inhibitory reflexes and injury-site inflammatory mediators play key roles in pathogenesis. Consequently, following laparoscopic surgeries, several researchers have shown that postoperative ileus lasts less time.

Symptoms of post-operative ileus include an intolerance to solid foods, a slow transit time for flatus and formed stool, gas or fluid collection in the bowels, nausea, vomiting, and abdominal distention. The activation of mast cells and inflammation caused by intestinal handling is linked to the extended postoperative ileus. Minimally invasive surgery often results in a quicker recovery time.

Low-pressure pneumoperitoneum (LPP) has demonstrated superior efficacy in restoring bowel sounds following laparoscopic cholecystectomy when compared to high-pressure techniques. This benefit primarily stems from the reduced intra-abdominal pressure, which minimizes the risk of bowel ischemia and postoperative ileus. The physiological advantage of LPP lies in its ability to preserve splanchnic circulation and reduce mechanical stress on the gastrointestinal tract.

Randomized trials have consistently shown that LPP significantly reduces the incidence of postoperative ileus. In one study, only 12.9% of patients in the LPP group exhibited signs of ileus at 6 hours postoperatively, compared to 41.9% in those who underwent surgery with standard-pressure pneumoperitoneum (SPP). The underlying mechanism is thought to be the diminished vascular compression and improved mesenteric perfusion that result from lower intra-abdominal pressure, which collectively facilitate quicker recovery of bowel motility.[15]

In terms of broader clinical outcomes, LPP also offers notable benefits. Postoperative shoulder tip pain, a common complaint following laparoscopic procedures, is reduced by 30–40% in patients treated under LPP. Additionally, hospital stays are shorter—typically by 6 to 12 hours—due to faster recovery. Analgesic requirements, particularly opioid usage, are also lower with LPP, which is attributed to decreased visceral and referred pain.[16,17]

From a surgical standpoint, LPP remains a feasible and safe alternative, despite a marginal increase in technical difficulty due to reduced intra-abdominal workspace. Importantly, studies indicate no significant differences in operative duration or complication rates between LPP and high-pressure techniques. When performed by experienced surgeons, intraoperative visibility under LPP remains adequate, supporting its routine use.[17,18]

The findings of this study have important implications for enhancing postoperative recovery in patients undergoing laparoscopic cholecystectomy. The significantly earlier return of bowel sounds in the low-pressure pneumoperitoneum group suggests that this technique can lead to quicker resumption of gastrointestinal function. This improvement can contribute to reduced hospital stays, thereby optimizing bed turnover and reducing healthcare costs. Additionally, the decreased incidence of postoperative pain—particularly shoulder tip discomfort—may reduce the reliance on opioid analgesics and associated side effects. From a patient-centered care perspective, the enhanced comfort and shortened recovery period associated with low-pressure pneumoperitoneum are likely to improve overall patient satisfaction.

CONCLUSION

Given the faster return of bowel sounds, potential for reduced analgesic use, and shorter hospital stays, the adoption of low-pressure CO_2 insufflation offers a safe and effective enhancement to standard surgical technique. It represents a valuable modification to current practice aimed at improving patient outcomes and optimizing postoperative recovery. Therefore, low-pressure pneumoperitoneum should be considered a preferred technique during laparoscopic cholecystectomy in eligible patients.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

