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COMPARISON OF SURGICAL SITE INFECTION IN TRANS UMBILICAL & INFRA UMBILICAL PORT SITE APPROACH IN LAPAROSCOPIC CHOLECYSTECTOMY

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Abstract

Background: *Laparoscopic cholecystectomy (LC) is a widely performed procedure for gallbladder removal, typically done for conditions such as cholelithiasis and chronic cholecystitis.*

Objectives: *To compare the SSI rates in patients undergoing LC with infraumbilical versus transumbilical port site approaches.*

Study Design & Setting: *This study was conducted at the Department of Surgery, DHQ Teaching Hospital, Sargodha from16 September 2024 - 15 March 2025.*

Methodology: *A total of 154 patients undergoing laparoscopic cholecystectomy were divided into two groups: Group A (Infraumbilical) and Group B (Transumbilical), with 77 patients in each group. Surgical site infection (SSI) rates were recorded postoperatively and compared between the two groups. Patients were stratified by age, BMI, ASA class, diabetes, and hypertension to assess their potential influence on SSI. Statistical analysis was performed using chi-square tests to determine significant differences in SSI rates.*

Results: *The mean age in Group A was 45.2 ± 10.1 years, while in Group B it was 46.3 ± 9.8 years. Gender distribution was fairly balanced, with 51.9% males and 48.1% females in Group A, and 54.5% males and 45.5% females in Group B. Diabetes Mellitus was present in 24.7% of Group A and 25.9% of Group B, while 28.6% of Group A and 27.3% of Group B had hypertension. SSI rates were 5.2% in Group A (infraumbilical) and 9.65% in Group B (transumbilical), but the differences were not statistically significant ($p > 0.05$). Stratified analysis revealed no significant effect of age, BMI, ASA class, diabetes, or hypertension on SSI rates.*

Conclusion: *No significant difference in SSI rates was found between the infraumbilical and transumbilical approaches. Other factors, such as age, BMI, and comorbidities, did not significantly affect the SSI outcomes.*

INTRODUCTION

Laparoscopic cholecystectomy (LC) is one of the most commonly performed surgical procedures worldwide, with between 750,000 and 1,000,000 cholecystectomies carried out each year in the USA alone.[1] After its introduction in Germany, the laparoscopic approach became the gold standard for cholecystectomy. Since then, it has continued to evolve, becoming increasingly minimally invasive, with smaller incisions and a reduced number of trocars required.[2]

The most critical and conceivably dangerous first step in laparoscopic surgery is the safe and successful insertion of the primary port. This procedure is typically achieved by creating pneumoperitoneum through a supraumbilical or infraumbilical, transumbilical approach. Each of these approaches offers distinct advantages, but it is the successful insertion of the laparoscopic camera port that marks a critical point in the operation.[3]

Transumbilical port insertion through the umbilical fossa has been advocated due to its advantages. These include comparative ease of insertion, a successful first attempt, reduced force required (especially in obese patients), and a bloodless procedure. Additionally, it provides patient satisfaction due to the invisible scar left after surgery. However, it does carry some disadvantages, including a higher risk of wound infection, as it requires the incision of all layers of the abdominal wall. The first trocar is then inserted under direct vision, followed by gas insufflation.[4,5] The infraumbilical technique, in contrast, involves a small, C-shaped incision just below the umbilicus. Subsequently, all layers of the abdominal wall are incised, and the first trocar is inserted under direct vision, again followed by gas insufflation. This method is often preferred for its smaller incision and ease of access.[6,7,8]

A study conducted by Sir Ibum Rung Wong and colleagues, aimed at comparing postoperative pain and surgical site infection (SSI) between the two techniques, found that the SSI rate at the umbilical wound was significantly higher in the transumbilical group than in the infraumbilical group. However, the difference in SSI was not statistically significant, with the relative risk of 4.0 (95% CI 0.9, 17.9; p = 0.070).[9] Despite this, there are no local studies comparing surgical site infections after transumbilical versus infraumbilical incisions in conventional laparoscopic cholecystectomy. This gap in the literature prompted the design of this study. Our research aims to compare these two surgical approaches in terms of the incidence of surgical site infections. The results of this study will not only help analyze which technique is associated with a lower rate of infection but will also contribute to determining the best approach for patients undergoing laparoscopic cholecystectomy at our hospital. The hypothesis was that there was a difference in the frequency of surgical site infection between the transumbilical and infraumbilical port site approaches in laparoscopic cholecystectomy.

