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Original Article

Surgery Section

Effect of Low Pressure Versus High Pressure Pneumoperitoneum on Liver Functions in Laparoscopic Cholecystectomy

MANISHA AGGARWAL[1], ASHWANI KUMAR[2], SAHIL GARG[3], ATUL PRUTHI[4]

ABSTRACT

Introduction: Intra-operative and post-operative outcomes are largely affected by the pneumoperitoneum used in laparoscopic cholecystectomy.

Aim: To assess the impact of high pressure and low pressure pneumoperitoneum in selected group of patients undergoing laparoscopic cholecystectomy.

Materials and Methods: Sixty patients with confirmed diagnosis of chronic cholecystitis with cholelithiasis undergoing laparoscopic cholecystectomy were randomised into two groups. Group I- in which low pressure pneumoperitoneum (<10 mm of Hg) was used intra-operatively and Group II- in which high pressure pneumoperitoneum (>14 mm of Hg) was used intra-operatively. The two groups were compared using unpaired t-test.

Results: There was no significant difference in bilirubin and ALP in both the groups but serum Aspartate Aminotransferase (AST) and Alkaline phosphatase (ALP) were raised significantly post-operatively in group II patients. Operative time, hospital stay and time to return to normal routine was less in group I post-operatively but this was statistically non-significant.

Conclusion: As post-operative liver function tests were deranged more in patients who underwent laparoscopic cholecystectomy using high pressure pneumoperitoneum, low pressure pneumoperitoneum may be recommended in laparoscopic cholecystectomy when performed by experienced surgeons.

Keywords: Intra-operative and post-operative outcomes, Liver function, Surgery

INTRODUCTION

Minimally invasive surgery, or laparoscopic surgery, describes an era that crosses all traditional disciplines and has changed the face of general surgery, with the goal to make operative procedures more patient and surgeon friendly [1]. Laparoscopic Cholecystectomy is the most common laparoscopic intervention done worldwide [2].

Laparoscopic surgery requires creation of pneumoperitoneum by insufflation of carbon dioxide or other gases to a standard pressure of 10-14 mm of Hg and a constant pressure is maintained till the end of surgery. Air, oxygen, nitrous oxide apart from carbon-dioxide can be used in the creation of pneumoperitoneum.

Although, laparoscopic cholecystectomy has fewer complications and less hospital stay as compared to open cholecystectomy but new concerns regarding the adverse effects of pneumoperitoneum on various body systems have been seen. Increased intra-abdominal pressure affects venous return, systemic vascular resistance and myocardial function. Pneumoperitoneum and Trendelenberg position causes cephalad shift of diaphragm decreasing functional residual capacity and pulmonary compliance, increases airway resistance and airway pressure and thus increases risk of baro-trauma. It also impairs renal function and reduces urine output due to increased renal vascular resistance and reduced glomerular filtration rate. One more important haemodynamic change that occurs is the transient reduction in hepatic blood flow which can be known by assessing the liver function tests [3]. Elevation of liver enzymes such as AST and Alanine Aminotransferase (ALT) after non-complicated laparoscopic cholecystectomy is not the rare finding. The probable aetiology is explained to be atransient hepatic malfunction due to decreased blood flow to liver [3].

Other side effects are nausea and vomiting, post-operative shoulder tip pain and post-operative abdominal pain [4]. To minimise the intra-operative and post-operative effects of pneumoperitoneum, low pressure laparoscopic cholecystectomy was proposed [5]. At the same time, there was concern about decreased visibility of operative field and difficulty in handling of laparoscopic instruments leading to higher chance of injury if low pressure is used. Several studies have showed unexplained changes in post-operative liver function tests after laparoscopic cholecystectomy. Rana ML et al., found high level of change in AST, ALT and Gamma-glutamyl transferase (GGT) whereas level of ALP remain minimally changed with exception of few cases, all the values returned to normal at follow-up after three weeks [6]. Mohindra M et al., found an overall increase in the mean SGOT (aspartate aminotransferase), SGPT (alanine aminotransferase), Total Bilirubin (TB), Direct Bilirubin (DB) values in 95%, 93%, 73% and 70% subjects, respectively. Alteration in hepatic profile does occur in patients undergoing laparoscopic cholecystectomy [7].