1. 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; 36(10):7092-113.
2. Tian F, Sun X, Yu Y, Zhang N, Hong T, Liang L, et al. **Comparison of low-pressure and standard-pressure pneumoperitoneum laparoscopic cholecystectomy in patients with cardiopulmonary comorbidities: a double blinded randomized clinical trial.** BMC Surgery. 2024; 24(1):348.
3. Mazzotta E, Villalobos-Hernandez EC, Fiorda-Diaz J, Harzman A, Christofi FL. **Postoperative ileus and postoperative gastrointestinal tract dysfunction: Pathogenic mechanisms and novel treatment strategies beyond colorectal enhanced recovery after surgery protocols.** Front Pharmacol. 2020; 11:583422.
4. Prince H, Cripps MW. **Anesthesia considerations for MIS in emergency and trauma surgery. In: Mini-invasive approach in acute care surgery.** Cham: Springer International Publishing; 2023; 361-74.
5. Watrowski R. **Complications of gynecological laparoscopy. In: Advances in minimally invasive gynecologic reproductive surgery.** Boca Raton: CRC Press 2021:24-45.
6. Abdallah HA, Kabbash MM, Saad MR. **Comparative study of low-pressure versus standard-pressure pneumoperitoneum in laparoscopic cholecystectomy.** The Egyptian Journal of Surgery. 2024 Jan 31; 43(1).
7. Shunmugavelu K, Jeevaprita MS, Ali RF, Aouf A, Zaghloul MS, Kandel MM, et al. **The Official Journal of The Kuwait Medical Association. 2025.**
8. Malhotra N, Chanana C, Roy KK, Kumar S, Riwari V, Sharma J. **To compare the efficacy of two doses of intraperitoneal bupivacaine for pain relief after operative laparoscopy in gynecology.** Archives of Gynecology and Obstetrics. 2007; 276:323-6.
9. Boddy AP, Mehta S, Rhodes M. **The effect of intraperitoneal local anesthesia in laparoscopic cholecystectomy: A systematic review and meta-analysis.** Anesthesia & Analgesia. 2006; 103(3):682-8.
10. Golubović S, Golubović V, Sotošek TokmadžiĆ V, **Intraperitoneal analgesia for laparoscopic cholecystectomy.** Periodicum Biologorum. 2009; 111(2): 263-6.
11. Hussain Z, Ghani U, Mian MA. **Morbidity of laparoscopic cholecystectomy.** Pakistan Armed Forces Medical Journal. 2006; 56(3):264-70.
12. Maharjan S, Shrestha S. **Intraperitoneal and periportal injection of bupivacaine for pain after laparoscopic cholecystectomy.** Kathmandu University Medical Journal (KUMJ). 2009; 7(25):50-3.
13. Joshipura VP, Haribhakti SP, Patel NR, Naik RP, Soni HN, Patel B, et al. **A prospective randomized, controlled study comparing low pressure versus high pressure pneumoperitoneum during laparoscopic cholecystectomy.** Surgical Laparoscopy Endoscopy & Percutaneous Techniques. 2009; 19(3):234-40.
14. Mahajan S, Shankar M, Garg VK, Gupta V, Sorout J. **Intraoperative safety of low pressure pneumoperitoneum cholecystectomy: A comparative study.** International Surgery Journal. 2017; 4(11):3679-84.
15. Shakoor S, Asad M, Najeeb E, Imtiaz T, Rehman IU, Haq MB, et al. **Postoperative outcomes of low pressure versus standard pressure pneumoperitoneum in laparoscopic cholecystectomy.** Ann Pak Inst Med Sci. 2025; 21(1):159-63.
16. Baig S, Qureshi A, Siddiqui Z, Khan R, Hussain M, Ali T. **Right shoulder-tip pain in standard vs low-pressure CO_2 pneumoperitoneum in laparoscopic cholecystectomy: A comparative study.** Int J Sci Res. 2021 Aug; 10(08):34-38.
17. Arun BC, Jeyalaksmi T, Pranab K, Navin RS. **A comparative study on effect of low pressure versus high pressure pneumoperitoneum on liver functions and operative field visibility in laparoscopic cholecystectomies in a tertiary care centre.** J Acad Med Pharm. 2024; 6(1):1939-45.
18. Madhok B, Nanayakkara K, Mahawar K. **Safety considerations in laparoscopic surgery: A narrative review.** World J Gastrointest Endosc. 2022 Jan 16; 14(1): 1-13.

AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Asif Lateef:** Writing.
2	**Tayyab Riaz:** Data collection.
3	**Usama Farrukh:** Data analysis.
4	**Hussain Anwar:** Discussion writing.
5	**Mudassar Jabeen:** Data entry.
6	**Mubashar Abrar:** Revisions.