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Original Article

Surgery Section

Retrospective Study of Three-port versus Standard Four-port Laparoscopic Cholecystectomy: A Single Surgical Unit Experience of 1456 Patients

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ABSTRACT

Introduction: Although laparoscopic surgeries have proven beyond doubt their benefit in terms of early recovery, better patient care and cost-effectiveness, the quest for reduction in either the size or number of ports still continues.

Aim: To compare the safety, outcome, and advantages between three-port versus four-port Laparoscopic Cholecystectomy (LC) in acute and chronic cholecystitis.

Materials and Methods: Medical records of 1456 patients that underwent LC (three- or four-port) for acute and chronic cholecystitis from January 2015 to December 2019 (60 months) were retrospectively analysed. All patients were given the same anaesthetic drugs for induction and maintenance, with standard anaesthetic protocol. The results were compared for both the techniques in terms of operating time, conversion rate, intraoperative complications, immediate postoperative complications, pain score, analgesic requirement and hospital stay.

Results: Total 1456 patients underwent LC; 1282 were female and 174 were male. The mean age of the patients was 39.2 years (range 18-70 years). The three-port LC technique was performed on 816 (56.04%) patients, while the traditional four-port LC technique was performed on 640 (43.96%) patients. Visual Analog Score (VAS) in the postoperative period at six hour was 2.11±0.82 in three-port group versus 3.17±1.12 in four-port group, this suggests that there was a significant difference in pain in these two groups in the early postoperative period ($p<0.001$). In three-port group, the requirement of analgesic drug was significantly less as compared to four-port group (2.86±0.98 versus 3.22±0.87; $p<0.001$). There was no statistically significant difference in the mean operating time, duration of hospital stay, intra and postoperative complications, days to return to normal activity, satisfaction score and conversion rate ($p=0.087$, $p=0.061$, $p=0.578$, $p=0.555$, $p=0.572$ and $p=0.145$, respectively).

Conclusion: Three-port LC is a feasible, effective and safe technique that further enhances the surgical outcome in terms of postoperative pain, fewer needs for analgesic medication.

Keywords: Acute, Cholecystitis, Chronic, Visual analog score

INTRODUCTION

Laparoscopic Cholecystectomy (LC) is considered the gold standard for treating symptomatic diseases of the gall stone. Since the first few cases performed in the mid 1980's, the procedure has developed by leaps and bounds. Standard LC is performed by using four trocars [1,2]. Recent developments have focused on reducing the size or number of ports to reach the goal [1,3,4]. Since experience with the use of four trocars in LC has been accumulated, several surgeons noticed that the fourth-port played a minor role in the operation and therefore opted to remove the lateral port and conduct the operation with only three trocars.

Several studies have reported that LC with three-ports is technically possible [5,6]. In addition, effectively lesser postoperative pain and early recovery are the advantages of laparoscopic surgery which in turn are cost-effective too. Several studies have shown that a reduction in either the size or number of ports is associated with less postoperative pain [1,5,6]. In this large retrospective study, the safety, outcome, and advantages between three-port versus four-port LC in acute and chronic cholecystitis were compared.

MATERIALS AND METHODS

This retrospective study evaluated the medical records of 1456 patients that underwent LC (three or four-port) for acute and chronic cholecystitis from January 2015 to December 2019 (60 months). The medical records entered in the Unit computer was retrieved and reviewed. In all patients LC was performed by surgeons with experience of more than 300 laparoscopic surgeries and was divided in two categories based on number of ports made for completing LC. LC performed by four surgeons were included with two surgeons performing LC by standard four-ports and two surgeons by three-ports.

Data related to history, physical examination, laboratory tests including liver function tests and abdominal ultrasound were taken. All patients were given the same anaesthetic drugs for induction and maintenance, with standard anaesthetic protocol. The prophylactic antibiotic dose was administered just before induction. Before shifting to operating room, the urinary bladder was emptied.

During four-port LC, patient was placed in reverse Trendelenburg position with 15° left lateral tilt. Monitor was placed to the right of the patient's head. Surgeon and assistant stood to the patients left. Pneumo-peritoneum achieved with closed verres needle technique from the supraumbical 10 mm port. Through this port a 0° laparoscope was introduced and a 10 mm epigastric and two 5 mm ports in midclavicular and anterior axillary line were made under vision. As defined by Kum CK et al., four-port LC was performed using the classical method (North American 'flip over' technique) [7].

In the three-port technique the forth-port at anterior axillary line was omitted. In the three-port LC the 5 mm port was simultaneously used for holding the Hartman's pouch and retracting it in superior-lateral direction as well as its shaft was used to retract the liver. The epigastric port was used to do the necessary posterior dissection followed by anterior dissection by flipping the Hartman's pouch medially or laterally creating a wide window and displaying the critical view of safety. After delineation of the Calot's anatomy, cystic

duct and artery were clipped and cut.

