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ORIGINAL RESEARCH

Comparative study between single incision and standard laparoscopic cholecystectomy

Chandra Bhushan Pandey[1], Ekta Dwivedi[2], Ashish Kumar Tripathi[3], Ashish Kumar Sharma[4]

[1,3]Assistant Professor, Department of General Surgery, Madhav Prasad Tripathi Medical College, Siddharthnagar, Uttar Pradesh, India
[2]Assistant Professor, Department of Pathology, Madhav Prasad Tripathi Medical College, Siddharthnagar, Uttar Pradesh, India
[4]Assistant Professor, Department of Biochemistry, Madhav Prasad Tripathi Medical College, Siddharthnagar, Uttar Pradesh, India

Corresponding Author
Chandra Bhushan Pandey
Assistant Professor, Department of General Surgery, Madhav Prasad Tripathi Medical College, Siddharthnagar, Uttar Pradesh, India
Email: cbpandey1984@gmail.com

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ABSTRACT

Background: Laparoscopic cholecystectomy is the gold standard for gallbladder removal, with recent advances introducing Single Incision Laparoscopic Cholecystectomy (SILC) as an alternative to the Standard/four-Port Laparoscopic Cholecystectomy (SLC). This study aims to compare the outcomes of SILC and SLC. **Methods:** A total of 100 patients were enrolled and equally divided into two groups: Group A (SLC) and Group B (SILC). Demographic data, operative time, postoperative pain, complications, hospital stay, and cosmetic outcomes were compared between groups. **Results:** Most patients in both groups were aged between 31–50 years (SILC: 56%, SLC: 54%), with a female predominance (SILC: 70%, SLC: 76%). The mean time to gallbladder removal was significantly longer in the SILC group (24.38±3.53 minutes) compared to the SLC group (16.4±3.28 minutes) ($p<0.001$). Port site closure was faster in SILC (3.18±0.77 minutes) than in SLC (3.84±0.79 minutes) ($p<0.001$). Pain scores were significantly lower in SILC on both the first and second postoperative days ($p<0.001$). No vascular injuries were reported. Ductal injuries occurred in 6% of SLC patients but none in SILC. Biliary leakage (4%) and biliary peritonitis (4%) were similar in both groups. Seroma formation was slightly higher in SILC (6%) compared to SLC (2%). Hospital stays were comparable between groups ($p=0.838$). Cosmetic outcomes were significantly better in the SILC group (7.48±0.86 vs. 4.98±0.80, $p<0.001$). **Conclusion:** SILC is a safe and effective alternative to standard laparoscopic cholecystectomy, offering the advantages of less postoperative pain and superior cosmetic outcomes, though with a slightly longer operative time. With appropriate patient selection and surgical expertise, SILC can be considered a favorable option for gallbladder surgery.

Keywords: Single incision laparoscopic cholecystectomy, Standard laparoscopic cholecystectomy, Cholelithiasis.

INTRODUCTION

Cholelithiasis, often referred to as gallstone disease, is a substantial nationwide public health concern and one of the most widespread illnesses impacting the biliary system [1]. Gallstones nestled within the gallbladder are its signature characteristic, frequently resulting in symptoms such as pain in the upper right abdomen, indigestion, queasiness, regurgitation, and associated conditions such as pancreatitis, cholecystitis, and cholangitis. Cholecystectomy, or the surgical excision of the gallbladder, remains the sole effective remedy for gallstone-related ailments [2]. With advancements in surgical methods, this operation has transitioned from being highly invasive to a minimally invasive approach, facilitating a swifter recovery with reduced morbidity [3].

The domain of general surgery transformed when laparoscopic cholecystectomy became accessible in the late 1980s [4]. Since then, standard laparoscopic cholecystectomy (SLC) has become the gold standard and the most often carried out gallbladder removal procedure in the globe [5]. SLC is typically performed using four tiny incisions that provide passage to the abdominal cavity for a laparoscope and other surgical instruments [6]. Compared to traditional open surgery, this method offers better aesthetic outcomes while significantly reducing postoperative discomfort, hospital stay length, and recovery time. Although these advantages, there is still the risk of port-site

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complications such infection, bleeding, hernia, and noticeable scarring when there are several incisions [7].