MATERIALS AND METHODS

The study was started after receiving approval from the Institutional Ethical Review Committee and CPSP. Informed consent was taken from each participant before inclusion in the study. The study was conducted at the Department of Surgery, DHQ Teaching Hospital, Sargodha from16 September 2024 - 15 March 2025. The sample size was calculated using the WHO sample size calculator (www.openepi.com), with a confidence level of 95% and a significance level of 5%. The power of the study was set at 80%. Surgical site infection rates were evaluated for two different types of incisions. For the infraumbilical incision (P1), the rate of infection was 4%, and for the transumbilical incision (P2), it was 16%.[9] A sample size of 154 patients was allocated and 77 patients in each group. Non-probability, consecutive sampling was used for participant selection. The study included both genders, with participants aged between 18 to 60 years. They were required to have an ASA class I, II, or III and undergo conventional laparoscopic cholecystectomy (LC). Laparoscopic cholecystectomy was performed in patients who presented with pain in the right hypochondrium for ≥6 weeks, along with ultrasound evidence of cholelithiasis (stones in the gallbladder appearing as echoic shadows). The procedure was done under general anesthesia in reverse Trendelenburg position, using conventional 4 ports placed at a minimum distance of 5 cm apart. Pregnant females were excluded from the study. Additionally, patients who were immunocompromised (i.e., those with human immunodeficiency virus, those taking

immunosuppressive drugs, or on peritoneal dialysis, as assessed by medical records/history) were also excluded. Obese individuals (body mass index (BMI) > 35 kg/m²), patients with end-stage renal disease (on history), and individuals with cirrhosis with ascites (on history) were excluded from participation. Participants were briefed about the objectives of the study and assured that their information would remain confidential. Patients were selected based on inclusion criteria from the surgical ward. All patients underwent evaluation based on history and clinical examination.

Patients were divided into two groups by a lottery method. Group A underwent LC with an infraumbilical incision, and Group B underwent a transumbilical incision. LC was performed as an inpatient procedure under general anesthesia. The techniques used in LC were similar for all patients, except for the type of umbilical incision. Operations were performed using four ports. A 10-mm port was used for the umbilical incision, while 5-10 mm ports were used for other abdominal incisions. For the transumbilical intervention, the incision was made in the umbilicus, either in a transverse or vertical direction, depending on the characteristics of the umbilicus. In the infraumbilical group, a transverse incision was made 1-2 cm below the umbilicus. Surgery was conducted by a consultant surgeon with three years of post-fellowship experience. Surgical site infection (SSI) was diagnosed following the Center for Disease Control (CDC) criteria, which indicated that the infection occurred within 30 days and was limited to skin and subcutaneous tissue involvement. The diagnosis required one of the following: purulent drainage, the isolation of an organism from fluid or tissue, or at least one of the following signs or symptoms: pain or tenderness, localized swelling, redness, or heat.

The data was analyzed using SPSS version 25.0. Quantitative variables like age and BMI were described as the mean ± standard deviation. Categorical variables such as gender, indication for LC, comorbidities like DM, Hypertension, ASA class, and SSI were presented in terms of frequencies and percentages. The Chi-square test was applied to compare SSI in two groups. Effect modifiers like gender, age, BMI, ASA class, and comorbidities were controlled by stratification. Post-stratification Chi-square test was applied to see their effect on the outcome. A p-value less than 0.05 was considered significant.

RESULTS

In the study, the mean age was 45.2 ± 10.1 years for Group A (Infraumbilical) and 46.3 ± 9.8 years for Group B (Transumbilical). Most participants in both groups were aged 46-60 years. In terms of gender, Group A had 40 males (51.9%) and 37 females (48.1%), while Group B had 42 males (54.5%) and 35 females (45.5%). The average BMI in Group A was 29.5 ± 4.2, and in Group B, it was 30.2 ± 3.9. More participants in Group A had a BMI ≤ 30 (58.4%) compared to Group B (54.5%). Group A had 22 participants (28.6%) in ASA Class-I, 42 (54.5%) in Class-II, and 13 (16.9%) in Class-III, while Group B had 23 (29.9%) in Class-I, 40 (51.9%) in Class-II, and 14 (18.2%) in Class-III. Diabetes Mellitus was present in 19 participants (24.7%) in Group A and 20 participants (25.9%) in Group B. Hypertension was observed in 22 participants (28.6%) in Group A and 21 participants (27.3%) in Group B. The most common indication for laparoscopic cholecystectomy (LC) was cholelithiasis, found in 63 participants (81.8%) in Group A and 65 participants (84.4%) in Group B, followed by chronic cholecystitis as given in table 1.

