# COMPARATIVE STUDY OF STANDARD FOUR-PORT, THREE PORT AND SINGLE INCISION LAPAROSCOPIC CHOLECYSTECTOMY PERFORMED BY A SINGLE SURGEON IN NOBEL MEDICAL COLLEGE TEACHING HOSPITAL, NEPAL.

*Ruslan Sulaimankulov[1*], Gulmira Jolochieva[2]*

**Affiliation**

1. *Senior Consultant, Department of General Surgery, Nobel Medical College Teaching Hospital, Biratnagar, Nepal.*
2. *Consultant, Department of Gynaecology, Nobel Medical College Teaching Hospital, Biratnagar, Nepal*

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**** Corresponding Author***

*Dr. Ruslan Sulaimankulov*
*Senior Consultant*
*Department of General Surgery*
*Nobel Medical College Teaching Hospital, Nepal*
*Email: ruslansulaimankulov@gmail.com*
*ORCID: https://orcid.org/0000-0002-4114-8285*

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## ABSTRACT

### Introduction

Laparoscopic Cholecystectomy is a standard operative procedure for patients with gallbladder diseases and is the most common laparoscopic procedure performed worldwide.

The aim of this study is to analyze the different methods of laparoscopic cholecystectomies done by a single surgeon at Nobel Medical College Teaching Hospital.

### Objectives

The objective and aim of this study are comparing 4 port classic Laparoscopic Cholecystectomy (4PLC), 3 port (3PLC) and Laparo-Endoscopic Single-Site Cholecystectomy (LESC) performed by a single surgeon and correlate worldwide experience with outcomes in our institution.

### Methodology

The study includes retrospective analysis of 8192 patients who underwent elective laparoscopic Cholecystectomy (LC) from October 2010 to July 2020 performed by the single surgeon. All cases divided into 3 groups depending on the type of LC (4PLC, 3PLC, LESC). The data included the type of the surgery, gender, age, operative time, conversion and complication rate and duration of hospital stay.

### Results

The hospital stays, operation time and conversion rate decreased from group I to group III. Female patients out numbered the male ones (M:F=1:4). The hospital stays (3.4 days), operation time (35 min), conversion (0.4%) and complications (0.7%) rate decreased from Group of 4PLC to Group of LESC (1.5 days, 13 min, 0.1% conversion, 0.4% complication respectively) which is true for almost all other similar studies.

### Conclusion

The advantages of LESC include a better cosmetic effect and reduced chance of infections. It has been postulated to be superior in scarless surgery with added benefits of lower pain level and reduced need for analgesics, shorter hospital stays, quicker return to work and lower financial expenses.

**KEY WORDS**

*Four port laparoscopic cholecystectomy, laparoscopic surgical procedure, LESS, minimally invasive surgery, single port laparoscopic cholecystectomy, symptomatic gall stone disease, SILS.*

## INTRODUCTION

Cholelithiasis is one of the most common surgical disease that affects the larger populations of Nepal. LC considered as the standard procedure of choice for treatment of patients with gallbladder disease all over the world as well as in Nepal.

The first LC was performed by Muhe in 1985, and publicly reported by Mouret, Perissat and Dubois in 1987 and 1988.[1,2] This procedure overtook open cholecystectomy as the treatment of choice for cholelithiasis. Its introduction resulted in surgical procedures with reduced blood loss, enhanced recovery and less major wound complications.

The concept of single incision laparoscopic surgery (SILS) techniques was established by the father of modern thoracoscopic surgery Dr. Raimund Wittmoser in 1990s. Navarra et al, (1997) performed the first single incision laparoscopic cholecystectomy (SILC) using two trocars through one umbilical incision.[3] After its introduction, standard multiport cholecystectomy was long debated and often opposed, just as LESC today.[4,5] For this particular type of laparoscopic surgery only one incision is made, usually through the umbilicus. In general, smaller and fewer incisions result in less pain, accelerate postoperative recovery and improve cosmetic result.[6,7]

It is a new modality in the field of minimal access surgery which leads to further reduction of the negative outcomes of standard multiport laparoscopy. In order to achieve scarless surgery SILS was developed as a modern technique with minimal visible scars.

