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Original Research Article

COMPARATIVE EVALUATION OF LOW-PRESSURE AND STANDARD-PRESSURE PNEUMOPERITONEUM IN LAPAROSCOPIC CHOLECYSTECTOMY

Javed Ahmed[1], Muhammad Bilal Ghazipura[2], Rabia Farooque[3], Raja Muhammad Adeel Khan[4], Imam Bakhsh[5], Syed Moin Islam Shah[6]

[1]*Assistant Professor General Surgery, Indus Medical College Tando Muhammad khan Pakistan.*
[2]*General and Laparoscopic Surgeon Department of General Surgery, Sheikh Khalifa Hospital Fujairah UAE.*
[3]*Consultant General Surgeon Department of General Surgery, Red Crescent General Hospital Hyderabad Pakistan.*
[4]*Assistant Professor General Surgery, Suleman Roshan Medical College Tando Adam Pakistan.*
[5]*Associate Professor General Surgery, Mekran Medical College Kech Turbat Pakistan.*
[6]*Assistant Professor General Surgery, Suleman Roshan Medical College Tando Adam Pakistan.*

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Corresponding Author:
Dr. Javed Ahmed,
Assistant Professor General Surgery, Indus Medical College Tando Muhammad khan Pakistan.
Email: drjvdmemon@gmail.com

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ABSTRACT

Background: The objective is to compare postoperative outcomes of low-pressure pneumoperitoneum and standard-pressure pneumoperitoneum in patients undergoing laparoscopic cholecystectomy. Study design is prospective Controlled trial. This study was conducted at Indus Medical College Tando Muhammad khan from October 2024 to October 2025.

Materials and Methods: One hundred and twenty patients receiving laparoscopic cholecystectomy were recruited and assigned 60 to each using random allocation. Group 1 underwent laparoscopic cholecystectomy with standard-pressure pneumoperitoneum of 12-18 mm Hg, whereas Group 2 was done at low-pressure pneumoperitoneum of 8-12 mm Hg. Each procedure was recorded in terms of operational time. All patients were evaluated on the pain at the end of the shoulder as well as vomiting during the postoperative period. Shoulder tip pain, which was measured using visual analogue score was recorded at 4 hours, 8 hours, 12 hours and 24 hours. Comparison between the two groups of outcomes was done.

Results: The number of patients with shoulder tip pain was found to be significant between the standard-pressure group (24 patients) and the low-pressure group (10 patients), at a statistically significant difference of 40 versus 16.67 percent. The standard-pressure group recorded higher-means of the postoperative pain in comparison to the low-pressure group. Group 1 had 13.33 percent postoperative vomiting and Group 2 had 10 percent which was not statistically significant.

Conclusion: Low-pressure pneumoperitoneum is also linked with lower occurrence and intensity of postoperative pain in the tip of the shoulders than conventional-pressure pneumoperitoneum in the patients who have undergone laparoscopic cholecystectomy. There is no significant difference between the two approaches as far as rates of postoperative vomiting are concerned.

Keywords: Laparoscopic cholecystectomy, low-pressure pneumoperitoneum, standard-pressure pneumoperitoneum, postoperative pain.

INTRODUCTION

The application of laparoscopic cholecystectomy has become the new standard in treating symptomatic gallstone disease and it is currently one of the most used treatments in the world in terms of minimally invasive surgery. The reason why it has been widely accepted is the fact that it has fewer postoperative pains than open cholecystectomy, shorter hospital stay, quicker recovery, and better cosmetic results. Although these are positive, some postoperative pain remains, the most obvious is the shoulder tip pain and nausea, which in most cases, are commonly associated with the use of carbon dioxide pneumoperitoneum in the operation.[1-4]

Pneumoperitoneum is necessary in the provision of sufficient working space and clarity of vision during laparoscopic procedures. Conventionally, intra-abdominal pressure of 12-15 mmHg has been regarded as normal to expose and guarantee safety of the operation.[5] Yet, the range of the pressure has been linked to the physiological changes, including the decreased venous return, the increase in systemic vascular resistance, and the augmentation of diaphragmatic irritation, which may also be used as a possible cause of postoperative pain and cardiopulmonary stress.[6,7] Such worries have led to an increase in the interest in the use of low-pressure pneumoperitoneum which generally entails the maintenance of intra-abdominal pressure at a range of 8-12 mmHg.

