Original Article

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Is Single Incision Laparoscopic Cholecystectomy Really Less Invasive than Traditional Laparoscopic Cholecystectomy

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Abstract

Objective: Our objective was to assess the clinical outcomes (benefits and drawbacks) and change in level of inflammatory parameter IL-6 in patients undergoing single incision laparoscopic cholecystectomy and comparison with classical four port laparoscopic cholecystectomy. *Methods:* Between September 2013 to July 2015 a prospective randomised study was conducted. Sixty patients were included in the study and they underwent elective gall bladder removal by applying the laparoscopic technique. All the patients were divided into two groups. Single incision laparoscopic cholecystectomy (group I) and four port laparoscopic cholecystectomy (group II). Outcome Measures included operative time, pain intensity post operatively and consumption of pain killers, hospital stay, need for conversion, complications, cosmetic effects and change in the level of serum Interleukin-6 post operatively as an inflammatory marker. *Results:* Mean operating time in group I was 71 min and group II 39 min. Intensity of pain evaluated by using the VAS at 8 hours after surgery in group I was 6.5 and in group II 6.5, whereas after 7 days in group I it was 2.7 and in group II 3.6. The pain killer requirement in group I was smaller than group II. Mean hospital stay after the operation in group I was 2.2 days and in group II 2.0 days. There were 2 conversions in group I and 1 in group II. Cosmesis evaluated by a 0 to 10 scoring system which showed better cosmesis in group I patients. Change in the serum level of IL-6 post operatively was more in case of multiport laparoscopic choecystectomy than single incision laparoscopic cholecystectomy. *Conclusion:* Single incision laparoscopic cholecystectomy is a safe and feasible procedure which has a better cosmesis and faster recovery.

Keywords: Laparoscopic Cholecystectomy (LC); Symptomatic Gallstone Disease; Single Incision Laparoscopic Cholecystectomy (SILC).

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Introduction

Laparoscopic cholecystectomy (LC) is the gold standard treatment for benign and symptomatic gallstone disease [1,2]. Its main advantages over open cholecystectomy are the reduced early post-operative pain, shorter hospital stay, rapid return to the normal activity and better cosmesis. The continuous endeavour to reduce the invasiveness and thus the reduction of wound related complications and betterment of cosmesis following surgery has led the surgeons to further reduce the number and size of access ports during laparoscopic procedure. Various natural orifices including the trans-gastric, trans-rectal, and trans-vaginal route have been used as access although limited by lack of reproducibility, longer learning curve and ethical issues [3-6]. To reduce the invasiveness of standard four port cholecystectomy, single incision laparoscopic cholecystectomy (SILC) has also become an attractive option of the performance of laparoscopic cholecystectomy [7-10]. Navarra et al first reported trans-umbilical single incision laparoscopic cholecystectomy in 1997 and proposed that SILC might be associated with less pain and reduced hospitalization [11]. However, there was not enough data to support SILC as the standard of care as compared to multiport laparoscopic cholecystectomy as it was associated with longer operating time and required additional instruments more frequently. Inteleukin-6 (IL-6) is an inflammatory marker assessed post operatively which can be used as a surrogate marker of inflammation and can predict

the overall surgical stress, an important factor for recovery. There are many studies comparing laparoscopic cholecystectomy and open cholecystectomy reported significantly lower level of IL-6 post-operatively in the laparoscopic groups, which suggests that the minimally invasive approach is less stressful. There are very few studies comparing the rise of IL-6 post operatively between SILC with conventional laparoscopic cholecystectomy and the results are inconclusive also.

Hence, we planned a study to compare the various outcome parameters and level of rise of IL-6 between SILC and traditional four port LC.

Material and Methods

The study was conducted at a University hospital between September 2013 to July 2015 among consecutive patients undergoing elective LC for ultrasonographically diagnosed symptomatic gallstone disease aged between 18-70 years with ASA I/II score. The exclusion criteria were suspected Mirrizi syndrome, common duct stones or malignancy, deranged coagulation profile and with acute cholecystitis or choledocholithiasis proven on ultrasound. After enrollment in the study the patients were randomly allocated to Single incision Laparoscopic Cholecystectomy (SILC) group, Three port LC (3LC) group or Conventional four port LC (4LC) group by use of computer generated random number table.