The SILS procedure is used for many types of laparoscopic operations, such as bariatric and colorectal surgery, nephrectomy, cholecystectomy, appendectomy and splenectomy.[8,9]

Standard 4PLC, 3PLC as well as LESC has regularly been performed by our team since 2010.[10] Therefore, the aim of this study is to compare the outcomes of these three procedures.

## METHODOLOGY

Patients admitted through OPD in the Department of General and Minimally Invasive Surgery of Nobel Medical College and Teaching Hospital and planned for laparoscopic cholecystectomy were included in the study. Retrospective analysis included patients operated Between Kattik 2067 BS (October 2010) and Shrawan 2077 (July 2020) after taking ethical clearance from Institutional Review committee. All 8192 patients, selected by random sampling technique, who received cholecystectomy were divided into 3 groups. 1st group (4PLC), 2nd group (3PLC) and 3rd group (LESC) underwent cholecystectomies. Informed written consent was obtained from all patients preoperatively for surgery including for research inclusion also.

Preoperatively all patients underwent USG to document GB abnormalities. All diagnosed cases of cholelithiasis were prepared for laparoscopic cholecystectomies. Patients were taken up for surgery after optimizing investigation parameters and obtaining written consent for operation under general anesthesia. A minimum of 8 hours fasting prior to surgery was followed in all cases. Detailed pre-anesthetic checkup, investigations, preparation and anesthetic techniques were carried out as per hospital protocol.

All patients were monitored closely till discharge and minimum of one post-operative follow-up was done in all cases. The usual 1st post-operative follow-up was one month after surgery and in case of any complication the patients were readmitted or followed-up at regular intervals until the full recovery.

Preoperative data included: age, gender, indication of surgery, previous abdominal surgery and comorbidity. Intraoperative data included: operating time (defined as time from first skin incision to completion of closure), conversion to open cholecystectomy and intraoperative complications. Intraoperative blood loss of more than 200 ml was considered as a complication. Postoperative data included: duration of stay in hospital (including the day of operation), complications (during hospitalization), reoperation, readmission to the hospital (within 30 days after discharge) and mortality.

**Inclusion criteria:** The consenting patients of all ages and both genders with symptomatic cholelithiasis planned for laparoscopic cholecystectomy.

**Exclusion criteria:** Any contraindication to laparoscopic procedure such as pregnancy, bleeding disorder, critical conditions, chronic cardiovascular, pulmonary, liver and kidney diseases.

Patients having choledocholithiasis, cholangitis, biliary fistula and surgical jaundice.

Statistical analysis was performed using Fisher test, Chi-square test and Mann-Whitney U test based on the distribution of the variables (MEDCALC software version 19.3, MedCalc Software Ltd, Belgium). Statistical significance was considered when $P$ *values*$< 0.05$.

## RESULTS

In the period from Kartik 2067 BS (October 2010) till Shrawan 2077 (July 2020), a total 8192 cholecystectomies were performed of whom 1971 patients were treated with the 4PLC technique (Group I), 2487 patients–with 3PLC approach (Group II) and in 3734 cases LESC was performed (Group III). Out of 8192 patients, 2101 (25.6%) were male and 6091 (74.4%) were female with the ratio (M:F=1:3.9).

The mean age of patients in all groups was 41.23, the youngest patient was 6 years old (F) and the oldest was 90 years (F). The highest number of patients was detected in 32-43-year age group and it holds true for both male & female patients. As can be seen in Figure 1, 74% of patients in the current study were female.