In the quest to further diminish surgical trauma, a novel technique referred to as single incision laparoscopic cholecystectomy (SILC) has surfaced. This method entails executing the entire operation through a solitary incision, typically at the navel. The reasoning behind SILC is to improve aesthetic outcomes, further lessen postoperative discomfort, and decrease the likelihood of multiple port-site complications. As surgical tools and methodologies have progressed, SILC has grown increasingly practicable and is being embraced by numerous surgical facilities as a substitute for the conventional approach [8, 9].

However, in spite of the theoretical benefits of SILC, its broader implementation is still restricted and somewhat contentious. The procedure introduces various technical hurdles, including constrained instrument triangulation, heightened instrument clashes, limited visibility, and a more challenging learning curve. These aspects can possibly result in extended operative duration and complication rates, especially in the hands of less experienced surgeons. Further concerns have been voiced regarding its overall safety, particularly when undertaken in cases involving complex anatomy or acute inflammation [10, 11].

Several studies have attempted to compare the outcomes of SILC and SLC, but the results have been varied and sometimes contradictory. While some reports suggest that SILC is associated with shorter recovery time, lower postoperative pain scores, and improved patient satisfaction in terms of cosmetic outcomes [12, 13], others have shown no significant difference in clinical outcomes or have highlighted increased operative times and technical difficulties with the single incision technique [14, 15].

Therefore, a comparative study between single incision and standard laparoscopic cholecystectomy is essential to provide clearer evidence on the advantages and limitations of each method. Such a study can help determine whether SILC can be considered a viable and safe alternative to SLC in routine surgical practice, especially in resource-constrained or high-volume settings. It can also shed light on patient preferences, surgeon experiences, and perioperative outcomes such as operative time, postoperative pain, and length of hospital stay, complication rates, and cosmetic satisfaction.

MATERIALS AND METHODS

Study Design: This randomized comparative study was carried out at a tertiary care teaching hospital, Maharani Laxmi Bai Medical College, Jhansi to assess and compare the results of single incision laparoscopic cholecystectomy (SILC) and standard laparoscopic cholecystectomy (SLC). The study protocol received approval from the Institutional Ethics Committee.

Study Setting: The research took place in the Department of General Surgery at Maharani Laxmi Bai Medical College, Jhansi, which is a tertiary care teaching hospital.

Study Sample: 100 consecutive patients meeting the inclusion criteria were incorporated into the study. Patients were placed in the multiport cholecystectomy group and in the single port cholecystectomy group. Patients exhibiting symptoms indicative of gallbladder disease underwent random allocation into two groups following a confirmatory ultrasound study. The groups were outlined as follows:

Group A: Patients receiving Standard/4 port Laparoscopic Cholecystectomy (SLC)

Group B: Individuals receiving Single Incision Laparoscopic Cholecystectomy (SILC) treatment

Inclusion Criteria: Adults aged 18 to 65 years who were diagnosed with symptomatic uncomplicated cholelithiasis and deemed medically fit for laparoscopic surgery under general anesthesia were eligible for the study. Informed written consent was necessary for participation.

Exclusion Criteria: The exclusion criteria comprised patients diagnosed with acute cholecystitis, choledocholithiasis, or gallbladder cancer; individuals with a prior history of upper abdominal surgery; those with severe obesity (characterized by a BMI exceeding 35); patients with bleeding disorders or other restrictions against laparoscopic surgery; and individuals who declined to give consent.

Surgical Technique

All operations were conducted under general anesthesia by skilled laparoscopic surgeons.

Standard Laparoscopic Cholecystectomy (Group A):

- Four ports were utilized: one umbilical (10 mm), one epigastric (10 mm), and two subcostal (5 mm).
- Pneumoperitoneum was established employing the Veress needle or the open method.
- The gallbladder was separated from the liver bed and extracted via the umbilical port.

Laparoscopic Cholecystectomy with a Single Incision (Group B):

- A solitary transumbilical incision measuring 2–2.5 cm was created.
- A dedicated SILC port or several trocars inserted through a single incision were utilized.
- Standard laparoscopic tools or flexible instruments were utilized depending on what was available.
- The gallbladder was excised and removed via the same umbilical incision.

