

Original Research Article

Safety and feasibility of three port procedure in laparoscopic cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy is widely accepted gold standard technique for management of cholelithiasis and has undergone many refinements including decrease in size and number of ports. Many researchers have claimed that three-port laparoscopic cholecystectomy is safe and feasible method for management of cholelithiasis but still it is not performed widely by the surgeons. Objective of our study was to assess the safety and feasibility of three-port laparoscopic cholecystectomy by comparing the various defined parameters with the standard four-port laparoscopic cholecystectomy.

Methods: The study included 100 patients and was divided equally in 2 groups. Patients in Group A underwent laparoscopic cholecystectomy by three-port technique and in Group B were operated by four-port technique. Patients in both the groups were compared in terms of operative time, intra-operative complications, post-operative pain, post-operative complications and cosmesis outcome.

Results: The mean operative time was similar in both groups. Intra-op and post-op complications were also similar. 3 patients in Group A needed fourth port and 1 patient in both group required conversion to open cholecystectomy. Mean pain score and requirement of parental analgesia was found to be lower in Group A. Duration of hospital was similar in both the groups. Patients in group A had slightly better cosmetic outcome.

Conclusions: Three-port laparoscopic cholecystectomy is a minimally invasive, safe and feasible technique and is not difficult to master than other advanced techniques. In experienced hands, laparoscopy cholecystectomy can be initially started with three-ports and can be converted to four-port if rarely necessary.

Keywords: Laparoscopic cholecystectomy, Cholelithiasis, Three port cholecystectomy

INTRODUCTION

Gallstones are significant health problem worldwide, affecting 10% to 15% of adult population.¹ They are asymptomatic in majority of the cases. Approximately 1-2% of asymptomatic patients will develop symptoms per year requiring surgery, making cholecystectomy one of the most common operations performed by surgeons. Laparoscopic cholecystectomy is one of the most commonly performed surgery in practice.² Prof. Dr. Erich

Mühe of Böblingen, Germany, performed the first laparoscopic cholecystectomy on September 12, 1985. Today laparoscopic cholecystectomy is the gold standard procedure in gallstone diseases.³⁻⁵ Standard laparoscopic cholecystectomy is done by using 4 ports.

With increasing surgeon experience, laparoscopic cholecystectomy has undergone many refinements including reduction in port number and size.⁶⁻⁹ The fourth port is used to retract the liver for better exposure of

Calot's triangle (French technique) or to grasp the fundus of the gallbladder, pulling upward and outward to expose the Calot's triangle (American technique). As experience accumulated with the use of four ports in laparoscopic cholecystectomy, many surgeons found that the most lateral port played a minor role in the operation and therefore decided to omit the most lateral port and perform the operation with only three ports, which could be done easily.¹⁰ It has been argued that the fourth port may not be necessary, and laparoscopic cholecystectomy can be performed safely without using it. Cooperative manipulation of the surgical instruments is very important for this procedure, for exposing Calot's triangle and dissecting the gallbladder from the gallbladder bed when using the three-port techniques.

Further, in the era of laparoscopic surgery, less postoperative pain and early recovery are major goals to achieve better patient care and cost effectiveness. Surgery itself is a trauma to the patient and the response to that trauma increases depending on the severity of the injury. Hence, minimizing the trauma should be one of the main objectives of performing a procedure. Several studies have demonstrated that less postoperative pain is associated with a reduction in either size or number of ports.¹¹ Reducing the number of ports is indicated as means of further minimizing post-operative pain, allowing a rapid return to activity and work, and obtaining patient satisfaction and better cosmetic result.

This study was designed to assess the safety and feasibility of three-port laparoscopic cholecystectomy by comparing it with the standard four-port in terms of various defined parameters.

Safety was evaluated in terms of performing three-port procedure without any major complications like common bile duct injury, major vessel injury or visceral injury.

Feasibility was evaluated in terms of performing three port procedure without much difficulty, need of one less assistant and assessment of operative time, postoperative pain score using a 10-cm unscaled visual analogue score (VAS) need of analgesia, duration of hospital stay, cost-effectiveness, cosmetic satisfaction.

METHODS

This study was conducted in the Department of Surgery, Uttar Pradesh University of Medical Sciences, Saifai, Etawah from January 2017 to July 2018 considering inclusion and exclusion criteria. Careful history along with thorough physical and general examination was done. An informed consent was taken. Patients with symptomatic gallstone disease based on physical findings and ultrasonography of abdomen were taken under the study. This was a prospective randomise control study in which 100 patients were included. Patients were divided in 2 groups (Group A & Group B) using computer generated random numbers. 50 patients in Group A were

operated by three-port laparoscopic cholecystectomy and 50 patients in Group B were operated by four-port laparoscopic cholecystectomy. All patients with uncomplicated symptomatic gallstone disease, patients presented within 72 hours of development of acute cholecystitis and who were willing to undergo laparoscopic cholecystectomy for cholelithiasis and have signs of cholecystitis detected during the operation were included in the study. Patients not giving consent for participation in the study, patients with acute cholecystitis for >72 hours, with impaired liver function test, GB perforation, empyema gall bladder, suspected GB malignancy, choledocholithiasis, significant portal hypertension, deranged coagulation profile, those who underwent additional surgical intervention at the same time as laparoscopic cholecystectomy, and patients unfit for general anesthesia were excluded from the study.

