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A comparative study of low-pressure pneumoperitoneum versus standard-pressure pneumoperitoneum in laparoscopic cholecystectomy in tertiary care center

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ABSTRACT

Background: Laparoscopic cholecystectomy is the gold standard management of symptomatic cholelithiasis. We try to use low-pressure pneumoperitoneum (LPP) to study the effect of pneumoperitoneum in the duration of surgery, field of visualization with providing sufficient work space for surgeon, and post-operative shoulder pain and hospital stay in laparoscopic cholecystectomy. **Aims and Objectives:** The aims and objectives of the study are to compare outcomes in LPP versus standard-pressure pneumoperitoneum (SPP) with respect to duration of surgery, CO_2 consumption, field of visualization, and surgical difficulties to convert SPP or open cholecystectomy and post-operative shoulder pain and hospital stay. **Materials and Methods:** The prospective randomized study was conducted in tertiary care center, Government Medical College, Banda, Uttar Pradesh from July 2021 to October 2022. All consented 100 patients after randomization were allotted into two groups. **Results:** In our study, the mean duration of surgery surgical difficulties to convert open and standard pressure and difficulty in field visualization insignificant is more in LPP as compared to SPP but CO_2 consumption, post-operative shoulder pain, and mean hospital stay is less in LPP as compared to SPP. **Conclusion:** Laparoscopic cholecystectomy in LPP is safe and feasible. Field visualization, conversion rate, and duration of surgery are affected non-significantly because depend on the expertise of surgeon but shoulder pain, CO_2 consumption, and hospital stay are less in LPP.

Key words: Laparoscopic cholecystectomy; Low-pressure pneumoperitoneum; Shoulder pain and standard-pressure pneumoperitoneum

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INTRODUCTION

The presence of stone in gall bladder is known as cholelithiasis. Gallstone disease is more common in some regions of the world. In India, 4% but 10% are in western countries. Every year, 3% of asymptomatic become symptomatic. The first laparoscopic cholecystectomy was performed by Mouret in 1996 in Paris.[1] Now, laparoscopic cholecystectomy is the gold standard for symptomatic cholelithiasis. In 1966, Kurt Semm invented and automatic insufflation device which is capable of monitoring intra-abdominal pressure[2] in low-pressure pneumoperitoneum (LPP) intra-abdominal pressure 6–10 mmHg and standard-pressure pneumoperitoneum (SPP) 12–15 mmHg is set.[3] International guidelines recommended that the use of LPP allows adequate operative field to minimize the impact of pneumoperitoneum on normal physiology and positive effect in post-operative pain.[4] In LPP, long operative time and conversion to SPP or open cholecystectomy are more but less shoulder pain and hospital stay.[5]

In this study, LPP pressure is 10 mmHg set in comparison to SPP 14 mmHg in laparoscopic cholecystectomy studied.

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Different parameters were evaluated in the present study such as duration of surgery, CO_2 consumption, field of visualization, and surgical difficulties to convert SPP or open cholecystectomy and post-operative shoulder pain and hospital stay.

Aims and objectives

The aim of the study was to compare the outcome of LPP versus SPP with respect to the mean duration of surgery, CO_2 consumption, field of visualization, and surgical difficulties to convert SPP or open cholecystectomy and post-operative shoulder pain and mean hospital stay.

MATERIALS AND METHODS

The prospective randomized study was conducted in Department of Surgery, Government Medical College, Banda, Uttar Pradesh in tertiary care center. In this study, 100 patients after consent and satisfying the inclusion and exclusion criteria, data were collected. Ethical clearance from the institute ethics committee was taken and procedure was explained in detail and informed consent was taken.

Inclusion criteria

- Age >18 years
- Uncomplicated symptomatic cholelithiasis.

Exclusion criteria

- Cholelithiasis with CBD stone
- Gall bladder malignancy
- Previous history of shoulder pain, upper abdominal surgery
- Patient with cognitive impairment.

Methodology

All routine pre-operative investigations such as ultrasound, blood investigation, and cardiopulmonary fitness were done. Randomization of 100 patients was done between two groups.

- Group A: SPP 50 patients.
- Group B: LPP 50 patients.

Operative

All patients were operated under general anesthesia and Foley's catheterization was done. Injection ceftriaxone 1 g IV was given in all patients 2 h before surgery than 4 port placement was done in all patients. In LPP group, 10 mmHg and in SPP group, 14 mmHg pressure are maintained in intraoperative period.

At any point of surgery if surgeon complained of surgical difficulties/problem in surgical field visualization, he was informed about the gas pressure of pneumoperitoneum and he was asked for an opinion to convert it to SPP (in case of LPP) or to convert it to open cholecystectomy (in case of both pressure situations). Closure of ports was done in a standard procedure for all participants.