This study was done to compare the effects of low pressure pneumoperitoneum (<10 mm of Hg) and high pressure pneumoperitoneum (>14 mm of Hg) on the liver functions in patients undergoing laparoscopic cholecystectomy.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of General Surgery at Rajindra Hospital Patiala, Punjab, India on 60 patients, in the age group of 21-70 years, from September 2012-2015 after obtaining ethical committee clearance.

Patients with the confirmed diagnosis of uncomplicated chronic cholecystitis with cholelithiasis on ultrasonography and undergoing laparoscopic cholecystectomy. Patients with acute cholecystitis, abnormal liver and renal functions, uncontrolled diabetes mellitus and hypertension, cholangitis, chronic cardiac disease, concomitant malignant disease, poor cardiopulmonary reserve, portal hypertension, coagulopathy, Corticobasal Degeneration (CBD) pathology, pregnancy and patients not giving consent and patients who underwent emergency surgery were excluded from the study.

Patients were randomised into two groups using a chit system:

Group I: Low pressure (<10 mm of Hg) pneumoperitoneum was used intra-operatively.

Group II: High pressure (>14 mm of Hg) pneumoperitoneum was used intra-operatively.

Thorough physical examination, appropriate laboratory investigations and pre-anaesthetic check-up was done prior to surgery. A standard laparoscopic cholecystectomy were included in the study with four ports was done by a group of experienced consultant surgeons. Under general anaesthesia, Supra-umblical incision was given and veress needle was inserted. Pneumoperitoneum, upto 12 mm of Hg, was reached 1st port was inserted. Pressure was raised to >14 mm of Hg in high pressure group and reduced to <10 mm Hg in low pressure group. Preoperative and intra-operative monitoring of vitals was done non-invasively. The various readings were recorded, documented and analysed.

STATISTICAL ANALYSIS

Statistical analysis was carried out by using unpaired t-test using 2018 GraphPad Software version. The p-value≤0.05 was considered to be significant.

RESULTS

Mean age of patients was 43.88 years with maximum patients in the fifth and sixth decade of their life. Out of 60 patients,11 were males (18.33%) and 49 were females (81.67%).

The operative time in the two groups was comparable statistically, although mean in group II was slightly more than group I [Table/Fig-1].

Groups	Mean (Minutes)	SD	p-value
Group I	58.53	5.91	0.917
Group II	58.70	5.57	

[Table/Fig-1]: Mean operating time (in minutes) in both the groups.
SD- Standard Deviation

The difference in serum bilirubin levels in both the groups, post-operatively, was non-significant (p=0.2562). Liver enzymes (AST and ALT) decreased in group I post-operatively but increased in group II post-operatively and this difference was found to be highly statistically significant (p=0.0001). Post-operatively, serum levels of ALP decreased in patients of both the groups and this difference was non-significant (p=0.8953) [Table/Fig-2].

Parameters	Group I (Mean±SD)	Group II (Mean±SD)	p-value
S. Bilirubin (mg/dL)			
Preoperative	0.64±0.26	0.68±0.27	0.5612
Post-operative	0.51±0.26	0.59±0.28	0.2562
AST (U/L)			
Preoperative	24.03±6.51	26.00±7.33	0.2756
Post-operative	23.13±5.77	34.46±1.25	0.0001
ALT (U/L)			
Preoperative	27.83±8.42	27.13±8.68	0.7523
Post-operative	26.03±7.81	35.93±1.40	0.0001
ALP (U/L)			
Preoperative	88.50±8.64	87.66±2.40	0.6098
Post-operative	87.03±9.25	86.80±2.24	0.8953

[Table/Fig-2]: Liver functions preoperatively and post-operatively in both the groups.
SD- Standard Deviation

The length of post-operative stay in the hospital was slightly more in high pressure laparoscopic cholecystectomy, with non-significant difference (p=0.3001) [Table/Fig-3].

The drain output in both the groups was comparable and found to be statistically non-significant (p=1.000) [Table/Fig-4].

