



THREE PORT VERSUS CONVENTIONAL FOUR PORT LAPAROSCOPIC CHOLECYSTECTOMY: COMPARATIVE STUDY

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ABSTRACT

Background: Modifications in the Laparoscopic Cholecystectomy (LC) technique is done by reducing the size and number of ports in an attempt to improve patient's satisfaction and outcome. This study was conducted to assess and compare the safety, outcome and advantages of three-port and four-port laparoscopic cholecystectomy.

Methods: This prospective study included 92 patients who were presented with symptomatic gall stone disease or gall bladder polyp more than 1 cm. Patients with obstructive jaundice and choledocholithiasis, carcinoma gall bladder were excluded from the study. Patients were grouped into two groups: three port and four port group, who underwent three-port and four-port laparoscopic cholecystectomy respectively. Outcomes of the both groups were assessed and compared in terms of operative time, intra-operative and post-operative variables including rate and nature of complications, conversion rates, post-operative pain, duration of hospital stay, return to work and cosmetic outcome.

Results: Statistically significant difference was found between the two groups in terms of Visual Analogue Score for pain at 6 and 24 hours, analgesic requirement, duration of hospital stay and return to work; all being less in the three-port laparoscopic cholecystectomy group. Results of other variables were comparable in the two groups.

Conclusions: Three-port laparoscopic cholecystectomy is safe and appears to be more cost effective than four-port laparoscopic cholecystectomy. If laparoscopic cholecystectomy is carried out by an experienced surgeon, it can be started with three ports, if needed, a fourth port can be inserted.

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INTRODUCTION

Gallbladder diseases constitute a major portion of digestive tract disorders. Among these, gall stone disease is the most commonest biliary pathology and has troubled the mankind for over two thousand years¹ causing general ill health and thereby requiring timely surgical intervention for total cure.^{2,3} Females are three times more susceptible to develop gall stone disease than men.⁴ Furthermore, first degree relatives of patients with gall stone have twofold greater prevalence. As the age increases, prevalence also increases from four percent in the third decade of life to twenty-seven percent in the seventh decade of life.⁵

Earlier, numerous alternative methods had been introduced for the treatment of gall stone disease in an attempt to decrease the morbidity and disability associated with cholecystectomy. Such methods include application of oral desaturation agents (Chenodeoxycholic acid, Ursodeoxycholic acid); contact dissolution agents with methyl tertbutylene ether; percutaneous cholecystolithotomy; extra corporeal shock wave lithotripsy & chemical cholecystectomy.^{6,7} All the above cited methods leave the gall bladder in situ and as Carl Lange buch had rightly

stated: "Gall bladder should be removed not because it contains them but because it forms them".⁸

Cholecystectomy done by open method was considered the standard procedure for the last hundred years in the definitive management of patients with symptomatic cholelithiasis.^{9,10} The first laparoscopic cholecystectomy recorded in medical literature was carried out by Philip Mouret in 1987 in Lyon (Europe).¹¹ Later on it was carried out by Dubois in May 1988 in France.^{12,13}

In India, laparoscopic cholecystectomy surgery was first carried out by T.E. Udwardia in Mumbai in 1991.¹⁴ It is also worthwhile mentioning that the maximum number of Laparoscopic cholecystectomies carried out is by Dr. Pradeep Chowbey (Delhi) who holds this record in the Limca Book of Records.¹⁵

Since National Institute of Health Consensus (NIH) Development Conference in September, 1992, laparoscopic cholecystectomy is now being recognized as the most accepted method of treatment of cholelithiasis and is considered "Gold standard" for the treatment of gall stones¹⁰ and has replaced open cholecystectomy as the gold standard.

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As of now, the present status of laparoscopic cholecystectomy is that it is the procedure of choice in all gall bladder diseases. In two port laparoscopic cholecystectomy, by introducing a suture needle to fix the gall bladder to abdominal wall in the right hypochondrial region with two ports. Moreover, these three and two ports laparoscopic cholecystectomy are less expensive and less scar forming than four ports laparoscopic cholecystectomy. The conventional surgery has reduced the number of emergency operations and morbidity, with fewer common bile duct exploration, shortened hospital stay, reduced overall cost in expert hands and better cosmetic results.¹¹

