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ORIGINAL ARTICLE

Incidence of Post-Operative Pain and Vomiting after Elective Laparoscopic Cholecystectomy with Per-Operative High Versus Low Intra-Abdominal Pressure of Carbon Dioxide (CO_2)

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ABSTRACT

Background: Laparoscopic cholecystectomy is performed by creating pneumoperitoneum via carbon dioxide pressure between 9-14 mmHg. Increased incidence of pain, vomiting and nausea has been related with higher pressures of carbon dioxide pressures leading to significant morbidity and increased length of stay in hospital.

Objective: To assess the incidence of post-operative pain and vomiting after elective laparoscopic cholecystectomy with per operative high versus low intra-abdominal pressure of carbon dioxide.

Study design: Comparative analytical study

Place and duration of study: Department of Surgery, Muhammad Aslam Chaudary Hospital, Wah Cantt from 1st January 2023 to 30th June 2023.

Methodology: One hundred and ten patients were recruited within the age group of 18-55 years undergoing elective laparoscopic cholecystectomy for symptomatic gall stones. The patients were divided into two groups with each group having 55 patients in it. Group I was administered with low gas pressure of carbon dioxide during the surgery while in group II a high-pressure carbon dioxide was administered. Post-operative pain, nausea and vomiting was recorded at various intervals. Length os stay in hospital was also recorded in both the groups. All the results were compared within group I and group II. Pain maintenance was ensured. The vomiting symptoms were monitored at postoperative 24 hours up till five times. The patient's nausea and vomiting were recorded at various intervals such as at 0-4, 4-8, 8-12, 12-24 hours as post operative through Visual analogue scale (VAS) and assessment of vomiting was performed through episodic estimation per 24 hours.

Results: The Group II patients have relatively more weight than Group I. There were significantly more females than males in this study ($p<0.05$). The duration of anaesthesia, surgery and pneumoperitoneum in minutes was noticed lower in Group II than Group I patients. The difference between pain complaints was significantly reduced with 18.1% at recovery in group I and 10.9% after 4 hours. In group II 43.63% of cases had pain at time of recovery and 32.72% had it after 4 hours of recovery. The present study results showed that there were a greater number of cases reported between 0-4 hours in high carbon dioxide group II than low carbon dioxide Group I. Similar trend was noticed in the 4-8, 8-12 and 12-24 hours. The difference in nausea cases in low and high gas pressure groups presented an insignificant variance with an increased trend of nausea observed in high carbon dioxide group II than group I.

Conclusion: The shoulder pain was reduced at an incidence of 21.82% in low pressure of carbon dioxide in comparison with high pressure however there was no change or reduction in nausea and vomiting observed in low pressure group I than group II cases.

Keywords: Incidence, Post-operative pain, Vomiting, Elective laparoscopic cholecystectomy, Intra-abdominal pressure

INTRODUCTION

Cholecystectomy is the standard surgical procedure for many gallbladder pathologies. The procedure can be performed laparoscopically (minimally invasive) or open (traditional). Cholecystectomy is most commonly performed for symptomatic gallstones (90% of cases). The other pathologies include gallbladder cancer, biliary dyskinesia and biliary pancreatitis.[1-4] There are various types of cholecystectomy procedures. However, the most efficient and low risk procedure is the laparoscopic cholecystectomy which is less painful and has faster recovery as compared to Open cholecystectomy.[5]

The recovery time for laparoscopic surgery is 1-2 weeks while it takes almost 4-6 weeks for open cholecystectomy. The incidence of acute pain is around 50-80% as degree of pain after laparoscopic cholecystectomy.[6] The severity of pain is less in patients with the majority complaining mild to moderate, with only10-30% of patients experiencing severe pain. The pain usually resolves within 24-48 hours but can persist for up to 7 days in some cases.[5-7]

The incidence of post operative vomiting is reported as 20-50% of patients after laparoscopic cholecystectomy. The episodic vomiting settles down within 24 hours, but in some cases can persist for up to 3 days. The factors which induce vomiting and nausea in patients includes age, female gender, anesthesia technique applied, and surgical procedure opted and the management of pain and vomiting focus on multimodal strategies; analgesia, anti-emetic medications, fluid management and early mobilization.[8,9]

