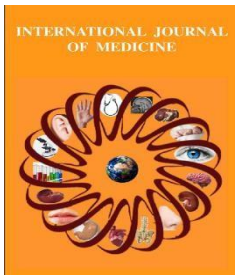

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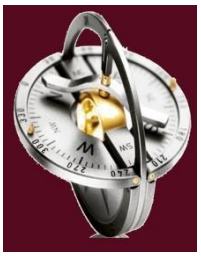

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Review Article

Outcome Analysis of Low-Pressure Pneumoperitoneum During Laparoscopy and Sucking Out of Remaining Co2 After Completion of Laparoscopy

Dr. Gautam Bhaumik[1], Dr. Arunava Jana[2]
[1]*Associate Professor, Department of General Surgery, MS (Cal), DNB (General Surgery), FRCS (Edin), FRES (Glasgow), FIAGES, KPC Medical College & Hospital, Jadavpur, Kolkata, West Bengal 700032.*
[2]*Senior Resident, M.S. (General Surgery), FMAS (Minimal Access Surgery), Department of General Surgery, KPC Medical College & Hospital, Jadavpur, Kolkata, West Bengal 700032.*

Abstract

Introduction: Laparoscopic surgery has revolutionized modern surgical practice by enabling minimally invasive access to the abdominal cavity, resulting in reduced postoperative pain, shorter hospital stays, faster recovery, and improved cosmetic outcomes compared with traditional open surgery. ***Aims***: To evaluate the effect of low-pressure pneumoperitoneum on postoperative pain, nausea, and shoulder discomfort in patients undergoing laparoscopic surgery.To assess the impact of actively suctioning residual CO_2 at the end of surgery on improving postoperative outcomes. ***Materials & Methods***: This prospective interventional study was conducted at KPC Medical College & Hospital, Kolkata, over a period of one year (1st February 2023 to 31st January 2024) and included 100 patients undergoing elective laparoscopic surgery. ***Result***: The mean intra-abdominal pressure was comparable between the CO_2 suction and no-suction groups (8.4 ± 1.1 vs 8.6 ± 1.2 mmHg; p = 0.32). Although blood loss was slightly lower in the suction group (58 ± 18 ml vs 62 ± 22 ml), this difference was not statistically significant (p = 0.21). However, the duration of surgery was significantly shorter in patients who underwent CO_2 suction compared to those without suction (73 ± 12 vs 77 ± 15 minutes; p = 0.04). ***Conclusion***: We concluded that low-pressure pneumoperitoneum in conjunction with active suctioning of residual CO2 produced better postoperative results in this trial of 100 patients undergoing laparoscopic surgery. The groups' baseline parameters, intra-abdominal pressure, and blood loss were similar, indicating that the cohorts were well matched.

Keywords: Low-pressure pneumoperitoneum, laparoscopy, carbon dioxide suction, postoperative pain, shoulder-tip pain.

Introduction:

