

Comparative Evaluation of High Pressure Carbon Dioxide with Low Pressure carbon Dioxide for Hemodynamic Changes and Pain Symptoms in Laparoscopic Cholecystectomy

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Abstract

Introduction: Hemodynamic changes and pain symptoms are influenced by volume and pressure of CO₂ in laparoscopic cholecystectomy (LC). The study aimed to compare the above parameters in the low pressure (<8mm Hg) and standard pressure (12-14mmHg) LC.

Methods: A randomised, double blind study was done on 80 patients categorised into 2 groups. Group A encompassed patients undergoing Low pressure LC (<8mm Hg). In group B, Standard pressure LC (12-14mmHg) was done. Blood pressure, liver enzymes and pain was assessed in different time intervals. SPSS 21 was used to analyse the data.

Results: Difference in both systolic and diastolic pressure of Group A and Group B was seen to be statistically significant. ALP was the only liver enzyme showed significant difference between the groups at $p = 0.032$. Abdominal and shoulder tip pain exhibited significant difference amongst the group even at 24 hours at p value at 0.037 and 0.027 respectively.

Conclusions: It concludes that lower pressure pneumoperitoneum seems to have significant effects on blood pressure; both systolic and diastolic, liver enzymes and shoulder pain as compared to standard pressure pneumoperitoneum in patients undergoing LC.

Keywords: Laparoscopic Cholecystectomy, Pneumoperitoneum, CO₂ pressure, systolic blood pressure, diastolic blood pressure.

Introduction

Carbon dioxide (CO₂) at a certain pressure is utilised to enable better visualisation in laparoscopic cholecystectomy (LC). Off late, gall stones are a widely encountered condition in the biliary tract, with a prevalence of 10%. Cholecystectomy was the commonly employed conventional surgical procedure to treat gallstone.^{1,2} Now a days, LC is regarded as the standard technique to treat³. Initially proposed by Dubois in 1988, it has now evolved into the more advanced form with the aid of monitors and video system. It is the most commonly employed technique by surgeons and has also demonstrated patient compliance.

LC offers the advantage of shorter healing time, small sized cuts, reduced postsurgical torment and faster recovery to normal physical activities. To ensure better outcomes, surgical area has to

be clearly seen during the procedure⁴. Pneumoperitoneum is the adapted strategy to achieve this effect, where in CO₂ diffuses the peritoneum while maintaining steady pressure. The ports are evacuated under the same pressure⁵.

The standard pressure levels employed in creation of peritoneum is 12 – 14 mmHg. But is correlated with complications arising due to reverse trendelenburg position and carbon– di – oxide transmission to peritoneum such as reduction of lung capacity, arterial blood gases concentration alteration, hemodynamic side effects, altered liver enzymes and renal compromise^{6,7}. In order to overcome these difficulties, pressure is lowered to 7- 10 mm Hg as against the conventional level. This has showed better results in elderly patients and those with compromised cardiovascular or respiratory conditions⁸. But, this compromises the clear vision of LC site. Hence, this comparative study was conducted to evaluate hemodynamic changes and abdominal pain in high and low pressure CO₂ among patients undergoing L

Materials and Methods:

Study design and consent: The present study employed a concurrent randomised parallel design, double blinded clinical trial conducted on 80 cases in IMS and SUM hospital. The study was conducted from August 2018 to August 2020. Informed consent of all participants were obtained, after explaining the risks and benefits of the study. Institutional ethical clearance was obtained from the parent institution in which the study was conducted.

Eligibility criteria: Patients in the age range of 20 – 70 years, including both genders were recruited based on eligibility criteria. Consenting patients with symptomatic cholelithiasis were included. Patient presenting with ripped gall bladder, bile duct stones, existing co-morbidities, previous history of abdominal surgery, pregnant females, diagnosed malignancy, Body Mass Index score less than 19 or greater than 30, Grade 3 and Grade 4 levels of fatty liver were excluded.

Groups: Patients were categorised into two groups. Group A were patients administered with CO₂ pressure of 7– 10 mm Hg and Group B with 12– 14 mm Hg .