Anaesthesia Technique

The anaesthesia techniques, anaesthetic drugs and surgical techniques were standardized. Anesthesia was induced with propofol 2–2.5 mg/kg IV, glycopyrrolate 0.2 mg IV, and fentanyl 2 ìg/kg IV. Endotracheal intubation was facilitated with vecuronium 0.15 mg/kg IV. Anesthesia was maintained with 1.0%–2.5% (inspired concentration) isoflurane in oxygen. Ventilation was controlled mechanically and adjusted to keep an end-tidal CO2 partial pressure of 30–40 mm Hg. Neuromuscular block was maintained with vecuronium IV. After tracheal intubation, a nasogastric tube was placed to promote baseline emptying of the stomach of air and gastric contents.

Surgical Technique for Single Incision Laparoscopic Cholecystectomy (SILC)

Patient was placed in reverse trendelenburg leg apart position with the table tilted downward to the patient's left (15 degree). After infiltration of 5 ml bupivacaine solution around the umbilicus, transumbilical 2.5-3.5 cm incision was given and SILC port was placed in the umbilicus through the same skin incision. Pneumoperitoneum was created with insufflation of the abdomen with C02 using SILS port inlet at 15 mm Hg. The two 5mm trocars were used for introducing the convention LC hand instruments. The central 5 mm port was used to introduce 30 degree long telescope (50 cm). An initial gross examination of the entire abdomen cavity was made primarily to exclude injury/bleeding during the creation of the pneumoperitoneum. The anatomy was visualized. A Maryland dissector and a grasper were introduced through other 5mm trocars introduced in SILS port. The fundus of the gallbladder was grasped initially and progressing gradually to Hartman's pouch doing necessary adhesiolysis and flipped upwards over the superior edge of the right lobe by a curved grasper through the SILC port. The sufficient length of cystic duct and cystic artery on gallbladder side were skeletonized, clipped with liga-clips and divided making sure to visualize the gallbladder cystic duct junction and common bile duct cystic duct junction wherever possible. The dissection of the gallbladder from the liver bed was done by laparoscopic hook with monopolar cautery. The gallbladder was then held with toothed grasper and brought out through the umbilical incision. Any bile spill was irrigated with normal saline and suctioned and any stone spill were retrieved. Rectus sheath at umbilicus was closed with vicryl no 1 and skin was approximated with stapler.

Surgical Technique for Standard 4 port Laparoscopic Cholecystectomy

All patients were placed in reverse Trendelenburg position with 15 degree left lateral tilt. Premptive analgesic with 5 ml bupivacaine solution was given at the site of incision and pneumoperitoneum was created via Veress needle with closed technique. A 10-mm supraumbilical port was placed for camera and 3 working ports were made- 10mm port in the mid-epigastrium just to the right of the falciform ligament, and two 5-mm ports in the right upper abdomen two finger breadths below the right margin in the mid-clavicular and the anterior-axillary line. A 10 mm 0° laparoscope was used. An initial gross examination of the entire abdomen cavity was made primarily to exclude injury/bleeding during the creation of the pneumoperitoneum and secondly to identify any gross macroscopic additional disease. The fundus of the gallbladder was grasped by the

assistant and flipped upwards and over the superior edge of the right lobe. A Maryland dissector and a grasper was used to identify the structures in the Calot's triangle using monopolar cautery. The sufficient length of cystic duct and cystic artery on gallbladder side were skeletonized, clipped with 10 mm liga-clips and divided making sure to visualize the gallbladder cystic duct junction and common bile duct cystic duct junction wherever possible. The dissection of the gallbladder from the liver bed was done by laparoscopic hook with monopolar cautery. The gallbladder was then held with toothed grasper and brought out through the epigastric incision. Any bile spill was irrigated with normal saline and suctioned and any stone spill were retrieved.

Assessed Factors

In this study we assessed the conversion rate, duration of surgery, degree of postoperative pain, use of analgesics, hospital stay, complications, cosmetic satisfaction and change in serum level of interleukin 6 postoperatively.

