



Comparison of Outcomes of Laparoscopic Cholecystectomy versus Robot Assisted Cholecystectomy

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ARTICLE INFO

Keywords: Cholecystectomy; Gallstones; Laparoscopy; Postoperative complications; Robotics

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Declaration

Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History

Received: 10-06-2025 Revised: 02-07-2025
Accepted: 11-07-2025 Published: 15-07-2025

ABSTRACT

Objective: To compare outcomes of laparoscopic cholecystectomy versus robot assisted cholecystectomy in patients at tertiary care hospital, Karachi. **Study Design:** Randomized controlled trial. **Duration and Place of Study:** Department of General Surgery, Jinnah Postgraduate Medical Centre, Karachi from March 2025 to May 2025. **Methodology:** Total 96 patients (n=96) age 18–65 years were included and divided into two groups with 48 in laparoscopic group and 48 in robot assisted group. Data recorded for demographics and outcomes. Operative time, blood loss, bile spillage, wound complication and pain score were noted. Data analysed by independent sample t test and chi square test or Fischer exact test. **Results:** Mean age in laparoscopic group was 47.06 ± 9.87 years and in robot group 43.81 ± 9.98 years. Female were 26 (54.2%) in laparoscopic group and 30 (62.5%) in robot group. Operative time was more in robot group 81.81 ± 8.93 minutes as compared to laparoscopic group 57.13 ± 7.33 minutes ($p < 0.001$). Blood loss was 40.88 ± 17.33 ml in laparoscopic and 43.10 ± 15.32 ml in robot group ($p = 0.506$). Bile spillage seen in 7 (14.6%) laparoscopic and 11 (22.9%) robot group ($p = 0.296$). Wound complication was 5 (10.4%) in laparoscopic and 2 (4.2%) in robot group ($p = 0.435$). Pain score also not significant between groups ($p > 0.05$). **Conclusion:** Both methods are safe and effective but robot assisted cholecystectomy take more operative time with similar outcomes.

INTRODUCTION

Laparoscopic cholecystectomy is now considered as the gold standard technique and is used extensively owing to the small incisions, less pain after surgery, and quick resumption of daily activities.¹ The laparoscopic cholecystectomy is done using the help of a camera along with thin instruments inserted into the body via small incisions, offering better visibility within the operating field.² Robotically assisted cholecystectomy is a relatively new technique whereby robots are used to provide greater accuracy to the procedure. This method offers three-dimensional vision as well as ergonomics but involves considerable cost and preparation time.³

Laparoscopic cholecystectomy is currently considered the gold standard operation and is being used widely because of its small incisions, painlessness after the surgery and quick recovery.⁴ In laparoscopic cholecystectomy, a camera along with special long tools is used through some openings made on the abdomen to get better visualization.⁵ Robot-assisted cholecystectomy is a relatively new approach wherein the surgeon uses a robot to increase his or her ability to operate with higher

precision and dexterity.⁶ Nevertheless, this method demands expensive instruments as well as prolonged preparations.

Parameters like operative time, amount of bleeding during surgery, bile spillage rate, and wound complications are some of the parameters that can be used as measures of successful surgery.⁷ The laparoscopic approach will have shorter operative times since it has been around for quite some time while robot-assisted surgeries will take longer because of the docking process, among others.⁸ Amount of bleeding during surgery is expected to be insignificant for both techniques although some researches show that there will be less bleeding when using robot assistance.⁹ Bile spillage may occur in both cases depending on whether the gallbladder is perforated or not. However, proper handling will reduce this complication. There will be lower chances of wound complications for both techniques but robotic surgery might be better because of smaller and more precise incisions.¹⁰

The reason for this study lies in the common use of both laparoscopic and robotic cholecystectomies, but there remains a dearth of literature comparing them in different

clinical scenarios. There are many institutions, especially in developing nations, that experience issues with regard to finances, availability, and education; thus, it is important to determine if the robotic method offers any distinct benefits over the laparoscopic method. Differences in factors like surgery duration, blood loss, bile leakage, and wound infections might affect surgical choices and patient safety.

METHODOLOGY

This randomized controlled trial was carried out in the Department of General Surgery at Jinnah Postgraduate Medical Centre, Karachi over a period of 3 months from March 2025 to May 2025 after approval of synopsis from the institutional ethical review committee was obtained before start of study, ethical approval certificate No. (F.2-81/2025-GENL/211-CE/JPMC). Sample size was calculated by using WHO sample size calculator, taking prevalence of bile spillage during surgery in laparoscopic versus robotic group as 23.3% vs 5.6%,¹¹ with power 70% and level of significance 5%. Total sample size was 96, with 48 patients in each group.

