

Original Research Article

Modified three port laparoscopic cholecystectomy versus conventional four port technique

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Received: 12 April 2020

Accepted: 04 May 2020

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ABSTRACT

Background: The current study was undertaken to compare the results of modified three-port laparoscopic cholecystectomy and conventional three or four-port surgery in terms of technical feasibility, safety of the technique, postoperative pain and need of post-operative analgesia, cosmetic satisfaction of the patient and cost effectiveness and were found to be better with the modified technique.

Methods: In modified three port laparoscopic cholecystectomy technique, first 10 mm umbilical, second 5 mm epigastric and third 5 mm subcostal ports are made, i.e., "10-5-5" instead of "10-10-5" or "10-10-5-5" of conventional three or four port techniques and finally, gallbladder is extracted through the umbilical port.

Results: The pain in the postoperative period and the requirement of postoperative analgesia were significantly less and there was better cosmetic satisfaction of the patients operated by the modified three port laparoscopic cholecystectomy technique as compared to conventional three or four port surgery.

Conclusions: The modified three-port laparoscopic cholecystectomy technique is safe and has the same comfort and feasibility to the surgeon along with added advantage of less pain and better cosmetic appearance to the patient in comparison to the conventional three or four-port surgery, with no obvious increase in complications and is definitely a viable alternative procedure for the management of cholelithiasis.

Keywords: Cholelithiasis, Cholecystectomy, Modified, Pneumoperitoneum, Ports, Trocar

INTRODUCTION

Surgical removal of gall bladder has been the mainstay of treatment for cholelithiasis. In 1882, Carl Langenbuch, a noted German surgeon, performed the first successful cholecystectomy by subcostal Kocher's incision.^{1,2} However, in the past several decades, research has been going on to develop less invasive and less painful treatment for gallstones. Although mini-cholecystectomy

was introduced to minimize the pain and recovery time in comparison to conventional open cholecystectomy, but the introduction of laparoscopic cholecystectomy has revolutionized the procedure.³ The first laparoscopic cholecystectomy was performed in 1987 by Phillip Mouret and later established by Dubois, Perissat, Reddick and others in 1990.^{4,5} Since then, it has met with widespread acceptance and presently, laparoscopic cholecystectomy has been established as a gold standard

procedure for gall bladder surgery because of reduced incision related morbidity, early feeding, less pain, reduced hospital stay, early return to routine work and better cosmesis.

In India, first case of laparoscopic cholecystectomy was performed by Udwardia TE, in Mumbai in 1991.⁶ Laparoscopic cholecystectomy has been traditionally performed by the standard four port technique, wherein the fourth (lateral) trocar is used to grasp the fundus of the gallbladder so as to expose Calot's triangle.

With increasing surgeons experience, laparoscopic cholecystectomy has undergone many refinements including reduction in port size by the introduction of micro-laparoscopic cholecystectomy using 5 mm trocar for the umbilical port and 3 mm trocars for other ports and mini-laparoscopic (needlescopic) cholecystectomy using all 2-3 mm trocars and instruments and also reduction in number of ports.⁷⁻¹⁴

It has been argued that the fourth trocar may not be necessary and laparoscopic cholecystectomy can be performed safely by just three ports and more recently two ports and even single port only.¹⁵⁻¹⁷ In the modified 3 port laparoscopic cholecystectomy technique named "10-5-5", some refinements were made such as placement of primary port through umbilicus, reduction in size of epigastric port to 5 mm, ligation of cystic duct with extracorporeal silk knot, bipolar coagulation of cystic

artery and extraction of gall bladder through umbilicus.^{18,19} Experience of the operating surgeon is very important while exposing the Calot's triangle and dissecting the gallbladder from liver bed for performing laparoscopic cholecystectomy by the modified three port technique.

This study was designed to explore and evaluate the feasibility, safety and benefits associated with the modified 3 port technique. Technical feasibility was defined as performance of the laparoscopic cholecystectomy without much difficulty by using 3 ports only and the need of a fourth port was considered a failure of the technique.