Low-pressure pneumoperitoneum has been suggested as one of the measures to reduce the negative physiological consequences of carbon dioxide insufflation. Some studies have proposed that, decreasing the amount of insufflation pressure could enhance patient comfort, decrease the level of postoperative pain and reduce the rate of shoulder tip pain without any significant reduction in surgical visibility and safety.[8-10] These positive effects, including the decrease in diaphragmatic stretch with reduced carbon dioxide uptake are thought to be central to such positive changes.[11] Moreover, the reduction of intra-abdominal pressure could be of benefit to the patients with underlying cardiovascular or respiratory comorbidities, which provides a safer operative profile.[12]

Nevertheless, there are still questions about whether the low-pressure pneumoperitoneum can be relevant enough to offer sufficient operative exposure. Surgeons usually underline the importance of having a clean surgical field as the main necessity of ensuring the efficiency of the procedure and the absence of complications related to bile duct injury, bleeding, and increased operative time.[13] There have also been other studies that have indicated longer operating hours and technical problems at lower pressures especially in patients who have obesity, acute inflammation or past surgery adhesions.[14] This has led to the fact that the application of low-pressure pneumoperitoneum is not widely applied, and additional evidence is needed to prove its consistency in normal surgical work.

As the focus on the concept of patient-centred care, the development of enhanced recovery regimes, and the mitigation of postoperative pain grows, the need to assess the interventions that can potentially improve the perioperative experience, without jeopardizing the safety of the procedures, has become more significant. The shoulder tip pain after laparoscopic cholecystectomy is the most frequent clinical complaint reported with approximately 80 percent incidence on the report by the surgeon according to surgical technique and patient related factors.[15] This has been termed as painful and chronic during the initial hour subjects of the post operation period, and though in most cases it is self-limiting, it may adversely impact patient satisfaction and postpone the mobilization process. Since pressure of pneumoperitoneum is among the factors that can be changed to cause this symptom, the investigation of the options to the conventional insufflation should be considered as a clinically important and essential task.

Even though the comparison of low-pressure and standard-pressure pneumoperitoneum has been made in past, the results have not been completely homogeneous. Other studies have shown definite decreases in the post-operative pain by lower insufflation pressures,[8,10] but other studies have shown insignificant or no differences at all.[13,14] Additionally, the concept of heterogeneity in the study designs, population of patients, and methods of assessment makes it difficult to understand the findings. Consequently, further well-designed comparative studies are necessary in order to establish the reliability of low-pressure pneumoperitoneum in enhancing postoperative performance, especially on pain of shoulder tip and vomiting which are important indicators of patient recovery.

Considering all these, the purpose of the current study is to shed more light and compare the postoperative outcomes of patients that have undergone laparoscopic cholecystectomy on low and standard pressure pneumoperitoneum. This study with its concentration on clinically significant parameters (pain intensity, pain in the tip of the shoulder, postoperative vomiting) adds to the accumulated body of literature that supports the use of more refined and patient-friendly laparoscopy methods.

MATERIALS AND METHODS

In this comparative study, 120 patients who had elective laparoscopic cholecystectomy were included in the study. The institutional review committee provided ethical approval, and all participants gave written informed consent before enrolling in the study. A lottery was used to assign patients in two equal groups, 60 each.

Group 1 was underwent laparoscopic cholecystectomy when standard pressure of pneumoperitoneum was applied, which was maintained at 12 and 18 mmHg. The same was carried out to Group 2 in low-pressure pneumoperitoneum in a range of 8 to 12 mmHg. The experienced surgeons conducted all the surgeries using a standardized operative technique.

Eligible patients were both males and females aged 20 to 60 years and with a body mass index of 20 to 35 kg/m 2 and ASA I to ASA II. Only the patients who were booked to have elective laparoscopic cholecystectomy due to symptomatic gallstone disease were recruited. The exclusion criteria were a history of ischemic heart disease, hypertension, diabetes mellitus, bleeding disorders, previous upper

abdominal surgery, acute cholecystitis, and known drug abuse.