Conversion was assessed by change from one surgical procedure to another for successful removal of gallbladder. The reasons for conversion were recorded.The port site wound infections were classified according to the CDC classification [12] for surgery site infections. Operative time was measured in minutes defined as time taken from, start of giving first incision to skin closure of the last incision. Severity of postoperative pain was recorded at 8hrs after operation and during follow up at 1 week, 3 months by using Visual Analogue Scale (VAS). Hospital stay was calculated as the number of days in the hospital after the surgery until the patient was deemed fit for the discharge by operating surgeon. Cosmetic satisfaction of surgical scar was rated on a scale [range, 0(worst) to 10(best)] and was evaluated at POD 7 or stitch removal which one is earlier and at the 3 month and 6 month follow up visit.

Pre operatively serum level of IL-6 was measured in all patients. Post operatively after 24 hr serum level of IL-6 was re-measured. IL-6 estimation was done by chemiluminesence immunoassay system kit. Then level of increase of this inflammatory mediator was compared between the groups.

Statistical Analysis

Statistical analysis was done using SPSS version 16.0. For continuous data ANOVA test was used to compare the significant difference in mean for more than two groups. For categorical variables Chi-square test and Fisher's – exact test were used. The P-value of < 0.05 considered as statistically significant.

Results

Of 46 patients enrolled in the study 40 patients completed the study. One patient had incidentally diagnosed carcinoma gallbladder on laparoscopy, two had uncontrolled comorbidity, one patient had Mirrizi syndrome and two patient lost to followup after discharge. A total of 40 patients were randomized into two groups. Group I underwent SILC and Group II 4 port LC. The patient characteristics between the two groups were comparable (Table 1a and 1b). There were 2 conversions in Group and 1 in Group II (pvalue-0.804) all because of non progression due to dense Calot's adhesions. There was no difference in the post operative analgesic intake, type of analgesic used and the rate of surgical site wound infection rate (Table 2). The postoperative outcomes are shown in Table 3.The SILC group significantly longer operating time when compared to conventional LC group (Mean time 71 versus 39.5 minutes) although the duration of hospital stay was similar. The VAS was similar on day 0 but was significantly less in SILC group on day 7 and at 3 months postoperatively. Similarly, the day of resuming work was significantly shorter in SILC group compared to conventional LC. The rise in IL-6 level was significantly higher in conventional group compared to SILC group (p-value-<0.001). The cosmesis as assessed by the patient was

Table 1a: Comparison of preoperative parameters between the groups

Variables (N=40)		SILC		4 port		p-value
		No.	%.	No.	%.	
Sex	Male	3	15.0	1	5.0	0.418
	Female	17	85.0	19	95.0	
Socio-economic Status	High	3	15.0	2	10.0	0.767
	Middle	17	85.0	17	85.0	
	Low	0	0.0	1	5.0	
Dyspepsia	Yes	20	100.0	20	100.0	0.001
	No	0	0.0	0	0.0	
Pain abdomen	Yes	20	100.0	20	100.0	0.362
	No	0	**0.0**	0	0.0	

Acid Peptic Disorder	Yes	20	100.0	18	90.0	0.006
	No	0	0.0	2	10.0	
Previous operation	Yes	2	10.0	1	5.0	0.804
	No	18	90.0	19	95.0	
Diabetes Mellitus	Yes	0	.0	2	10.0	0.349
	No	20	100.0	18	90.0	
Tenderness	Yes	1	5.0	0	0.0	0.362
	No	19	95.0	20	100.0	