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Parameters Studied

The following parameters were recorded and compared between the two groups:

- Operative time (in minutes)
- Intraoperative complications
- Postoperative pain (measured using Visual Analog Scale [VAS] at 6, 12, and 24 hours)
- Postoperative analgesic requirement
- Duration of hospital stay (in days)
- Time to resume normal activities
- Cosmetic outcome (evaluated using a patient satisfaction questionnaire or scale)
- Conversion to open surgery or standard laparoscopy (in SILC group)

Data Collection and Statistical Analysis: All information was gathered utilizing a pre-established template. Statistical analysis was conducted utilizing SPSS version 26.0. Continuous variables were represented as mean ± standard deviation and analyzed using the Student's t-test. A p-value of less than 0.05 was deemed statistically significant.

OBSERVATION AND RESULTS

100 patients participated in the study and were split equally between Group A (SLC) and Group B (SILC). According to table 1's age distribution, the SILC group's majority (56%) were between the ages of 31 and 50, 36% were between the ages of 11 and 30, and only 8% were older than 51. Of the patients in the SLC group, 54% were between the ages of 31 and 50, 22% were between the ages of 11 and 30, and 24% were aged than 51.

The SILC group comprised 70% females and 30% males, whereas the SLC group had 76% females and 24% males, according to the sex distribution revealed in Table 2.

With a p-value <0.001, the SILC group's mean time till gallbladder removal was substantially longer (24.38±3.53 minutes) than the SLC group's (16.4±3.28 minutes). On the other hand, the port site stitching time was marginally less in SILC (3.18±0.77 minutes) than in SLC (3.84±0.79 minutes), which is also statistically significant (p <0.001) as shown in table 3. On the first and second postoperative days, pain levels were assessed. With a p-value <0.001, the mean first-day pain score in SILC was considerably lower (2.44±0.50) than in SLC (3.04±0.49). Likewise, on the second day, SILC's pain score was substantially lower (1.38±0.49) than SLC's (1.90±0.30) (p <0.001) as shown in table 4.

Neither group suffered any vascular damage as consequence of peri-operative complications. Three patients (6%) in the SLC group experienced ductal damage, while none in the SILC group were reported to have it. Table 5 suggests biliary leakage was equally prevalent in both groups (4%). Table 6 shows that neither group experienced flap necrosis or any other post-operative issues with the exception of biliary peritonitis (4% in both groups) and seroma development (6% in SILC vs. 2% in SLC).

Table 7 shows that there was no significant difference (p=0.838) in the mean hospital stay between the groups (2.64±0.49 days in SILC and 2.62±0.49 days in SLC).

Lastly, table 8 indicates that the SILC group had significantly better cosmetic results, with a mean cosmesis score of 7.48±0.86 against 4.98±0.80 in the SLC group (p<0.001) days in SLC, with no significant difference (p=0.838).

Table-1: Age Wise Distribution of study population (SILC and SLC)

Age (yrs)	SILC		SLC	
	No of Patients	Percentage	No of Patients	Percentage
11-30	18	36%	11	22%
31-50	28	56%	27	54%
>51	4	8%	12	24%
Total	50	100%	50	100%

Table-2: Sex Wise Distribution of study population (SILC and SLC)

Sex	SILC		SLC	
	No of Patients	Percentage	No of Patients	Percentage
Male	15	30%	12	24%
Female	35	70%	38	76%
Total	50	100%	50	100%

Table-3: relationship between patient with operative time in the SILC and SLC.

Variables	SILC (Mean ± S.D.)	SLC (Mean ± S.D.)	p value
Time Up to Removal of GB (in min.)	24.38±3.53	16.4±3.28	<0.001
Port site stitching (in min.)	3.18±0.77	3.84±0.0.79	<0.001

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Table-4: Comparison of the mean of pain score of 1st and 2nd day in the SILC & SLC.