Laparoscopic surgery has revolutionized modern surgical practice by enabling minimally invasive access to the abdominal cavity, resulting in reduced postoperative pain, shorter hospital stays, faster recovery, and improved cosmetic outcomes compared with traditional open surgery. A fundamental requirement for laparoscopic procedures is the creation of a pneumoperitoneum, most commonly using carbon dioxide (CO_2) due to its high blood solubility and low risk of gas embolism. Conventionally, pneumoperitoneum is maintained at intra-abdominal pressures of 12–15 mmHg to provide adequate surgical exposure. However, these higher pressures may contribute to adverse physiological effects, prompting an increased interest in the use of low-pressure pneumoperitoneum (LPP), typically ranging from 6–8 mmHg [1].Low-pressure pneumoperitoneum has demonstrated several potential clinical advantages. Elevated intra-abdominal pressure can compromise venous return, increase systemic vascular resistance, reduce cardiac output, and impair pulmonary compliance. These hemodynamic alterations are especially significant in patients with pre-existing cardiopulmonary disease. LPP, by reducing the mechanical and physiological burden of insufflation, has been associated with improved intraoperative stability and decreased anesthetic requirements. Beyond physiological benefits, LPP may also reduce postoperative pain. High-pressure CO_2 can irritate the peritoneum, leading to increased nociception and postoperative discomfort. Studies have shown that lowering insufflation pressures can decrease early postoperative abdominal and shoulder-tip pain without significantly impairing visualization for many routine laparoscopic procedures[2,3].Another important contributor to postoperative shoulder pain and discomfort following laparoscopy is residual CO_2 retained in the abdominal cavity. The gas can become trapped under the diaphragm, stimulating the phrenic nerve and causing referred pain to the shoulder region. Active suctioning or evacuation of remaining CO_2 at the end of surgery has been recognized as a simple, low-cost intervention that may significantly improve patient comfort. Techniques such as gentle abdominal compression, pulmonary recruitment maneuvers, and direct suctioning have demonstrated efficacy in reducing residual CO_2 volume and minimizing postoperative pain scores [4,5,6]. Study aims to evaluate the effect of low-pressure pneumoperitoneum on postoperative pain, nausea, and shoulder discomfort in patients undergoing laparoscopic surgery.To assess the impact of actively suctioning residual CO_2 at the end of surgery on improving postoperative outcomes.

Address for Correspondence: Dr. Gautam Bhaumik, Associate Professor, Department of General Surgery, MS (Cal), DNB (General Surgery), FRCS (Edin), FRES (Glasgow), FIAGES, KPC Medical College & Hospital, Jadavpur, Kolkata, West Bengal 700032

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MATERIALS AND METHODS

Type of Study: This is a prospective interventional study
Place of Study: KPC Medical College & Hospital, Kolkata
Study Duration: 1 year (From 1st February 2023 to 31st January 2024.)
Sample Size: 100 patients undergoing elective laparoscopic surgery

Inclusion Criteria:
Patients aged 18–65 years undergoing elective laparoscopic surgery.
Patients classified as ASA grade I or II.
Patients willing to provide informed consent.
Patients with no prior major upper abdominal surgery that could affect pneumoperitoneum.

Exclusion Criteria:
Patients with ASA grade III or above or significant systemic comorbidities.
Emergency laparoscopic surgeries.
Patients with known allergy to anesthetic agents or CO_2 pneumoperitoneum intolerance.
Patients with pregnancy.

Patients with coagulopathy or bleeding disorders.
Study Variables:
Age, sex, body mass index (BMI).
ASA physical status.
Type and duration of laparoscopic procedure.
History of previous abdominal surgery.

Statistical Analysis:

Data were entered into Excel and subsequently analyzed using SPSS and GraphPad Prism. Continuous variables were summarized as means with standard deviations, while categorical variables were presented as counts and percentages. Comparisons between independent groups were performed using two-sample t-tests, and paired t-tests were applied for correlated (paired) data. Categorical data were compared using chi-square tests, with Fisher's exact test applied when expected cell counts were small. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Profile of Participants (n=100)

Variable	CO_2 Suction	No Suction	p-value
Age <40 years	23	22	0.84
Age ≥40 years	27	28	
Male	24	24	1
Female	26	26	

Table 2: Distribution According to ASA Grade

ASA Grade	CO_2 Suction	No Suction	p-value
I	30	30	0.83
II	18	17	
III	2	3	

Table 3: Intraoperative Outcomes (Low-Pressure Pneumoperitoneum)

Outcome	CO_2 Suction	No Suction	p-value
Mean intra-abdominal pressure (mmHg)	8.4 ± 1.1	8.6 ± 1.2	0.32
Duration of surgery (minutes)	73 ± 12	77 ± 15	0.04
Blood loss (ml)	58 ± 18	62 ± 22	0.21

