

Comparison of the Effect on Renal and Liver Functions of Low Pressure Versus Standard Pressure Pneumoperitoneum in Laparoscopic Cholecystectomy



Medical Science

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ABSTRACT

With advancement of medical practice in present era the introduction of laparoscopic surgeries has changed dramatically the management of gall bladder disease and establishing the laparoscopic cholecystectomy as the method of choice for treatment of uncomplicated cholelithiasis. This study is planned to evaluate the effect of low pressure versus standard pressure pneumoperitoneum in laparoscopic cholecystectomy on renal and liver function test and explore the physiological effect of both method of cholecystectomy. A total of 68 cases were enrolled; in the study group (LPP) n=33 cases were operated by creating low-pressure pneumoperitoneum and n=35 cases were operated under standard pressure pneumoperitoneum (SPP). Significant derangements in liver and renal functions were observed in SPP group where as LPP group showed non-significant changes in liver and renal functions. To conclude standard pressure pneumoperitoneum is associated with significant changes in liver and renal function test as compared to low-pressure pneumoperitoneum.

Introduction

Archaeological excavations demonstrating the presence of gallstones in young Egyptian woman have confirmed that cholelithiasis has plagued mankind over 2000 years. During last centuries numerous innovative and creative techniques have been introduced in an effort to manage patients with symptomatic gallstones disease. With advancement of medical practice in present era the introduction of laparoscopic surgeries has changed dramatically the management of gall bladder disease and establishing the laparoscopic cholecystectomy as the method of choice for treatment of uncomplicated cholelithiasis. Laparoscopic cholecystectomy has a number of advantages as compared to conventional therapy including improved patient's compliance and satisfaction and reduced cost but it is seen that in laparoscopic cholecystectomy commonly used method of creating pneumoperitoneum by carbon dioxide gas has few disadvantages in critically ill patients having cardiovascular respiratory and renal insufficiency¹⁻⁵. Carbon dioxide gas pneumoperitoneum causes hypercapnia or increase intra-abdominal pressure during laparoscopic cholecystectomy. It leads to decrease portal venous flow, decrease intra-abdominal blood flow and increase renal cell apoptosis⁶⁻⁸.

Standard pressure pneumoperitoneum employing a pressure range of 12-14 mmHg over prolonged period has been associated with adverse effects such as decreased pulmonary compliances, altered blood gas parameter, impaired functioning of the circulatory system, raised liver enzymes and renal dysfunction and even increased intra-abdominal venous pressure⁹⁻¹³. An emerging trend has been the use of low pressure for pneumoperitoneum in the range of 7-10mmHg instead of the standard pressure pneumoperitoneum in an attempt to lower the impact of pneumoperitoneum on human physiology while providing adequate working space^{12, 13}. On the other hand there are controversial studies showing that intraabdominal pressure ranging from 11-13 mm hg is not associated with compromised splanchnic circulation¹⁴. Due to all these observations gasless laparoscopic cholecystectomy is proposed by some surgeons to prevent disadvantages of carbon dioxide pneumoperitoneum.

This study is planned to further evaluate the effect of low pressure versus standard pressure pneumoperitoneum in laparoscopic cholecystectomy on renal and liver function test and ex-

plore the physiological effect of both method of cholecystectomy.

Material and Methods

The study was carried out in the department of General Surgery in Integral Institute of Medical Sciences and Research Lucknow in India over a period of one year from July 2013 to June 2014. Patient attending outdoor or emergency with complaints suggestive of cholelithiasis were selected for laparoscopic cholecystectomy in absence of other obvious pathology. The study was started only after taking ethical clearance from Institute Ethics Committee. The procedure was explained in detail and informed consent taken. Cases selected by random sampling using a random number table and divided into two groups. Patients who do not give consent or with acute cholecystitis and with complications of gallstones disease like gall bladder perforations, emphysema and common bile duct stones were excluded. Cases with grossly deranged liver function test or deranged renal function test preoperatively or who had undergone ERCP within one week before surgery and case of laparoscopic cholecystectomy converted into open cholecystectomy were also excluded from the study.