After operation, all ports closed with vicryl 1-0 and ethilon 2.0 post-operative shoulder pain record 12 h, 24 h, and 48 h by Visual Analog Scale (VAS). Antibiotic and other drugs are the same for all patients.

RESULTS

In our study, the mean duration of surgery surgical difficulties to convert open and standard pressure and difficulty in field visualization insignificant is more in LPP as compared to SPP but CO_2 consumption, post-operative shoulder pain, and mean hospital stay is less in LPP as compared to SPP.

Majority of the participants were 36–50 years followed by 18–35 years and mean age of distribution in SPP 39.82±13.80 and LPP group is 39.86±1.58. Hence, the most common age group is 36–50 years (Table 1).

In this study, 100 patients were in this study in SPP; 42% are male and 58% are female so cholelithiasis is most common in female patients (Tables 2 and 3).

DISCUSSION

In this study, CO_2 consumption is less in LPP compared to SPP group, which is statistically significant difference (109.13 L vs. 96.2 L) but Mahajan et al.,[6] found LPP

Table 1: Age distribution

Age (in years)	Group A SPP (n=50)		Group B LPP (n=50)	
	n	%	n	%
18–35	13	26.00	14	28.00
36–50	27	54.00	22	44.00
>51	10	20.00	14	28.00
Total	50	100	50	100

LPP: Low-pressure pneumoperitoneum, SPP: Standard-pressure pneumoperitoneum

Table 2: Gender distribution

Gender	Group A SPP (n=50)		Group B LPP (n=50)	
	n	%	n	%
Male	21	42.00	16	32.00
Female	29	58.00	34	68.00
Total	50	100	50	100

LPP: Low-pressure pneumoperitoneum, SPP: Standard-pressure pneumoperitoneum

Table 3: Mean parameters in our study

Mean	Group A SPP (n=50)	Group B LPP (n=50)	P-value (t-test)
Age	38.34±9.012	39.50±6.822	0.46
Intraoperative gas consumption	109.84±14.468	96.32±12.146	0.01
Post-operative pain by Visual Analog Scale			
12 h	4.56±1.033	3.34±1.099	0.01
24 h	3.22±0.975	2.20±0.904	0.01
48 h	1.46±0.838	0.96±0.727	0.01
Mean hospital stay	4.22±0.840	3.24±0.716	0.01

LPP: Low-pressure pneumoperitoneum, SPP: Standard-pressure pneumoperitoneum

consumed less amount of CO_2 which is statistically insignificant difference.

In this study, we found that there was a greater number of difficult visualization and conversion rate is more in LPP group 6% which is statistically insignificant compared to SPP 2%. Kumar et al.,[6] found that comparing surgeon operative difficulty in terms of surgical field visualization and conversion rate are non-significant.

In SPP, Group 1 patient was converted to open due to dense adhesion and LPP group due to poor visualization, 3 patients converted to SPP and 1 patient converted to open cholecystectomy after SPP converted. In the present study, we found that there was a greater number of surgical difficulty and surgical field visualization difficulty in low-pressure group, although both were statistically insignificant compared to standard-pressure group (Table 3). Kumar et al.,[6] found that comparing surgeon's operative difficulty between the two groups, there was no significant difference in terms of visualization, grasping, and dissection at Calot's triangle. The findings were as per the findings.

Post-operative shoulder pain is noted in 15 patients in SPP where 11 patients complain in LPP group (Table 3). Difference is significant because VAS pain score is higher in SPP as compared to LPP.[7-10] This difference significant similar result Sarli et al.,[11] shows low incidence in LPP.

The length of hospital stay, in the present study, was greater in SPP group (4.22±0.840 vs. 3.24±0.716 in LPP, P=0.001) and it was statistically significant. Many studies concluded that in low-pressure group, there was improved post-operative recovery[12] (Table 3).

Limitations of the study

Sample size small and single-center study.

CONCLUSION

Laparoscopic cholecystectomy in LPP at 10 mmHg pressure is safe and feasible in the hand of an experienced surgeon. Intra-operative complications, operative field visualization, operative difficulties, conversion rates, and duration of surgery are not affected by LPP. Moreover, LPP decreases consumption of intraoperative CO_2, post-operative pain, shoulder tip pain due to pneumoperitoneum, thus reducing hospital stay. Hence, low-pressure pneumoperitoneum imparts significant patient advantages. This simple reduction of the pressure of pneumoperitoneum from 14 mmHg to 10 mmHg imparts the extended benefits of laparoscopic cholecystectomy.

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RCA, KK- Concept and design of the study, prepared first draft of manuscript; interpreted the results; reviewed the literature and manuscript preparation; concept, coordination, preparation of manuscript, and revision of the manuscript.

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