Operative technique- Before shifting the patients to the OT, they were asked to pass urine. After induction of anesthesia, every patient was given pre-operative Injection Ceftriaxone 1gm i.v stat routinely (after prior sensitivity). The operating surgeon and the assistant stood to the left of the patient and scrub nurse stood on the right side of the patient. Three ports were inserted, umbilical, epigastric and right subcostal. The first 10mm port was inserted just below the umbilicus for videolaparoscope by closed technique using veress needle. Pneumoperitoneum was created by insufflating carbon dioxide gas. The camera was handled by the assistant. Epigastric (11 mm) and right subcostal port (5mm) were inserted under vision (Figure 1).

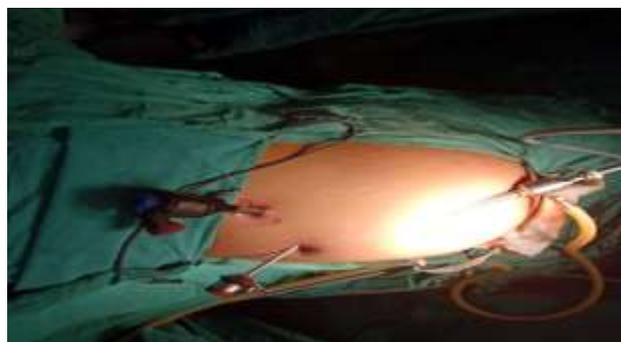


Figure 1: Position of the ports.



Figure 2: Retraction of gall bladder via subcostal port.

The operating surgeon holds the dissecting instrument in the right hand through the epigastric port (11 mm) and holding the infundibulum of the gall bladder with grasper in the left hand through the right subcostal port (5 mm). Gallbladder was retracted with the 5 mm port and dissection was done through epigastric port in Calot's triangle to display cystic duct and cystic artery (Figure 2).

After dissection, cystic duct and artery were secured by titanium clips and cut (Figure 3).



Figure 3: Application of clip over cystic duct.

Gallbladder was dissected out from the GB fossa using hook diathermy. In the four-port laparoscopic cholecystectomy, as described above, the operating surgeon and the assistant stood on the left of the patient, and scrub nurse to the right. Umbilical, epigastric and right subcostal port were inserted similarly as described in three-port LC. Here an additional 4th port (5mm) was placed at the level of umbilicus in right anterior axillary line. Through the 4th port, grasper was inserted to retract the GB (American technique) upward, backward and laterally for which one more assistant was required. Dissection of Calot's triangle was done with epigastric and subcostal ports. Rest of procedure was same as described in three-port laparoscopic cholecystectomy.

Intra-operatively patients were observed for difficulty in surgery in terms of operative time, bile spillage, conversion to four-port or open procedure, need of drain placement, any major intra-operative complications. In post-operative period, patients were evaluated for pain score using visual analogue, intramuscular analgesia requirement, drain output and content, jaundice and duration of hospital stay. Cosmesis score was evaluated 6 weeks after the surgery using subjective satisfaction score. Patients were asked about the number and appearance of the scar and as per patient's satisfaction, a score was evaluated ranging from 1-10. A higher score signifies a greater satisfaction of the physical appearance of the scar.

Statistical analysis

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean and SD. Quantitative variables were compared

using Mann-Whitney U Test (when the data sets were not normally distributed) between two groups. Qualitative variables were compared using Chi-Square test/Fisher's exact test as appropriate. A p value of <0.05 was considered statistically significant. The data analysis was done using Statistical Package for Social Sciences (SPSS) version 16.0.

RESULTS

Patients in both groups were similar in terms of demographic characteristics (Table 1).

Table 1: Age-wise distribution of patients in 2 groups.

Age group (in years)	Group A (n=50)		Group B (n=50)		Total (n=100)	
	No.	%	No.	%	No.	%
18-35	26	52	23	46	49	49
36-50	14	28	15	30	29	29
51-60	8	16	9	18	17	17
Above 60	2	4	3	6	5	5
Min-Max (Median)	18-74 (35.0) years		20-70 (40.0) years		18-74 (37.5) years	
Mean±SD	38.34±13.76 years		41.24±14.16 years		39.79±13.97 years	

Table 2: Comparison of operative time in both the groups.