To evaluate the change in liver and renal functions two samples were taken in context to low pressure and standardized pressure laparoscopic cholecystectomy i.e. preoperative and postoperative day one. To evaluate liver function test, serum bilirubin (total, direct and indirect), SGOT, SGPT and alkaline phosphatase are taken as outcome variables. Similarly for renal function test serum urea and serum creatinine were evaluated. One group with n=33 patients under went laparoscopic cholecystectomy with standard pressure pneumoperitoneum at 14 mm hg while the other group with n=35 patients underwent laparoscopic cholecystectomy with low-pressure pneumoperitoneum at 8 mmHg. All the surgeries were performed by two experienced consultant surgeons. During all surgeries the first port was inserted at a pressure of 14mmHg. In the standard pressure group the pressure was taken up to 14mmHg whilst in the low pressure group the pressure was reduced to 8mmHg for the remaining duration of surgery. A standard laparoscopic cholecystectomy was performed with the insertion of four ports at the start of surgery.

Intraoperative monitoring was performed by monitoring heart rate and blood pressure noninvasively every 5 minutes. Closure of the rectus sheath was done at 10 mm ports at umbilicus site

and at the epigastric site using absorbable sutures. Skin was approximated at all the port sites using nylon 2-0 cutting sutures.

The anaesthetic protocol was same for both groups. Post-operative analgesia was administered in the form of injection diclofenac aqueous 8 hourly with additional doses where necessary. Patients were encouraged for early ambulation and were allowed oral intake 6 hours after surgery. They were discharged on day one following surgery.

Analysis of continuous data with normal distribution was analyzed by student 't' test and non-normally distribution data by Wilcoxon's rank sum test. Categorical data was analyzed by "chi-square test". A p-value<0.05 was taken as statistically significant.

Results

A total of 68 cases were enrolled; in the study group (LPP) n=33 cases were operated by creating low-pressure pneumoperitoneum and n=35 cases were operated under standard pressure pneumoperitoneum (SPP). Base line characteristics of both the groups are comparable. The duration of the operation was comparable in both the groups (table 1).

In SPP group the preoperative total bilirubin (0.80+/-0.36mg/ml) was significantly increased upto 100% compared to postoperative period (1.60+/-0.45mg/ml) (p<0.05). Changes in the values of aminotransferases were also remarkable in SPP group statistically. The preoperative SGOT (38.06+/-0.745U/ml) was significantly increased upto 79.6% postoperatively (68.3+/-0.982U/ml) (p<0.05). The preoperative SGPT (32.50+/-1.032U/ml) was significantly increased upto 67.07% postoperatively (54.3+/-0.612U/ml) (p<0.05). The preoperative alkaline phosphatase (68.4+/-1.022U/l) was significantly increased upto 29.69% postoperatively (88.7+/-0.192U/l) (p<0.05).

In LPP group though there was alteration in all values of liver function tests but the change was not statistically significant. Similar trend was observed when renal function tests were compared in SPP and LPP patients' pre and postoperatively.

Discussion

The advent of laparoscopic surgery has profoundly changed the way of management of patients with both the gallbladder disease and common bile duct stones. Laparoscopic cholecystectomy has become the 'gold standard' in the treatment of benign gallbladder diseases such as gallbladder stone and cholecystitis. The first step in laparoscopic cholecystectomy is creation of pneumoperitoneum to elevate the abdominal wall. Traditionally standard pressure is used employing the pressure range of 12-14 mmHg. This allows visualization and manipulation of internal organs inside the abdominal cavity. The normal intra-abdominal pressure of non-obese individuals is 5 mmHg or less¹⁴ in contrast morbidly obese patients have a chronically elevated intra-abdominal pressure at 9 to 10 mmHg¹⁵.