Safety was defined as performance of the procedure without any major complications like bleeding and injury to the bile duct or any viscera. Benefits were measured by various parameters like postoperative pain, requirement of analgesia after surgery and cosmetic satisfaction of the patient.

METHODS

The study is a retrospective review of 3600 patients of consecutive laparoscopic cholecystectomy performed by a single surgeon, Dr. Rajive Gupta, the corresponding author at various private hospitals in Jammu (Jammu and Kashmir), India over a period of 18 years from March 2002 to March 2020.

Table 1: Hospital wise and group wise distribution of cases.

Name of the hospital	Number of cases (%)	Group A	Group B
Bee Enn General Hospital, Talab Tillo	900 (25.00%)	300	600
Kalindi Nursing Home, Subash Nagar	650 (18.05%)	350	300
Care and Cure Hospital, Trikuta Nagar	550 (15.27%)	280	270
Maxxlyfe Hospital, Bathindi	423 (11.75%)	228	195
Ganeshdaya Nursing home, Talab Tillo	400 (11.11%)	217	183
Lochan Nursing Home, Trikuta Nagar	200 (5.55%)	150	50
Goel Hospital, Canal Road	100 (2.77%)	60	40
AV Nursing Home, Channi Himmat	90 (2.50%)	55	35
Vini Hospital, Janipur	80 (2.22%)	35	45
Mediaids Nursing Home, Channi Himmat	70 (1.94%)	40	30
Medicare Nursing Home, Gandhi Nagar	40 (1.11%)	30	10
JK Medicity, Narwal Bypass	30 (0.83%)	20	10
Kapoor Nursing Home, Bakshi Nagar	15 (0.41%)	5	10
72 Beats Hospital, Bypass Channi Himmat	14 (0.38%)	10	4
Maharishi Dayanand Hospital, Rehari Chungi	10 (0.27%)	6	4
SHS Memorial Hospital, Rehari Chungi	08 (0.22%)	4	4
Shree Om Hospital, Bari Brahmana	08 (0.22%)	5	3
SDDM Hospital, Channi Himmat	06 (0.16%)	2	4
Lifeline Hospital, Last Morh Gandhi Nagar	03 (0.08%)	2	1
Baba Nanak Medicity, Gadigarh	03 (0.08%)	1	2

Inclusion criteria

- Both acute (400 cases) as well as chronic (3200 cases) patients of sonographically proved cholelithiasis were part of the study.

Exclusion criteria

- Patients who weren't fit for general anesthesia (ASA-grade IV) and patients with portal hypertension, cirrhosis of liver, uncorrectable coagulopathies, acute pancreatitis, surgical jaundice associated with choledocholithiasis and suspected or proven malignant gall bladder were excluded from the study.

All the patients with acute cholecystitis and empyema or thick edematous gall bladder wall were taken up for conventional four port laparoscopic cholecystectomy and rest of the cases were randomly divided into two groups (A and B). Group A comprising of 1800 patients taken up for modified three port laparoscopic cholecystectomy and Group B comprising of 1800 patients taken up for regular four port surgery. The list of different hospitals along with distribution of cases in two groups is given in Table 1.

Preoperative assessment

The patients were initially evaluated and subjected to all the routine investigations for general anesthesia like CBC, blood sugar, LFT, RFT, serology, X-ray chest and ECG and admitted for surgery on the same day. Before the procedure, fully informed consent was taken. Urinary bladder was emptied before shifting the patient to operation room.

Operative technique

The patients of both groups were given general anesthesia. In both the techniques, primary placement of 10mm umbilical (camera) port was by the blind method by creating carbon dioxide pneumo-peritoneum through a veress needle inserted into the peritoneal cavity from a puncture wound within the umbilicus, though many surgeons make either supra or infra-umbilical incision. The operating telescope (zero-degree Karl Storz) was placed through the umbilical port and peritoneoscopy performed with the intra-abdominal pressure maintained at 14 mm.

