

# Comparison of Three-port vs Four-port Laparoscopic Cholecystectomy in a Medical College in the Periphery

<sup>1</sup>Riki Singal, <sup>2</sup>Pradeep Goyal, <sup>3</sup>Muzzafar Zaman, <sup>4</sup>RK Mishra

## ABSTRACT

**Aims and objectives:** To compare three-port laparoscopic cholecystectomy (LC) with four-port LC in chronic *calculous cholecystitis* patients. We compared the feasibility of the procedure, total operative time, postoperative pain, incidence of complications, and cosmetic results.

**Materials and methods:** The present study was conducted in the Department of Surgery at Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala. Totally, 200 adult patients of cholelithiasis with chronic cholecystitis were included in the study. These cases were randomly divided into two groups (I and II) consisting of 100 cases in each group. The study was conducted for a period of 1 year from April 2014 to March 2015. Three-port LC was performed in group I patients and four-port LC was performed in group II. The cosmetic results, incidence of postoperative complications, and operative time were noted in both the groups.

The present study is being undertaken to compare the various merits and demerits of three-port LC vs four-port LC performed by the same surgical team in the same scenario, in terms of parameters mentioned subsequently and assess the feasibility of both the procedures in our setup in a medical college.

**Results:** Gallstone disease is found to be more common in the 4th and 5th decades. Mean age of presentation was 41 years. Three-port LC is difficult in cases of dense adhesions. There were significant differences in operative time (93.16 minutes for three-port LC and 50.66 minutes for four-port LC). There was no significant difference due to type of operation. Cosmetic appearances for both the procedures were comparable.

**Conclusion:** We concluded that both three-port and four-port cholecystectomies are equally good procedures in the hands of experienced laparoscopic surgeons. The complications, operative time, hospital stay, cosmesis, and disability days were comparable in both groups. The four-port technique should be accepted and adopted only by beginners in minimal access surgery. The operator who performs three-port LC should be prepared for placement of an additional port or conversion to open laparotomy whenever complication arises.

**Keywords:** Cholecystectomy, Complications, Incision, Laparoscopy, Ports.

**How to cite this article:** Singal R, Goyal P, Zaman M, Mishra RK. Comparison of Three-port vs Four-port Laparoscopic Cholecystectomy in a Medical College in the Periphery. World J Lap Surg 2017;10(1):12-16.

**Source of support:** Nil

**Conflict of interest:** None

## INTRODUCTION

The introduction of minimal access surgery for gallbladder surgery has revolutionized the treatment of gallstones. The advantages of laparoscopic procedure are lesser postoperative pain, lesser incidence of surgical site infection and shorter hospital stay.<sup>1</sup> Abdominal incision has been reduced to four (or more) small stab incisions. This approach significantly causes less postoperative pain, less bleeding, short hospital stay, and a good cosmetic outcome. The benefits were assessed very soon afterward: Less postoperative pain, shortened hospital stay, rapid recovery, and better cosmetic results. As the technique became a routine procedure, modifications were made in order to make it less invasive and more cosmetic.<sup>1</sup> Later, technical advances introduced the 5-mm laparoscope and the 5-mm clip applicators, thus decreasing the port size, and later, the newer 2- or 3-mm instruments allowed the surgeons to make smaller incisions. The use of a working channel laparoscope made it possible to use only two ports, along with transdermal sutures and needles, for an easier manipulation of the gallbladder. Natural orifice transluminal endoscopic surgery (NOTES) has been shown to offer further improvements in advantages of laparoscopic cholecystectomy (LC), i.e., decreased pain, early ambulation, and better cosmesis.<sup>2</sup> Gallstone disease has been known since long as far as the 5th century when Greek physician Trallianus wrote about gallstones.<sup>3</sup> Nowadays, LC is the gold standard for the treatment of symptomatic gallstones.

Gallstones are remarkably common, especially in female population, and are a major expensive health problem. Its prevalence has become more apparent since the introduction of ultrasonography. The incidence of cholelithiasis in the United States is reported to be 10%. In addition to these 20,000,000 people with documented cholelithiasis, another 800,000 new cases are diagnosed annually<sup>4</sup> and 500,000 cholecystectomies are being

<sup>1</sup>Professor, <sup>2</sup>Associate Professor, <sup>3</sup>Assistant Professor, <sup>4</sup>Chief

<sup>1,3</sup>Department of Surgery, Maharishi Markandeshwar Institute of Medical Sciences and Research, Ambala, Haryana, India

<sup>2</sup>Department of Surgery, Maharishi Markandeshwar University Solan, Himachal Pradesh, India