The technique of laparoscopic cholecystectomy is now available throughout the world and has number of advantages compared to the conventional therapy, including reduced pain, patient satisfaction, better cosmesis, cost reduction, fast recovery, reduced hospital stays and early return to work. The primary advantage of laparoscopic cholecystectomy over non-operative modalities for the treatment of gall stone disease is that the gall bladder is completely removed. Initially it was done by conventional four ports but now with improved skills of the surgeons and availability of better instruments this surgery has seen reduction in the number and size of the ports which has had no ill effect in the safety of the procedure but improved the cosmesis and reduced pain in the post-operative period. These techniques require a similar time to perform with no increase in the intra operative complication rate of the procedure in the hands of experienced surgeon. The most practical option is by reducing the number of the ports to three ports. The value of the lateral fourth port in the American technique used to hold the gall bladder fundus was challenged. Recently published data showed that the three-port technique did not compromise the procedure safety with a reduction in the analgesia requirement with better cosmesis, however the procedure was carried out on elective patients only, in these published reports.¹³

This comparative study has been done to compare the safety and efficacy of three ports and four ports laparoscopic cholecystectomy in both acute and chronic cholecystitis which showed reduced post-operative pain, reduction in analgesia needed and length of hospital stay. The benefits of three port laparoscopic cholecystectomy over four port standard laparoscopic cholecystectomy requires confirmation by prospective clinical trials in center like ours. Moreover, a lot of experience and costly equipment is needed for the same and a "steep learning curve" exists for this procedure.

In this large comparative study, we compared the safety outcome and advantages of three port over four port laparoscopic cholecystectomy to recommend the rational guidelines as it in fact is the responsibility of the surgical community to evaluate carefully the results of these two minimally invasive techniques before embarking on their use the results of the study are detailed herein

METHODOLOGY

This prospective study was conducted on patients with gall bladder disease who were to undergo laparoscopic cholecystectomy in Department of Surgery at ESICMC & PGIMS Rajajinagar Bengaluru from January 2018 to June 2019. Randomized sequence generated using computer software. Patients were allotted into two separate groups as per the sequence generated –three port laparoscopic

cholecystectomy group and four port laparoscopic cholecystectomy to my group. Three port laparoscopic cholecystectomy group patients were subjected to three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group patients were subjected to conventional four port laparoscopic cholecystectomy.

Study Design

Prospective Randomized controlled study

Study Period

From January 2018 to June 2019.

Inclusion Criteria

1. Patients who willing to participate in the study with valid consent.
2. Patients with age group of above 20 years.
3. Patients who presents with symptomatic gallstone disease. i.e. acute cholecystitis and chronic cholecystitis
4. Gall bladder polyp with more than 1 cm in diameter.

Exclusion Criteria

Patients with

1. Acute cholecystitis presenting 72 hours after the onset of symptoms
2. Choledocholithiasis, history of obstructive jaundice
3. Carcinoma of gallbladder
4. Perforated gallbladder
5. Endoscopic retrograde cholangio-pancreatography with in last one week
6. Patient unfit for general anesthesia due to severe cardiopulmonary disease
7. Patient who did not give consent to be included in the study.

Sample Size

The sample size for the present study has been calculated by considering the mean hospital stay in days in three port laparoscopic cholecystectomy group (1.72±0.678) and in four port laparoscopic cholecystectomy group (2.24±0.523). The minimum sample size has been calculated to be 46 cases in each group which will ensure a power of at least 80% with 0.52 as effect size at 5% level of significance assuming one tailed hypothesis. Therefore, the minimum total sample size is 92 cases. We will enrol total 92 cases, 46 in each group.

Following formula has been used to calculate the sample size:

$$n = \frac{6.18 \times 2 \sigma^2}{(\bar{X}_1 - \bar{X}_2)^2}$$

Where, $\bar{X}_1 = 1.72$, $\bar{X}_2 = 2.24$ and $\sigma = 1$

Method of Collection of Data

Data was collected from patients who got admitted in surgical wards of ESIC Model Hospital, for laparoscopic cholecystectomy. After giving admission each case was clinically examined, investigated with biochemical and pathological blood tests and evaluated for any associated co-morbid diseases which were adequately managed before fixing the patient for surgery under general anesthesia. The preoperative preparation was done as advised by the

anesthetist in the pre anesthesia checkup for all the patients. Patients were admitted on the day prior to surgery and were advised light diet and adequate sedation on the night prior to surgery and were given additional drugs if any for the associated disease as advised by the physician. All cases operated in this study were carried out by surgeons who had carried out more than 100 conventional laparoscopic cholecystectomies and at least 30 three port laparoscopic cholecystectomy cases prior to the study.

The patients were kept fasting for at least 10-12 hrs. Prior to surgery and were also advised to empty the bladder before being shifted to the operation theatre. Single dose of prophylactic antibiotic, second generation cephalosporin, was given during induction.

METHODOLOGY

Operative Details

Three-port method

Two 10mm trocars (in the epigastrium for working port and supraumbilical region for camera port) and one 5mm trocar (right mid clavicular subcostal region) was inserted. A grasping forceps was then inserted through the third port to hold the infundibulum, moving it right and left or back and forth to display the Calot’s triangle.