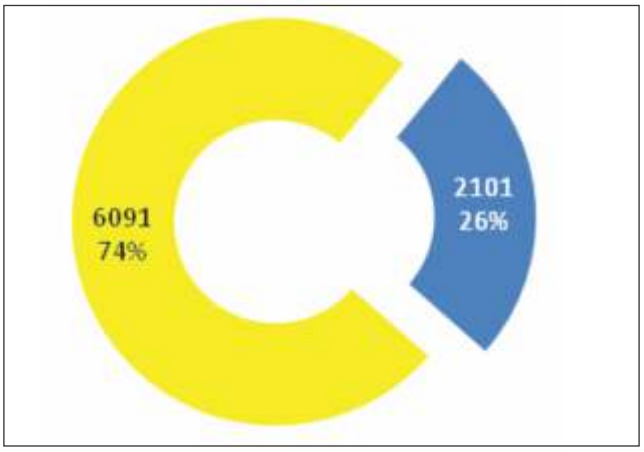


**Figure 1:** Distribution by gender.

The mean operating time was 19.5 minutes (range=4-35 min) (Table 1). The operative time in Group I was 35.11±5.21 minutes, while in Group II it was 27.55±3.32 minutes and in Group III -13.5±3.17 minutes [p<0.001]. The mean operative time is correlated with the particularities of the case and the learning curve, as has been advocated by several studies.[11,12]

**Table 1:** Operation time

| | Group I | Group II | Group III |
|---|---|---|---|
| **Operation time (Mean ± S.D.)** | 35.11±5.21 | 27.55±3.32 | 13.5±3.17 |

A total of 141 complications occurred (1.72 percent of the 8192 patients) (Table 2). Overall, the most common postoperative complication was a wound infection, which occurred in 81 patients (0.98 percent of all patients), they had superficial wound infections involving the site of insertion of the umbilical trocar (also the site of removal of the gallbladder).

**Table 2:** Complications

| Complications | Group I | Group II | Group III | Total (%) |
|---|---|---|---|---|
| Wound infection | 39 | 27 | 15 | 81 (0.98%) |
| Biliary injures | 8 | 8 | 7 | 23 (0.3%) |
| Bleeding | 5 | 6 | 6 | 17 (0.2%) |
| Hernia | 7 | 7 | 6 | 20 (0.24%) |
| **Total (%)** | **59 (0.72%)** | **48 (0.6%)** | **34 (0.4%)** | **141 (1.72%)** |

Biliary tree injures took place in 8 cases in group I, 8 patients in Group II and 7 in Group III making overall incidence of 0.3% (23 patients). Four out of these 23 patients had injures repaired after conversion.

Nineteen injuries (0.23%) were not recognized until 3, 5, 14 and 24 days after the procedure, till the patients had abdominal distention, abnormal results on liver-function tests or unexplained ileus. Among them 4 patients required a second operation by relaparoscopy (two in Group I and one in second Group and another one in III) and 15- by relaparotomy (six in Group I, five in Group II and four in Group III). They had choledochoduodenostomy done.

A total of 17 bleeding complications took place: 12 intraoperative bleedings (4, 5 and 4 respectively in Group I, II and III) and 5 postoperative diagnosed bleedings (1, 1, 2 respectively). One patient with intraoperative bleeding required laparotomy due to uncontrolled bleeding. In two patients, in postoperative period, bleeding was stopped by relaparoscopy.

In addition, 23 patients had unexplained postoperative abdominal pain, which resolved spontaneously in each case. 17 of them had transient abnormalities in liver-function tests. There was a total of 42 read missions (0.5 percent of all laparoscopic cholecystectomies), particularly,14 (0.7%) in group I, 13 (0,5%) in group II and 15 (0,4%) in group III.

One of the common late postoperative complications was incisional (trocar site) hernia. A total of 20 (0.24%) patients were reoperated for herniation (7 (0.4%), 7 (0.3%), 6 (0.2%) respectively for group I, II, III).

Mean duration of hospital stays in Group I was 3.39±0.65, in Group II was 2.64±0.67 and Group III 1.54±0.46 days [p<0.001]. During the follow-up period scars looked cosmetically better after SILC.

**Table 3**: Duration of hospital stays

| | Group I | Group II | Group III |
|---|---|---|---|
| **Hospital stays (Mean ± S.D.)** | 3.39±0.65 | 2.64±0.67 | 1.54±0.46 |

## DISCUSSION

Nowadays, 4PLC is a worldwide standard operative procedure for gallbladder pathology. Good results in LC depend on many factors and the most important one is experience of the surgeon in laparoscopy.[13] The standard four-port approach is followed by the majority of surgeons and 3PLC require good experience in LC for not to jeopardize the benefits of this procedure.[14] LESS cholecystectomy is gaining an increasing popularity, and there is a trend to replace 4PLC and 3PLC with the aim of minimizing the invasiveness of the procedure, achieving better quality of life in terms of reduced postoperative pain and optimizing the cosmesis.