Patients aged between 18–65 years, of either gender, having ASA score I and II and scheduled for laparoscopic cholecystectomy or robot assisted cholecystectomy were included. Only those patients who were willing to give informed consent were enrolled. Patients having history of upper abdominal surgery, gallbladder empyema, xanthogranulomatous cholecystitis, pancreatitis, malignancy, acute cholecystitis, or those undergoing open surgical technique were excluded. Patients with complicated obstruction such as choledocholithiasis, cirrhosis or carcinoma of gallbladder and pregnant women were also excluded.

Written informed consent was taken from all patients before data collection after explaining purpose and procedure of study. Demographic details were recorded including age, gender, height, weight, BMI and ASA score. Relevant history including previous abdominal surgery was also taken. Preoperative assessment was done one day before surgery including baseline investigations and anaesthesia evaluation. Patients were randomly allocated into two groups by sealed opaque envelope method. Group-A underwent laparoscopic cholecystectomy while Group-B underwent robot assisted cholecystectomy. All procedures were performed under general anaesthesia in supine position. In laparoscopic group, umbilical port was introduced by open technique and remaining ports were placed under vision. A 12 mm rigid scope and conventional instruments were used and cystic duct and artery were dissected, clipped and divided, followed by gallbladder removal in retrograde manner. In robotic group, a 2 cm umbilical incision was made, glove port inserted, pneumoperitoneum created at 15 mmHg and robotic system was docked. Cystic structures were dissected using robotic instruments, clipped and divided, and gallbladder detached similarly. Patients were followed till discharge and observations were recorded.

After the procedure had been performed and the required follow-up period had elapsed, results were analyzed. Operating time was measured by the time between the moment of the skin cut and closing the wound, which was

noted in minutes. The amount of intraoperative bleeding was calculated through counting the number of gauzes used, with one piece being equal to 5 mL of blood loss. Bile leakage was considered if bile was found in the abdominal cavity during surgery. Wound complications included a wound infection that was confirmed by culture and accompanied by inflammation and tissue damage. Postoperative pain was assessed on a visual analog scale at 24 hours after surgery, with a score of 0-2 meaning there was no pain on a scale of 0-10.

All collected data were entered and analysed using SPSS version 26. For continuous variables such as age, height, weight, BMI, ASA score, operating time, blood loss, pain score and hospital stay mean and standard deviation were calculated. Categorical variables like gender and history of abdominal surgery were presented as frequency and percentages. Independent sample t-test and chi-square test/Fischer Exact test was applied to compare outcomes between both groups. P-value ≤ 0.05 was considered statistically significant.

RESULTS

The study was conducted on a total of 96 patients who was equally divided into two groups, with 48 patients undergone laparoscopic cholecystectomy (LC) and 48 patients undergone robot assisted cholecystectomy (RAC). In terms of patient demographics, the mean age of patients in the LC group was 47.06 ± 9.87 years, whilst the RAC group had a slightly younger mean age of 43.81 ± 9.98 years. With regard to gender distribution, females were the predominant gender in both groups, accounting for 26 patients (54.2%) in the LC group and 30 patients (62.5%) in the RAC group, whilst males constituted 22 patients (45.8%) and 18 patients (37.5%) respectively. A prior history of abdominal surgery was reported in 12 patients (25.0%) in the LC group and 9 patients (18.8%) in the RAC group, with the majority of patients in both groups having no such surgical history, that is 36 patients (75.0%) and 39 patients (81.3%) respectively. In respect of ASA classification, ASA class I was more frequently observed in the RAC group, with 33 patients (68.8%) compared to 22 patients (45.8%) in the LC group, whereas ASA class II was more prevalent in the LC group, comprising 26 patients (54.2%) versus 15 patients (31.3%) in the RAC group (Table 1).

Table 1
Patient Demographics in Both Groups (n=96)

Variables	Laparoscopic Cholecystectomy n=48		Robot Assisted Cholecystectomy n=48	
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
Age (years)	47.06 ± 9.87		43.81 ± 9.98	
Weight (kg)	68.92 ± 8.74		69.38 ± 8.31	
Height (m)	1.62 ± 0.07		1.64 ± 0.08	
BMI (kg/m ²)	27.25 ± 3.84		26.73 ± 3.07	
Gender n (%)	Male	22 (45.8%)	18 (37.5%)	
	Female	26 (54.2%)	30 (62.5%)	
History of Abdominal Surgery n (%)	Yes	12 (25.0%)	9 (18.8%)	
	No	36 (75.0%)	39 (81.3%)	
ASA Classification n (%)	I	22 (45.8%)	33 (68.8%)	
	II	26 (54.2%)	15 (31.3%)	