The instruments used to perform dissection were passed through the epigastric port. This was followed by dissection of the Calot’s triangle and the gall bladder from liver bed. Special maneuvering of the grasping forceps was done, in which the shaft of the forceps was moved in opposite direction to the movement of the jaw to retract the liver. This maneuver practically achieved similar exposure in the region of Calot’s triangle as is done by fundal grasper. Finally, cystic duct and cystic artery were clipped, and gall bladder was extracted through the epigastric port. In case of bile spillage, irrigation was done and a drain (Romovac) No.14/16 was placed in the sub-hepatic pouch of Morrison’s, inserted through the 5mm port and was positioned under vision. Skin incisions were closed by 2-0 ethilon. Incision sites were subcutaneously infiltrated with 0.5% Bupivacaine in all cases.

Four port technique

In addition to the above-mentioned ports, another 5mm port was inserted in the anterior axillary line in right flank region. This was used to grasp the fundus of the gall bladder to facilitate the dissection of the Calot’s triangle and provide traction to the gall bladder. Rest of the procedure was the same as that mentioned for the three-port technique

Following parameters were compared

The outcome of the two groups i.e. three port laparoscopic cholecystectomy group & four port laparoscopic cholecystectomy group were assessed by the following parameters:

1. Duration of surgery
2. Conversion of three port to four port technique and its reasons
3. Conversion to open cholecystectomy and its reasons
4. Cystic duct and common bile duct injuries
5. Cystic artery and hepatic artery injuries
6. Bile spillage from gall bladder perforation
7. Postoperative complications

- a. Port site pain
- b. Requirement of analgesics
- c. Wound infection of port site
- d. Port site hernia
8. Early ambulation/ return to work
9. Cosmesis

Statistical Analysis

Data was entered in MS Excel and analysed using SPSS. Continuous variable were summarised as mean with standard deviation and categorical variables were summarised as percentages. Distribution of continuous variables was expressed in Box whisker plot and bar charts were used to pictorially express the categorical variables. t test or appropriate non parametric test was used to test the statistical significance of difference in continuous variables. Chi square test or Fischer exact test was used to test the statistical significance of difference in categorical variables. Intention to treat analysis was done.

OBSERVATIONS AND RESULTS

Table 1 Age-wise distribution of the study population

No. of ports	N	Minimum age (years)	Maximum age (years)	Mean age (years)	Standard Deviation
Three	46	21.00	70.00	45.37	14.19
Four	46	25.00	66.00	42.17	9.87
Total	92	21.00	70.00	43.77	12.26

Table 2 Age – range of the study population

		Age group				
		20 to 29 years	30 to 39 years	40 to 49 years	50 to 59 years	60 to 69 years
PORT 3	n	5	13	10	6	12
	%	10.9%	28.3%	21.7%	13.0%	26.1%
PORT 4	n	4	18	13	9	2
	%	8.7%	39.1%	28.3%	19.6%	4.3%
Total	n	9	31	23	15	14
	%	9.8%	33.7%	25.0%	16.3%	15.2%

Table 3 Sex-wise distribution of the study population

		SEX	
		Female	Males
PORT 3	n	32	14
	%	69.6%	30.4%
PORT 4	n	32	14
	%	69.6%	30.4%
Total	n	64	28
	%	69.6%	30.4%

Table 4 Weight-wise distribution of the study population

No. of ports	n	Minimum weight (kg)	Maximum weight (kg)	Mean weight (kg)	Standard Deviation
Three	46	49.0	85.0	70.17	9.67
Four	46	49.0	94.0	71.5	10.47
Total	92	49.0	94.0	70.84	10.05

Table 5 USG results of patients in three port and four port laparoscopic cholecystectomy group

		Usg findings		
		Multiple calculi	Multiple gb polyps	Single calculi
PORT 3	n	25	2	19
	%	54.3%	4.3%	41.3%
PORT 4	n	25	1	20
	%	54.3%	2.2%	43.5%
Total	n	50	3	39
	%	54.3%	3.3%	42.4%

Table 6 Etiological distribution of patients in three port cholecystectomy and four port laparoscopic cholecystectomy group

		Etiology		
		Acute cholecystitis	Chronic cholecystitis	Gall bladder polyp
		n		
PORT 3	n	3	41	2
	%	6.5%	89.1%	4.3%
PORT 4	n	3	42	1
	%	6.5%	91.3%	2.2%
Total	n	6	83	3
	%	6.5%	90.2%	3.3%

Table 13 Comparison of variables in patients of three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group