In four port technique

Second 10 mm epigastric port (working port) in the midline to the right of falciparum ligament 5 cm below the xiphisternum, third 5 mm subcostal port 5 cm below the right costal margin in the mid clavicular line and fourth 5 mm port in the anterior axillary line at the level of umbilicus were placed under direct vision. Fourth port 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.

In modified three port laparoscopic cholecystectomy technique

Second 5 mm epigastric port instead of conventional 10 mm size and third 5 mm subcostal port were placed in the same fashion as in standard four port surgery. The fourth port in the anterior axillary line was omitted. A toothed grasper was then inserted through the third port to hold the gall bladder at infundibulum and dissection started high in the neck of gallbladder by passing a Maryland dissecting forceps through the epigastric port. 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 in 4 port technique. The cystic artery and cystic duct were defined and separated. Cystic artery was coagulated and cut by using bipolar diathermy and cystic duct was ligated by number 0 silk employing extracorporeal Roeder's knot using a knot pusher or clipped using a 5 mm clip applicator and cut. The gallbladder was dissected off the liver bed using electrocautery and finally extracted through the umbilical port by visualizing with 5 mm telescope passed through the epigastric port. The skin incision at umbilicus was closed by subcutaneous 00 vicryl suture, whereas the other two ports didn't require stitches and were simply covered by the pressure gauge dressings (Figure 1).

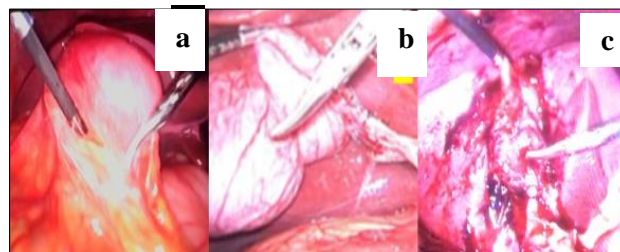


Figure 1: (a-c) Steps in modified 3 port laparoscopic cholecystectomy.

In both the groups, normal saline and betadine irrigation was done in case of bile spillage and an intra-abdominal tube drain (ADK) number 24 or 28 was placed in Morrison's sub-hepatic pouch through the subcostal port and was positioned under vision. All the patients were put on intravenous fluid during first 12 hours. Two doses of intravenous antibiotics (ceftriaxone) were given, one at the time of induction of general anesthesia and second after 12 hours. Every patient was given injection of diclofenac 75 mg in intravenous infusion first preoperatively and repeated after 8 hours for postoperative pain control and any additional analgesic injection required was noted. Patients were monitored for pulse rate, temperature, respiratory rate, color and quantity of discharge from drain, if kept and any jaundice

and gallbladder sent for histopathological examination. Patients were discharged either on the same evening or next morning and were advised to take oral antibiotics for five days and analgesic tablets containing 50 mg of diclofenac and 10 mg of serratiopeptidase on need basis only and to keep a record of it. Patients were followed weekly for 4 weeks and they were particularly asked about the severity of pain at port sites and the number of analgesic tablets needed, if any and cosmetic satisfaction regarding the scar.

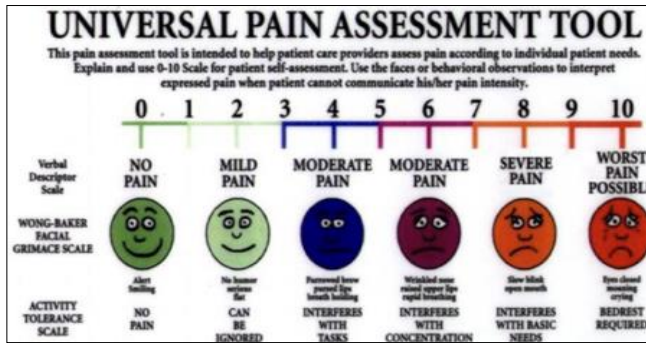


Figure 2: Visual analogue scale (VAS) for assessment of pain.

