

*Research article***Comparison between Two-Port and Standard Four-Port Laparoscopic Cholecystectomy****Kamal Mamdouh, MD and Mohamed Aboelnaga, MD**

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Abstract

Background: Laparoscopic cholecystectomy (LC) has replaced open cholecystectomy as the standard procedure for gallbladder removal whenever possible. Recent developments regarding LC have been directed toward reducing size or number of ports to achieve the goal of minimal invasive surgery. The utilization of laparoscopes with operating channels made two-port LC technically feasible. **Objective:** To compare the outcome between two-port and four-port LC in terms of safety of procedure, operating time, postoperative pain, hospital stay, cosmesis, and need for conversion to open surgery. **Design:** Prospective study. **Patients and Methods:** From November 2014 and May 2015. The prospective randomized study of 60 patients with chronic calculous cholecystitis who underwent laparoscopic cholecystectomy divided into 2 groups, the group A included 30 patients; they were underwent traditional four-port laparoscopic cholecystectomy. The group B included 30 patients who were underwent two-port laparoscopic cholecystectomy. We compared accessibility, safety, intraoperative and postoperative complications. **Results:** Group B patients gave the best results as regard postoperative pain and postoperative cosmesis in comparison to group A with P value=0.04 and 0.03 respectively. But time of operation and intraoperative Gall bladder perforation were slightly more in group B than group A. **Conclusion:** Two-port laparoscopic cholecystectomy is a feasible technique in selected cases. It has some advantages over traditional four-port laparoscopic cholecystectomy as regard postoperative pain and cosmesis. But operative time in two-port technique is quite longer than conventional LC. Clinical trials on a large scale are recommended to modify and improve this approach.

Key words: Laparoscopic cholecystectomy, four-port, two-port.**Introduction**

Since the first laparoscopic cholecystectomy (LC) was reported in 1985, various modifications of LC have been developed. Innovative techniques of Natural Orifice Endoscopic Surgery (NOTES)⁽¹⁾, Single-Incision Laparoscopic surgery (SILS)⁽²⁾ along with two-port⁽³⁾ and three-port⁽⁴⁾ laparoscopic surgeries have been applied to gall bladder removal as a step towards even lesser invasive procedures than the conventional four-port surgery. These newer techniques represent the advent of essentially scarless, more pain-free, better cosmesis and early return of function for the patient.

Standard laparoscopic cholecystectomy is performed using four trocars. With increasing surgeon experience, laparoscopic cholecystectomy has undergone many

refinements including reduction in port size. Two-port laparoscopic cholecystectomy has been reported in the international literature to be safe and feasible⁽⁵⁾.

In four-port laparoscopic cholecystectomy, the critical view of safety is best ensured by three instruments, which enable both attainment of sufficient operative vision and bimanual manipulation. However, as the number of incisions for ports increases, the potential risks of port related complications also can increase. Furthermore, as patients have growing awareness of the quality of life, there has been an increase in demand for cosmesis⁽⁶⁾.

The introduction of single-port laparoscopic cholecystectomy has drawn as much attention and interest as initial introduction of laparoscopic cholecystectomy⁽⁷⁾.

However, it was not proved to have the other potential benefits such as reducing postoperative pain and return to normal activity^(A).

This study compare the outcome between two-port and four-port LC in terms of safety of procedure, operating time, postoperative pain, hospital stay, cosmeses, and need for conversion to open surgery.

Patients and Methods

This study was designed as prospective researches that were conducted on 60 patients with chronic calcular cholecystitis in the period between November 2014 and May 2016. They were admitted to Ain Shams University Hospitals, Cairo, Egypt and underwent laparoscopic cholecystectomy.

Patients were chosen in each group by randomization using closed envelope method. Informed patient consent was taken.

Inclusion Criteria:

Patients with chronic calcular cholecystitis evaluated from history, clinical examination, investigations and proved by abdominal ultrasound.