		Number of ports	N	Mean	Std. Deviation	P value
Operative time	3	3	46	45.65	11.954	0.61
	4	4	46	47.28	18.550	
Post op pain- vas at 6 hours	3	3	46	6.22	0.629	0.54
	4	4	46	6.30	0.726	
Post op pain- vas at 24 hours	3	3	46	2.26	0.681	0.08
	4	4	46	2.61	1.183	
Analgesia used no of tramadol ampouls	3	3	46	3.13	0.749	0.04
	4	4	46	3.76	1.968	
Duration of hospital stay in hours	3	3	46	48.78	10.246	0.15
	4	4	46	53.48	19.548	
Return to normal activity in days	3	3	46	5.93	0.574	0.09
	4	4	46	6.30	1.348	

Table 7 Adhesions in patients in three port and four port laparoscopic cholecystectomy group

		Adhesions		Total
		Absent	present	
		n		
PORT 3	n	29	17	46
	%	63.0%	37.0%	100.0%
PORT 4	n	31	15	46
	%	67.4%	32.6%	100.0%
Total	n	60	32	92
	%	65.2%	34.8%	100.0%

Table 8 Bleeding from cystic artery in three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group

		Intra op complication		P value
		Bleeding from cystic artery.	None	
		n		
Port 3	n	0	46	0.24
	%	0.0%	100.0%	
Port 4	n	3	43	0.24
	%	6.5%	93.5%	
Total	n	3	89	0.24
	%	3.3%	96.7%	

Table 9 Conversion rate in three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group

Groups		Conversion			P value
		4 port	No	Open	
		n			
PORT 3	n	5	41	0	0.01
	%	10.9%	89.1%	0.0%	
PORT 4	n	-	43	3	0.01
	%		93.5%	6.5%	
Total	n	5	84	3	0.01
	%	5.4%	91.3%	3.3%	

Table 10 Amount of bleeding in patients in three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group

		Bleeding				P value
		5ml	10ml	15ml	20ml	
		n				
PORT 3	n	25	21	0	0	0.17
	%	54.3%	45.7%	0.0%	0.0%	
PORT 4	n	25	16	3	2	0.17
	%	54.3%	34.8%	6.5%	4.3%	
Total	n	50	37	3	2	0.17
	%	54.3%	40.2%	3.3%	2.2%	

Table 11 Intraoperative Bile spillage in patients in three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group

Groups		Bile spillage		P value
		N	Y	
		n		
PORT 3	n	34	12	0.30
	%	73.9%	26.1%	
PORT 4	n	39	7	0.30
	%	84.8%	15.2%	
Total	n	73	19	0.30
	%	79.3%	20.7%	

Table 12 Drain placement in patients in three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group

Groups		DRAIN		P value
		Not placed	Placed	
		n		
PORT 3	n	36	10	0.8
	%	78.3%	21.7%	
PORT 4	n	34	12	0.8
	%	73.9%	26.1%	
Total	n	70	22	0.8
	%	76.1%	23.9%	

Table 14 Post-operative complications in patients in three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group

		Complications			P value
		No complications	Wound haematoma	Wound infection	
		n			
Port 3	n	44	1	1	0.61
	%	95.7%	2.2%	2.2%	
Port 4	n	43	3	0	0.61
	%	93.5%	6.5%	0.0%	
Total	n	87	4	1	0.61
	%	94.6%	4.3%	1.1%	

Table 15 Cosmetic outcome in patients in three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group

Groups		Cosmesis			P value
		Average	Good	Poor	
		N			
PORT 3	N	16	26	4	1.0
	%	34.8%	56.5%	8.7%	
PORT 4	N	16	26	4	1.0
	%	34.8%	56.5%	8.7%	
Total	N	32	52	8	1.0
	%	34.8%	56.5%	8.7%	

DISCUSSION

In the present study, the patients excluded from the study are those who were not fit for general anesthesia (ASA-grade IV), acute cholecystitis patients presenting after 72 hours, choledocholithiasis, history of obstructive jaundice, carcinoma of gallbladder, perforated gallbladder with peritonitis, Endoscopic retrograde cholangio-pancreatography with in last one-week, uncorrectable coagulopathies. Similar exclusion criteria were considered in the study conducted by Gupta A *et al* (2005)¹⁶ and Trichak S (2003).¹⁷

parameters	Al-Azawi <i>et al</i> (2007) ¹⁸		Lee JH <i>et al</i> (2003). ¹⁹		Our study	
	3 port	4 port	3 port	4 port	3 port	4 port
Mean age (years)	53.22 ± 15.31	53.74 ± 15.05	48.2	48.6	45.37 + 14.19	42.17 + 9.87
Age range	14-87	14-84	22-80	16-79	21-70	25-66