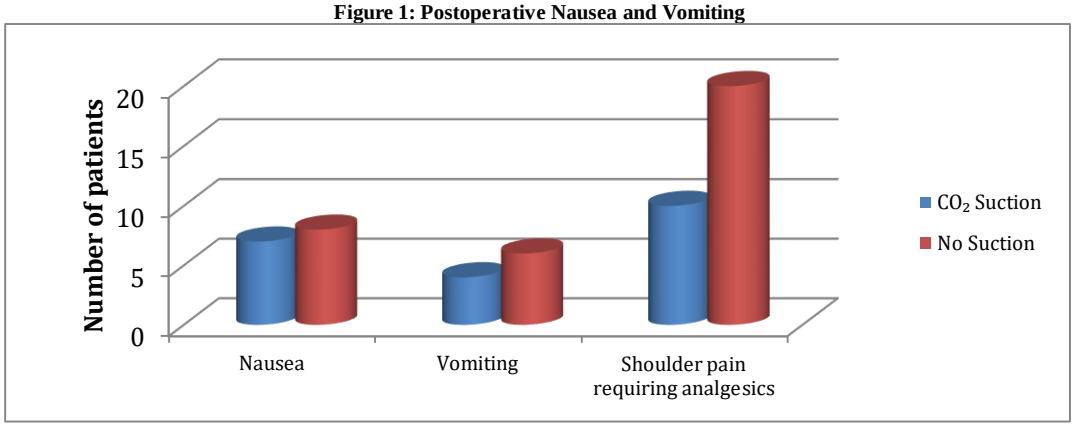
Table 4: Postoperative Shoulder Pain (VAS Score)

Time Post-op	CO_2 Suction	No Suction	p-value
6 hours	2.8 ± 1.0	3.5 ± 1.2	0.02
12 hours	2.0 ± 0.8	2.9 ± 1.1	0.01
24 hours	1.0 ± 0.5	1.2 ± 0.6	0.15

Table 5: Postoperative Nausea and Vomiting

Outcome	CO_2 Suction	No Suction	p-value
Nausea	7	8	0.78
Vomiting	4	6	0.5
Shoulder pain requiring analgesics	10	20	0.04

Figure 1: Postoperative Nausea and Vomiting



In this study of 100 participants, the distribution of patients across age and gender was similar between the CO_2 suction and no suction groups. Among participants aged <40 years, 23 were in the CO_2 suction group and 22 in the no suction group, while for those aged ≥40 years, 27 were in the CO_2 suction group and 28 in the no suction group (p = 0.84), indicating no significant difference. Gender distribution was also equal, with 24 males and 26 females in each group (p = 1). The distribution of patients according to ASA grade was comparable between the CO_2 suction and no suction groups. In the CO_2 suction group, 30 patients were ASA I, 18 were ASA II, and 2 were ASA III, while in the no suction group, 30 were ASA I, 17 were ASA II, and 3 were ASA III (p = 0.83). The comparison of intraoperative outcomes between the CO_2 suction and no suction groups showed that mean intra -abdominal pressure was similar in both groups (8.4 ± 1.1 mmHg vs. 8.6 ± 1.2 mmHg, p = 0.32). The duration of surgery was slightly shorter in the CO_2 suction group (73 ± 12 minutes) compared to the no suction group (77 ± 15 minutes), reaching statistical significance (p = 0.04). Mean blood loss wa s comparable between the groups (58 ± 18 ml vs. 62 ± 22 ml, p = 0.21). Postoperative pain scores were lower in the CO_2 suction group compared to the no suction group. At 6 hours postoperatively, the mean VAS score was 2.8 ± 1.0 versus 3.5 ± 1.2 (p = 0.02), and at 12 hours, it was 2.0 ± 0.8 versus 2.9 ± 1.1 (p = 0.01), both showing statistically significant reductions. At 24 hours, the difference was smaller and not statistically significant (1.0 ± 0.5 vs. 1.2 ± 0.6, p = 0.15). Postoperative complications were generally similar between the groups, except for shoulder pain. The incidence of nausea was 7 in the CO_2 suction group versus 8 in the no suction group (p = 0.78), and vomiting occurred in 4 versus 6 patients (p = 0.5), showing no significant difference. However, shoulder pain requiring analgesics was significantly lower in the CO_2 suction group (10 patients) compared to the no suction group (20 patients, p = 0.04).