In this study, primary outcome measure was pain score and was assessed by using VAS (visual analogue scale) which is a validated subjective measure for pain and is used to help patient communicate the severity or intensity of pain (Figure 2). It is presented as a 10 cm horizontal line on which the patient's pain intensity is represented in millimeters from the left end of the line to the point that the patient marks. VAS score is in range of 0-10 and score 1-3 is called as low pain score (mild) and 4-6 (moderate) and 7-10 as high pain score (severe).

RESULTS

A total of 3600 patients were included in the study and were divided into two groups, Group A and Group B, each comprising of 1800 patients. Patients in Group A were subjected to modified three port laparoscopic cholecystectomy, whereas patients in Group B were subjected to conventional four port surgery. Most of the patients had multiple calculi in the gall bladder and 200 patients in the Group A and 250 patients in group B had single calculus. 4 patients in each group had gall bladder polyps. Of the patients with cholelithiasis, majority had chronic symptoms. Various observations made during the course of the study are shown in Table 2.

Table 2. Comparison of study variables.

Parameter	Group A	Group B	(p value)
Average age in years	38±12 (4-91)	41±10 (12-84)	NS
Sex ratio (M:F)	1:3.5	1:3.86	NS
Mean operative time in minutes	29.26±4.60 (15-50)	30.66±4.02 (14-48)	NS
Conversion rate	28 (16 to 4 port, 12 to open)	29 to open	NS
Operative complications	251	266	NS
Mean Post operative pain score	2.70	3.08	S*
Analgesic injection requirement	1.96±0.450	2.22±0.418	S*
Analgesic tablet requirement	5.52±0.735	5.86±0.700	S*
Hospital stay	1 day	1 day	NS
Number of days to return to routine work	8.02±0.553	8.16±0.681	NS
Cosmesis satisfaction score	8.16±0.37	7.99±0.46	S*

p value <0.05 (significant)*, NS: Non-significant, S: Significant.

Table 3: List of complications in two groups of laparoscopic cholecystectomy.

Complication	Total number	Percentage (%)	Group A	Group B
Hemorrhage	197	5.47%	90	107
Iatrogenic perforation of gallbladder	192	5.33%	98	94
Port site infection	68	1.88%	32	36
Bowel injury	15	0.41%	9	6
Port site hernia (umbilical hernia)	14	0.38%	6	8
Injuries to CBD and choleperitoneum	13	0.36%	6	7
Postoperative pancreatitis	9	0.25%	4	5
Postoperative biliary stricture	6	0.16%	4	2
Colon injury	2	0.05%	1	1
Stomach injury	1	0.02%	1	0

The average age of the patients in Group A was 38 ± 12 years with a range of 4 to 91, whereas average age of the patients in Group B was 41 ± 10 years with a range of 12 to 84. In Group A, 380 (21.11%) patients were male and 1420 (78.88%) were female. On the other hand, in Group B, 370 (20.55%) patients were male and 1430 (79.44%) were female. Operative times were almost similar in the two groups. The average operative time in Group A was 29.26 ± 4.60 minutes (range, 15-50) compared to 30.66 ± 4.02 minutes (range, 14-48) in Group B. The incidence of conversions in Group A was 16 conversions to 4 port method and 12 conversions to open method, whereas in Group B, there were 29 conversions to open cholecystectomy. The reasons for conversion were similar in both the groups and included difficult access to Calot's triangle and obscure anatomy, gallbladder empyema with thickened edematous wall, bleeding from vascular injury, CBD transection, iatrogenic visceral injury, cholecystocolic fistula and scarred abdomen. Complication rate was almost similar in the two groups with no statistical difference ($p > 0.05$) and included hemorrhage, gall bladder perforation, port site infection, bowel injury, umbilical hernia, injury to CBD and is shown in Table 3.

Table 4: Comparison of mean VAS pain score in two groups.