In the present study, the sex wise distribution of the patients witnessed that the females were more than the males in both the groups. The total number of males is 28 (30.4%) out of which 14 are in three port laparoscopic cholecystectomy group and 14 are in four port laparoscopic cholecystectomy group. The overall female to male ratio is 2.2:1. Trichak S (2003)¹⁷ reported in their series male to female ratio of 25:75 (1:3) in three port group and 27:73 (1:3) in four port group. Gupta A *et al* (2005)¹⁶ reported in their series a male to female sex ratio of 1:3 in four port group and 1:2.3 in three port group. Al-Azawi D *et al* (2007)¹⁸, reported in their series that out of total 495 patients who underwent laparoscopic cholecystectomy, 399 were females and 96 were males. Lee JH *et al* (2003)¹⁹ reported a male to female ratio of 18:52 in three port group and 72:106 in four port group. So, in our study the sex ratio was almost

similar with the studies of a Trichak S (2003)¹⁷ and. Lee JH *et al* (2003)¹⁹

The mean weight of the patients in the present study in three port laparoscopic cholecystectomy group was 70.17+₋9.67kgs, it ranged from 49-85 kgs. In four port laparoscopic cholecystectomy group weight of the patients was in the range of 49- 94 kgs with mean weight of 71.5 +₋ 10.47 kgs. Trichak S (2003)¹⁷, reported in their series that three port group patients were having weight in the range of 35-108 kg with mean weight of 59.12±13.45 kg and patients operated by four port technique were having weight in the range 29-93 kg with mean weight of 57.78±11.05 kg. The weight of the patients in the present study is almost similar to the weight in the study of Trichak S (2003).¹⁷

Preoperative ultrasonography of abdomen was done in all the cases. In three port laparoscopic cholecystectomy group solitary calculus was present in 41.3% of the patients and multiple calculi in 54.3 % of the patients. In four port laparoscopic cholecystectomy group single calculus was found in 43.5% and multiple calculi were found in 54.3 % patients. Schirmer BD *et al* (1991)²⁰ in their study had single calculus in 22.4% and multiple calculi in 77.6% of cases on ultrasonography. Preoperative ultrasonography can definitely predict the technical difficulties and complications which have been proved in a study by Corr P *et al* (1994).²¹This has been the experience by our study. Al-Azawi D *et al* (2007)¹⁸ established the existence of gall bladder stones in all their patients by preoperative ultrasonography. Koscak D *et al* (2005)²² also confirmed the gallstone diseases by preoperative ultrasonography in all cases.

There were no adhesions in the operative field in 63% in three port laparoscopic cholecystectomy group and 67.4% in four port laparoscopic cholecystectomy group. Those patients, who had adhesions, were found to have adhesions with omentum, small bowel, stomach, transverse colon and anterior abdominal wall. Adhesions were present at the fundus of the gall bladder and near the Calot's triangle. All these adhesions could be separated by using monopolar cautery, fundal pressure, irrigation and suction aided dissection. The operative field was clearly visualized in all cases except in one case after adhesiolysis, wherein gall bladder was plastered thickly with vascular adhesions to duodenum, stomach and transverse colon, which had led to the conversion of the procedure from the four-port group to open cholecystectomy. These findings are comparable to those reported in a study conducted by Peters JH *et al* (1991).²⁹

Intra-operative complications in our study groups ranged from bleeding from the liver bed, bile spillage, gall bladder perforation, cystic artery bleed and adjoining visceral organ injury. In 12 patients of three port laparoscopic cholecystectomy group, bile spillage occurred and adequate irrigation was done before completion of procedure. In four port laparoscopic cholecystectomy group, 3 patients had intraoperative bile spillage which was managed in similar manner. Slim K *et al* (1995)²³ reported four common bile duct injuries, 2 in the either group. Rashid A *et al* (1995)²² reported in their series gall bladder perforation of 33 cases (22.4%) in three port group and 24 cases (16.3%) in four ports. Stone spillage was seen in seven cases (4.7%) in three port groups and three cases (2%) of the four-port group. Gupta A *et al* (2005)¹⁶ reported no major complications in their study. Their study showed that one patient in four port group had trocar site

bleed and two patients in three port group had bile spillage and there was no conversion to open surgery. Two patients needed conversions to four port technique.

There were 5 conversions to four port technique and no conversion to open cholecystectomy in the three-port laparoscopic cholecystectomy group patients. A fourth port had to be placed for the various reasons like, difficult anatomy of the calot's triangle in which there were aberrant relations of the cystic duct and cystic artery; distended Hartman's pouch which was obscuring the anatomy of the calot's triangle. In one case there was long right hepatic artery which had to be traced high up in the gall bladder fossa of the liver bed and a long cystic duct before joining the common hepatic duct and in another case partly intra-hepatic gall bladder with dilated cystic duct.

