

Original research article

Low- pressure laparoscopic cholecystectomy in patients with comorbid conditions: A prospective study

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Abstract

Background: In the present era, laparoscopic cholecystectomy is considered as gold standard for symptomatic gallstone disease. This study aimed to assess the feasibility of Low-pressure capnoperitoneum laparoscopic cholecystectomy (i.e. at 7 mmHg) in patients with the comorbid condition and compared the result with normal patients without any comorbidity.

Material and method: This prospective, single-centre comparative study was conducted in Department of Surgery, in Baba Raghav Das Medical College, Gorakhpur, for a period of 1 year from 2nd April 2019 to 1st April 2020, on symptomatic gall stone patients who were admitted with or without comorbid conditions and were planned for cholecystectomy. A total of 72 patients were included in the study and after detailed investigation, the patients were divided into two groups based on whether they have any comorbid conditions or not. Low-pressure capnoperitoneum laparoscopic cholecystectomy was performed in 37 patients with the comorbid condition and they are referred to as a study group. The control group includes 35 patients without any comorbidity. Different intraoperative and postoperative parameters were studied in both groups.

Results: In patients with co-morbid conditions mean blood loss (p value=0.0001) and mean operative time (p value=0.0006) was significantly higher compared to the control group. Conversion rate (p value=0.42), intra-operative complication rate (p value>0.05), postoperative pain score (p value>0.05), postoperative complication, postoperative nausea and vomiting (p value>0.05), mean time to resume diet (p value=0.05) quality of life on day 5 (physical domain) and postoperative hospital (p value=0.09), were not different in patient with comorbid condition as compared to patient without comorbid condition. Low-pressure capnoperitoneum laparoscopic cholecystectomy is a safe treatment for cholecystitis in elderly, in obese or in diabetic patients. However elderly and obese patients are at greater risk for conversion, slightly more blood loss, and increased operative time. In diabetic patients incidence of postoperative complication is more compared to the control group.

Conclusion: This study concluded that Low-pressure capnoperitoneum laparoscopic cholecystectomy is a safe procedure for patients with comorbid conditions.

Keyword: Low-pressure, capnoperitoneum, laparoscopic cholecystectomy, diabetes, obesity, elderly

Introduction

The Gall stone disease remains to be a major cause of morbidity and mortality worldwide (1). In western countries, cholecystectomy is the most common type of surgery performed in the surgical department of many hospitals (2). In any laparoscopic procedures the chances of occurrence of surgical site infections are rare compared to the open surgical procedure and hence In recent times, compared to open cholecystectomy, laparoscopic cholecystectomy (LC) has become the treatment of choice (3).

The most crucial step in LC procedure is creating enough space inside the abdomen for greater exposure of the anatomical structures. This is an important step that dictates patient safety as well as the success rate of the surgery (4). This can be achieved either by creating a pneumoperitoneum in the abdomen or by abdominal wall lifting methods including laparolift and laparotensor (5).

Creation of pneumoperitoneum is the most commonly used method practiced by surgeons for laparoscopic cholecystectomy. This allows the surgeons to identify the anatomic structures properly. This pneumoperitoneum is usually created by administering a gas preferably Co₂. Usually, a standard pressure in the range of 12-14 mm Hg is applied for creation of the pneumoperitoneum and this technique is known as the Standard pressure pneumoperitoneum. On the other hand, low-pressure pneumoperitoneum ranges from 7-10 mm Hg is used in the low-pressure laparoscopic process (6).

Recently researches have suggested that the pressure of the pneumoperitoneum is directly related with the increased postoperative complications and the shoulder tip pain in patients. Moreover, it was also indicated that the gas causes hemodynamic changes and has been regarded as unsafe in ASA class III and above (7). Therefore, low-pressure laparoscopic cholecystectomy (LPLC) has been employed to lower the impact of pneumoperitoneum including vasovagal reflex, CO₂ embolism, cardiac arrhythmia, and hypercarbic acidosis. In addition, it also minimizes the hemodynamic effect of insufflations (8).

In gall stone patients with comorbid conditions such as obesity, chronic obstructive pulmonary disorder, liver diseases or cardiac problems pose a unique surgical challenge as they have complex health issues complicating the whole procedure. Similarly, In elderly patients, the diminished cardiopulmonary reserve makes the situation more complicated (9).