The results were compared for both techniques in terms of operating time, conversion rate, intraoperative complications, immediate postoperative complications, pain score, analgesic requirement from the anaesthesia record. Pain score at six hours postoperative using VAS was recorded which was mentioned in the discharge ticket. A VAS score 1-3 was labelled as the low (mild) pain score and 4-10 the high (severe) pain score. The same analgesics were used in all patients on the basis of need, initially intravenous analgesics during the hospital stay and oral analgesics on discharge. Intraoperative complications include perforation of the gall bladder wall, bile leakage; liver bed bleeding, iatrogenic injury to the liver and bile duct injury was recorded from the operative record entered by the assisting resident trainee surgeon. Total length of hospital stay and satisfaction score as assessed using a 10 point scale (0=unsatisfied to 10 very satisfied) was taken from discharge records.

STATISTICAL ANALYSIS

Data were analysed with the Statistical Package for the Social Sciences (SPSS) version 23 (IBM SPSS Statistics for Windows, Version 23.0, IBM Corp., Armonk, NY, USA). Categorical values were analysed with a chi-square test, parametric values with student's t-test, and non-parametric values with the Mann-Whitney U test. A p-value <0.05 was considered to indicate statistical significance in all tests.

RESULTS

Total 1456 patients underwent LC; 1282 were females and 174 males. The mean age of the patients was 39.2 years (range 18-70 years). The three-port LC technique was performed on 816 (56.04%) patients, while the traditional four-port LC technique was performed on 640 (43.96%) patients. Out of 1456 patients, 369 (25.34%) patients were diagnosed with acute cholecystitis and 1087 (74.66%) patients were diagnosed with chronic cholecystitis by histology. The demographic characteristics were comparable in the both groups [Table/Fig-1].

Parameters	Three-port (n=816)	Four-port (n=640)	p-value
Age (years), mean±SD	38.66±14.52	39.74±13.86	0.154
Sex n (%)			
Female	710 (87.0)	572 (89.4)	0.167
Male	106 (13.0)	68 (10.6)	
Weight (kg), mean±SD	51.78±10.52	52.34±11.21	0.327
BMI (kg/m^2), mean±SD	25.34±1.23	25.49±2.13	0.092
Previous laparotomy, n (%)	31 (3.8)	28 (4.4)	0.580
Gall bladder contracted, n (%)	47 (5.8)	39 (6.1)	0.788
Raised alkaline phosphates, n (%)	56 (6.9)	39 (6.1)	0.555
Raised Bilirubin, n (%)	117 (14.3)	106 (16.6)	0.242
Acute attack, n (%)	12 (1.5)	9 (1.4)	0.918
Previous ERCP, n (%)	17 (2.1)	13 (2.0)	0.944

[Table/Fig-1]: Demographic data of the study groups.
ERCP: Endoscopic retrograde cholangiopancreatography

The mean operating time for the three-port LC procedure was 45.54±7.56 minutes versus 46.23±7.75 minutes for the four-port technique (p=0.087). VAS in the postoperative period at six hours was 2.11±0.82 versus 3.17±1.12 (p<0.001). In three-port group, the requirement of analgesic drug was significantly less as compared to four-port group (2.86±0.98 versus 3.22±0.87; p<0.001) [Table/Fig-2]. There was no statistically significant difference in the duration of hospital stay, intra and postoperative complications, days to return to normal activity and satisfaction score (p=0.061, p=0.578, p=0.555 and p=0.572, respectively).

Parameters	Three-port (n=816)	Four-port (n=640)	p-value
Operating time (min), mean±SD	45.54±7.56	46.23±7.75	0.087
Postoperative pain score (VAS), mean±SD	2.11±0.82	3.17±1.12	<0.001
Analgesic drug requirement, mean±SD	2.86±0.98	3.22±0.87	<0.001
Duration of Hospital stay, mean±SD	1.92±0.59	1.98±0.63	0.061
Days to return to normal activity, mean±SD	4.32±0.68	4.34±0.59	0.555
Satisfaction score, mean±SD	8.54±1.66	8.49±1.70	0.572
Converted to open, n (%)	8 (1.0%)	12 (1.9%)	0.145

[Table/Fig-2]: Comparison of the study variables in both groups.