In this study, Surgical Site Infection (SSI) rates were observed as follows: Group A (Infraumbilical) had 4 cases of SSI (5.2%), while Group B (Transumbilical) had 7 cases (9.65%). The remaining participants in both groups did not experience SSI, with 73 (94.8%) in Group A and 70 (90.9%) in Group B as given in table 2.

For age, SSI rates were similar in both groups for those aged 18-45 years ($p = 0.564$) and 46-60 years ($p = 0.217$). In terms of BMI, no significant difference was observed for participants with BMI ≤ 30 ($p = 0.109$) and BMI > 30 ($p = 0.943$). Regarding ASA class, there were no significant differences in SSI rates for Class-I ($p = 0.125$), Class-II ($p = 0.297$), or Class-III ($p = 0.404$). Diabetes Mellitus and Hypertension also showed no significant differences, with p-values of 0.213 and 0.169, respectively as given in table 3.

Table 1: Demographic and Baseline Characteristics of Participants

Characteristic	Category	Group A (Infraumbilical)	Group B (Transumbilical)
Age	Mean ± SD	45.2 ± 10.1	46.3 ± 9.8
	18-45 years	35 (45.5%)	33 (42.9%)
	46-60 years	42 (54.5%)	44 (57.1%)
Gender	Male	40 (51.9%)	42 (54.5%)
	Female	37 (48.1%)	35 (45.5%)
BMI	Mean ± SD	29.5 ± 4.2	30.2 ± 3.9
	BMI ≤ 30	45 (58.4%)	42 (54.5%)
	BMI > 30	32 (41.6%)	35 (45.5%)
ASA Class	Class-I	22 (28.6%)	23 (29.9%)
	Class-II	42 (54.5%)	40 (51.9%)
	Class-III	13 (16.9%)	14 (18.2%)
Diabetes Mellitus	Yes	19 (24.7%)	20 (25.9%)
	No	58 (75.3%)	57 (74.1%)
Hypertension	Yes	22 (28.6%)	21 (27.3%)
	No	55 (71.4%)	56 (72.7%)
Indications for LC	Cholelithiasis	63 (81.8%)	65 (84.4%)
	Chronic Cholecystitis	14 (18.2%)	12 (15.6%)

Table 2: Surgical Site Infection (SSI) Rates in Both Groups

Surgical Site Infection (SSI)	Category	Group A (Infraumbilical)	Group B (Transumbilical)
SSI	Yes	4 (5.2%)	7 (9.65%)
	No	73 (94.8%)	70 (90.9%)

Table 3: Comparison of Surgical Site Infection (SSI) Rates Between Study Groups across Stratified Variables

Variable	Category	Category	SSI (Yes)	Group A (Infraumbilical) (n=77)	Group B (Transumbilical) (n=77)	Total (n=154)	p-value
Age	18-45 years	Yes	2 (5.7%)	2 (5.7%)	0 (0%)	2 (2.6%)	0.564
		No	33 (94.3%)	33 (94.3%)	33 (100%)	66 (97.4%)	
	46-60 years	Yes	2 (4.8%)	2 (4.8%)	5 (11.4%)	7 (9.1%)	0.217
		No	40 (95.2%)	40 (95.2%)	39 (88.6%)	79 (90.9%)	
BMI	BMI ≤ 30	Yes	1 (2.2%)	1 (2.2%)	4 (9.5%)	5 (6.5%)	0.109
		No	44 (97.8%)	44 (97.8%)	38 (90.5%)	82 (93.5%)	
	BMI > 30	Yes	3 (9.4%)	3 (9.4%)	3 (8.6%)	6 (8.1%)	0.943
		No	29 (90.6%)	29 (90.6%)	32 (91.4%)	61 (91.9%)	
ASA Class	Class-I	Yes	1 (4.5%)	1 (4.5%)	3 (13.0%)	4 (8.0%)	0.125
		No	21 (95.5%)	21 (95.5%)	20 (87.0%)	41 (92.0%)	
	Class-II	Yes	2 (4.8%)	2 (4.8%)	4 (10.0%)	6 (7.7%)	0.297
		No	40 (95.2%)	40 (95.2%)	36 (90.0%)	76 (92.3%)	
	Class-III	Yes	1 (7.7%)	1 (7.7%)	0 (0%)	1 (2.0%)	0.404
		No	12 (92.3%)	12 (92.3%)	14 (100%)	26 (98.0%)	
Diabetes Mellitus	DM	Yes	2 (10.5%)	2 (10.5%)	5 (25.0%)	7 (18.4%)	0.213
		No	17 (89.5%)	17 (89.5%)	15 (75.0%)	32 (81.6%)	
Hypertension	HTN	Yes	2 (9.1%)	2 (9.1%)	4 (19.0%)	6 (14.3%)	0.169
		No	20 (90.9%)	20 (90.9%)	17 (81.0%)	37 (85.7%)	

