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Laparoscopic Cholecystectomy at low pressure VS standard pressure pneumoperitoneum: A comparative study

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ABSTRACT

Background: Laparoscopic cholecystectomy is established as gold standard for management of cholelithiasis, the current trend is towards patient safety and satisfactory results. Hence this study was undertaken to compare the low pressure pneumoperitoneum (LPP 8-10mm Hg) versus standard pressure pneumoperitoneum (SPP 12-14mmHg) in patients undergoing laparoscopic cholecystectomy with main areas of interest are operative duration, intra-operative gas consumption, bile spillage, postoperative ileus assessed by return of bowel sounds, passage of flatus and tolerance of oral feed.

Methods: 50 patients in the age group of 30-60 years with uncomplicated gallstone diseases were randomized into the LPP(8-10mmHg) and the SPP (12-14 mmHg) group (n=25) prospectively. Difficulty in secondary port insertion, contact of trocar to visceral peritoneum, major vascular injury, organ injury, visibility and difficulty of Calot's triangle dissection, time for dissection of Calot's triangle, bile spillage, intra-operative gas consumption, mean duration of procedure, postoperative pain and nausea, early return of bowel activity and early tolerance to oral feed were assessed.

Results: There was significant difference in terms of difficulty in secondary port insertion, visibility and difficulty of Calot's triangle, time for dissection of Calot's triangle, duration of procedure, intra-operative gas consumption, post-operative pain and nausea, early return of bowel activity and early tolerance to oral feed.

Conclusions: Laparoscopic Cholecystectomy is safe and feasible at 8-10 mmHg. Further studies are required to establish the application of using low pressure pneumoperitoneum in laparoscopic cholecyustectomy.

Keywords: Low pressure pneumoperitoneum, Laparoscopic cholecystectomy, Standard pressure pneumoperitoneum.

INTRODUCTION

Gallstones are known ever since dawn of civilization and have always put the man in trouble.[1] Cholecystectomy is one of the commonest procedure these days. Now, days laparoscopic cholecystectomy is the procedure of choice in all gallbladder diseases. [2]During laparoscopic procedure creation of pneumoperitoneum by carbon dioxide insufflations is most widely accepted technique for adequate working space and patient safety.[3,4]The standard pressure foe pneumoperitoneum 12-14 mm Hg, over prolonged periods is associated with decrease of pulmonary compliance, altered blood gas parameters, decrease in cardiac output, impaired renal, hepato-portal and splanchnic blood flow along with impairment of venous return.[5,6,7,8] Therefore a rising trend has been the use of low pressure pneumoperitoneum 8-10 mmHg in an attempt not to alter the human physiology and also

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providing adequate working space at the same time. One important advantage in low pressure pneumoperitoneum is decrease shoulder tip pain and better quality of life in post operative period. The present study proposes to compare the use of the low pressure pneumoperitoneum with standard pressure pneumoperitoneum in patients undergoing laparoscopic cholecystectomy with main areas of interest will be difficult in secondary ports insertion, contact of parietal peritoneum to visceral peritoneum, major vascular or hollow viscera injury, visibility and dissection of Calot's triangle, duration for Calot's triangle dissection, bile spillage, intra-operative gas consumption, post operative ileus assessed by return of bowel sounds, passage of flatus and tolerance of oral feed.

METHODS

The study was conducted in the department of general surgery at Guru Gobind Singh Medical College and Hospital, Faridkot, Punjab, India over a period of 12 months.50 consecutive patients in the age group of 30-60 years with uncomplicated gallstones were included in this study. Exclusion criteria include patients with acute cholecystitis, patints having history of previous abdominal surgery, coagulation disorders, pregnancy, malignancy, chronic obstructive pulmonary disease, coronary artery disease and cerebrovascular accident.

Ethical clearance from the Institute Ethics Committee was taken. The details of procedure were explained to patients and informed consent was taken before procedure. This study was done in randomized prospective manner with a sample size of 50 patients. Patients were divided into two groups Group A study group and Group B control group using randomization software with 25 patients in each group.