The outpatient department made all the appointments, and the patients were ready in line with the usual preoperative procedures. The first moment of time was the moment of trocar insertion and the last moment was closure of the final port site. The 24-hour observation was conducted on postoperative patients to determine shoulder tip pain and vomiting episodes. The frequency and intensity of the pain at the shoulder tip were noted at 4, 8, 12, and 24 hours on a visual analogue scale. Bouts of vomiting had been reported and compared between the two groups.

Both groups of data entered were submitted on structured pro forma and analyzed in the SPSS version 23.0. Quantitative variables like pain scores were done as mean and standard deviation, whereas qualitative variables like the presence of shoulder tip pain and vomiting were in terms of frequencies and percentages. Chi square test was used to compare the categorical variables and the p-values lower than 0.05 were regarded to be statistically significant.

RESULTS

In this study, 120 patients were considered, and each group consisted of 60. The average age of the total patients was 41.27 (9.45) years. Group 1 had a mean age of 41.83+9.32 years whereas Group 2 had a mean age of 40.72 years + 9.58 years which was not statistically significant (p = 0.563). The majority of the patients (n = 64, 53.3 percent) were aged 41 to 60 years old.

Most of the patients were females (n = 82, 68.3 percent). The difference in the gender between the two groups was not statistically significant (p = 0.487). The proportion of 52 patients (43.3 percent) in the ASA class II was zero difference between ASA class II and ASA class III.

In Group 1, the mean BMI was 27.14 +/- 3.08 kg/m 2 and in Group 2 it was 26.48 +/- 2.95 kg/m 2 and there was no significant difference between the groups (p = 0.214). The total patients with a BMI of between 26 and 30 kg/m 2 were 58 (48.3 percent).

The average time of operation was 32.96 and 35.41 minutes in the standard-pressure (Group 1) and low-pressure (Group 2) pneumoperitoneum group respectively. This was statistically observed (p = 0.041).

The average postoperative pain rating of Group 1 and Group 2 was 1.38 and 0.89 respectively and this was significantly different (p=0.027). The total number of postoperative vomiting accounted 13 patients (10.8 percent). They were 8 patients (13.33 percent) in Group 1 and 6 patients (10 percent) in Group 2 who knew how to vomit, which is statistically insignificant (p = 0.542).

The shoulder tip pain was general with 34 patients (28.3 percent). In Group 1, 24 patients (40 percent) and in Group 2 10 patients (16.67 percent) reported having shoulder pain. The two groups had significant difference (p = 0.004).

Table I provides the detailed distribution of shoulder tip pain in different intervals of time after the operation.

Table 1: Distribution of Postoperative Shoulder Tip Pain at Different Time Intervals

Time Interval	Group 1 (Standard Pressure) n=60	Group 2 (Low Pressure) n = 60	p-value
4 hours	18 (30%)	6 (10%)	0.008
8 hours	20 (33.3%)	8 (13.3%)	0.010
12 hours	22 (36.7%)	9 (15%)	0.006
24 hours	24 (40%)	10 (16.67%)	0.004

DISCUSSION

This research conducted in 120 patients who had laparoscopy cholecystectomy showed that low-pressure pneumoperitoneum was associated with a much lower incidence and severity of postoperative shoulder tip pain than normal pressure pneumoperitoneum. This is consistent with numerous other studies that have also supported the use of low insufflation pressures as a way of enhancing the comfort of the postoperative period. An example is by Brody et al., which found that low-pressure pneumoperitoneum in comparison to the normal pressure reduced shoulder tip pain and general postoperative pain to a considerable extent.[16] On the same note, Subramanian and colleagues reported low-pressure group with lower pain scores without jeopardizing health.[17] These similarities support the clinical importance of the low-pressure sets in improving patient comfort.

Montes et al. noted that patients having low-pressure pneumoperitoneum had a lower diaphragmatic irritation and shoulder pain, especially in the first 24 hours of operation.[18] Their findings reflect on ours in terms of timing and extent of pain alleviation. A different study by Barbaros et al. showed that low-pressure pneumoperitoneum was safe and resulted in less postoperative discomfort, which was evidence that the safety profile and patient-centred advantages of lower insufflation pressures were observed.[19] Our data additionally support these findings, as they provide no effect of low-pressure use on major complications and adverse events.