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DISCUSSION

We showed that in this study of 100 participants, baseline characteristics including age, gender, and ASA grade were comparable between the CO_2 suction and no suction groups (age <40 years: 23 vs. 22; age ≥40

years: 27 vs. 28, p = 0.84; males: 24 vs. 24; females: 26 vs. 26, p = 1; ASA I: 30 vs. 30, ASA II: 18 vs. 17, ASA III: 2 vs. 3, p = 0.83), ensuring well-matched cohorts. Intraoperatively, mean intra-abdominal pressure and blood loss were similar (8.4 ± 1.1 vs. 8.6 ± 1.2 mmHg, p = 0.32; 58 ± 18 vs. 62 ± 22 ml, p = 0.21), while the duration of surgery was slightly but significantly shorter in the CO_2 suction group (73 ± 12 vs. 77 ± 15 minutes, p = 0.04), likely reflecting improved operative conditions. Postoperatively, patients in the CO_2 suction group experienced significantly lower pain scores at 6 hours (2.8 ± 1.0 vs. 3.5 ± 1.2, p = 0.02) and 12 hours (2.0 ± 0.8 vs. 2.9 ± 1.1, p = 0.01), with no significant difference at 24 hours (1.0 ± 0.5 vs. 1.2 ± 0.6, p = 0.15), indicating reduced early discomfort. The incidence of nausea and vomiting was similar between groups (nausea: 7 vs. 8, p = 0.78; vomiting: 4 vs. 6, p = 0.5), but shoulder pain requiring analgesics was significantly lower in the CO_2 suction group (10 vs. 20 patients, p = 0.04), suggesting that removal of residual CO_2 effectively reduces diaphragmatic irritation and referred shoulder pain. In similar study by Gurusamy et al. demonstrated that active gas aspiration after diagnostic laparoscopy significantly reduced shoulder pain and analgesic requirement in infertile women (p = 0.035) [7]; Bessa et al. reported that gas aspiration after laparoscopic cholecystectomy decreased early postoperative shoulder pain (p = 0.001–0.021) [8]; Gupta et al. found that intraperitoneal drains in gynecological laparoscopy reduced shoulder pain in the first 12 hours, with no significant difference at 24 hours (p = 0.451) [9]; Saad et al. showed that intraperitoneal saline instillation lowered shoulder pain up to 48 hours postoperatively (p < 0.001) [10]; and Patil et al. observed that low-pressure pneumoperitoneum was associated with reduced shoulder-tip pain compared to standard pressure (p < 0.05) [11]. Together, these studies support the biological plausibility of our results, demonstrating that active removal or minimization of residual CO_2 after laparoscopy consistently reduces early postoperative discomfort and shoulder pain.

Conclusion

We concluded that low-pressure pneumoperitoneum in conjunction with active suctioning of residual CO2 produced better postoperative results in this trial of 100 patients undergoing laparoscopic surgery. The groups' baseline parameters, intra-abdominal pressure, and blood loss were similar, indicating that the cohorts were well matched. The slightly shorter operating time for the CO2 suction group suggests better surgical circumstances. Crucially, whereas nausea and vomiting were unchanged, these patients had considerably less early postoperative pain at 6 and 12 hours as well as a decreased incidence of shoulder pain requiring analgesics. These results suggest that actively eliminating residual CO2 at the conclusion of laparoscopic surgeries can successfully lessen shoulder pain and early postoperative discomfort, suggesting its regular use to improve patient comfort and recovery.

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