Procedure: A pre-surgical checkup and investigations was done in all patients. Surgical procedure of four port laproscopic cholecystectomy was performed under general anesthesia. The first port was constructed using the Veress needle under 12 mm Hg pressure. In Group A pressure was lowered to 10 mm Hg and in Group B, it was elevated to 14 mmHg. Vitals of blood pressure and heart rate was constantly monitored. End tidal CO₂ was recorded at predetermined time intervals of ; prior to CO₂ insufflation, during insufflations, during surgery, at exsufflation and before anesthesia reversal. Diclofenac sodium (75mg IM) was administered postoperatively for analgesic purpose. Subjects were motivated to begin eating after 8 post-operatively.

Outcome: Post –operative and Shoulder tip pain was evaluated by Visual Analogue scores at time periods of 1, 3, 6, 12 and 24 hours. Liver enzyme and hemodynamic changes were also assessed.

Statistical analysis: Data was analysed using SPSS version 21.0 (IBM; Chicago). Chi square test and

independent t test was applied to test significant differences between the groups. P value of lesser than 0.5 was considered to be statistically significant.

Results

The present study evaluated 80 patients undergoing LC. The mean age of Group A and Group B patients were 42.79 ± 2.24 and $44.08 \pm .97$ respectively, with no significant difference between them at $p = 0.58$. A clear female predilection was noted with 88.33% in Group A and 91.01% in Group B patients.

Comparative assessment of systolic blood pressure revealed a higher pressure in the Group A cases at 1, 3 and 6 hours post operatively, when charted against Group B patients at $p < 0.001$. (Table 1; Figure 1 and Figure 2).

Liver function evaluation showed significant differences between preoperative and postoperative time period in both groups. Intra group comparison showed significant differences, with ALT and AST reaching a remarkable higher score in the lower CO₂ pressure group as compared to high CO₂ pressure. (Table 2). When comparing between the two groups, only ALP enzyme showed significant difference between them (Table 2a).

Both shoulder tip pain and abdominal pain was lesser in the lower CO₂ pressure group. (Table 3). Long term complications were reported in neither of the groups. Overall, Group B exhibited better effectiveness in terms of blood pressure, liver enzymes and pain evaluation.

Table 1: Comparative evaluation of Blood pressure for the two groups

Time Intervals	Group A	Group B	P value
Systolic Pressure			
Prior surgery – at admission	127.73 ± 1.63	121.54 ± 0.96	0.78(NS)
During surgery	118.00 ± 1.07	116.07 ± 0.50	0.45(NS)
1 hour post surgery	124.27 ± 0.95	112.87 ± 0.42	$<0.001^{**}$
3 hour post surgery	121.93 ± 0.69	109.13 ± 1.29	$<0.001^{**}$
6 hour post surgery	126.65 ± 0.58	110.56 ± 0.68	$<0.001^{**}$
Diastolic pressure			
Prior surgery – at admission	77.61 ± 0.83	75.86 ± 0.68	0.10(NS)
During surgery	75.90 ± 1.09	71.87 ± 0.55	0.64(NS)
1 hour post surgery	73.14 ± 0.68	71.59 ± 0.49	$<0.001^{**}$
3 hour post surgery	72.77 ± 0.79	68.17 ± 0.99	$<0.001^{**}$
6 hour post surgery	72.86 ± 1.02	67.10 ± 0.37	$<0.001^{**}$

**=Highly significant; * =Significant; NS= Nothing Significant

Table2:Comparativeevaluation of LiverFunction tests forthetwogroups

Liver Function test	Group A			Group B		
	Post-operative	Pre-operative	P value	Post-operative	Pre-operative	P value
AST	39.6 ± 12.1	23.7 ± 5.3	0.002*	46.8 ± 31.04	22.3 ± 8.2	<0.001**
ALT	33.85 ± 11.3	21.8 ± 9.6	0.02*	35.3 ± 14.32	19.7 ± 8.9	<0.001**
ALP	176.01 ± 63.3	182.01 ± 59.8	0.73(NS)	156.49 ± 59.71	171.8 ± 61.32	<0.01*
BILLT	0.6 ± 0.3	0.7 ± 0.4	0.03*	0.71 ± 0.01	0.57 ± 0.47	0.02*
BILLD	0.4 ± 0.05	0.3 ± 0.05	0.02*	0.4 ± 0.15	0.34 ± 0.12	0.01*