Exclusion Criteria:

A) Preoperative:

1. Acute cholecystitis (clinical or radiological).
2. Mucocele or empyema of gall bladder proved by abdominal ultrasound.
3. Patients with gallbladder lesions.
4. Suspicion of malignancy proved by ultrasound or computed tomography.
5. Patients not fit for laparoscopy.
6. Pregnancy.
7. Any medical condition which is contraindicated with laparoscopic approach.
8. Previous major abdominal surgeries.
9. Refused consent.
10. Features of acute cholecystitis, chole-docolithiasis, and pancreatitis.

B) Intraoperative:

1. Excess intraoperative adhesions that necessitate at least 2 ports for manipulation.

2. Proved intraoperative gall bladder mucocele, empyema or suspicious lesion.
3. Conversion to open surgery.

The patients were divided into two groups; **the first group (group A)** included 30 patients, they were underwent four-port laparoscopic cholecystectomy and **the second group (group B)** underwent two-port laparoscopic cholecystectomy.

All patients were subjected to:

- 1) **History taking:** symptoms of biliary colic, fever, nausea and vomiting.
- 2) **Clinical examination:** General and abdominal examinations were carried out, right upper quadrat tenderness are usually present, it was also helpful in assessment of the general condition of the patient.
- 3) **Investigations:**
 - a. Laboratory: such as full blood count, liver function tests, alkaline phosphatase, fasting blood sugar, serum urea, creatinine, bilirubin (total& direct), albumin, prothrombin time and concentration, INR.
 - b. Radiological: in the form of ultrasonography of the gall bladder to confirm the gallbladder calculi, measure its wall thickness, common bile duct (CBD) diameter and stones and features of acute inflammation or malignancy.

Patient Preparation:

All patients were admitted to the appropriate ward via outpatient clinic, underwent surgery according to an elective schedule. All patients consented to undergo conversion to conventional laparoscopic cholecystectomy if necessary. One gm ceftriaxone was injected ½ hours before the operation

Surgical Technique:

Instruments:

Endoscopic dissectors, scissors, graspers, Maryland and hook, monopolar electrocautery, clip applier, 30 degree camera and 2 straight needles (Proline 1 or 2 or 3/0) with cutting end.

The Procedure:

Patients were placed in a supine position with the operating surgeon standing on the patient left.

As regards group A (four-port technique), trocars were on the semi-circle shape, one 10mm port would be put above or below umbilicus, one 10mm port in the epigastrium, one 12mm port in the right hypochondrium and one 12mm port in the anterior axillary line.

As regards group B (two-port technique), one 10mm port would be put above or below umbilicus, one 10mm port in the epigastrium.

The following steps were done in group B patients:

1. Pneumoperitoneum was established by Hasson method (open method).
2. Umbilical port 10mm was inserted and telescope was inserted into it.
3. Epigastric port 10mm was inserted.
4. One traction suture was placed in the fundus of the gall bladder using proline 1 or 2 or 3/0 on straight and cutting needle and passed through anterior abdominal wall and then placed high up in the right hypochondrium, just below the tip of the ninth costal cartilage or in the last intercostal space, extracorporeal knot was done.
5. Another traction suture was passed through anterior abdominal wall and placed in the Hartman pouch. Then intracorporeal knot was done over the Hartman pouch and the needle was passed through lateral abdominal wall in the right flank. Occasionally, a third traction suture was applied through body of the gall bladder if traction of the gall bladder was not enough.

The operative difficulty was assessed based on the degree of inflammation, adhesions, condition of gall bladder wall, presence of fistula formation with neighboring organs/structures (duodenum, CBD, colon, stomach, etc.).

The following steps were done in both groups:

1. Dissection of Callot's triangle.

2. Clipping of cystic artery and cystic duct.
3. Dissection of the gall bladder from liver bed using electrocautery.
4. Extraction of the gall bladder from epigastric port.
5. Routinely, Drain insertion for 24 hours.

Closure of anterior abdominal wall sheath at the umbilicus using 1/0 Polypropylene Suture and closure of skin by 4/0 poliglecaprone 20 Suture.