<sup>4</sup>World Laparoscopy Hospital, Gurugram, Haryana, India

**Corresponding Author:** Muzzafar Zaman, Assistant Professor Department of Surgery, Maharishi Markandeshwar Institute of Medical Sciences and Research, Ambala, Haryana, India, Phone: +918059931554, e-mail: muzzafarzaman@yahoo.com

performed annually.<sup>5</sup> The advantages of laparoscopy over conventional or classic surgery include decreased pain, improved cosmetic results, and a decreased duration of hospital stay. For this reason, LC is nowadays performed through fewer and smaller ports. In recent years, multiple studies of single-incision laparoscopic surgery (SILS) have been published. The only reported advantage of SILS over standard LC is an improved cosmetic result.<sup>6,7</sup> Four-port LC is most commonly used, as this method provides better anatomic views and is easier to learn.<sup>8</sup> This study has been undertaken to assess the feasibility of three-port LC and compare its advantages and disadvantages over the standard four-port technique.

## MATERIALS AND METHODS

A total of 260 adult patients with cholelithiasis of either sex and in the age group of 18 to 60 years, admitted to the surgical wards of the Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, from April 2014 to March 2015, were taken up for the study. From this group, 60 patients were excluded as they did not meet the inclusion criteria.

The patients were divided into group I: Three-port LC and group II: Four-port LC, as 100 in each group.

All the cases of chronic calculous cholecystitis were included in the study, and the cases diagnosed with acute cholecystitis, empyema gallbladder, perforation gallbladder, and contraindications for laparoscopic surgery were excluded from this study.

In all the cases, relevant history, general physical examination, and the routine blood and radiological investigations were done as per proforma attached, to confirm the diagnosis and assess medical fitness of the patients.

### Procedure of Laparoscopic Cholecystectomy

All the patients were given an injection of ceftriaxone 1 gm intravenously before the procedure. Patients were asked to empty the urinary bladder before moving to the operation theater. All patients were operated under general anesthesia. A nasogastric tube was inserted and stomach aspirated, in cases where stomach was distended.

The Veress needle was inserted through a stab incision in the supraumbilical region. Once the needle tip entered the free peritoneal cavity, it was connected to the pneumoinsufflator and insufflated until the pressure was raised to 10 mm Hg. The Veress needle was removed and then at the site of Veress needle puncture a 10-mm safety trocar was inserted. When the trocar reached the abdominal cavity, it was removed and a telescope was introduced through the cannula. Operating table was tilted, head end

up and right side up. Then 10-mm working port in the subxiphoid (epigastric) area was inserted.

In group II patients, two 5-mm ports in the right midclavicular line subcostally and in the anterior axillary line at the level of the umbilicus were put. In patients of group I, a 5-mm port was put in the right midclavicular line. In patients of group II, the fundus of the gallbladder was grasped through the lateral port and retracted above the liver margin. In patients of group I, the gallbladder fundus was retracted toward the superolateral direction with the help of atraumatic grasper.

After port placement, posterior dissection of the Calot's triangle was started. Once posterior dissection was complete, anterior dissection of Calot's triangle was done. A large window between the cystic duct and cystic artery was made. The junction of the cystic duct and common bile duct was identified. Then two proximal and one distal LIGACLIPs were applied on the cystic duct. The cystic duct was then cut off in between the clips. Cystic artery was either coagulated with bipolar cautery or was divided between the two clips. Then, the gallbladder was removed from the liver bed using a hook dissector. The gallbladder was extracted through the subxiphoid port. Subhepatic drain was used in selected cases if postoperative bleeding or bile leakage was expected. Operative time from start of procedure (supraumbilical incision) to the closure of the wound was noted down.

Postoperative assessment included temperature, pulse, blood pressure, postoperative pain, and postoperative analgesia requirements. After surgery, postoperative complications were recorded on day 1 and after day 7. The findings noted down for the patients in the two subgroups were compared, and results were evaluated at the end of this study.

## OBSERVATIONS

In the present study, we have compared the two methods of LC, i.e., three-port LC and the standard four-port LC.

Cases were divided into two groups of 100 each randomly and were designated as groups I and II. In group I, three-port LC was performed and in group II four-port LC was performed.

Most of the patients in the present study were in the age group of 31 to 40 years (33%), ranging between 18 and 60 years, with a mean age of 39.33 years.

### Table of Age Distribution

Regarding symptoms, all the patients had pain as their chief complaint. So, pain was the single most driving force for the patient to seek treatment. Vomiting was present in only 22 to 24% of the patients, especially during acute attacks (Table 1).