**=Highly significant; * =Significant; NS= NothingSignificant

Table2a:Comparativeevaluationofintergroupliverfunctiontestassessedpostoperatively

LiverFunctiontest	GroupA	GroupB	Pvalue
AST	39.6 ± 12.1	46.8 ± 31.04	0.63(NS)
ALT	33.85 ± 11.3	35.3 ± 14.32	0.24(NS)
ALP	176.01 ± 63.3	156.49 ± 59.71	0.032*
BILLT	0.6 ± 0.3	0.71 ± 0.01	0.56(NS)
BILLD	0.4 ± 0.05	0.4 ± 0.15	0.79(NS)

**=Highlysignificant; * =Significant; NS =NothingSignificant

Table3:Comparativeevaluationof abdominalandshouldertippainbetweentwogroups

VASscore	Group A	Group B	P value
Abdominalpain			
1 hr	1.12±0.46	1.89 ±0.30	0.04*
3 hr	1.48 ±0.71	2.52 ±0.07	0.03*
6 hr	2.93 ±0.90	2.25±1.76	0.57(NS)
12 hr	2.20 ±0.25	0.92 ±0.36	<0.001**

24 hr	5.03 $\pm$ 0.34	2.84 $\pm$ 0.45	0.037*
Shouldertippain			
1 hr	0.91 $\pm$ 0.68	1.52 $\pm$ 0.57	0.021*
3 hr	1.78 $\pm$ 0.50	2.21 $\pm$ 0.46	0.011*
6 hr	2.35 $\pm$ 0.56	1.95 $\pm$ 1.67	0.048*
12 hr	2.57 $\pm$ 0.69	0.76 $\pm$ 0.46	<0.001**
24 hr	4.68 $\pm$ 0.91	2.97 $\pm$ 0.84	0.027*

**=Highlysignificant; *=Significant;NS =NothingSignificant

Figure1:LinegraphforcomparativeevaluationofSystolicBloodpressurebetweenthegroups

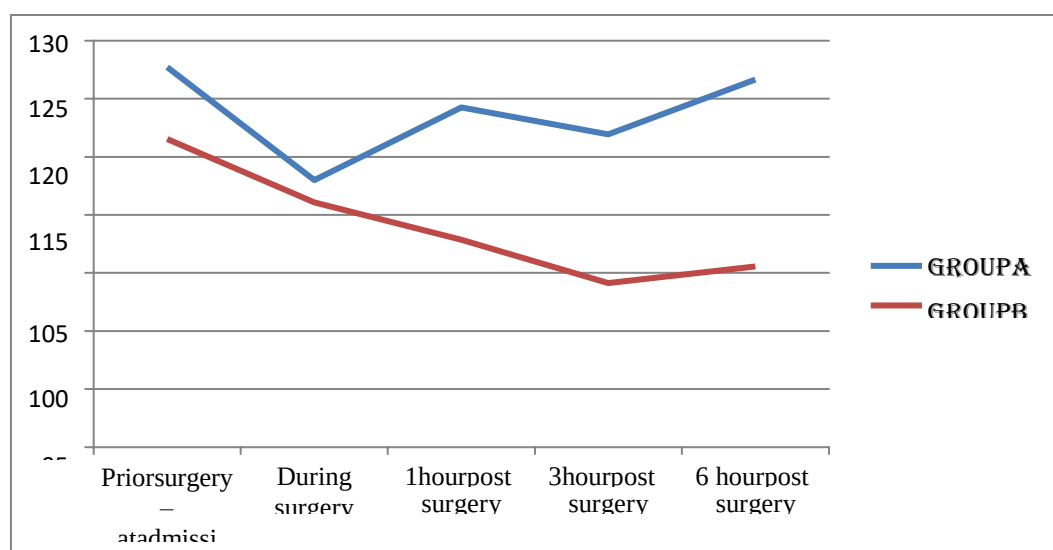
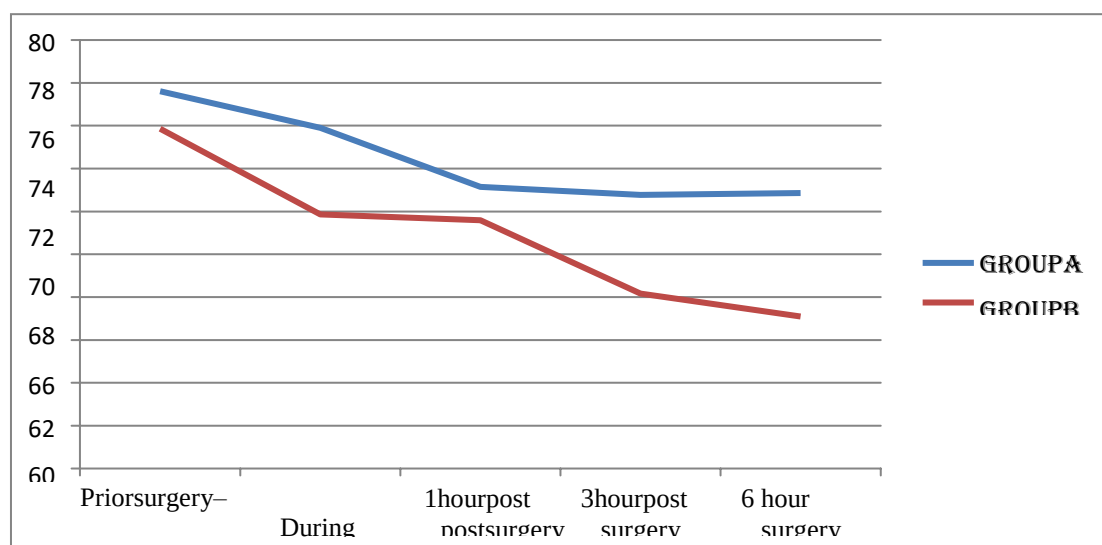