Postoperative Care and Follow up:

The patients were followed up till discharge from the hospital and drain removal. Pain was assessed by visual analogue scale at 2, 4, 6, 8, 12 and 24 hours; and total 24 hours and the patients' satisfaction of scar were also assessed. Cosmesis: Assessed at the end of 30 days by the patient and independent nurse in the ward/OPD. Each was asked to rate cosmesis on a scale of 1 (worst) to 10 (best). The mean of both the patients' score and nurse's score was taken as the final score. The patients were followed up for 30 days after discharge.

Complications: CBD injury, hepatic injury/bleed, biliary/stone spillage, bowel injury, vascular injury or any other complication.

Data was collected regarding age, date of surgery, time of operation Counted from "skin to skin", i.e., from first incision to the end of closure of the final wound, time of hospital stay and drain removal, history of complications, clinical examination of the wound.

Statistical analysis

"Data were described in terms of mean standard deviation (SD), median and range, or frequencies (number of cases) and percentages when appropriate. For comparing categorical data, the "Chi square test" was performed. "P values" less than 0.05 were considered statistically significant. All statistical calculations were done using the program "IBM SPSS Statistics" (Statistical Package for the Social Science; IBM Corp., USA) and the graph Pad Prism".

Results

The study was conducted on 60 patients who were divided into 2 groups, 30 patients for each group, number of males and females were 15 and 15 respectively in group A and were 15 and 15 respectively in group B, with mean age \pm SD 30.53 \pm 6.48, 30.90 \pm 8.12 for group A patients and group B patients respectively. There was no statistically significance between both groups as regard age and sex of the patients.

Comparison between both groups as regard operative timeshowed that it is ranging between 28-72 minutes in group A and ranging between 39-134 minutes in group B with mean operative time \pm SD 44.07 \pm 17.73 and 59.93 \pm 19.8 for group A and B respectively. There was highly statistically significance difference between both groups as regard operative time (p value = <0.001).

As regard conversational approach to open cholecystectomy or three ports approach, no cases were converted in group A while in group B, one case converted to open cholecystectomy and two cases converted to three port approach with no statistical significant difference between both groups (p value= 0.206).

For monitoring and comparing the port-site pain intensity 3 days postoperatively between the two groups, a visual analog scale (VAS) with a 10cm vertical score ranging from "No pain" score 0 to "worst possible pain" score 10 was used. After the patients had been adequately instructed about the range for measuring pain, they selected a value on the scale.

Pain score analysis showed statistically significant differences postoperatively regarding port-site pain (p value=0.04).

Patients in the 3 port group usually reported significantly higher pain scores.

There was statistically significant difference between both groups regarding post-operative pain as postoperative pain in group B is much better than group A with $P=0.04$.

For reporting and comparing the patients' satisfaction with the aesthetic results of both procedures during the follow ups between the two groups, a visual analog scale with a vertical score ranging from "very dissatisfied" score 0 to "very satisfied" score 10 was used. After the patients had been adequately instructed about the range for measuring their satisfaction with the scar, they selected a value on the scale (between 0 and 10). Scar satisfaction analyses showed a marked statistically significant differences regarding the aesthetic results between the two groups (p value= 0.0319). Where most of the cases in the 3 port group were highly satisfied with the aesthetic results while, on the other hand, many of the cases in the 4 port group were dissatisfied with the aesthetic results of the conventional approach.

Also, There was statistically significant difference between group A and group B results regarding scar satisfaction as it is better in group B with $P=0.02$.

This study showed no statistically significant difference between group A and group B results regarding intraoperative and postoperative complications as regard bleeding, biliary injury, biliary leakage and wound infection with $p=1.00$. Although intraoperative gall bladder perforation and drain insertion were more in group B than group A but there was no statistically significant difference with $p=0.987$, $p=0.07$ respectively.