There were 3 conversions in the four port laparoscopic cholecystectomy group which were started as a standard 4 port procedure and then had to be completed by open cholecystectomy to manage the intra-operative complications. The reason for conversions in the Four port laparoscopic cholecystectomy group were; gall bladder was thickly adherent to duodenum, stomach and transverse colon by dense vascular adhesion which could not be separated by the laparoscopic method in one case so had to be completed by the open cholecystectomy. In another case it was a hour glass type of gall bladder with a long cystic duct in which there was bleeding from cystic artery due to the slippage of the clips applied on the cystic artery stump arising from the right hepatic artery which could not be controlled by laparoscopic method so had to be completed by open cholecystectomy. The reasons for converting procedures in the present study were similar to the various published studies. Slim K *et al* (1995)²³ in his study reported the reason as cystic artery injury in 2 cases, common bile duct injury in 1 case, common bile duct stones in 5 cases, cholecysto digestive fistula in 3 cases, intrahepatic adhesions in 3 cases, acute cholecystitis in 10 cases, anesthetic troubles in 1 case and equipment failure in 1 case.

Gupta A *et al* (2005)¹⁶ reported in a study 2 conversions of three port laparoscopy to four port laparoscopies because of surgeon's inability to dissect anatomical structures. No conversion was done from four ports laparoscopy to open surgery. Al-Azawi D *et al* (2007)¹⁸ reported no conversion from three to four port surgery but conversion of three port to open procedure and 4 port to open procedure were 8 (2.8%) and 6 (2.8%) respectively. Lee JH *et al* (2003)¹⁹ reported in their series the rate of conversions as 7 (9%) in three port laparoscopic cholecystectomy group and 4 (2%) in four port laparoscopic cholecystectomy group. Causes of conversions were: Bleeding in one case of three port group, anomalous cystic duct in two cases of four port group, impacted stone in three cases of three port group, thickened gall bladder wall and adhesions in three cases, of three port group and two cases of four port group. Rashed A *et al* (1995)²², reported in their series bleeding in the post-operative period requiring blood transfusion in two patients and one open conversion to repair minor injury to the junction between cystic and hepatic ducts. Five cases needed 4th port for completion of surgery. Koscak D *et al* (2005)²² reported in their series that out of 599 cases, 22 (4%) cases needed conversion to open technique. Fourth trocar was needed in 20 (3.5%) of 577 (96%) successful three trocar procedures. In 18 (82%) of these 22 patients' reasons for

conversion were numerous solid adhesions on the inflamed gall bladder with adjacent organs, where the introduction of the 4th trocar failed to ensure safe continuation of the procedures. In all these patient's decision of conversion was made with in the first 30 minutes. In the remaining 3 patients' conversions was done due to technical problems with laparoscopic instrumentation that could not be resolved during the procedure including the loss of monitor image in one case and laparoscopic error in two cases. In one female patient conversion was needed due to the presence of gall bladder cancer which unfortunately failed to be detected by the preoperative ultrasonography.

In view of the intra operative complications either due to difficult anatomy or due to injury to adjoining organs / vessels, the procedure was converted to open method. Three cases in four port laparoscopic cholecystectomy group were converted to open method. Further evaluation of these patients was not done in the study as the variables assessed were disproportionate to those included in the study.

Suction drain was kept in the sub hepatic space or Morrison's pouch in 10 patients of three port group and 12 patients of 4 port group in our study. The use of suction drain by Lee JH *et al*¹⁹ was 70 (100%) cases in three port and 146 (82%) cases in four port group. The use of drain was occasional whenever, dissection was difficult in studies Peters JH *et al* (1991)²⁷, Soper NJ *et al* (1992).²³ In all above mentioned studies they have used closed section drain which was placed via mid clavicular port in three port laparoscopic cholecystectomy group and through mid-axillary port in Four port laparoscopic cholecystectomy group and it was positioned in Morrison pouch with an instrument from the epigastric port following which the port was withdrawn over the drain. We followed this procedure in all patients where drain was necessary using Romovac (No.16) drain. In all the cases of three port laparoscopic cholecystectomy group drain was removed within one day. In all the cases in four port laparoscopic cholecystectomy group drain was removed within one day. For skin closure we have used skin stapler in all the cases.

In the present study, the mean operative time in minutes in the both groups were compared.