A standard laparoscopic cholecystectomy was performed using four port technique. After induction of general anesthesia primary port was inserted at infraumblical region open Hasson's technique and pneumoperitoneum created using carbon dioxide. Pressure of pneumoperitoneum was set at 8-10mm Hg in study group and pressure of 12-14 mm of Hg in control group. Rest of three ports, first port of 10mm in epigastric region, second port of 5mm in mid clavicular line and third port of 5mm in anterior axillary line were inserted under laparoscopic vision using 30 degree telescope. The patient was then placed in Reverse Trendelenberg position with 15 degree right shoulder up. Titanium ligaclips were used to secure cystic duct and cystic artery. Gallbladder was separated from gallbladder fossa using electro cautery and was extracted through epigastric port. A 14 Fr vaccum drain was inserted in the right sub hepatic space. The fascial defect of umbilical incision was closed using No.1 Vicryl. The skin incisions were closed using Nylon 2-0. After completion of procedure and extubation patients were shifted to recovery room .For comparison between two groups special attention was paid on following outcomes:

- Difficulty in secondary port insertion was compared in both groups.
- Contact of parietal peritoneum to the visceral peritoneum during secondary port insertion was compared.
- Intra-operative time of calot's triangle, visceral/vessel injury, bile spillage, intra-operative gas consumption during operation was noted.
- Operative time was noted starting from time of making incision to time of skin closure.
- Post-operative pain and nausea in both groups.
- Post-operative ileus was measured with three parameters taking return of bowel sounds, passing flatus and tolerance of oral feed in both groups compared.

STATISTICAL ANALYSIS

Quantitative variables were compared using unpaired t-test between the two groups. Qualitative variables were compared using Chi-Square test. A p value of <0.05 was considerable statistically significant. The data was entered in MS EXCEL spreadsheet.

ISSN:0975-3583,0976-2833 VOL12,ISSUE05,2021

RESULTS

- Both groups were matched for age and sex. Most of the patients in our study are females in the age group of 40-50 years. (Table 1,2)
- Difficulty in secondary port insertion was present in study group. There was statistical significant value ($p<0.05$). (Table 3)
- There was no contact of trocar to visceral peritoneum, no Major vascular injury and no organ injury was observed in either group. (Table 3)
- There was visibility and difficulty of Calot's triangle dissection was present in study group which was statistically significant value ($p<0.05$). (Table 3)
- The mean time for dissection of Calot's triangle was 36±2 minutes study group as compared to 25±2.8 minutes for control group,which was statistically significant value ($p<0.05$). (Table 3)
- There was no statistical difference in terms of bile spillage. (Table 3)
- There was one patient in study group which needed conversion to open surgery due to adhesions in the Calot's triangle. (Table 3)
- The mean duration of procedure in the study group was 88±5 minutes as compared to control group which was 71±5 minutes which was statistically significant value ($p<0.05$). (Table 3)
- The mean consumption of gas volume in study group was 123±3.3 liters as compared to control group which was 142±6 liters, which was statistically significant value ($p<0.05$). (Table 3)
- 28% of patients in control group complained of pain and which was statistically significant value ($p<0.05$). (Table 4)
- There was early return of bowel activity and early tolerance to oral feed in study group which was statistically significant value ($p<0.05$). (Table 4)
- Mean duration of hospital stay was 2 days which was non-significant. (Table 4)

TABLE 1 : AGE DISTRIBUTION

AGE GROUP (Years)	GROUP-A (Study Group)	GROUP-B (Control Group)	Total
30-40	6 (24.0%)	7 (28.0%)	13 (26.0%)
40-50	13 (52.0%)	15 (60.0%)	28 (56.0%)
50-60	6 (24.0%)	2 (8.0%)	8 (16.0%)
>60	0 (0%)	1 (4.0%)	1 (2.0%)
Total	25 (100.0%)	25 (100.0%)	50 (100.0%)
Mean±SD	46.00±6.78	45.24±6.98	45.62±6.80

Most of the patients were in the age group of 40-50 years.

TABLE 2: GENDER DISTRIBUTION

Gender	GROUP-A(Study Group)	GROUP-B(Control Group)	Total
Female	25 (100%)	23 (92%)	48 (96%)
Male	0 (0%)	2 (8%)	2 (4%)
Total	25	25	50

There were 25 female patients in the study group and 23 female and 1 male patients in the control group. The ratio of female to male in this study was 21:1.