Groups	Mean (Days)	SD	p-value
Group I	1.1	0.45	0.3001
Group II	1.21	0.36	

[Table/Fig-3]: The mean hospital stay in both the groups.
SD- Standard Deviation

Groups	Mean (mL)	SD	p-value
Group I	30	3.50	1.000
Group II	30	6.00	

[Table/Fig-4]: The mean drain output in both the groups.
SD- Standard Deviation

DISCUSSION

During the last decade, many studies have demonstrated many physiological changes in patients underlying laparoscopic procedure, due to creation of pneumoperitoneum which can be attributed to the mechanical effect of gas in the peritoneal cavity and due to chemical nature of gas used e.g., carbon dioxide [8,9].

Serum bilirubin level difference in patients undergoing low pressure and high pressure laparoscopic cholecystectomy was found to be statistically non-significant (p-value=0.2562). Singal R et al., when studying the effect of pneumoperitoneum concluded that bilirubin level is not altered significantly [10]. Post-operatively, it was found that serum levels of AST and ALT both are raised significantly (p=0.0001) in patients ungergoing high pressure laparoscopic cholecystectomy. Thus, it can be concluded that high pressure used for laparoscopic cholecystectomy has deleterious effects on AST and ALT. In a similar study by Ahmad NZ it was found that AST and ALT levels increased in patients who underwent HPPLC [11].

Serum levels of ALP decreased in patients of both the groups but this difference was non-significant (p-value=0.8953). Similar results were seen in study by Ahmad NZ et al., where significant levels were raised for AST and ALT with the exception of ALP [11].

Previously, it was debated that squeeze pressure effect on liver, diathermy use and general anaesthesia contribute to derangement of the liver function. But these parameters are present in both low pressure and high pressure laparoscopic cholecystectomy. Moreover, the alterations are still present in procedures other than laparoscopic cholecystectomy, which donot involve manipulation of the liver which indicates a common factor in all laparoscopic procedures is responsible for these altered liver enzymes. Similar results were found in study done by Rana ML et al., [6].

Due to CO_2 insufflation and increased intra-abdominal pressure there is reduced portal blood flow causing sub lethal ischemia of hepatocytes. Carbon-di-oxide has solubility in the blood and may cause hypercapnia with respiratory acidosis resulting in increased arterial pressure and peripheral resistance affecting overall hepatic perfusion thus leading to liberation of hepatic enzymes in the blood. Reperfusion injury i.e., sudden increase and decrease in intra-abdominal pressure in a short span of time during laparoscopic surgery can be causative factor. Increased intra-abdominal pressure triggers the neuro-humoural response of rennin-angiotensin-aldosterone system. Vasopressin and nor-epinephrine play a significant role in causing damage to hepatic function and thus elevating liver enzymes post laparoscopic surgery. These factors are responsible for significantly higher elevation of liver enzymes in high pressure pneumoperitoneum group [3,4].

In this study, it was noted that operating time was slightly more in high pressure pneumoperitoneum group (but the difference was non-significant statistically) though it is expected to be more in low pressure group due to less space for intervention and consequent difficulty. This can be due to more time taken by the insufflators to reach the higher pressure in group 2 and as all surgeries were

performed by experienced surgeons, low pressure did not pose a problem.

Limitation(s)

The study has a small sample size. It excludes patients who underwent emergency operations and the procedures which converted to open surgery.

CONCLUSION(S)

Based on the findings, it can be concluded that low pressure laparoscopic cholecystectomy is superior to high pressure laparoscopic cholecystectomy as it does not alter the liver enzymes and does not have any disadvantage in terms of operating time, when performed by experienced surgeons. However, the raised post-operative liver enzymes in high pressure laparoscopic cholecystectomy have no immediate clinical implications and further studies are advocated to know long term side effects. Therefore, in patients undergoing laparoscopic cholecystectomy, especially those with pre-existing deranged liver functions;low pressure laparoscopic cholecystectomy is preferred when performed by experienced surgeons.

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PARTICULARS OF CONTRIBUTORS:
1. Senior Resident, Department of Surgery, Government Medical College, Patiala, Punjab, India.
2. Professor, Department of Surgery, Government Medical College, Patiala, Punjab, India.
3. Senior Resident, Department of Anaesthesia, Government Medical College, Chandigarh, India.
4. Junior Resident, Department of Surgery, Government Medical College, Patiala, Punjab, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Sahil Garg,
Garg Trading Company, Main Bazar, Dist., Sherpur (Thana), Punjab, India.
E-mail: sahilgarg79@gmail.com

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