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Original Research Article

Low Pressure vs Standard Pressure Pneumoperitoneum during Laparoscopic Cholecystectomy a prospective comparative study

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Abstract

Background: Laparoscopic cholecystectomy is currently thought to be the best course of treatment for people with symptomatic gallstone disease. Blowing CO2 into the peritoneal cavity and keeping it there until the treatment is over, when it will be eliminated and the ports removed, is the most popular method of creating pneumoperitoneum during laparoscopic cholecystectomy.

Objectives: The objective of the study was to compare the intra operative Hemodynamic changes, difficulty in surgical field visibility and Conversion rate to open surgery during laparoscopic cholecystectomy between two groups. To compare the Postoperative surgical site pain and Shoulder tip pain. To assess the Recovery time and hospital stay between two groups.

Method: This was a prospective comparative study was carried out in the Department of General Surgery, Sri Venkateshwaraa Medical College and Hospital, Ariyur, Puducherry, India from November 2024 to April 2025, study period was 6 months. A total of 50 patients of both genders (Male and Female), presenting with cholelithiasis were included in the study by simple random sampling divided into groups: Group A: Low pressure (8 mmHg) and Group B: Standard pressure (14 mmHg), 25 in each group. The Patient were admitted and planned for laparoscopic cholecystectomy.

Results: In our study among 50 patients who underwent laparoscopic cholecystectomy 38 females, 12 males. In our study maximum number of cases between the age group 30 - 40 patients of 23 patients and 40-50 years of 17 patients. In our study mostly presents with dyspepsia 26 patients followed by vomiting in 12 patients and biliary colic in 12 patients. In our study hemodynamic instability less commonly seen in low pressure pneumoperitoneum of 5-10% when compared to standard pressure pneumoperitoneum around 25-30%, because low pressure pneumoperitoneum, reduces systemic vascular resistance, reduces cardio pulmonary effects

Conclusion: Low-pressure pneumoperitoneum is a safe and effective alternative to standard pressure in elective laparoscopic cholecystectomy in selected group of patients. Even though low pressure pneumoperitoneum is having technical challenge for surgeons, the main advantage for the patient is maintaining Intra operative hemodynamic stability and less post-operative morbidity.

Keywords: Low Pressure, Standard Pressure, Pneumoperitoneum, Laparoscopic Cholecystectomy.

Introduction

Laparoscopic cholecystectomy is currently thought to be the best course of treatment for people with symptomatic gallstone disease [1]. Blowing CO2 into the peritoneal cavity and keeping it there until the treatment is over, when it will be eliminated and the ports removed, is the most popular method of creating pneumoperitoneum during laparoscopic cholecystectomy [2]. The usual pressure range for creating pneumoperitoneum is 12 to 16 mmHg. However, this can have a number of adverse effects, such as altered blood gas levels, impaired circulatory function, reduced pulmonary compliance, elevated hepatic enzyme levels, kidney impairment, and even elevated abdominal venous pressures [3]. According to the investigation by Helmy et al. [4], the generated pneumoperitoneum caused damage to the liver cells. Their study's histology results made it abundantly evident that increasing intraabdominal pressure results in some degree of inflammation of the hepatic architecture.

According to Helmy and colleagues, monitoring liver function is critical for early diagnosis of any predicted impairment that may emerge, especially in patients with compensated impaired liver, both during and after pneumoperitoneum release in any laparoscopic procedure [4]. As an alternative, low-pressure pneumoperitoneum has been founded [3, 4]. Shoulder tip soreness is common after a laparoscopic cholecystectomy, which makes the recuperation period uncomfortable. The cause of the shoulder tip pain, which is so severe that frequent analgesic administration is necessary, is believed to be CO2 insufflation. It has been noted that 30 to 50% of patients experience shoulder tip pain following laparoscopic cholecystectomy [5]. Although nothing is known about the safety of doing a laparoscopy at peritoneal pressures lower than normal, lowering the quantity of CO2 insufflation during the procedure can help a patient who is already impaired. However, using low-pressure pneumoperitoneum with poor vision in a patient who is not compromised would not be beneficial [6,7]. Compared to normal pressurization, a growing body of evidence now supports the use of the lowest peritoneal pressure that permits acceptable exposure of the operative space [8]. Low-pressure pneumoperitoneum is frequently defined in literature as having an intraabdominal pressure between 6 and 10 mmHg [9–11]. The aim of the study was to compare intraoperative and postoperative outcomes between low-pressure and standard-pressure pneumop eritoneum during laparoscopic cholecystectomy.