	Groups	Mean	SD	P value
Operative time (in min)	Group A	38.96	12.93	0.418
	Group B	41.02	12.41	

SD= Std. deviation.

The male:female ratio in both the group was 5.2:1. In group A 8 (16%) patients had history of previous abdominal surgery in group B it was 6 (12%). The mean of duration surgery in group A was 38.96±12.93 minutes and in group B it was 41.02±12.41 minutes (p>0.05) (Table 2).

In our study, out of 50 patients in Group A, 3 patients required fourth port. In 2 patient dense adhesions was present in Calot's triangle obscuring the normal anatomy and causing difficulty in dissection and in 1 patient enlarged lobe of liver was present causing difficulty in handling the gallbladder. 1 patient from both the groups was converted to open procedure. Reason of conversion in group A was frozen Calot's triangle with contracted gallbladder and in group B it was bleeding from cystic artery. Conversion rate to open procedure in both the group was same. There was no case of CBD or viscus injury in present study. In group A bile spillage was found in 9 (18%) patients and in group B it was noted in 11 (22%) patients. Sub-hepatic drain placement at the end of surgery was required in 2 patients in group A and 3 patients in group B. The mean pain score in group A at 3

hours, 6 hours, 12 hours and 24 hours after the surgery was calculated, and the values were 5.94, 4.26, 2.84 and 1.44 respectively and in group B it was calculated to be 7.70, 5.74, 3.56 and 1.86 respectively (Table 3). $P < 0.05$ which was considered significant.

Table 3: Comparison of mean pain score on VAS.

	Groups	Mean	SD	P value
Pain score on VAS 3 hr	Group A	5.94	0.98	<0.001
	Group B	7.70	0.58	
Pain score on VAS 6 hr	Group A	4.26	0.92	<0.001
	Group B	5.74	0.63	
Pain score on VAS 12 hr	Group A	2.84	0.65	<0.001
	Group B	3.56	0.70	
Pain score on VAS 24 hr	Group A	1.44	0.50	<0.001
	Group B	1.86	0.61	

SD= Std. deviation.

Table 4: Comparison of hospital stay.

	Groups	Mean (days)	SD	P value
Hospital stay (in days)	Group A	1.26	0.69	0.664
	Group B	1.32	0.68	

SD= Std. deviation.

Analgesic requirement was measured as number of parental doses post-operatively needed (each of 75 mg diclofenac). Mean number of doses required in group A was 2.24 and in group B was 2.50 ($p > 0.05$). The difference was statistically significant indicating lesser analgesic requirement in the three-port group. The mean duration of post-operative hospital stay in group A was 1.26 days and in group B was 1.32 days and was statistically insignificant (Table 4).

In our study, port site infection occurred in 2 patients in group B. In both patients epigastric port was infected. In group A 1 patient develop port site infection. In our study, Gallbladder was routinely extracted from epigastric port and can be a possible reason for infection of this port due to the associated spillage of the bile. Post-operatively two patients in four-port group had collection of 30cc and 70cc which was managed by ultrasound guided aspiration and antibiotics. Both patients recovered uneventfully. The mean cosmesis score was evaluated 6 weeks post-operatively using subjective satisfaction score. In group A the score was 7.9 and in group B it was 7.6 and was statistically insignificant. The reason may be, in most of the patients the scar of fourth 5mm port was hardly visible after 6 weeks. Some patients were less satisfied with the outcome of epigastric scar. Overall, patients in both the groups were satisfied with outcome of the surgery except those who were converted to open procedure. There was no port site hernia or any delayed complication in any patients. None of the patients develop jaundice post-operatively and there was no mortality.

DISCUSSION

Laparoscopic cholecystectomy is one of the most commonly performed abdominal surgery worldwide. It is undergoing regular refinements with growing technology in order to make it safer, more cosmetic and more cost effective. Though four-port laparoscopic cholecystectomy is acceptable gold standard for gallstone diseases, a lot of modifications of this technique are waiting for making new standards. In the present study, reduction in number of ports to 3 by omitting the 4th lateral port has shown positive results without compromising the procedure safety.