Other authors have also investigated cardiopulmonary and hemodynamic stability besides pain control. According to Goupil et al., low-pressure pneumoperitoneum led to a more stable cardiovascular parameter and reduced postoperative pain scores in comparison to normal pressure.[22]

Although intraoperative hemodynamic parameters were not systematically recorded in our study, the fact that no intra or postoperative complications occurred indicates that low-pressure pneumoperitoneum may be safe in a general elective cholecystectomy group.

Of interest has been the occurrence of postoperative nausea and vomiting. Vomiting in our series was found in 13.3 per cent of patients in the standard-pressure group and 10 per cent in the low-pressure group, and not statistically significant. This finding is consistent with the results of Rogmark et al., who have noted that there were no significant decreases of the postoperative nausea and vomiting rates related to the decreased insufflation pressure.[21] This indicates that low-pressure pneumoperitoneum might not have significant effects on other postoperative conditions including nausea or vomiting, yet the pneumoperitoneum can improve the pain outcomes.

In our research, the time of operations was somewhat longer in the low-pressure group (34.82 minutes on average) than in the control group (32.96 minutes on average), and this difference became statistically significant. The same result is connected with the findings of Hunt and Molloy on obese patients in which low-pressure pneumoperitoneum was correlated with a longer surgery period.[23] It is possible that the less dramatic extension of surgery at reduced pressure is indicative of lower quality working space and possibly less favorable exposure. However, the growth was clinical and did not cause any negative incidences. Tension between a little prolonged operating time and enhanced postoperative comfort seems positive.

Conversely, other previous reports have suggested that low-pressure pneumoperitoneum can harm the surgical view or even add technical difficulty particularly when dealing with obese, Acute inflammation, or adhesions in patients.[14,13] In our work, we excluded the patients with major comorbidities or previous upper abdominal surgery and, therefore, this could limit the generalization. This choice can also be a determining factor of our positive results and the lack of any complications on a higher level.

Collectively, our results contribute to a gradually accumulating body of evidence that low-pressure pneumoperitoneum is an effective technique that can be used to perform laparoscopic cholecystectomy in patients who are selected correctly. The decrease in the levels of pain in the shoulder tips, low scores of pain, and satisfactory operative times, indicate that the low-pressure methods must be envisaged as more popular, particularly in elective scenarios when the patients might prefer to feel comfortable and mobilize early.

Nevertheless, this research has weaknesses. First, we did not use patients whose BMI was above 35 kg/m 2, acute cholecystitis, or previous surgery of upper abdomen and our results might not be applicable to this riskier group. Second, the intraoperative hemodynamic and cardiopulmonary parameters were not recorded systematically to formally evaluate the physiologic benefits. Third, the follow-up was done within 24 hours after the operation, therefore no 6 and 12 months postoperative pain, complications or outcomes like restoration of mobility and resumption of normal activities were monitored. It will be interesting to conduct future studies that include a wider inclusion criterion, a longer follow-up, and a more extensive physiologic follow-up.

To sum up, we find no evidence against the clinical value of low-pressure-pneumoperitoneum in elective laparoscopic cholecystectomy. The patients with low to moderate BMI, and with no comorbid conditions and conditions are said to experience less postoperative shoulder tip pain and general improved comfort with a slight rise in the operative time but no rise in adverse events. In laparoscopic cholecystectomy, surgeons should consider using low-pressure measures as a component of an enhanced recovery and patient-centred care process.

CONCLUSION

This research paper shows that low pressure pneumoperitoneum during laparoscopic cholecystectomy is quite effective in decreasing the occurrence and severity of post-operative shoulder tip pain as compared to standard pressure pneumoperitoneum, without further elevating the risk of post-operative vomiting and other severe cases. Even though the operative time on the low-pressure group was a little longer than on the high-pressure group, it was not a significant difference. Low-pressure pneumoperitoneum can thus be considered to be a safe and effective method that ensures the comfort of the patient and can especially be used in elective cases where patients have a low to moderate BMI and no major comorbidities. The implementation of the low-pressure protocols would help to achieve a better postoperative outcome and customer satisfaction in laparoscopic cholecystectomy.

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