The incidence of post-operative pain and vomiting after elective laparoscopic cholecystectomy can be influenced by various factors, including the intra-abdominal pressure of carbon dioxide used during the procedure. Research suggests that high intra-abdominal pressure of carbon dioxide (>12 mmHg) may lead to increased post-operative pain, higher incidence of vomiting, and longer hospital stays. Contradictory to this research elaborates that low intra-abdominal pressure of carbon dioxide (<8 mmHg) may result in reduced post-operative pain, lower incidence of vomiting and shorter hospital stays.[10]

The present study was designed to compare high and low carbon dioxide (CO_2) pressure levels used during an elective laparoscopic cholecystectomy for determining the effect of both on pain, vomiting and nausea in patients. The study was aimed at providing a better opted procedure for the health benefits and ease of patients undergoing laparoscopic cholecystectomy.

MATERIALS AND METHODS

The comparative analytical with a double blinded study was conducted at Department of Surgery, Muhammad Aslam Chaudary Hospital, Wah Cantt from 1st January 2023 to 30th June 2023**.** A total of 110 patients were recruited in the study post filling of a written informed consent for the study. The inclusion criteria were based on all patients within the age group of 18-55 years undergoing elective laparoscopic cholecystectomy for acute

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cholecystitis. The exclusion criteria were termed as patients suffering from cholangitis or having any kind of history of vertigo, severe respiratory or cardiac conditions, motion sickness, bleeding disorders, psychotic issue, pregnancy or malignancy. In addition to this, those patients who had taken anti-emetic agents within the last 24 hours were also excluded from the study. The sample size was generated using online available authentic sample size calculation website which considered 95% confidence of interval, 80% power of test and 5% margin of error for sample size generation though prevalence of acute cholecystectomy in the region. All the demographic, clinical and symptomatic details of the patients were added in a well-structured questionnaire. The weight of each patient was assessed and clinical fitness prior to elective laparoscopic procedure was received. The patients were divided into two groups with each group having 55 patients in it. Group I was administered with low gas pressure of carbon dioxide during the surgery while in group II a high-pressure carbon dioxide was administered. Group I received low pressure gas (7-9 mmHg) while group II received high and standard pressure gas (14-15 mmHg). Patients were randomly selected through computer generated numbers. All the enrolled cases belonged to class 1-2 in American Society of Anesthesiologist (ASA). The laparoscopic cholecystectomies were conducted by a single surgical team with SOP followed for monitoring anaesthesia. Mechanical ventilation was accustomed to sustaining end tidal carbon dioxide tension as 35-40 mmHg during the operation. A nasogastric tube was passed into the stomach for the purpose of suction post-induction of anaesthesia. A complete monitoring of patients vital was performed during and post-surgery. Pain maintenance was ensured through infusion of paracetamol 1 gram at recovery and repetition of dose as after 6 hours. The vomiting symptoms were monitored at postoperative 24 hours up till five times. The patient's nausea and vomiting was recorded at various intervals such as at 0-4, 4-8, 8-12, 12-24 hours as post operative. Visual analogue scale (VAS) wherein "zero" indicated no nausea and a score of "10" meaning severe nausea was applied, [0-1 (no nausea), 1-4 (mild) , 4-7 (moderate) and 7-10 (severe)]. The assessment of vomiting was performed through episodic estimation per 24 hours.[1-2 (mild), 3-4 (moderate) and more from 5 (severe)]. All the results were compared those patients who suffered from constant nausea for 20-30 minutes were administered by Ondansetron 4 mg and were excluded from the study. The shoulder pain comparison was also accomplished within group I and group II at the time of recovery and 4 hours post-surgery. Data was analyzed statistically using SPSS version 26.0. The independent t and Chi-square tests were applied and p value <0.05 was considered as significant.

RESULTS

There was no significant variance within either group I and group II referring to low and high gas pressure delivered in enrolled patients respectively. The Group II patients have relatively more weight than Group I. There were significantly more females than males ($p<0.05$). The duration of anaesthesia, surgery and pneumoperitoneum in minutes was noticed lower in Group II than Group I patients (Table 1).