Figure2:LinegraphforcomparativeevaluationofDiastolicBloodpressurebetweenthegroups



Discussion:

LC demonstrates sustained maintenance of body functions as against open surgical procedure. Advantages of reduced hospital stay, fewer post-operative complication incidences and decreased treatment cost. Furthermore, pain experienced is of lower intensity in laparoscopic procedure. Laparoscopy is widely employed in the recent times, with laparoscopic cholecystectomy accounting to one⁸.

Better visibility of the surgical site is of prime importance for obtaining better surgical outcomes. CO₂ is used for better surgical performance, with its concentration directly influencing the surgical site. Though higher concentrations suggest better visualisation, it is also associated with certain complications⁹.

LC brings in potential changes in the hemodynamic system, such as altered mean blood pressure and liver enzyme levels. Pathophysiological changes are principally manifested in the cardiovascular system brought about by insufflation of CO₂¹⁰. Considering the probability of hemodynamic modification while CO₂ insufflation, an effort was made to assess the difference between low and high pressure pneumoperitoneum for LC.

The current study showed both systolic and diastolic blood pressure were reported to be higher in the Group A patients at 1, 3 and 6 hours. A. R. Mohammadzade et al¹¹ had similar findings with significant difference between his 60 patients, with mean systolic BP having lower values in low pressure group, but were not extended to diastolic blood pressure. On the contrary, Kanwer et al¹² demonstrated no significant differences in blood pressure in his patients, administered with 14 and 10 mmHg of CO₂ pressure.

Liver enzymes increase in LC and is considered as one of the complications. Both the groups showed an enhanced enzyme level when compared pre and postoperatively. However, ALP was the only enzyme to have significant difference between the high and low pressure groups. These were in concordance with the study of A. R. Mohammadzade et al¹¹. Shoulder tip pain was remarkably lesser in the low pressure group in all time periods assessed postoperatively. Literature evidence documents similar findings in the studies of Sarli et al, Yasir M et al, Bhattacharjee HK, Apoorva Goe et al.¹³⁻¹⁶.

Conclusion

The present study hypothesises that lower pressure pneumoperitoneum performs superior to higher pressure pneumoperitoneum in terms of regulated blood pressure, liver enzymes and lesser pain postoperatively.

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