Mean VAS score	Group A	Group B
At 4 hours	2.88	3.18
At 8 hours	5.22	5.74
At 12 hours	4.24	4.70
At 18 hours	4.00	4.42
At 24 hours	2.34	2.84
At 1 week	0.16	0.44
At 2 weeks	0.08	0.24

Postoperative pain was assessed by visual analogue scale (VAS). The pain scores were calculated at 4, 8, 12, 18 and 24 hours postoperatively and at first and second week of follow up and difference in pain score in early and late postoperative period between the two groups was statistically significant ($p < 0.05$) as shown in Table 4.

All the patients required analgesia in the postoperative period. The requirement of analgesics was in range of one to three injections of diclofenac by each patient during the first 24 hours and it was significantly lower in Group A ($p < 0.05$). There was also statistically significant difference in the number of oral analgesic tablets consumed by the patients in the two groups after they were discharged from hospital.

The postoperative hospital stay in the present study was a mean stay of 1 day in each group. Days to return to normal activity were 8.02 ± 0.553 in Group A and 8.16 ± 0.681 in Group B, which was not statistically significant ($p > 0.05$).

Patient satisfaction score on scars were reviewed four weeks after surgery by using a 10 cm unscaled VAS (0, unsatisfied, 10 fully satisfied). In Group A, 1350 (75%) patients were fully satisfied with the scar and cosmetic outcome, 360 (20%) patients were partially satisfied, whereas 90 (5%) patients were unsatisfied due to poor scar and cosmetic result. In Group B, 900 (50%) patients were fully satisfied with the cosmetic outcome, 600 (33.3%) were partially satisfied and 300 (16.6%) patients were unsatisfied. In the Group A, cosmesis satisfaction score was 8.16 ± 0.37 as compared to 7.99 ± 0.46 in the Group B. Thus, overall patient satisfaction regarding scar outcome was significantly better with the modified 3 port technique (Table 5).

Table 5: Cosmetic outcome in patients in two groups.

Cosmetic outcome	(Group A) n (%)	(Group B) n (%)	p value
Fully satisfied	1350 (75%)	900 (50%)	<0.05
Partially satisfied	360 (20%)	600 (33.3%)	
Unsatisfied	90 (5%)	300 (16.6%)	
Cosmesis satisfaction score	8.16 ± 0.37	7.99 ± 0.46	

Modified three-port technique proved to be more cost effective because of requirement of smaller number of ports and less instruments, reduced intake of analgesics, less number of OT assistant needed and less number of work days lost. Also, the procedure was performed by the routine laparoscopic instruments and extra instruments or any specialized apparatus as needed in SILS (single port laparoscopic surgery) technique were not required. Moreover, none of the patients in Group A in this study required application of ligacip for cystic duct and cystic artery, thus reducing the cost of the procedure. Overall

results suggest that the modified three port technique was not difficult to master and could be safely performed by trained personnel.

DISCUSSION

Laparoscopic cholecystectomy has been traditionally performed by the four-port technique, but it can safely be performed by the modified three port method which is technically feasible and has cosmetic and cost advantages. A large number of studies conclude that the

three-port laparoscopic cholecystectomy results in less individual port-site pain and fewer surgical scars compared to four-port surgery.¹⁵⁻¹⁹

In this study, the difference in the age of the patients in two groups was statistically insignificant ($p>0.05$). Manoj Kumar et al reported a similar age distribution in their study with a mean age of 38.22 years in three port group and a mean age of 39.13 years in four port group.²⁰ This study results were also comparable to those obtained by Nafeh AI et al.²¹ The preponderance of females in this study is also reflected by the results of Al-Azawi D et al in which male to female ratio was 1.14:4.15.²² Present study results were also comparable to those obtained by Cerci C et al, Tuveri et al and Mayir B et al.²³⁻²⁵

The difference in operative time in two groups was statistically insignificant ($p>0.05$). Mixed results have been reported in literature in this regard. Some studies have reported mean operative time in the four-port group to be slightly less than that in three-port group probably because the addition of the fourth port facilitates dissection of the Calot's triangle as it is better exposed due to laterally retracted gall bladder. Some authors have reported three port procedure to be shorter than four-port because less time was spent on the establishment and subsequent closure of the additional port. Mayir B et al reported similar results, with a mean operative time in three port group as 31 ± 9.1 versus 31.6 ± 7.6 minutes in four port group with no statistically significant difference.²⁵