In the case of any new surgical procedure, there must be a critical assessment of the related complications. A pretty low mortality rate, however, may well reflect the fact that the patients were a selected population undergoing elective surgery.

At our hospital, we have been performing all types of cholecystectomies for a long time.[15] Our study shows that LESS could be a safe procedure, performed in a shorter operating time, having lower percentage of per- and postoperative complications, shorter hospital stay, less pain and better cosmesis compared with other procedures.

A total of 8192 patients, 1971 in standard 4PLC (Group I), next 2487 in 3PLC (Group II) and 3734 in LESC (Group III) were studied, which showed female predominance (74.4%). In this study there was no major difference in the age and gender distribution for patients undergoing all types of LC.

The duration of surgery in 4PLC was 35.11±5.21 minutes, 3PLC was 27.55±3.32 minutes and in SILC was 13.5±3.17 minutes. Operating time in SILC group was significantly

shorter than in Group II and III, which is corresponds to several other similar studies.[16,17]

A total of 141 complications occurred (1.72 percent of the 8192 patients). Overall, the most common postoperative complication was a wound infection, which occurred in 81 patients (0.98 percent of all patients) who had superficial wound infections involving the site of insertion of the umbilical trocar (also the site of removal of the gallbladder).

The overall rate of bile-duct injury during laparoscopic cholecystectomy in this series was 0.9 percent, and the incidence of bile-duct injury not recognized at the time of the initial surgery was 0.6 percent. The exact frequency of bile-duct injury as a consequence of conventional cholecystectomy is uncertain, but such injury probably occurs in 0.6 to 0.9 percent of patients.[18,19]

Therefore, the rate of biliary injury in Group I and Group II may be only slightly higher than in Group III. This rate may still be relatively high, however, since this was a selected population of patients undergoing elective surgery. Because early in the work of every surgeon this type complication occurred more frequently, a large proportion of such injuries can be attributed to the learning experience.[20]

The total rate of complications in this series was 1.72 percent, which corresponds to the rates of patients undergoing conventional cholecystectomy. Many of the complications reported here were relatively less important in comparison with the cardiac, pulmonary, and other serious problems for which higher rates were reported by some authors.[21,22]

There is another important issue of a surgeon finding a silent stone in the duct at laparoscopic cholecystectomy. Three major factors that should influence the decision: the experience in CBD exploration the availability of endoscopic retrograde cholangiopancreatography, which the surgeon would use postoperatively, and the size of the stones, which indicates if they must be removed or are likely to come out on their own.

The short hospital stay can be assumed to indicate the early resumption of normal activities; three of the surgical groups reported that 6963 (85 percent) of 8192 patients who underwent LESC returned to full time employment within 7 days after the surgery.[23]

The large number of laparoscopic cholecystectomies being performed within the frame work of this study suggests that LESC may be a more popular alternative to 3PLC surgery and more than 4PLC.[24] Skilled surgeons can master the procedure which is less invasive than traditional (4PLC) cholecystectomy. There is a longer time for learning curve with LESC beyond 4PLC, which, however, does not currently replace the "gold standard" status that belongs to the standard laparoscopic cholecystectomy, but has a great development potential for the future.

## CONCLUSION

LESC proved to be a safe procedure for the treatment of uncomplicated benign gallbladder disease when performed by an expert and resulted in shorter operative time, less port site pain, required less analgesia, shorter hospital stay, cosmetically more preferable and cost-effective due to a less crowded space near the operating table as there is no need for a second assistant, which reduces the required manpower and hospital expenses.

## LIMITATIONS OF THIS STUDY

The study was limited to our institution so further studies with a larger population would be helpful to establish the conclusion.

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## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest related to the publication of this manuscript.

## FINANCIAL DISCLOSURE

There are no financial conflicts to disclose.

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