The increased intra-abdominal pressure due to pneumoperitoneum causes several cardiopulmonary changes and decreased pulmonary compliance, altered blood gas parameters, impaired functioning of the circulatory system, which have been proved in various studies. In animal and human studies the increased intra-abdominal pressure at 15 mmHg has been shown to reduce portal venous flow¹⁶.

In a clinical study of laparoscopic cholecystectomy, Lakimowics et al reported a 53% reduction in portal blood flow with abdominal insufflations to 14 mmHg. A reduction in portal venous blood flow during pneumoperitoneum may lead to hepatic hypoperfusion and acute hepatocyte injury. Portal hypoperfusion can lead to transient elevation of liver enzymes. Understanding the effect of pneumoperitoneum on portal venous flow is particularly important in the morbidly obese as these patients often

have pre-existing liver disease.

Pneumoperitoneum has a direct pressure effect on the renal cortical blood flow. In a swine model, Chie et al¹⁷ reported that superficial renal cortical perfusion decreased by 60% with abdominal insufflations and returned to baseline level after disinflation. In addition intra-operative release of certain hormones such as antidiuretic hormone (ADH), plasma rennin activity and serum aldosterone may diminish urine output.

In this study reason behind significant changes in liver functions in SPP group may be due to hepatic hypoperfusion caused by increased intra-abdominal pressure leading to hepatocytes damage, free radicals generation at the end of a laparoscopic procedure, possibly as a result of an ischemia-reperfusion phenomenon induced by the inflation and deflation of the pneumoperitoneum. Free radicals can damage tissues and organs, especially the kupffer and the endothelial cells of the hepatic sinusoids. Therefore the elevated intra-abdominal pressure due to pneumoperitoneum may be responsible for the increase of liver enzymes after laparoscopic cholecystectomy. Similarly changes in renal function can occur due to decrease in cortical blood flow, due to increase in intra abdominal pressure, release of certain hormones such anti diuretic hormones (ADH), plasma rennin activity and serum aldosterone may diminish urine output.

Conclusion

Standard pressure pneumoperitoneum is associated with significant changes in liver and renal function test as compared to low-pressure pneumoperitoneum.

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Table 1: Base line characteristics

Parameter	Low-Pressure Pneumoperitoneum	Standard Pressure Pneumoperitoneum	P value
Age (Years)	34+/-3.1	33+/-2.78	NS
Sex (M:F)	14:19	16:19	NS
Weight (kgs)	52.34	49.62	NS
Duration of Operation (Minutes)	40+/-6.22	36+/-4.59	NS

Mean+/-SD

Table 2: Liver and renal function tests in SPP and LPP patients

Group	Standardized Pressure Pneumoperitoneum			Low Pressure Pneumoperitoneum		
	Pre-operative	Postoperative day-1	P Value	Pre-operative	Postoperative day-1	P Value
S.Bilirubin Total(mg/dl)	0.80+/-0.360	1.60+/-0.45	<0.05 (0.005)	0.86+/-0.24	1.32+/-0.36	>0.05 (0.6108)
SGOT(U/ml)	38.06+/-0.745	68.30+/-0.982	<0.05 (0.003)	43.11+/-0.9632	46.03+/-1.179	>0.05 (0.1282)
SGPT(U/ml)	32.50+/-1.032	54.30+/-0.612	<0.05 (0.0002)	31.45+/-0.253	33.36+/-1.251	>0.05 (0.2083)
S. Alkaline phosphatase (U/ml)	68.4+/-1.022	88.71+/-0.1921	<0.05 (0.0045)	64.45+/-0.801	67.69+/-1.421	>0.05 (0.1172)
Blood Urea(mg/dl)	25.32+/-0.024	43.076+/-1.012	<0.05 (0.0001)	33.78+/-0.946	34.69+/-1.733	>0.05 (0.6677)
Serum creatinine (mg/dl)	0.89+/-0.055	1.47+/-0.081	<0.05 (0.0041)	0.82+/-0.080	1.063+/-0.086	>0.05 (0.1114)

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