ISSN:0975-3583,0976-2833 VOL12,ISSUE05,2021

TABLE 3: INTRAOPERATIVE FINDINGS

Group / Operative Finding	Difficulty in secondary port insertion	Contact of trocar to visceral peritoneum	Vascular injury	Visceral Organ injury (Solid/ Hollow)	Visibility & difficulty of Calot's triangle dissection	Mean time for dissection of Calot's triangle (Min)	Any spillage of stone/bile	Conversion to open procedure	Mean duration of surgery (min)	Mean volume of gas consumption (litres)
Group-A (Study Group) N=25	17 (68 %)	NIL	NIL	NIL	7 (28%)	(36±2)	2 (8%)	1 Converted (4%)	(88±5)	(123±3.3)
Group-B (Control Group) N=25	NIL	NIL	NIL	NIL	NO	(25±2.8)	2 (8%)	NIL	(71±5)	(142±6)
Statistical significance	p-Value =0.001(Sig)	NS	NS	NS	p-Value =0.004 (Sig)	p-Value =0.001 (Sig)	NS	NS	p-Value =0.001 (Sig)	p-Value =0.001 (Sig)

TABLE 4: POSTOPERATIVE FINDINGS

Group-A (Study Group) N=25	NIL	7.3 ± 1.6	10 ± 2	NIL	2
Group-B (Control Group) N=25	7 (28%)	14 ± 2	19.7 ± 4	NIL	2
Statistical significance	p-Value =0.004 (Sig)	p-Value =0.001 (Sig)	p-Value =0.001 (Sig)	NS	NS

DISCUSSION

There is widespread use of laparoscopic cholecystectomy around the world since the first laparoscopy cholecystectomy was reported in 1987. During this time, there have been some modifications to the approach, such as a reduction in number of ports from four to three and adverse side effects including circulatory, respiratory and kidney problems have been reported with high pressure pneumoperitoneum. The aim was to reduce the trauma during access and maintain appropriate exposure of surgical field during surgery. To achieve this

ISSN:0975-3583,0976-2833 VOL12,ISSUE05,2021

surgeons have traditionally relied on creating a pneumoperitoneum of upto 14-15 mmHg by insufflating carbon dioxide gas into peritoneal cavity at the time of insertion of ports. This has the desired effect of raising the abdominal wall away from viscera giving room to visualize the gall bladder and surrounding organs, allowing manipulation of instruments and also allowing the intestine to fall away from sub hepatic space when the patient is positioned properly. However, pneumoperitoneum with carbon dioxide gas at the pressures commonly used has been shown to be associated with unique and specific side effects. To negate these specific problems, the concept of low pressure pneumoperitoneum with carbon dioxide has been introduced. There are the studies which have indicated that the use of low pressure pneumoperitoneum during laparoscopic cholecystectomy is associated with better intraoperative tolerance.

Total number of patients in our study was 50. Majority of the patients in our study were in the age group of 40-50 years. Same ratio was seen in both study and control groups. 49 out of 50 (96%) patients were females (F>M), as it was seen that gall stone disease was more common in female population. In a study by Gohit et al. majority of patients belonged to age group 30-40 years. 39 out of 50 (78%) patients were females (F>M). Similar age and sex distribution was seen in other studies like Kanwer et al., Barczynski et al. and Haribhakti et al.[9,10]

In our study there was difficult in insertion of 2nd, 3rd and 4th ports in study group at low pressure pneumoperitoneum. We suggest that these ports should be inserted carefully and by experienced surgeons, who are fully trained in laparoscopic surgeries. In a similar study by Aggarwal Nitin and Sharma Ashish difficulty was encountered in placing the 2nd, 3rd and 4th ports.[11] As mentioned this problem was partly circumvented by initially piercing the anterior abdominal fascia with a blade and by sometimes using slightly oblique tracts. Anticipating this, others in similar situations have used a higher pressure initially for port placement. According to similar study by Sandhu et al.[12]at low pressure pneumoperitoneum insertion of port was more difficult and thus extra care is necessary to avoid injury to the viscus. We suggest that in view of safety of the patient concern pressure of carbon dioxide can be increased according to requirements.

In our study in patients of study group difficulty was encountered in visibility and dissection of Calot's triangle. No difficulty was found in control group. This difficulty at different pressures of pneumoperitoneum has been reported in many similar comparative studies. Joshipura et al.[13] compared three parameters related to operative comfort that is vision space for dissection and vision while using suction. They observed difference in favor of the higher pressure group in all three parameters, but they were not statistically significant. In our study this parameter had statistically significant value, because there was difficulty in the visibility of operative field in the study group and we believe that it can be overcome by experience.