	Gupta A <i>et al</i> (2005) ¹⁶		Trichak S (2003) ¹⁷		Azawi D <i>et al</i> (2007) ¹⁸		Our study	
	3 port	4 port	3 port	4 port	3 port	4 port	3 port	4 port
Mean operative time	50 ± 21.1	45 ± 21.0	59.22 ± 22.97	57.05 ± 16.58	46.1	48.9	45.65 ± 11.954	47.28 ± 18.550
	min	min	minutes	minutes	min	min	minutes	minutes

In the present study, it was observed that the mean Visual Pain Analogue Scale was higher in four port laparoscopic cholecystectomy group (6.30 ± 0.726) as compared to three port laparoscopic cholecystectomy group (6.22 ± 0.629) assessed six hours after surgery. Similar result was noted 24 hours after surgery, i.e. higher in four port laparoscopic cholecystectomy group as compared to three port laparoscopic cholecystectomy group (2.61+1.183 versus 2.26+0.681). Trichak S (2003)¹⁷ reported a median visual analogue score of 2 in 3 port and 3.28 in four port. Gupta A *et al* (2005)¹⁶ compared mean score at different times and mean score was less in 3 port group. Kumar M *et al* (2006)²⁸ reported in series the Visual Analogue Score better in 3 port group. So, our observation in the present study were similar to the study done by Trichak S (2003)¹⁷ and Gupta A *et al* (2005)¹⁶ and Kumar M *et al* (2006).²⁸

Postoperative requirements of analgesics injection in the two groups were compared in our study. The analgesics used was Inj. Tramadol (50 mg). Most of the patients in both groups needed 3-4 ampoules of injection post operatively. In the three-port group the average number of ampoules used postoperatively was 3.13 +_0.749 ampoules. In the four-port group, the average number of ampoules used is 3.76+_1.968. Kumar M *et al* (2006)²⁸ reported no significant difference in the requirement of analgesics in the two groups. Gupta A *et al* (2005)¹⁶ reported no difference in two groups. The mean dose needed was 41.25 mg in 3 port group and 51.25 mg in 4 port group. Al Azawi D *et al* (2007)¹⁸ reported less opiate analgesia requirement in three port group. Diclofenac and pethidine were most common analgesics prescribed. Amount of pethidine consumed in first 48 hours after three and four port group were 167.23 mg and 210.73 mg respectively. Trichak S *et al* (2003)¹⁷ reported in their series the number of analgesics requirement of 0.4 ± 0.65 inj. in three port group and 0.77 ± 0.83 inj. in four port group. In the present study the requirement of analgesic injection post operatively was found to be less in three port laparoscopic cholecystectomy group which is in concordance with the above studies which shows that the requirement of analgesics was less in the three-port group.

Post-operative hospital stay in our series shows

	Gupta A <i>et al</i> (2005) ¹⁶		Trichak S (2003) ¹⁷		Lee JH <i>et al</i> (2003) ¹⁹		Our study	
	3 port	4 port	3 port	4 port	3 port	4 port	3 port	4 port
Post operative stay	24 ± 5.8	24 ± 6.0	1.40 ± 0.94	1.94 ± 1.76	5.5	4.9	48.78 ± 10.246	53.48 ± 19.548
	hrs	hrs.	days	days	days	days	hours	hours

The cosmetic effect of the patients in both groups were assessed one month after surgery by asking the patients to evaluate aesthetic results. In the three-port group, 56.5% patients were completely satisfied with the cosmetic outcome of surgical scar, 34.8 % of patients were partially satisfied and 8.7% of patient in whom the procedure was completed by open method were unsatisfied. In the four-port group, 56.5% patients were completely satisfied, 34.8 % patients were partially satisfied and 8.7% patients was unsatisfied with the cosmetic outcome. The main reason for partial satisfaction was that the patients were aware of the fact that the number of scars could have been reduced, a few patients had wound site infection and hematoma and those who were converted to open procedure were unsatisfied. No patient reported port site hernia in both the groups assessed.

CONCLUSION

This prospective study was undertaken in the Department of Surgery, ESICMC & PGIMSR Bengaluru from January 2018 to June 2019. A total of 92 patients were enrolled in the study and divided into two groups of 46 each. Three port laparoscopic cholecystectomy group underwent three port laparoscopic cholecystectomy and Four port laparoscopic cholecystectomy group underwent Four port laparoscopic Cholecystectomy. The results of the two groups were analyzed and the following conclusion was drawn:

Majority of patients in both the groups were females, constituting 69.6 % in three port laparoscopic cholecystectomy group and 69.6 % in four port laparoscopic cholecystectomy group. Males constituted 30.4% in three port laparoscopic cholecystectomy group and 30.4 % in four port laparoscopic

cholecystectomy group. Overall female to male ratio was found to be 2.2: 1.