Previously, no such studies were conducted that compared the feasibility of conducting the low-pressure laparoscopic cholecystectomy (LPLC) in these patients. The current study proposes to compare the advantages of conducting low-pressure laparoscopic cholecystectomy (LPLC) in patients with and without associated comorbid conditions.

Material and Method

This prospective, single-center comparative study was conducted in Department of Surgery in Baba Raghav Das Medical College, Gorakhpur, for a period of 1 year from 2nd April 2019 to 1st April 2020, on symptomatic gall stone patients who were admitted with or without comorbid conditions and were planned for cholecystectomy. Among these patients, 72 patients gave consent for low-pressure capnoperitoneum laparoscopic cholecystectomy (i.e. at 7 mmHg) and were included in this study.

After the full clinical evaluation, the patients were divided into 2 groups depending on the presence or absence of the comorbidity. Low-pressure capnoperitoneum laparoscopic cholecystectomy was performed in 37 patients with the comorbid condition and they are referred to a study group. The control group includes 35 patients without any comorbidity.

The comorbid conditions that were included in this study are as follows:

- Body mass index greater than 30 kg/m²

- Chronic obstructive lung disease and Asthma with a cough for 3 months or more and with airflow limitation as indicated by the pulmonary function test.
- Coronary heart disease and hypertension
- Patients with type 2 Diabetes mellitus, chronic liver diseases (cirrhotic portal hypertension)

Parameters studied

The data were collected with regards to the following parameters

Intra-operative assessments

Blood loss, duration of Operation (starting from the time of incision to the time of closure), and intraoperative complications such as spillage of bile or stone, CBD injury, bowel injury, hepatic injury, vascular injury

Post-operative assessment

- Postoperative complications such as fever, urinary retention and urinary tract infection, wound infection, respiratory tract infection abdominal collection, prolonged bleeding from the drain, Omental herniation, Hemorrhage from trocar site, cystic duct leak, upper gastrointestinal bleed, ascites aggravation, septicemia, myocardial infarction was noted.
- Postoperative pain score including the shoulder tip pain was recorded using the Visual Analogue Scale (VAS).
- Postoperative nausea and vomiting were recorded at 2 hours postoperatively.
- Time to resume a normal diet
- Postoperative recovery and hospital stay (in days)
- Postoperative return to normal activity in days.

The independent variables

These included age, sex, height, weight, body mass index and clinical diagnosis of the patient.

Statistical Analysis

All continuous variables were expressed as the mean \pm SD and compared using student's t-test. Proportions were compared using the chi-square test with Yate's correction. Statistical analysis was carried out by SPSS/PC+ (SPSS, Chicago, IL, USA) on an IBM-compatible computer; and $p < 0.05$ was considered statistically significant.

Result

The present prospective study included 72 patients with symptomatic gall stone disease, of which 37 patients were presented with associated comorbid conditions and were included in the study group whereas 35 patients were without any complication and were included in the control group. Table 1 shows the group of patients with different comorbid conditions.

Maximum patients in both study group and in the control group were female. However, this difference was found to be nonsignificant after the statistical analysis was done. Height, weight and BMI among both the study groups were comparable and no statistical significance was reported between them.

Intraoperative parameters were also compared between the two groups. Mean blood loss, and mean operative time was significantly higher in the study group. In aged, diabetic, and cardiac patients mean blood loss is significantly higher than others. 5.7% of the patients were converted to open procedure due to bleeding and dense adhesions in the control group. However, in the study group, the rate of conversion was 8.1% to open and 2.7% to Standard pressure capnoperitoneum Laparoscopic cholecystectomy. Most of the conversions in the study group were in obese patients.

No statistically significant difference was observed in postoperative pain score of the study group and control group at 4, 8, 12, 24, 48, and 144 hours. Moreover, no statistically significant difference was reported in the occurrence of shoulder tip pain between the two groups.

The incidence of postoperative nausea was similar for both the control as well as the study group (21.2%), whereas vomiting was more in the study group (12.1% in control group vs. 15.1% in the study group).

Meantime to resume diet in Control group was 20.60 ± 8.52 hours compared to 24.49 ± 10.03 hours in the study group. Quality of life on day 5 (Physical domain) in Study group was (80.2 ± 4.3) and in Control group it was (84.3 ± 4.4) . The difference between the two groups are statistically significant (p value=0.004).

