

Original Research Article

An observational study on the effect of high versus low carbon dioxide pressure in laparoscopic cholecystectomy

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ABSTRACT

Background: Gall bladder stone is one of the common diseases of hepatobiliary system. If it is symptomatic then it needs to be treated and sometimes it may lead to multiple complications. Laparoscopic approach for cholecystectomy is widely acceptable and routinely done procedure for gall bladder stone. Laparoscopic cholecystectomy reduces postoperative pain and hospital stay as compared to open surgery. Laparoscopic surgeries require carbon dioxide (CO₂) to inflate peritoneal cavity.

Methods: It is an observational study at tertiary care centre. In present study authors have included all patients undergoing elective laparoscopic cholecystectomy. Patients required conversion to open cholecystectomy from laparoscopic cholecystectomy and emergency laparoscopic cholecystectomy and laparoscopic cholecystectomy for malignancy were not included. In present study, patients were randomly allocated into two groups: group A (n=50) low CO₂ pressure (8-10 mmHg) pneumoperitonium and group B (n=50) high CO₂ pressure (12-14 mmHg) pneumoperitonium to perform laparoscopic cholecystectomy. In present study authors have compared post operative effects in term of pain (at 4, 8 and 12 hrs post operatively), hospital stay and requirements of injectable analgesics between group A and group B.

Results: 14 patients in group B complained of post operative shoulder tip pain as compared to only 5 patients in group A. Analgesic requirement and mean length of post operative hospital stay were also less in group A as compared to group B.

Conclusions: Low pressure laparoscopic cholecystectomy (LPLC) significantly decrease the frequency and intensity of post operative shoulder tip pain. So, LPLC decrease the demand for postoperative analgesics and decrease post operative hospital stay.

Keywords: Low CO₂ pressure, High CO₂ pressure, Laparoscopic cholecystectomy

INTRODUCTION

Gallstone disease is one of the major causes of abdominal morbidity and mortality.³

The prevalence of gallbladder stones varies widely in different regions of India, the north Indians having higher prevalence as compared with those among south Indians.²

Gall stones are highly prevalent and the most of them are asymptomatic. However, symptoms and complications due to gallstone diseases are leading gastrointestinal cause for hospitalisation and even surgical interventions.⁴

First open cholecystectomy was performed by Langenbuch in 1882. Open cholecystectomy has been the primary treatment of gall bladder disease in the early 1990s.⁵

The first endoscopic cholecystectomy was performed by Muhe of Boblingen in Germany in 1985. Then, pioneers in France and the United States coupled a charged coupled device video camera with a laparoscope to allow entire surgical team to view the operative field and performed cholecystectomies with laparoscopic equipments. Since then laparoscopic cholecystectomy has been performed around the world, and then recognized as the gold standard for the treatment of gallstone disease.⁶⁻⁹

The National Institute of Health Consensus Development Conference stated in 1992 that laparoscopic cholecystectomy is very safe and effective treatment for symptomatic gall stone.¹⁰

The advantages of laparoscopic over open cholecystectomy have been well documented. These advantages include earlier return of bowel function, less post operative pain, improved cosmesis (less scar), shorter hospital stay, earlier return to routine activity and decreased overall cost of hospital.¹¹⁻¹⁵

Laparoscopic surgeries require CO₂ insufflation to inflate peritoneal cavity.

In this study, we have tried to evaluate the benefit of low intraperitoneal CO₂ pressure over standard intraperitoneal CO₂ pressure during laparoscopic cholecystectomy.

METHODS

This is an observational study. This study was conducted at tertiary care centre, Surat municipal institute of medical education and research, Surat. Sample was collected from July 2021 to July 2022 according to inclusion criteria.

Study population

All the patients with cholelithiasis who underwent elective laparoscopic cholecystectomy and fulfilled inclusion criteria were taken as study population.

Inclusion criteria

All the patients who have symptomatic gall bladder stone, and who underwent elective laparoscopic cholecystectomy and age >18 years were included in the study.

Exclusion criteria

Patients with age <18 years, and who required emergency laparoscopic cholecystectomy were excluded.

All these patients were divided into two groups.

Patients were prepared for laparoscopic cholecystectomy and pre-anaesthetic check-up was done.

After proper anaesthesia, adequate painting and drapping done.

All the patients were operated with conventional four port laparoscopic cholecystectomy. One 10 mm port at umbilicus, one 10 mm port at epigastrium, one 5 mm port at midclavicular line in subcostal region, one 5 mm port in anterior axillary line at level of umbilicus.