Table 10b: Comparison of pre-operative parameters between the study groups

Variables (N=40)	SILC (Mean±SD)	4 port (Mean±SD)	F-value	P-value
Age	36.60±9.087	41.15±13.299	.775	.465
Hemoglobin	12.1350±1.30436	12.4150±0.96860	.830	.441
Total Count	8266.50±1481.792	7650.00±1612.615	.830	.441
Creatinine	0.8050±0.19861	0.6550±0.25021	2.474	.093
Urea	25.125±8.7778	31.600±8.3376	2.956	.060
SGPT	33.760±8.8448	48.200±20.0935	3.495	.037
SGOT	35.775±7.7366	43.100±10.0990	1.945	.152
Direct Bilirubin	0.260±0.1429	0.340±0.1314	1.950	.152
Total Bilirubin	0.7200±0.24192	0.8450±0.16694	4.048	.023
Alkaline Phosphatase	103.305±26.8524	110.700±18.4622	.538	.587
Total Protein	7.8050±0.57626	7.7650±0.69606	6.733	.002
Albumin	4.3550±0.56240	4.0050±0.47404	3.181	.049

Table 2: Comparison of conversion rate, analgesic use and wound infection

		SILC		4 port		P-value
		No	%	No	%	
Failure of the technique (n=60)	Yes	2	10.0	1	5.0	**0.804**
	No	18	90.0	19	95.0	
Nature analgesic agents (n=60)	NSAIDs	15	75.0	14	70.0	**0.377**
	NSAIDs and opioid	5	25.0	6	30.0	
Wound infection (n=60)	Yes	2	10.0	1	5.0	**0.765**
	No	18	90.0	19	95.0	

Table 3: Comparison of post-operative parameters

Variables	Group 1 Mean±SD	Group 3 Mean±SD	F-value	P-value
Duration surgery	71.00±9.403	39.50±9.162	92.209	<0.001
Duration hospital stay	2.20±0.523	2.00±0.459	1.541	0.223
Pain day 0 (VAS score)	6.50±0.889	6.50±1.100	2.367	0.103
Pain day 7 (VAS score)	2.70±0.979	3.60±1.046	18.455	<0.001
Pain 3 month (VAS score)	1.60±0.821	1.90±0.788	6.077	0.004
Resuming daily work POD	6.65±1.182	5.75±1.070	5.443	0.007
IL6 preop	15.3185±7.13412	21.5100±11.30472	1.060	0.353
IL6 postop	76.15 ?19.83	155.23±80.50240	12.04	<0.001
Cosmetic satisfaction Day 7	7.20±1.361	5.20±1.196	16.964	<0.001
Cosmetic satisfaction 3months	9.30±1.342	7.20±1.196	31.683	<0.001
Cosmetic satisfaction 6months	9.60±0.821	7.80±0.894	34.977	<0.001

significantly better in SILC group at day 7 and 3 and 6 months after the operation.

Discussion

LC is the gold standard treatment for gall stone disease. The technique of LC has been standardised and the outcome of the patients following LC is almost stable with a conversion rate of 0.2% [13], biliary complication rate of 0.26 to 0.6% [14,15] and bowel injury rate of 0.14 to 0.35 % [14,15]. Majority of the morbidity related to pain, wound complications and cosmetic outcomes are related to the access sites for

LC. There has been a continuous endeavour to reduce the invasiveness and thus wound related complications of LC and also improve the cosmetic outcomes of LC.

The risk of conversion seems to be higher with SILC as compared to three and four port cholecystectomy. In a metaanalysis by Mate Milas et al, overall conversion of procedure was 69 (6%) among 1142 SILC [16]. The incidence of conversion with SILC was 4.39% vs. 0.53% with LC although the difference was statistically not significant (p value = 0.019). However with increasing experience with SILC the risk of procedure failure seems to have been reduced. In 10 trials with >40 SILC procedures, failure was 3.30% [17]. In our study there were 2 (10%) conversions in the SILC group as compared to 1 in conventional four port group(5%), and conversion rate was not significant (p=0.804). Conversion was mainly due to adhesions which interfered during dissection. Although the incidence appears to be higher than that reported in published literature but no definite inference could be drawn as the number of patients are quite less.

Milas M et al observed higher postoperative wound infection found following SILC. This may be due to longer periumbilical incision and its contamination during the delivery of the gallbladder, suboptimal hygiene of umbilicus itself despite cleaning [16,18]. Because anatomically umbilicus is probably the most difficult location for antiseptic and aseptic precautions and most SILC incision were given through umbilicus. Thus postoperative wound infection at the umbilical site has been a major concern [17] although infection seen was of minor SSI. In our study there has been a marginally higher incidence of wound infection but the difference was not statistically significant (p=0.765). Similar findings were also reported in metanalysis by Geng et al and Allemann et al [17,19]. During follow-up no incisional hernias were noted and it was ensured that sheath closure was done by the operating consultant. However, we need to have a longer follow-up to draw any inference on the development of incisional hernia from the present study.