No statistically significant difference was observed with respect to the occurrence of postoperative complications between the study and the control group. Mean hospital stay was also comparable between two groups. No mortality was observed in any group.

Discussion

The current study is a prospective single centre controlled study that was conducted in symptomatic gall stone patients with or without comorbid complications who have visited the department of surgery in Baba Raghav Das Medical College, Gorakhpur, for a period of 1 year from 2nd April 2019 to 1st April 2020. Total of 72 patients was included in this study and low pressure capnoperitoneum laparoscopic cholecystectomy was performed. The patients were aged between 20 years to more than 65 years. Most of the patients in the study group were females, however, no significant differences were observed between the study and the control group in respect to gender.

The mean blood loss in the study group was significantly higher in the study group compared to the control group. Among the study group, the blood loss was more for liver disease group (72.50 ± 12.58 ml) followed by an obese person (70.00 ± 17.70 ml). In a study by *Ji et al (2005)* among patients with symptomatic gall bladder disease with cirrhotic portal hypertension (CPH) a similar higher blood loss was reported. In this study, the patients with CPH had an operative blood loss of $75.5 \pm$ ml which is quite similar to the current study findings (10).

Studies have also pointed out that comorbid conditions prolonged the duration of operation time. Obesity increases the operation time significantly (11). In the present study, the mean operative time was more in the study group compared to the control group (61.06 ± 19.83 minutes vs. 46.06 ± 19.83 minutes, p value= 0.0006). Mean operative time was higher in the obese (69.37 ± 20.07 minutes) and the age group ($65 + 17.60$ minutes) compared to the control group. Previous studies also have shown that with associated comorbid conditions the operative time increases (2,12).

The conversion rate was also higher in the obese patients followed by the aged persons (14.3%). In our series of lung disease, we did not have to convert to open cholecystectomy in any patient. *Heich CH et al* have reported that in chronic obstructive pulmonary disease Laparoscopic cholecystectomy can safely be performed and no pulmonary complication arises due to this procedure (13). Similarly, *Bayrak and Altintas* (2018) have opined that LC can be performed in COPD patients under general and spinal anaesthesia (14). In the present series we did not have to convert to open cholecystectomy in any patient of liver disease.

The most common intraoperative complication observed was perforation of the gallbladder, stone left in the abdomen, and bleeding in both groups. No statistically significant difference was observed in postoperative pain score of study and control group at a 4, 8, 12, 24, 48, and 144 hours. In addition, no difference was reported for the prevalence of Shoulder

tip pain in both groups. The incidence of postoperative nausea was similar for both the control as well as the study group (21.2%), whereas vomiting was more in the study group (12.1% in control group vs. 15.1% in the study group).

Postoperative nausea and vomiting occurred in 7(21.2%) and 4(12.1%) patients of control group, 7(21.2%) and 5(15.1%) patients of study groups, respectively (p value>0.05). Postoperative nausea and vomiting occurred in 2(28.6%) and 1(14.3%) patients in aged group, 3(37.5%) and 2(25.0%) patients in obese group, 1(25%) and 0(0%) patients in diabetic group, 0(0%) and 1(20%) patients in cardiac disease group. and 1(25%) and 1(25%) patients in liver disease group.

The current study has shown that the patients in the study resumed to normal diet early (20.60 ± 8.52 hours) compared to the control group (24.49 ± 10.03 hours). The postoperative quality of life on postoperative day 5 was better for the study group compared with the control group (p value=0.0008). The postoperative complication rate was higher in aged (14%) and obese patients (12.5%). Whereas, people with COPD or liver disease were never reported such complications.

In a previous study conducted among the extremely elderly patients, it was observed that 17.1% of the patients had less one pt operative complication. The most common complication was pneumonia (3.3%) followed by urinary tract infection (2.7%) (15). However, the postoperative complication in the obese patients was higher in the current study compared with the previous studies (12,16). The mean hospital stay was significantly higher in the aged person compared to the control group (p value=0.01). *Lee et al (2015)* have shown that patients older than 80 years have a significantly higher hospital stay compared to the patients who were much younger (17).