Table (1): Demographic Distribution of Age, Sex and BMI in Both Groups

	Group A (N = 30)	Group B (N = 30)
Age		
Mean days ± SD	40.43 ± 7.48	30.9 ± 8.12
Range	28 – 50	22 – 57
Sex		
Male (%)	4 (13.3%)	3 (10%)
Female (%)	26 (86.7%)	27 (90%)
BMI		
Mean ± SD	29.03 ± 3.78	28.93 ± 3.20
Range	24 – 37	24 – 37

Table 2: Comparison Between The Two Groups As Regard Operative Time

	Range/min	Mean	SD	P	Sig.
Group A	28 – 72	44.07	7.73		
				<0.001	HS
Group B	39 – 134	59.93	19.8		

Table 3: Comparison Between The Two Groups As Regard The Mean Pain Score

	1st Day (Mean)	2nd Day (Mean)	3rd Day (Mean)	P	Sig.
Group A	8	7.70	0.80		
				0.04	Sig.
Group B	0.4	4.1	2.4		

Table 4: Comparison Between The Two Groups As Regard Scar Satisfaction (Score 1-10)

	No	Mean	SD	P	Sig.
Group A	30	4.26	0.870		
				0.03	Sig.
Group B	30	7.7333	1.143		

Table 5: Comparison Between The Two Groups As Regard Intra And Postoperative Complications:

Complications	Group A		Group B		P-value	Sig.
	NO	%	NO	%		
Intraoperative bleeding	0	0	0	0	1.000	NS
Intraoperative Biliary injury	0	0	0	0	1.000	NS
Intraoperative GB perforation	2	7.7	3	10	0.987	NS
Postoperative bleeding	0	0	0	0	1.0	NS
Postoperative biliary leakage	0	0	0	0	1.0	NS
Postoperative drain	18	60	26	87	0.07	NS