We found in this study that the total operative time required for SILC (71.00 ± 9.403) as compared to (39.50 ± 9.162) in 4 port LC group which was significantly higher (p<0.001). This is in agreement with the metaanalysis by Liangyuan Geng et al which also concluded a longer operative time for SILC (p=0.005) [17]. Similar results were seen from other mata-analysis [20-23]. However the metaanlysis by Zhong et al including 7 RCT including 611 patients concluded that there was no significant difference in the operative time [24]. Similar metaanalysis by Lai EC et al [25] and Chang SK et al [26] did not find a significant difference in the operative time between the SILC and conventional LC groups.

Postoperative pain is a useful surrogate marker of procedure related trauma. It is often the predictor for early ambulation and return to work. SILC is being introduced as a less invasive procedure with lesser pain. Outcome of SILC in terms of postoperative pain is variable in literature. Meta-analysis of various studies suggest no difference in postoperative pain in both the techniques [16,17,19]. However studies included in these meta-analysis were often heterogenous and there was no uniformity in measure of pain. In our study we found no significant difference in the pain score at 8 hr after surgery (p=0.103), but on 7th day post operatively and after 3 months significantly low pain score was seen in SILC group. According to Geng et al there was no significant difference between post-operative pain in SILC and conventional laparoscopic cholecystectomy [17]. On the other hand, many studies showed a significant increase in post-operative [27-33]. On the other hand pain can be assessed by number of analgesics and nature of analgesics needed on the day of surgery. In our study patients undergone SILC require mostly single analgesics agent (p=0.223) and that too NSAIDS group (p=0.214). But these parameters are not statistically significant. As pain is felt differently for each patient, it is difficult to conclude on whether or not there is less post-operative pain in either of groups. In our study resuming daily work in SILC cases was significant (p=0.007) which may be due to decreased post operative pain, patients resumed in daily work early than the other two groups.

SILC was said to have a significantly shorter stay in the hospital [34-37]. Many though, didn't find a much significant difference in hospital stay [38-39]. In this study we did not find any significant difference in hospital stay among the two groups (p=0.223).

Cosmetic outcome is a very important parameter in assessing out come in laparoscopic surgeries. In a meta-analysis by Mate Milas et al, 5 trials with non-blinded patients (N=513) in favour of SILC (SMD=T.83, p value=0.037), but in 6 trials with blinded patients (N=719) difference was small and insignificant (SMD=0.42, p value=0.548) [16]. The reason for high cosmetic satisfaction score in SILC was attributed to the fact that the scars receded into the umbilicus and was hardly visible following SILC and patients were very satisfied with the cosmetic results. In our study, overall cosmetic satisfaction score was higher in SILC group. The cosmetic

satisfaction was assessed at day 7($p<0.001$), after 3 months ($p<0.001$) and 6 months ($p<0.001$).

In this study after 24 hr of surgery inflammatory parameter IL-6 found to be significantly lower in SILC group ($p<0.001$) than the 4 port LC group, which may explain the fast recovery in these cases by reducing surgical stress and infectious complications correlated to the surgical procedure. According to Luna et al serum IL-6 level after 6hr of surgery was found to lower in SILC group than conventional laparoscopic cholecystectomy group, but it was not statistically significant [39].

Conclusion

The SILC is associated with a longer operating time. This procedure has a lower incidence of early postoperative pain but no pain difference in immediate post-operative period. There is no additional complication associated with SILC as compared to the other 2 groups. There is no difference in the wound healing in three groups. Patients undergone SILC resume daily work early. SILC provide better cosmetic outcome. In SILC group post-operative inflammation is less which may explain the fast recovery in these cases by reducing surgical stress and infectious complications correlated to the surgical procedure. SILC is a safe and feasible procedure.

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