Conclusion

This study has proved that low-pressure capnoperitoneum laparoscopic cholecystectomy is feasible in patients with the comorbid condition.

Table- 1: Distribution of comorbid condition in the study group

Comorbid condition	Number of patients	Percentage
Aged	7	19
Obese	11	29
Lung disease	6	16
Diabetes	4	11
Cardiac disease	5	14
Liver disease	4	11
Total	37	100

Table-2: Postoperative nausea and vomiting in groups (Number of patients)

	Study group							Control
	N=33							N=33
	Aged	Obese -	Diabetes	Lung Disease	Cardiac Disease	Liver disease	Total	
Nausea	2	3	1	0	0	1	7	7
Vomiting	1	2	0	0	1	1	5	4

Table-3: Mean time to resume diet in groups

	Control (N=33)	Study group(N=33)						
		Aged	Obese	Diabetes	Lung Disease	Cardiac Disease	Liver disease	Total
Range	8-44	8-44	8-44	8-44	8-30	22-30	22-30	8-44
Meantime to resume diet (hours)	20.60	29.66	24.25	24.0	20.99	23.68	24.6	24.49
Standard deviation ±	±8.52	±13.70	±12.11	±14.87	±7.12	±3.53	±4.00	±10.03
<i>DJ</i>		6	9	3	8	13	7	62
<i>P value</i>		1.56	0.80	0.44	0.11	1.42	1.36	1.69

Table-4: Quality of life on day 5 in groups (In Visual analog scale)

	Control (N=33)	Study group(N=33)						
		Aged	Obese	Diabetes	Lung Disease	Cardiac Disease	Liver disease	Total
Range								
Mean Quality of life (day 5)	84.3	78.3	79.6	80.5	84.3	80.4	81.9	80.2
Standard deviation ±	±4.4	+7.6	±6.8	±6.5	±5.0	±4.5	±3.6	±4.3
<i>Df</i>		6	19	3	6	5	3	38
<i>t value</i>		0.67	7.5	1.9	0.01	3.4	0.16	2.17
<i>P value</i>		0.057	0.05	0.13	0.11	0.06	0.14	0.0008

Table-5: Post-operative complications in groups

Complication	Study group(n=33)							Control (n=33)
	Aged	Obese	Diabetes	Lung Disease	Cardiac Disease	Liver disease	Total	
Fever	0	1	0	0	0	0	0	I
Urinary retention	0	0	0	0	0	0	0	0
Wound infection	0	1	1	0	0	0	2	I
Respiratory tract infection	1	0	0	0	0	0	I	1
UTI	0	0	0	0	0	0	0	0
Abdominal collection	0		0	0	0	0	0	0
Prolonged bleeding from drain	0	0	0	0	0	0	0	0
Omental herniation	0	0	0	0	0	0	0	0
Hemorrhage through the trocar site	0		0	0	0	0	0	0
Cystic duct leak	0	0	0	0	0	0	0	0
Upper gastrointestinal bleeding	0	0	0	0	0	0	0	0
Hepatic encephalopathy	0	0	0	0	0	0	0	0
Ascitis aggravation	0	0	0	0	0	0	0	0
Total	1	1	1	0	0	0	3	3

Table-6: Mean hospital stay in groups (Excluding converted patients)

	Control (N=33)	Study group(N=33)						
		Aged	Obese	Diabetes	Lung Disease	Cardiac Disease	Liver disease	Total
Range	1-4	2-4	1-4	2-5	1-4	1-4	2-4	1-5
Mean hospital stay (days))	2.36	3.16	2.62	3.12	2.43	2.75	2.96	2.66
Standard deviation ±	±0.65	±0.75	±1.06	±1.40	±1.24	±1.2	±0.95	±1.10
<i>Df</i>		5	8	3	5	4	3	52
<i>p-value</i>		3.05	2.01	1.13	0.217	1.39	1.20	3.38
<i>P value</i>		0.01	0.26	0.16	0.41	0.27	0.16	0.09

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Authors Contribution

Dr Abhinav Chaudhary and Dr Abhishek Jina designed the research paper. Dr Abhinav Chaudhary and Dr Abhishek Jina analysed the data. Dr Abhishek Jina wrote the paper and Dr Abhinav Chaudhary gave substantial contribution. All the authors approved the final version.

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