In this study, there were only 28 conversions in Group A and 29 conversions to open cholecystectomy in Group B. A similar success rate has been described in the other reported studies. Factors leading to conversion to open technique were comparable in both techniques and other authors have also reported similar causes of conversion.²⁶

Overall complication rates and factors leading to these were comparable in the two groups. Some surgeons have expressed concern about the safety of the three-port technique, arguing that it may lead to a higher percentage of the bile duct injuries. However, bile duct injury can be avoided if the gallbladder is gripped at the infundibulum, retracted laterally and dissected at the infundibulum-cystic duct junction rather than cystic duct-common bile duct junction. Harsha et al and Mayir B et al published results similar to this study in terms of complication rates.^{16,25}

Post-operative pain was assessed by visual analogue scale. In our study, the pain scores were significantly lower in Group A as compared to Group B in the early as well as late postoperative period. Kumar M et al reported similar findings in their study with the VAS pain score significantly low in three port group.²⁰ Mean pain score was 2.19 ± 1.06 in three port group as compared to 2.91 ± 1.20 at 12 hours in four port group ($p<0.05$) and mean pain score was 2.22 versus 2.44 at 24 hours

($p<0.05$). Nafeh AI et al reported similar findings in their study with the VAS pain score significantly low in three port group.²¹

In this study, number of analgesic injections required and number of oral analgesic tablets consumed was significantly less in patients of Group A. In a study conducted by Manoj Kumar et al, analgesic tablet requirement was significantly lower in three port group as compared to four port group (4.3 versus 3.6).²⁰ Nafeh AI et al also reported that the mean number of analgesic injections requirement was significantly lower in three port group (0.9 ± 0.6) than in four port group (1.3 ± 0.7).²¹

Mean hospital stay in both the groups was one day. Nafeh AI et al reported mean hospital stay of 2.2 days in three port group in comparison to mean hospital stay of 2.3 days in four port group which was statistically insignificant.²¹

In this study, mean number of days required to return to normal activity was 8.02 ± 0.553 in Group A and 8.16 ± 0.681 in Group B. This difference was statistically insignificant. In a study conducted by Manoj Kumar et al, mean number of days needed to return to normal activity was 4.9 in three port group and 5.8 in four port group and the difference was statistically insignificant.²⁰

Most of the patients in this study reported high satisfaction with the surgery and the surgical scars by the modified three port technique. Mean satisfaction score in Group A was 8.16 ± 0.37 versus 7.99 ± 0.46 in Group B and this was statistically significant (p value <0.05). This study results were similar to Kumar M et al with a mean satisfaction score of 8.2 in three port group and 7.8 in four port group.²⁰

Gorini P, mentioned advantage of 3 port technique as an apparent reduction in cost, assessed at about 18% and results were comparable to this study.²⁷

CONCLUSION

The modified three port laparoscopic cholecystectomy is a safe and feasible technique in the hands of an experienced laparoscopic surgeon and has better outcome in the form of less postoperative pain, less requirement of analgesia and leaves fewer scars resulting into more cosmetic satisfaction of the patient as compared to the regular four port surgery, with no obvious increase in bile duct injuries and it can be recommended as a viable alternative for the management of cholelithiasis. To ensure good results of this modified technique, careful case selection, meticulous dissection, well trained team and high standard equipment are needed. The procedure is simple and can be performed in any laparoscopic centre. However, the surgeon should not hesitate to add another port or to convert to open cholecystectomy, whenever any difficulty arises during the procedure, to prevent critical complications.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

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Cite this article as: Resutra R, Gupta R, Gupta M. Modified three port laparoscopic cholecystectomy versus conventional four port technique. *Int J Res Med Sci* 2020;8:2248-54.