The objective of the study was to compare the intra operative Hemodynamic changes, difficulty in surgical field visibility and Conversion rate to open surgery during laparoscopic cholecystectomy between two groups. To compare the Postoperative surgical site pain and Shoulder tip pain. To assess the Recovery time and hospital stay between two groups.

Materials and Methods

This was a prospective comparative study was carried out in the Department of General Surgery, Sri Venkateshwaraa Medical College and Hospital, Ariyur, Puducherry, India from November 2024 to April 2025, study period was 6 months.

A total of 50 patients of both genders (Male and Female), presenting with cholelithiasis were included in the study by simple random sampling divided into groups: Group A: Low pressure (8 mmHg) and Group B: Standard pressure (14 mmHg), 25 in each group. The Patient were admitted and planned for laparoscopic cholecystectomy.

Inclusion Criteria: The following patient were Including; elective laparoscopic cholecystectomy for symptomatic cholelithiasis (biliary colic). It should be Age > 18 years. It should be BMI <30.

Exclusion Criteria: The following patient were excluding; Acute and chronic cholecystitis, Previous abdominal surgery, Inflammatory and connective tissue disorder, Respiratory diseases like COPD, Patient age should be Age < 18 years, > 60 years. Excluding patient who had Cardiac co-morbidities, Choledocholithiasis, Patients BMI > 30.

Parameters Measured:

Intra operative Vitals:

- Pulse Rate
- Systolic Blood pressure
- Mean arterial pressure
- Respiratory rate
- Etco2
- Spo2

Intra operative:

- Visibility of calots triangle
- Surgeon difficulty back pain, hand pain
- Injury to surrounding structures (liver, duodenum, CBD)
- Difficulty in achieving hemostasis
- Duration of surgery
- Conversion to standard pressure pneumoperitoneum

Post-operative:

- Abdominal and shoulder tip pain score at 4, 8, 12, 24, and 48 hours post-operative by visual analogue scale (VAS)
- Analgesia requirement (number of doses/day)
- Lower lobe atelectasis
- Cardiac risk
- DVT risk

Statistical Analysis: Statistical analysis was carried out using SPSS-24. P-value less than 0.005 was considered statistically significant. Statistical tests were applied based on the type of variable and normality of the data.

Results

Table 1: Gender distribution Group A (low pressure pneumoperitoneum) Group B (Standard pressure pneumoperitoneum).

	Males	Females
Group A	5	20
Group B	7	18

In our study among 50 patients who underwent laparoscopic cholecystectomy 38 females, 12 males, Table 1.

Table 2: Age: Group A (low pressure pneumoperitoneum) Group B (standard pressure pneumoperitoneum)

	< 20 years	20-30 years	30-40 years	40-50 years	50-60 years	> 60 years
Group A	0	2	11	7	3	2
Group B	0	1	12	10	2	0

In our study maximum number of cases between the age group 30 - 40 patients of 23 patients and 40-50 years of 17 patients, Table 2.

Table 3: Presentation at the time of admission

	Biliary colic	Dyspepsia	Vomiting
Males	4 patients (15%)	6 patients (30%)	2 patients (10%)
Females	8 patients (34%)	20 patients (45%)	10 patients (36%)

In our study mostly presents with dyspepsia 26 patients followed by vomiting in 12 patients and biliary colic in 12 patients, Table 3.

Table 4: Intra op vitals: Group A (low pressure pneumoperitoneum) Group B (standard pressure pneumoperitoneum)

Hemodynamic changes		Group A	Group B
PR (Tachycardia)		1 patient (5%)	6 patients (30%)
BP (systolic Hypertension)		1 patient (5%)	7 patients (32%)
RR(Tachypnoea)		2 patients (10%)	6 patients (30%)
Mean arterial pressure increase		0	6 patients (30%)
EtCo2	Increase	2 patients (10%)	12 patients (60%)
Spo2 fall		0	2 patients (10%)

In our study hemodynamic instability less commonly seen in low pressure pneumoperitoneum of 5-10% when compared to standard pressure pneumoperitoneum around 25-30%, because low pressure pneumoperitoneum, reduces systemic vascular resistance, reduces cardio pulmonary effects, Table 4.