Within group I and II patients' complaint shoulder pain post-surgery. The difference between pain complaints was significantly reduced with 18.1% at recovery in group I and 10.9% after 4 hours. In group II 43.63% cases had pain at time of recovery and 32.72% had it after 4 hours of recovery not only at the time of leaving operation room but also over a 4 hour post operative period ($P = 0.033$) {Fig. 1).

The present study results showed that there was a greater number of cases reported between 0-4 hours in high carbon dioxide group II than low carbon dioxide Group I. Similar trend was noticed in the 4-8, 8-12 and 12-24 hours. However, the difference was not significantly determined through p value (Table 2).

The difference in nausea cases in low and high gas pressure groups presented an insignificant variance with an increased trend of nausea observed in high carbon dioxide group II than group I. However, there was no variance in severe nausea cases (Fig. 2).

Table 1: Comparison of demographic and surgical attributes of enrolled patients (n=110)

Demographic Variable	Group I (n=55)	Group II (n=55)	P value
Age (years)	46.2±11.9	43.4±16.2	0.655
Gender			
Male	19 (34.54%)	20 (36.36%)	0.032
Female	36 (65.46%)	35 (63.64%)	
Weight (kg)	64.6±8.7	66.4±10.3	0.761
Anaesthesia duration (minutes)	145.30±19.5	138.23±18.7	0.403
Surgical duration (minutes)	122.3±13.9	108.5±10.6	0.735
Pneumoperitoneum duration (minutes)	102.±9.3	94.5±10.5	0.671

Table 2: The frequency of nausea after surgery with low and high pressure gas

Time in hours	Gas pressure	Nausea				P value
		Nil	Mild	Moderate	Severe	
0-4	Group I	6	5	5	2	0.210
	Group II	2	5	8	4	
4-8	Group I	7	3	1	0	0.159
	Group II	2	5	4	1	
8-12	Group I	7	4	2	1	0.270
	Group II	4	6	3	2	
12-24	Group I	9	0	3	0	0.212
	Group II	4	0	3	2	

Fig. 1: Comparison of shoulder pain frequency between group I and II

Fig. 2: The frequency of vomiting after surgery with low- and high-pressure gas

DISCUSSION

Cholelithasis is more prevalent in females than males especially in women above the age of 40 years.[11] In the present study the mean age of the patients was found to be higher than 40 years. It is an established fact that high body mass index can lead into gall stones. A study by Tandon et al[12] reported high body mass index in patients suffering from gall stones. In the current study as well, it was observed that increased weight was observed in the patients suffering from cholelithiasis.

There are various studies which support the fact that low pressure of carbon dioxide during cholecystectomy (gallbladder removal surgery) is crucial for patient safety. The research elaborates reduced risk of gas embolism as carbon dioxide (CO_2) is used to inflate the abdominal cavity during laparoscopic cholecystectomy. Reduced/low pressure (around 10-12 mmHg) minimizes the risk of CO2 embolism, a potentially life-threatening complication.[13-15] In addition to this less post-operative pain has been reported in cases of cholecystectomy wherein lower CO_2 pressure was used which consequently results in minimal post-operative pain and discomfort for the patient. Improvement in visibility and decrease in the vascular injury has also been associated with application of low carbon dioxide.[16] The present study reported reduction in pain and discomfort in cases where low pressure of carbon dioxide was applied during surgery. These results are in coordination with previously reported research.

Research details that high pressure of carbon dioxide may occasionally be used during laparoscopic cholecystectomy procedures. High-pressure CO_2 is used to inflate the abdominal cavity, allowing for better visualization and workspace for the surgeon. It has been reported to reduce post operative pain, can improve visualization.[17-19] However, in the current research there was no such data interpretation which can evidently prove the reduction in pain or improvement in visualization through high pressure e of carbon dioxide.

There are studies which have contradictory reported respiratory acidosis (elevated CO_2 levels in the blood), cardiac issues and gas embolism especially in cases having severe respiratory or cardiac conditions, pregnancy and bleeding disorders.[20]

CONCLUSION

The shoulder pain was reduced at an incidence of 21.82% in low pressure of carbon dioxide in comparison to those having high levels of the same gas, however there was no change or reduction in nausea and vomiting observed in low pressure group I than group II cases.

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