There were no significant differences between the two types of procedures in terms of conversion rate (8 out of 816 and 12 out of 640 in three and four-port, respectively; p=0.145). The incidence of conversion to open in three-port group were difficult anatomy of Calot's Triangle (n=3); distended Hartmann's pouch obscuring the anatomy (n=2); tortuous right hepatic artery (n=1); long cystic duct joining the common hepatic duct at a lower level (n=1); intrahepatic gallbladder with a wide cystic duct (n=1). In four-port group had 12 conversions to open; due to thick vascular adhesions of inflamed gallbladder with duodenum (n=4), difficult anatomy of Calot's Triangle (n=3) distended Hartmann's pouch obscuring the anatomy (n=2), intrahepatic gallbladder with a wide cystic duct (n=1) and tortuous right hepatic artery (n=2). Both techniques showed similar intraoperative and postoperative complications. There was no case of intra/postoperative mortality [Table/Fig-3].

Complications	Three-port (n=816)	Four-port (n=640)	p-value
Gall bladder wall perforation	08	07	0.831
Bleeding from liver bed	06	05	0.919
Iatrogenic liver injury	05	04	0.976
Bile duct injury	04	03	0.953
Wound discharge	24	21	0.709
Wound infection	06	02	0.280
Bile collection	09	03	0.184
Common duct stricture	01	01	0.863
Port site hernia	02	00	0.627

[Table/Fig-3]: Intra and postoperative complications.

DISCUSSION

LC is the accepted gold standard treatment for gall-stone diseases worldwide. New innovations are coming forward with expertise in the process. The goal of minimal access surgery is to reduce postoperative pain, enhance cosmesis and promote earlier activity return. Reduction in the size and number of trocars produced improved results [1,3,8]. Trichak S, compared the three-port technique with the standard four-port method in prospective randomised controlled trial and concluded that the three-port technique is comparable to the four-port method, with no obvious increase in bile duct injuries and that it reduced the need for postoperative analgesic injections [1]. The results of this study indicated that the three-port group yields the same rate of success as the four-port one. In this study, mean six-hour postoperative VAS was significantly lower in three-port group compared to four-port group (p<0.001). This indicates that in the early postoperative period there was significant difference in pain in those two groups. The mean VAS score reported in a study by Trichak S and Gupta A et al., was less in the three-port group than in the four-port group that was correlated to present study (p<0.001) [1,9]. In comparison, the outcomes of the three-port group were more beneficial in that it

minimised discomfort, thereby requiring fewer analgesic medications for pain control. Statistically lesser analgesics were required in the three-port group than the four-port group. The findings were consistent with other studies as well [5,10-12].

The mean duration of surgery in the three-port group was 45.54±7.56 minutes in this analysis, compared to 46.23±7.75 minutes in the four-port group, although this difference was not statistically significant (p=0.087). Similar operating times for three- and four-port LC have been published in various studies similar to the present study [13,14]. Authors from other studies have reported that three-port procedures are shorter than four-port as there is less time spent inserting trocars and suturing. Additionally, the surgeon handles all instruments, except the camera, in three-port LC. On the other hand, instruments used to manipulate the fundus are held in four-port LC by assistants, and the surgeon must spend additional time orienting the assistant and requesting the correct positioning. We agree to this point as the reason for having reduced operative time in three-port LC.

In both the group, the mean duration of hospital stay, duration of return to work and normal activity and the satisfaction score were comparable between three-port groups and four-port groups (p=0.061, p=0.555 and p=0.572, respectively). In both groups, the intraoperative and postoperative complications and conversion to open technique were comparable. Singhal P et al., reported a conversion rate to an open surgery of 3.8% and 0.9% (p-value 0.15) in three and four-port LC [14]. There was no case of intra/postoperative mortality in present study.

The authors also feel that the common bile duct injuries were less likely to occur in the three-port technique as the gallbladder traction is fully controlled by the operating surgeon however, it is imperative to emphasise that this is a point to be studied before drawing any definite conclusion. Occasionally, due to the lack of space for positioning of four-ports, three-port technique is comparatively useful in children and patients of short stature. Problem can occur when anatomy is not clear due to adhesions (inflammatory/postoperative) and thick walled massively distended gallbladder but these problems can be solved by a competent and experienced laparoscopic surgeon or converted to a traditional four-port technique.

Limitation(s)

The limitations of the study include its retrospective design, multiple operating surgeons and longer duration of study which could have affected the outcome over the period of data collection.

CONCLUSION(S)

This is a large data of five years period from a single institution and the results conclude that three-port LC is a feasible, effective and safe technique that further enhances the surgical outcome in terms of postoperative pain and fewer needs for analgesic medication with similar intraoperative concerns as shown in the study. This retrospective study shows the outcome during the routinely performed procedure as a practice of operating surgeons thus removing the performance bias of a prospective study. Surgeons who are familiar with the technique of three-port LC should recommend this for routine practice.

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