**Table 1:** Symptoms

Symptoms	Group I (no. of patients)	Group II (no. of patients)
Pain	87	90
Vomiting	22	24
Dyspepsia	84	89
Fever with jaundice	4	2

**Table 2:** Ultrasound findings

Ultrasound findings	Group I (100)	Group II (100)
Multiple stones	63	40
Single stone	37	60
Group I		2
Group II		10

## Ultrasound Findings

In group I, 63 patients (63%) had chronic cholecystitis with multiple stones on ultrasound study and 37 patients (37%) had chronic cholecystitis with solitary stone. In group II, 40 patients (40%) had chronic cholecystitis with multiple stones on ultrasound study and 60 patients (60%) had chronic cholecystitis with solitary stone (Table 2).

Two patients (2%) in groups I and 10 patients (10%) in group II had undergone previous lower abdominal surgery.

Three patients (10%) of groups I were converted to four-port LC, and none of the patients of group II were converted to open cholecystectomy.

Mean operative time in three-port LC was 93.16 minutes and 50.66 minutes in four-port LC. This difference in time is significant as p value. The shortest period for cholecystectomy was 30 minutes, and the longest period was 150 minutes. No cholecystectomy was done within 40 minutes in group I, but in 10 patients (33%), cholecystectomy was done within 40 minutes in group II.

In 8 patients (27%) of group I, dissection of Calot's triangle was easy, and in 22 patients (73%), dissection of Calot's triangle was difficult. In 15 patients (50%) of group II, dissection of Calot's triangle was easy, and in 15 patients (50%), dissection of Calot's triangle was difficult.

Mean number of injections of analgesic (diclofenac) required in group I was 1.1 and in group II 1.0. Twenty-five patients (83%) in group I required one injection of analgesic postoperatively, and 29 patients (97%) in group II required one injection of analgesic postoperatively.

## DISCUSSION

Laparoscopic cholecystectomy is considered to be the procedure of choice for elective cholecystectomy.<sup>9</sup> With the increasing experience in advanced laparoscopic techniques, LC is performed by

- Four ports of entry into the abdomen (standard procedure)
- Three ports of entry into the abdomen
- Two ports of entry into the abdomen
- Single port of entry into the abdomen (SILS)
- NOTES<sup>9</sup>

Some surgeons observed that LC can be performed safely in the majority of cases by the three-port method. It is safe and requires conversion to four-port method in

only a minority of the cases.<sup>10</sup> In most of the cases the fascia was not closed and no port site hernia was seen on follow-up of these was patients. Rikki et al performed 200 cases of LC in 2 years time and fascia was not closed in all of them and no port site hernia was seen in follow-up of these patients<sup>11</sup> with time, many refinements have been made in decreasing the port number and port size leading to evolution of the three-port LC, two-port LC, and even single-port LC. The SILS has been recently developed as an alternate approach to standard four-port LC. In this technique, a single transumbilical incision is used to either have three ports through the sheath or have an adaptor with an inbuilt three-port system. It has been shown to offer significant improvement in port-related complications, but is still not widely used due to lack of standardization of instruments and a significantly long learning curve.<sup>11</sup>

In the present study, we have compared the two methods of LC, i.e., three-port LC and the standard four-port LC. Cases were divided into two groups of 100 each randomly and were designated as groups I and II. In group I, three-port LC was performed, and in group II, four-port LC was performed. Most of the patients in the present study were in the age group of 31 to 40 years (33%), range between 18 and 60 years, with a mean age of 39.33 years. Regarding symptoms, all the patients had pain as their chief complaint. So, pain was the single most driving force for the patient to seek treatment. Vomiting was present in only 3% of the patients.

In the present study, there was no bleeding due to vessel injury and its incidence is low because the number of cases was less.

In the present study, there were gallbladder perforations iatrogenically with spillage of stones in 10 patients (33%) in group I and 3 patients (10%) in group II.

The complications arising from dropped gallstones in LC patients are subsequent abscesses and inflammatory masses containing gallstones or stone fragments.<sup>12</sup> Morishita et al<sup>13</sup> reported that spilled stones floating free in the peritoneal cavity may migrate to the pelvic area and become embedded there in the cul-de-sac, causing a severe reaction. Due to the subsequent inflammatory reaction, the fertility may be adversely affected in females.