Table 5: Intra operative difficulties: Group A (low pressure pneumoperitoneum) Group B (Standard pressure pneumoperitoneum)

		Group A	Group B
Exposure of organs	Difficult	11 patients (46%)	2 patients (10%)
Dissection difficulty		6 patients (30%)	1patient (5%)
Achieving Haemostasis		7 patients (32%)	2 patients (10%)
Surgeon fatigue		8 patients (34%)	1patient (5%)
Duration of surgery	Prolonged	7 patients (32%)	3 patients (13%)
Conversion rate to standard pressure		4 patients (15%)	0

In our study low pressure has more difficulty in exposure of calots triangle, proper dissection of plane, difficulty in achieving hemostasis, and leads to prolonged duration of surgery. Due to difficulty in visibility of dissection causes surgeons postural strain, leads to easy fatiguability. More chances of conversion to standard pressure pneumoperitonea um, Table 5.

Table 6: Post-operative findings Group A (low pressure pneumoperitoneum) Group B (standard pressure pneumoperitoneum)

	Group A	Group B
Shoulder tip pain	2 patients (10%)	8 patients (35%)
Port site pain	3 patients (12%)	10 patients (40%)
Analgesic requirement	5 patients (15%)	18 patients (60%)

In our study low pressure pneumoperitoneum patients shows less incidence of shoulder tip pain, port site pain, requires less analgesia and shorter hospital duration compared to standard pressure pneumoperitoneum, Table 6.

Discussions

Laparoscopic cholecystectomy is a gold standard technique for symptomatic cholelithiasis. Laparoscopic surgeries need pneumoperitoneum of standard intra-abdominal pressure of 12 15mmhg for visibility, meticulous dissection and rapid achievement of hemostasis and prevention of surrounding structure injury. High intraabdominal pressure can reduce cardiac output by 30 %, increase blood pressure, increase central venous pressure, increase heart rate, and increase systemic vascular resistance. In our study we are doing

laparoscopic cholecystectomy, low pressure pneumoperitoneum to prevent hemodynamic instability.

In our study among 50 patients who underwent laparoscopic cholecystectomy 38 females, 12 males. In our study maximum number of cases between the age group 30 - 40 patients of 23 patients and 40-50 years of 17 patients. In our study mostly presents with dyspepsia 26 patients followed by vomiting in 12 patients and biliary colic in 12 patients. In our study hemodynamic instability less commonly seen in low pressure pneumoperitoneum of 5-10% when compared to standard pressure pneumoperitoneum around 25-30%, because low pressure pneumoperitoneum, reduces systemic vascular resistance, reduces cardio pulmonary effects. In our study low pressure has more difficulty in exposure of calots triangle, proper dissection of plane, difficulty in achieving hemostasis, and leads to prolonged duration of surgery. Due to difficulty in visibility of dissection causes surgeons postural strain, leads to easy fatiguability.

More chances of conversion to standard pressure pneumoperitoneum. Numerous studies have demonstrated that low-pressure groups experience higher conversion rates [12–18]. Our findings were different from these, most likely as a result of the current study's strict exclusion criteria, limited sample size, and high level of expertise.

While both were statistically insignificant when compared to the standard pressure group, we discovered in the current study that the low-pressure group experienced more surgical difficulty and surgical field visualization trouble. Kumar et al. discovered no discernible difference in the two groups' surgeons' operational difficulty when it came to visualization, gripping, and dissection at Calot's triangle [19, 20]. In our study low pressure pneumoperitoneum patients shows less incidence of shoulder tip pain, port site pain, requires less analgesia and shorter hospital duration compared to standard pressure pneumoperitoneum. Various studies demonstrated that early referred shoulder tip discomfort following surgery was linked to elevated pneumo-peritoneal pressure [21-25].

Conclusions

Low-pressure pneumoperitoneum is a safe and effective alternative to standard pressure in elective laparoscopic cholecystectomy in selected group of patients. Even though low pressure pneumoperitoneum is having technical challenge for surgeons, the main advantage for the patient is maintaining Intra operative hemodynamic stability and less post-operative morbidity. Offers less postoperative pain, faster recovery, and minimal compromise in surgical safety. May improve outcomes in cardiopulmonary risk patients.

Ethical approval: The study was approved by the Institutional Ethics Committee.

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