Majority of the patients in both the groups, i.e. Three port laparoscopic cholecystectomy group and four port laparoscopic cholecystectomy group were in their 3rd – 5th decade of life.

Ultrasonography of the abdomen was done in all the patients of both the groups to confirm the gall bladder disease, i.e. cholelithiasis, gall bladder polyp.

The mean weight of the patients in three port laparoscopic cholecystectomy group was 70.17 +₋ 9.67 kgs and in Four port laparoscopic cholecystectomy group was 71.5 +₋ 10.47 kgs, the overall mean weight of patients being 70.84 +₋ 10.05 kgs.

Most common indication for cholecystectomy was chronic cholecystitis with the ultrasonography findings suggestive of multiple calculi in majority of the patients in both the groups.

Intraoperatively, adhesion of gall bladder with omentum, small bowel & duodenum was present in majority of the patients which were separated using dissector, monopolar cautery and irrigation & suction.

In both the groups, the majority of patients did not have any intraoperative bile spillage.

Drains were needed in 10 patients of three port laparoscopic cholecystectomy group and in 12 patients of four port laparoscopic cholecystectomy group and the drains were removed postoperatively after 24 hours.

Intraoperative complications were observed in a few patients of both the groups which needed conversion of the procedure either from three port to four port method or from four port to open method, however there is no statistical difference in the complication rates or conversion rates of both the groups.

The operative time for three port laparoscopic cholecystectomy group was 45.65 +₋ 11.954 minutes and for four port laparoscopic cholecystectomy group was 47.28 +₋ 18.550 minutes. Though the mean operative time for three port laparoscopic cholecystectomy group was less than that of four port laparoscopic cholecystectomy group, the result was not statistically significant.

The Visual Pain Analogue scale score at the end of 6 hours for three port was 6.22+₋ 0.629 and for four port was 6.30+₋ 0.726. At the end of 24 hours the VPAS was 2.26+₋ 0.681 and 2.61+₋ 1.183 for three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy groups respectively. This difference in results was not statistically significant.

The mean duration of post-operative stay in the hospital was 48.78+₋ 10.246 hours and 53.48+₋ 19.548 hours for three port laparoscopic cholecystectomy and four port laparoscopic cholecystectomy group respectively. The mean duration for return to normal activity was 5.93+₋ 0.574 days and 6.30+₋ 1.348 days for three port laparoscopic cholecystectomy group and four port laparoscopic cholecystectomy group respectively. The difference in results for duration for return to normal activity was not statistically significant.

Based on our experience with the two procedures and after analysis of results, we would recommend that three port laparoscopic cholecystectomy can be done in patients of gall bladder stone disease. Duration of surgery is shorter in the three-port technique but it is statistically not significant (Three

port laparoscopic cholecystectomy mean duration 45.65 +₋ 11.954 minutes; Four port laparoscopic cholecystectomy mean duration 47.28 +₋ 18.550 minutes; p value – 0.61), intraoperative complication rates are comparable in both techniques (p value -0.24). The post-operative pain, recovery, time of discharge, return to work and cosmetic outcome was superior in three port laparoscopic cholecystectomy. The factors leading to conversion to open technique was comparable in both the groups (Conversion rate in three port - 10.9%; Conversion rate in four port – 6.5%; p = 0.01). The difficulty level in three port laparoscopic cholecystectomy was higher as compared to four port laparoscopic cholecystectomy in the following situations:

1. Thick walled gall bladder
2. Large stone impacted at Hartman's pouch
3. Severe pericholecystic adhesions
4. Frozen Calot's triangle
5. Emphyema of gall bladder

If an experienced surgeon performs laparoscopic cholecystectomy, can be started with three ports. In the instances of severe pericholecystic adhesions, large stone impacted in Hartman's pouch, frozen calot's triangle, thick walled gall bladder, large heavy & fatty liver a fourth port should be inserted

Summary

The study for comparing three port laparoscopic cholecystectomy and conventional four port laparoscopic cholecystectomy was conducted at ESICMC & PGIMSR Rajajinagar, Bengaluru.

This study includes consideration of various patient factors namely age, sex, weight and underlying aetiology along with intra operative factors like intra-operative adhesions, bleeding, operative time, and conversion and complication rates. Post-operatively patient was assessed in terms of pain using vas scale, duration of hospital stays, return to normal activity and cosmetic outcome.

Statistical analysis of results shows that three port laparoscopic cholecystectomy is superior to four port laparoscopic cholecystectomy in terms of less post-operative pain, use of analgesics and early return to normal activity. Various other factors had similar results without any significant increase in conversion or complication rates.

Hence in hands of experienced surgeon, the procedure may be started with three ports and the fourth port should be kept in stand by and should be used promptly as and when needed.

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