Duration of operation through three-port LC was an average 31 minutes and in four-port LC was 31.3 minutes.<sup>8</sup>

The mean operative time of three-port LC was 33.66 minutes and for four-port LC was 33.33 minutes, and it was statistically insignificant.<sup>9</sup> Among the variables studied, only mean operative time was statistically significant, with the LC one-port technique showing a longer duration of the surgical procedure ( $p = 0.007$ ).<sup>1</sup>

The mean operating time in the three-port group ( $44.00 \pm 7.217$  minutes) and four-port group ( $47.60 \pm 6.633$ ) was comparable ( $p = 0.073$ ).<sup>14</sup> In our study, it was taken as time from skin incision to skin closure. Also, as the experience of the surgeons grows in both the procedures, the operative time decreases.

Drain was used in nine patients (30%) of group I and four patients (13%) of group II. On the 1st postoperative day, mean volume drained in four-port LC group was  $8.66 \pm 22.85$  mL and in three-port LC group, this was  $24.66 \pm 33.80$  mL.

The volume of fluid in drain was more in three-port LC group than in four-port LC group, and this difference is statistically significant ( $p < 0.05$ ).

Drains were necessary in 20 (20%) of the three-port procedure patients, and all drains were removed by the 1st postoperative day.<sup>8</sup>

Assessment of pain was done by the number of doses of the analgesic required by the patients in the first 48 hours in both the groups. Analgesic used in the study was injection diclofenac. It was seen that the mean analgesic required in group I was 1.10 doses as compared with 1.03 doses in group II. Ten percent patients of both the groups required only two injections of diclofenac.

The mean analgesic requirement in four-port LC is less than that of three-port LC, but the difference is not statistically significant.

Pain scores showed differences during the recovery time, with less pain in the LC one port, but at 4 and 24 hours, there were no differences. At 5 and 8 days, patients from the LC one-port group reported more pain than the LC two-port or LC three-port groups.<sup>1</sup>

Postoperative pain ( $p < 0.008$ ) and analgesic requirement ( $p < 0.001$ ) were significantly less in the three-port group when compared with the four-port group.<sup>14</sup>

In the present study, patients were discharged from the hospital when they were fit and after getting their consent to go home. The mean hospital stay in three-port LC group was 3 days as compared with 4 days in the four-port LC group. Some of the patients wanted to go home after the removal of their stitches, as the cost of transportation to their villages was more than the cost of stay in the hospital. This factor was kept in mind while discharging the patients, and this led to late discharge of some of the patients. The difference in mean hospital stay in both the groups is statistically not significant.

The average hospital stay of patients was 1.1 days (1–2 days) in the three-port procedure. Length of hospital stay was similar in three-port and four-port LCs ( $p = 0.312$ ).<sup>8</sup> Hospital stay was significantly less in three-port group compared with the four-port group ( $p < 0.004$ ) owing to postoperative pain score.<sup>14</sup>

In the postoperative period, during hospital stay and during follow-up visits at 1 week, 1, 2, and 3 months, patients were asked for evaluation of their respective operations. Factors included were improvement in symptoms, return to normal activity, and cosmetic results. More than 77% patients in both the groups had assessed their respective procedures as good. Only 18% of the patients assessed their procedures as very good, but none complained of poor outcome after their operation.

Regarding evaluation of cosmetic results, patients in both the groups had accepted their scars as cosmetically good.

The difference in patient acceptance for the two groups is not statistically significant, so it can be said that the outcome of both the operations for the patients is similar.

Three-port LC is technically feasible, is safe, achieves good results, and is similar to those achieved with the four-port technique, with less postoperative analgesia, less assistance, and less number of scars, and so had better cosmetic appearance and was less expensive. Hence, we recommend it as a routine procedure in elective LC.<sup>9</sup>

The most important aspect of any surgical procedure is its safety and complications. Some surgeons have expressed concerns about the safety of the three-port technique, arguing that it may lead to a higher percentage of bile duct injuries.<sup>15</sup>

In our study the process of pneumoperitoneum creation in both these groups was done either by open or closed method randomly as the two methods are equally effective and feasible as evidenced in literature.<sup>16</sup>

## CONCLUSION

We conclude that both three-port LC and four-port LC are equally good techniques in the hands of experienced laparoscopic surgeons, with comparable operative time, pre- and postoperative complications, analgesic requirement, hospital stay, cosmesis, and disability days. The four-port technique should be accepted and adopted only by surgeons experienced in laparoscopic surgery and familiar with the three-port technique as it is more difficult to perform, particularly in patients with adhesions. The operator who performs the three-port LC should be prepared for placement of an additional port or conversion to open laparotomy whenever complication arises.

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