In our study, groups were comparable in terms of age and sex. Mean age of the patients undergone three-port laparoscopic cholecystectomy was 38.34 years and in four-port laparoscopic cholecystectomy was 41.24 years. This was similar to study done by Kumar et al in which mean age of patient in three port group was 38.7 ± 13.7 years and in four- port group it was 39.13 ± 14.1 years.¹² Female to male ratio in both groups in our study was 5.2:1. This was similar to study done by Al-azawi et al who had F:M to be 4:1 in both the groups.¹³

The mean of duration surgery in group A was 38.96 ± 12.93 minutes and in group B it was 41.02 ± 12.41 minutes. Mean duration of surgery in patients operated by three-port technique was slightly less than in patients operated by four-port, though the result was statistically insignificant. Mayir et al reported mean operative time in three-port group to be 31 ± 9.1 minutes and in four-port group to be 31.6 ± 7.6 minutes which was statistically insignificant.¹⁴ Trichak performed study on 200 patients and reported the operative time in three port group was 59.2 to + 22. 97 minutes and in four-port group it was 57.05 ± 16.58 minutes, though it was statistically insignificant.¹⁰ Multiple other studies reported operative time for the three-port and four-port laparoscopic cholecystectomy similar to the present study.^{15,16} Three-port laparoscopic cholecystectomy may have shorter operative times because less operative time is spent inserting additional trocar and suturing. Additionally, all the instruments except the camera are handled by the operating surgeon. In contrast, instruments used to manipulate the fundus are held by assistants in four-port laparoscopic cholecystectomy and the surgeon must spend additional time orienting the assistant and correct positioning.¹⁷

In our study operative times were found to be longer in patients with elongated gallbladder, dense adhesions in Calot's triangle, intra-abdominal adhesions and contracted intrahepatic gallbladder which was similar to observations of Kumar et al and Mayir et al.^{12,17}

In our study the conversion rate to four-port laparoscopic cholecystectomy was 6% which was similar to the studies of Kumar et al and Sharma et al.^{12,18} However lesser conversion rates were observed by Sinha et al (2.5%) and

Al-azawi et al (2.8%). Therefore, by analyzing the results of above mentioned studies, it can be concluded that there is no significant difference in conversion rates in both the groups. However surgeon should not hesitate in converting the three-port laparoscopic procedure to four-port or open technique, whenever required, because mostly these difficult cases are the ones where the probability of injury to other vital structures increases.

The comparison of mean pain score using VAS in our study showed results in favour of three-port ($p < 0.01$). Trichak and Gupta A et al. reported VAS score to be less in three-port than in four-port group which correlated with our study ($p < 0.01$).^{10,19} Less postoperative pain can be attributed to reduction in number of port from four to three without compromising the operative time and other intra operative complications.

Similarly the mean dose of parenteral analgesic in three-port group was 2.26 and in four-port group it was 2.50 which was statistically significant. In study performed by Sinha et al the mean analgesic dose required was 0.73 in three- port group and 1.36 in four port group which was even less than the result of our study.²⁰ Trichak also reported reduced parenteral analgesic requirement ($p < 0.05$).¹⁰ However study Pahuja et al and some other research worker demonstrated no difference in mean parenteral analgesia requirement in both the groups.²¹

Mean cosmesis score in three-port group was 7.9 and in four-port group was 7.6 ($p > 0.05$). Better cosmetic results were reported in three port group by Endo et al, Trichak and Chalkoo et al.^{9,10,22} Pahuja et al reported three-port laparoscopic cholecystectomy has better cosmetic results as the number of scars are less.²⁰

Furthermore, three- port laparoscopic cholecystectomy has been claimed to be more cost effective as compared to four-port. It can be explained by cost of one assistant is reduced, one additional monitor is not required for the assistant and most importantly one port and one instrument is reduced. Lesser requirement of analgesia, early recovery and early return to work further adds to the cost effectiveness. Chalkoo et al reported that three port LC requires less assistance.²²

In meta-analysis of five studies comparing three-port and four-port laparoscopic cholecystectomy, the operative time, need of analgesia success rate and duration of hospital stay were similar.¹⁶ However results from multiple studies suggest that the three port LC technique is not difficult to master and could be safely performed by trained personnel.^{10,23,24}

Dubois et al and few other surgeons concerned about safety of three-port laparoscopic cholecystectomy as it might lead to higher percentage of bile duct injuries but none of the study proved it.² However the bile duct injuries can be avoided if the gallbladder is gripped at infundibulum and not fundus and dissection started near

neck of gallbladder-cystic duct junction rather than cystic duct-CBD junction.³ Multiple studies have reported that three port laparoscopic cholecystectomy is safe.^{3,8,15} Conversion to standard four port laparoscopic procedure should be undertaken wherever necessary.

CONCLUSION

Three-port laparoscopic cholecystectomy is a minimally invasive, safe and feasible technique for laparoscopic cholecystectomy and is not difficult to master like other advanced laparoscopic cholecystectomy. In experienced hands, laparoscopy cholecystectomy can be initially started with three-ports and can be converted to four-port if rarely necessary. Though rate of conversion is decreasing with increasing experience, surgeon should not hesitate in converting three-port to four-port or open technique when extreme difficulty is encountered during the procedure. It should not be considered as a failure of the technique but as a demand of time in interest of patient.

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