The mean duration of dissection time for Calot's triangle in study group was 36±2 minutes and for control group was 25±2.8 minutes and the difference value was statistically significant value. In similar studies by Gurusamy KS and Davides D, no difference has been reported in the dissection time and complication rates.[8,14] The duration was more in study group because of limited space for dissection of Calot's triangle.

The mean duration of procedure was 71.6 minutes in control group and of 88.0 minutes in study group. The difference was statistically significant due to limited visual field. Our result is comparable with Kanwer et al.[10] study in which the mean duration of laparoscopic cholecystectomy in standard pressure group was 40.1 minutes and mean duration of procedure in low pressure group was 56.4 minutes with minimum of 40 minutes and maximum of 75 minutes. Our result was comparable with other studies like Sandhu T et al., Barczynski M et al., Haribhakti SP et al.[9 12]

In our study the mean consumption of carbon dioxide gas was less in low pressure group as compared to standard pressure group with statistical significance value. In a similar study by

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Salil Mahajan,[15] mean consumption of CO2 was less in low pressure pneumoperitoneum group compared to high pressure pneumoperitoneum laparoscopic cholecystectomy with no statistical difference. In a similar study by Songra Bhupen et al., intraoperative gas consumption was more in high pressure group as compared to low pressure group which was statistically significant. The increased intra-abdominal pressure increases the absorption of CO_2, causing hypercapnia and acidosis, which has to be avoided by hyperventilation.[16]
Carbon-dioxide pneumoperitoneum also predisposes to cardiac arrhythmias. During the early phase of pneumoperitoneum, there is reduction in the cardiac output by decreasing the venous return.[19]
Post-laparoscopy pain syndrome is well recognized and is characterized by abdominal and shoulder tip pain; it occurs frequently following laparoscopic cholecystectomy. In our study the pain and nausea was more in standard pressure group as compared to low pressure group which was statistically significant value. In a study conducted by Aggarwal Nitin, he concluded that higher pressures of pneumoperitoneum predisposes to worse pain scores after laparoscopic cholecystectomy.[11]After adequate binding of patients to eliminate bias, two studies report significant decrease in overall pain with low pressure. These findings were in accordance with findings in studies by Kanwer et al. and Topcu HO et al. Guruswamy KS et al.[17,18]They found that the intensity of pain was lower in low pressure group. Another study by Faisal et al. also demonstrated similar results.[20]
Some investigators have shown a reduction in the duration of postoperative ileus after laparoscopic procedures. Post-operative ileus is characterized by inability to tolerate a solid diet, delayed passage of flatus and formed stools and abdominal distension, nausea, vomiting and accumulation of gas and or fluid in the bowel. It has been traditionally accepted as a normal response to tissue injury.[21,22] This partly explains the faster recovery after minimal invasive surgery. In our study there was early return of bowel movements in low pressure group as compared to standard pressure group which was statistically significant value. In low pressure group there was early acceptance of oral feed as compared to standard pressure group, which was statistically significant. In a similar study by Salil Mahajan and Manu Shankar there was early return of bowel sound in low pressure group at 6 hours.[15] They concluded that low pressure pneumoperitoneum causes early recovery of gastrointestinal system from ileus. No complications were found in either of two groups. In none of patient was required of shift from low pressure to standard pressure. Only in one patient procedure was converted to open procedure due to adhesions around Calot's triangle.

CONCLUSION

The following conclusions have been drawn from our study: most of the patients are in the age group of 40-50 years and are females. It is safe to insert secondary ports in laparoscopic surgery at low pressure. Although it is difficult to insert secondary ports at low pressure pneumoperitoneum but can be overcome by experience. There was significant difference in difficulty in secondary port insertion ,visbilty and difficulty of Calot's triangle dissection,duration for Calot's triangle dissection, mean volume of gas consumption and mean duration of surgery. The main advantage of low pressure pneumoperitoneum is decreased postoperative pain, nausea and early return of bowel activity. Further studies are required to established the safety and application of using low pressure pneumoperitoneum in laparoscopic cholecystectomy.

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