Variables	SILC (Mean ± S.D.)	SLC (Mean ± S.D.)	p value
1st day pain score	2.44±0.50	3.04±0.49	<0.001
2nd day pain score	1.38±0.49	1.90±0.30	<0.001

Table-5: Comparison of the per operative complication

Complication	SILC (50)	SLC (50)
Vascular injury	0 (0%)	0 (0%)
Ductal injury	0 (0%)	3 (6%)
Biliary leakage	2 (4%)	2 (4%)

Table-6: Comparison of the post operative complication

Complication	SILC (50)	SLC (50)
Seroma formation	3 (6%)	1 (2%)
Biliary peritonitis	2 (4%)	2 (4%)
Flap necrosis & others	0 (0%)	0 (0%)

Table-7: Comparison of the hospital stays SILC & SLC (Mean Hospital Stay).

SILC (Mean ± S.D.)	SLC (Mean ± S.D.)	p value
2.64±0.49	2.62±0.49	0.838

Table-8: Comparison of the Cosmesis in SILC & SLC (Mean cosmesis).

SILC (Mean ± S.D.)	SLC (Mean ± S.D.)	p value
7.48±0.86	4.98±0.80	<0.001

DISCUSSION

This study aimed to examine the outcomes of Standard/four-Port Laparoscopic Cholecystectomy (SLC) compared to Single Incision Laparoscopic Cholecystectomy (SILC) concerning various factors, including hospital stay, complications, pain, operating time, and cosmetic results. Both groups of patients exhibited comparable demographic characteristics. Most patients in the SILC (56%) and SLC (54%) groups fell within the 31–50 age bracket, aligning with other studies indicating that middle-aged individuals are most prone to gallstone disease [16]. Women comprised the largest portion of the groups regarding gender distribution, representing 76% of the SLC and 70% of the SILC. This female dominance aligns with the understanding that gallbladder disease is more prevalent in women [17].

Regarding operative parameters, the mean time for gallbladder removal was significantly longer in the SILC group (24.38±3.53 minutes) compared to the SLC group (16.4±3.28 minutes), resulting in a highly significant p-value (<0.001). This finding corresponds with further studies showing that the single-incision technique is more complex and requires an extended surgical time, particularly during the surgeon's training phase [18, 19]. On the other hand, the time taken for stitching at the port site was significantly shorter in SILC (3.18±0.77 minutes) than in SLC (3.84±0.79 minutes), emphasizing the advantage of having fewer incision sites in the procedure. Pain assessment showed that patients who received SILC experienced significantly lower pain scores on both the first and second days post-surgery compared to those who had SLC ($p<0.001$ for both comparisons). This can be associated with fewer incisions and reduced tissue harm in the SILC technique. These outcomes correspond with previous research showing that single-incision surgeries are associated with reduced postoperative pain and quicker recovery [20, 21].

Concerning peri-operative complications, both groups showed no instances of vascular injuries, and biliary leakage occurred at similar rates (4% in both groups). Significantly, ductal injury was noted in three patients (6%) in the SLC group, while it was absent in the SILC group. These findings suggest that SILC can be safely executed without an increased risk of serious peri-operative complications when carried out by experienced surgeons [22]. Following the surgery, the incidence of seromas was somewhat higher in the SILC group (6%) compared to the SLC group (2%), while biliary peritonitis was recorded at an equal rate in both groups (4%). No cases of flap necrosis or major complications were noted in either group, highlighting that both techniques have comparable safety profiles during the post-operative period.

The typical length of hospital stay did not reveal a notable difference between the two groups (2.64±0.49 days for SILC versus 2.62±0.49 days for SLC; $p=0.838$). This finding is consistent with earlier research suggesting that discharge times from hospitals are typically similar between SILC and SLC

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when complications are minimal or absent [14]. Cosmesis demonstrated a significant enhancement in the SILC group, reaching an average score of 7.48±0.86, whereas the SLC group received a score of 4.98±0.80 ($p<0.001$). A key advantage of SILC is its outstanding cosmetic outcomes, leading to less scarring for patients and potentially higher satisfaction rates [23].

CONCLUSION

The findings of this study indicate that SILC is a safe and effective alternative to conventional SLC, providing better aesthetic results and reduced postoperative pain, though it demands an extended surgical time. With proper patient selection and surgical expertise, SILC can be seen as a favorable option for laparoscopic cholecystectomy

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