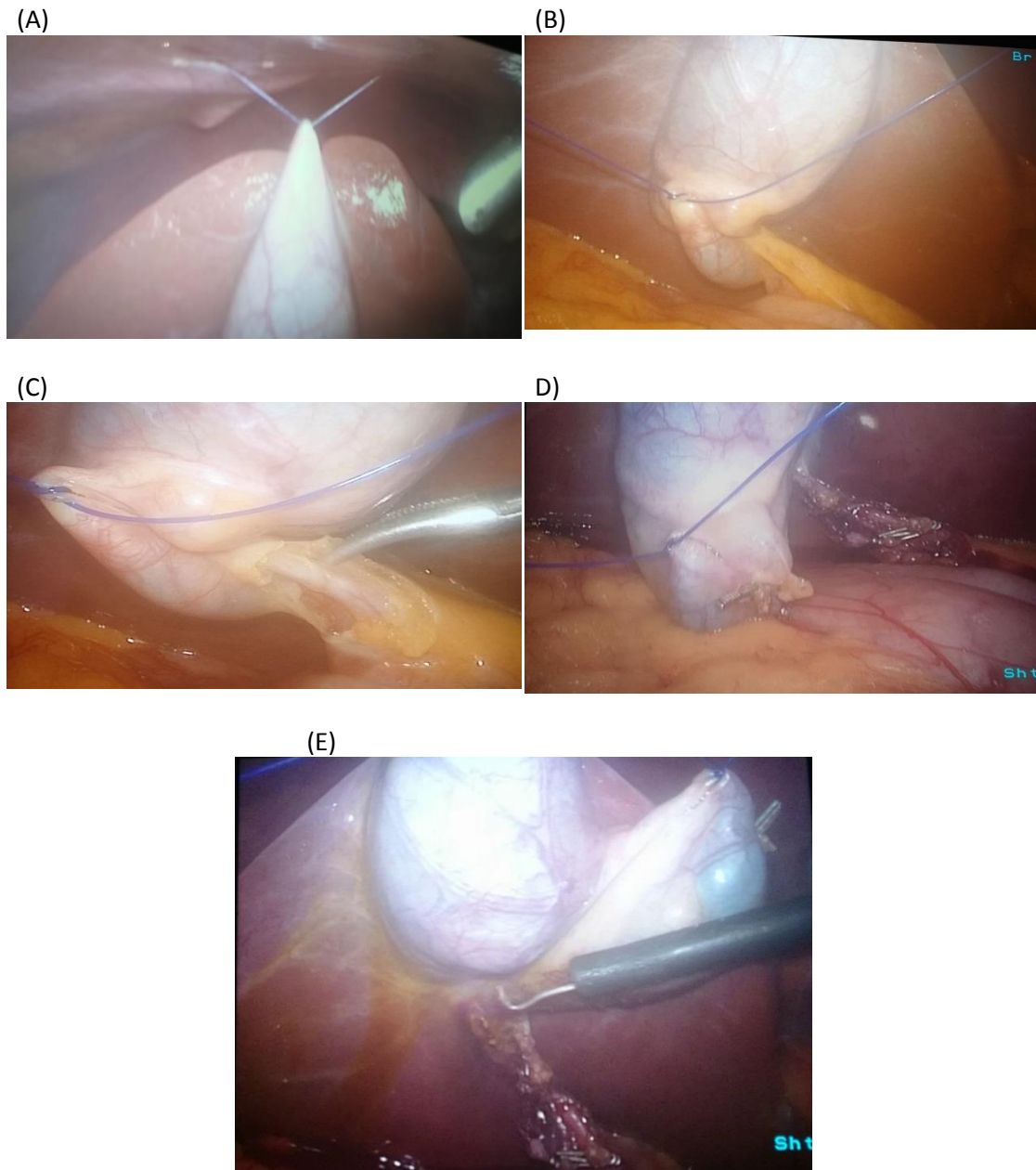


Figure (1): Illustration of two-port laparoscopic cholecystectomy steps; (A) Traction suture of the gall bladder fundus, (B) Traction suture of the Hartman`s pouch, (C) Dissection of the Callot`s triangle, (D) Clipping of cystic artery and cystic duct and (E) Dissection of the gall bladder from the liver bed using electrocautery.

Discussion

The evolution of surgery of gallbladder from Langenbuch's first cholecystectomy with a hospital stay of six weeks into a day-care specialty following the introduction of LC is indeed fascinating⁽¹⁾. The main thrust has been on the reduction of pain and improving cosmeses throughout the history of cholecystectomy. In fact, post-operative pain is the limiting factor for the delay in discharge in day-care cholecystectomies.

The idea of scarless surgeries has led to increased acceptance of the procedures among patients.

There have been a number of modifications in the technique of laparoscopic cholecystectomy. The use of fourth trocar, which is generally used for gall bladder fundus traction, in the American technique was deemed unnecessary for some surgeons,

whereas others used sutures to retract the gall bladder⁽¹¹⁾.

SILS or Single-Port-Access [SPA] proposes to offer an even better cosmoses since it leaves no visible scar as it is hidden in the umbilicus. However, the technique is more demanding as dissection becomes more difficult due to clashing of instruments, loss of normal triangulation, restricted vision and depth of dissection. Special large port, angulated instruments and scopes are needed for better dissection. All these factors lead to a steeper learning curve and increase the risk of wound-related complications including hernia formation⁽¹¹⁾.

In addition, a meta-analysis (Joseph et al., 2012)⁽¹²⁾, single incision laparoscopic cholecystectomy is associated with a high bile duct injury rate. 2626 patients on single port laparoscopic cholecystectomy, the rate of bile duct injury was significantly higher in single port than in four-ports laparoscopic cholecystectomy (4% versus 0% respectively). It can be attributed to the difficulties in securing "critical view of safety".

Four ports laparoscopic cholecystectomy has been the standard of treatment for symptomatic cholelithiasis, since the verification of its safety and feasibility in 1992 (NIH, 1992)⁽¹³⁾. Though 3 ports LC was introduced thereafter, it could not replace 4 ports LC completely due to limited evidence (Sun et al., 2009)⁽¹⁴⁾, in 4 ports by 3 instruments which enable both attainment of sufficient operative vision and bimanual manipulation. However, as the number of incision for ports increase the potential risks of port related complications also can increase. Furthermore, as patients have growing awareness of the quality of life, there has been an increase in demand for cosmoses, Few literature tested the feasibility of this technique because its difficulty. So, this study aimed to test the feasibility of this technique.