DISCUSSION

Laparoscopic cholecystectomy (LC) is a commonly performed procedure for gallbladder diseases such as cholelithiasis and chronic cholecystitis.[10] The choice of port site incision—infraumbilical versus transumbilical—can impact surgical outcomes, particularly the rate of surgical site infections (SSI). While the infraumbilical incision has been widely used, the transumbilical approach is gaining attention due to potential cosmetic benefits and reduced scarring. Understanding the impact of these two approaches on SSI rates is critical for optimizing surgical protocols. This study aims to compare SSI rates between these two incision methods in patients undergoing LC. It also examines how patient factors like age, BMI, and comorbidities influence infection outcomes

Sinha et al. (2023) reported similar infection rates in both groups (5%) for transumbilical and infraumbilical port insertions, but with a different sample size and demographic. Their study involved 66 females (82.5%) and 14 males (17.5%), whereas our study had a more balanced gender distribution (51.9% male in Group A and 54.5% male in Group B). The main indication for surgery in their study was **cholelithiasis** (96.2%), similar to our study, where 81.8% of patients in Group A and 84.4% in Group B had this condition. However, their study did not find any statistically significant difference in infection rates, which aligns with our results showing no significant difference in SSI between the two groups.[13]

In contrast, Wani et al. (2019) reported a significantly larger sample size of 200 patients, with 100 patients in each group. In their study, cholelithiasis was also the most common indication for surgery. Their study showed no significant difference in infection rates between the transumbilical and infraumbilical groups, but they did note a slight increase in obesity in their cohort, where 10.5% of patients were classified as obese.[14]

Kurobe et al. (2023) reported no statistically significant differences in postoperative infection rates between transumbilical and periumbilical incisions in a pediatric population. Their study showed slightly higher infection rates in the periumbilical group (7.3%) compared to the transumbilical group (5.3%), with p-values of 0.451 and 0.593, respectively. Although their study was conducted in children, it mirrors the trends observed in our study where no statistically significant difference was found between the groups.[15]

Mir et al. (2012) reported an overall SSI rate of 6.7% (45/675), with 4.4% (30/675) at the umbilical port site. They found more infections at the epigastric port site, which is consistent with our findings, though no significant difference was observed between the groups.[16] Keerthi et al. (2023) compared the two techniques and found 3 cases of SSI (3.9%) in both groups, with no significant difference in SSI rates, aligning with our results, though their transumbilical group had a lower infection rate than ours, likely due to demographic or procedural differences.[17] Birender Sharma (2019) reported SSI rates of 4% (4/100) in the umbilical group and 8% (8/100) in the periumbilical group, with no significant difference ($p = 0.677$), similar to our findings showing no impact of port site choice on SSI.[18] Athar et al. (2022) found SSI rates of 13.9% in the infraumbilical group and 11.8% in the periumbilical group, with no significant difference ($p = 0.655$), supporting our results.[19] Shih et al. (2020) reviewed five trials and found no significant difference in SSI rates, further confirming that the choice of incision site does not significantly affect SSI occurrence.[20] This finding further supports the idea that SSI rates are not significantly affected by the choice of incision site, consistent with the results of our study. Our findings align with the majority of the studies reviewed, indicating that the choice of port site (transumbilical or infraumbilical) does not significantly affect the rate of SSI in laparoscopic cholecystectomy.

A key strength of this study is its prospective design, allowing for real-time data collection and analysis. The large sample size (154 patients) ensures a reliable comparison between the two groups. Stratification by important clinical factors like age, BMI, and comorbidities strengthens the analysis. However, a limitation is the study's single-center setting, which may affect the generalizability of results. Another limitation is the observational nature, as randomization was not employed. Additionally, patient follow-up after surgery was limited, which could affect the assessment of long-term infection rates.

CONCLUSION

No significant difference in SSI rates was found between the infraumbilical and transumbilical approaches in this study. Other factors, such as age, BMI, and comorbidities, did not significantly influence SSI outcomes. Further studies with larger, multi-center samples and longer follow-up are recommended

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