In group A (n=50), low intraperitoneal CO₂ pressure was maintained to complete the procedure. Pressure was maintained around 8-10 mm hg.

In group B (n=50), around 12-14 mm hg intraperitoneal CO₂ pressure was maintained.

Each group was observed for post operative pain at 4, 8 and 12 hours by numeric rating scale (0-10), hospital stay and requirement of injectable analgesics.

Sample size calculated by using open epi software considering the proportion of elective laparoscopic cholecystectomy in department of general surgery at present institute as 4% (p), with 95% level of inference (Z alpha/2) with allowable error as 5% (L).

$$N = (Z \alpha/2)2pq/L^2 \\ = (1.96)2(0.44)(1 - 0.04)(0.05)2$$

Here, N=50. Authors have taken 2N number of cases, that is 100.

RESULTS

Significant post operative pain (NRS>5) after 4, 8 and 12 hours in group A and group B is important parameter of our study.

So, the number of patients having significant post operative pain (NRS>5) in group A and group B is described in Table 1.

Table 1: Male and female in group A and group B.

Gender	Group A	Group B
Male	18	20
Female	32	30

Average hospital stay in group A patients was lower than average hospital stays in group B patients (described in Table 2).

Table 2: Age distribution in group A and group B.

Age in years	Group A	Group B
18-40	28	25
40-60	22	23
>60	0	2

In group B patients, injectable analgesics required for longer duration than in group A patients (Table 5).

Table 3: Number of patients having significant post operative pain.

Post operative pain	Group A	Group B
After 4 hours	40	45
After 8 hours	38	44
After 12 hours	25	40

Table 4: Number of patients discharged on which postoperative day.

Discharge on postoperative days	Group A	Group B
1	2	0
2	25	4
3	20	25
4	3	18
5	0	3

Table 5: Requirement of injectable analgesics according to postoperative day.

Injectable analgesic required for days	Group A	Group B
1	27	27
2	20	25
3	3	18
4	0	3

In group A patients, total 10 patients require intraoperative time more than 45 minutes while in group B total 5 patients require intraoperative time more than 45 minutes (Table 6).

Table 6: Number of patients according to intraoperative time.

Intra operative time (minutes)	Group A	Group B
<45	40	45
45-75	9	4
75-90	1	1

So overall group B patients have more post operative pain, longer hospital stay and higher requirement of injectable analgesics than group A patients. But group A patients require slightly higher intraoperative time than group B.

DISCUSSION

Laparoscopic cholecystectomy is routinely performed surgery in general surgery department. Intraperitoneal pressure by CO₂ during surgery is important for dissection. Less pressure provides less space for dissection but better postoperative outcome.

An uncomplicated gall stone disease can be treated by low pressure laparoscopic cholecystectomy with reasonable

safety by an experienced surgeon. Though surgeons experience more difficulty in dissection during low pressure pneumoperitoneum, It is significantly advantageous in terms of postoperative pain, use of analgesics, preservation of pulmonary function and hospital stay.¹⁶

A carbon dioxide pneumoperitoneum pressure lower than that usually utilized to perform laparoscopic surgery reduces both the frequency and intensity of shoulder tip pain following laparoscopic cholecystectomy.¹⁷

Low pressure pneumoperitoneum is superior to SP pneumoperitoneum in terms of lower postoperative pain, a lower incidence of shoulder tip pain and a better QOL within 5 days following the operation. Low pressure should be used for laparoscopic cholecystectomy in case of uncomplicated symptomatic gallstones as a recommended procedure as long as an adequate exposure is obtained with this technique.¹⁸

Low pressure pneumoperitoneum is feasible and safe and results in reduced postoperative pain and near equal operative time compared with standard pressure pneumoperitoneum.^{1,19}

In our study, we found that low pressure pneumoperitoneum is associated with lower postoperative pain, lower hospital stays and low requirement of analgesics than high pressure pneumoperitoneum.

But with low intra peritoneal pressure we require slightly higher intraoperative time then standard intraperitoneal pressure. so, patients with comorbidities and, who cannot tolerate longer duration of anaesthesia and surgical procedure, cannot be evaluated for low CO₂ pressure pneumoperitoneum.

CONCLUSION

In laparoscopic cholecystectomy, low intraperitoneal pressure has lower postoperative pain, lower hospital stay and lower requirement of analgesics than high pressure pneumoperitoneum but have slightly higher intraoperative time, so whenever feasible low intraperitoneal pressure is better for overall postoperative period than high intraperitoneal pressure.

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