Our study showed that two-port approach is much better than four-port approach as regard postoperative pain and postoperative cosmoses and this result similar to report on two-ports LC has already shown that all

patients would choose this technique over four-ports approach, as the postoperative pain is significantly reduced and the procedure is cosmetically more acceptable to the patients (Trichak, 2003)⁽¹⁵⁾.

Two-ports LC proved to be safe and feasible, but it is technically difficult even in expert hands because of limited operative field. The modification of the operating telescope to achieve a wider field of view was done (Langwieler et al., 2009)⁽¹⁶⁾. This idea is agreed with our study in the form of more operative time in group B than group A.

The incidence of intra-operative and post-operative complications was similar in comparison to other studies; however, it is not reported by any other study. The conversion rates from two port mini LC to four-port LC and open cholecystectomy in many studies are in the range of 23% to 38%⁽¹⁷⁾.

Using modified operating telescope they have reported initial results of two ports LC. In the present study, operation was done by 30 degree telescopes. Tagaya et al. 1999⁽¹⁸⁾ reported a new technique of LC by two-port approach using abdominal wall lifting method. They noticed that retraction of the gall bladder is possible by the insertion of forceps through the umbilical port along the telescope of forceps through the umbilical port along the telescope which might eliminate the necessity of creating the third port.

Lee et al., 2005⁽¹⁹⁾ developed a two ports needlescopic cholecystectomy using 3mm or 5mm endograspers. Mishra has developed a unique technique with extra corporeal knot to perform two ports LC. In our study, used two traction sutures, passed through the fundus and the Hartmann's pouch respectively, with good results. The laparoscopic surgeons are developing and using a number of different techniques worldwide.

During testing this technique, the aim is to test feasibility of using sutures in retracting, manipulating gall bladder instead of using instruments. During this randomized

controlled study, both intracorporeal and extracorporeal were used. Extracorporeal knots were found to be much better than intracorporeal knots. Intracorporeal knots is quiet difficult because only single port was used. But using extracorporeal knot is easy and takes shorter time.

Hartman pouch stitch, often 1 stitch, if redundant gall bladder or long gall bladder slightly lateral to midclavicular line 2 to 3 fingers below last ribs, but sometimes, some difficulties appear in dissecting posterior wall of gall bladder on the right side. Alternative techniques can be applied, both by making a knot at Hartmann pouch, and going out by the needle near midline as much as possible. Other options are used to put a new stitch in the previous site near midline to manipulate gall bladder. By using one of the above techniques, the straight forward cholecystectomy becomes easy.

The disadvantages of our technique include slightly long operative time, bile slippage in some cases.

Ng et al., 1997⁽¹⁾ described LC using a single, umbilical incision, however, the single wound is, in fact, merely the result of combining the camera and adjacent 10mm working ports. A new operating device has been developed to further minimize the invasiveness. This is a single trocar with three channels that is placed using an open Hassan technique. It is designed to be used with flexible laparoscope. Preliminary results with this system have been reported with successful performance of laparoscopic renal surgery (Kaouk and palmer, 2008)⁽²⁾, Laparoscopic sigmoid-ectomy (Leroy et al., 2009)⁽³⁾, laparoscopic cholecystectomy (Romanelli et al., 2008)⁽⁴⁾ was performed successfully by single port access.

Conclusion

Two-port laparoscopic cholecystectomy is a feasible technique in straightforward cases which has no history of acute attacks and no intraoperative adhesions. It has advantages over traditional four-port laparoscopic cholecystectomy in that the patients needed

less analgesia, fewer scars, more patient satisfaction and cost effectiveness. Operative time in two-port technique is quite longer than conventional LC. Furthermore, clinical trials on a large scale are recommended to modify and improve this approach.

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