Regarding the comparison of operative outcomes, the preoperative pain scores were identical in both groups, with a mean of 4.60 ± 1.09 in the LC group and 4.60 ± 1.07 in the RAC group, and no statistically significant difference was observed ($t = 0$, $p = 1.000$). The operative time was noted to be significantly longer in the RAC group, with a mean of 81.81 ± 8.93 minutes compared to 57.13 ± 7.33 minutes in the LC group, and this difference was highly statistically significant ($t = -14.801$, $p < 0.001$). Mean intraoperative blood loss was slightly higher in the RAC group at 43.10 ± 15.32 ml compared to 40.88 ± 17.33 ml in the LC group, however this difference did not reach statistical significance ($t = -0.668$, $p = 0.506$). Postoperative pain scores at one hour following surgery was 5.35 ± 1.47 in the LC group and 5.60 ± 1.50 in the RAC group, with no significant difference identified between the two groups ($t = -0.826$, $p = 0.411$). At the time of discharge, pain scores were marginally lower in the RAC group (1.60 ± 0.98) in comparison to the LC group (1.81 ± 0.84), although again this difference was not statistically significant ($t = 1.115$, $p = 0.268$) (Table 2).

Table 2*Comparison of Outcomes in Both Groups*

Variables	Laparoscopic Cholecystectomy y n=48	Robot Assisted Cholecystectomy n=48	t	P value*
	Mean \pm SD	Mean \pm SD		
Pain Score (Preoperative)	4.60 ± 1.09	4.60 ± 1.07	0	1.000
Operative Time (minutes)	57.13 ± 7.33	81.81 ± 8.93	-14.801	<0.001
Blood Loss (ml)	40.88 ± 17.33	43.10 ± 15.32	-0.668	0.506
Pain Score (1 hour post-op)	5.35 ± 1.47	5.60 ± 1.50	-0.826	0.411
Pain Score (at discharge)	1.81 ± 0.84	1.60 ± 0.98	1.115	0.268

*Independent sample t test

Concerning the postoperative complications, bile spillage was observed in 7 patients (14.6%) in the LC group and 11 patients (22.9%) in the RAC group, though the difference between the groups was not statistically significant ($p = 0.296$). Wound complications were found to be slightly more frequent in the LC group, occurring in 5 patients (10.4%) in comparison to only 2 patients (4.2%) in the RAC group, however this difference also did not achieve statistical significance ($p = 0.435$) (Table 3).

Table 3*Comparison of Complications Between Both Groups (n=96)*

Variables	Laparoscopic Cholecystectomy y n=48 n (%)	Robot Assisted Cholecystectomy y n=48 n (%)	P value
Bile Spillage			
Yes	7 (14.6%)	11 (22.9%)	0.296*
No	41 (85.4%)	37 (77.1%)	
Total	48 (100%)	48 (100%)	
Wound Complication			
Yes	5 (10.4%)	2 (4.2%)	0.435**
No	43 (89.6%)	46 (95.8%)	
Total	48 (100%)	48 (100%)	

*Chi-square test **Fischer Exact Test

DISCUSSION

In this study, the operative time was found to be significantly longer in the RAC group (81.81 ± 8.93 minutes) as compared to the LC group (57.13 ± 7.33 minutes), and this difference was highly significant ($p < 0.001$). This can be explained by the additional time what is required for docking and setting up the robotic system before the actual surgical procedure begin, which naturally prolong the total operative duration particularly when the surgical team is still in the process of gaining experience with the robotic platform. There was a bile spillage incidence in 7 cases (14.6%) from the LC group and 11 cases (22.9%) from the RAC group, without a statistically significant difference between both groups ($p = 0.296$). While robot-assisted surgery enables a better three-dimensional view and greater precision, the chance for a bile spillage still exists and depends on how inflamed and thickened the gallbladder wall is. The incidence of wound-related complications was relatively higher among the LC group as 5 cases (10.4%) were noted to have it compared to only 2 cases (4.2%) among the RAC group; nevertheless, this difference did not significantly differ ($p = 0.435$).

The present study compared outcomes of laparoscopic and robot assisted cholecystectomy in 96 patients. Female predominance was observed in both groups, with 26 females (54.2%) in LC group and 30 females (62.5%) in RAC group, which is in agreement with the findings of Klein *et al.*¹² who also reported 69.2% female patients in their study population, reflecting the well-known higher susceptibility of females to gallstone disease due to oestrogenic influence on bile composition.

Operative time was found to be significantly longer in RAC group (81.81 ± 8.93 min) as compared to LC group (57.13 ± 7.33 min), with $p < 0.001$. This finding is supported by Singh *et al.*¹³ who demonstrated significantly shorter operative duration in laparoscopic group (mean difference -10.23 , $p = 0.0008$), and similarly Singhal *et al.*¹⁴ also reported significantly higher operative duration in robotic group ($p < 0.05$). The prolonged operative time in robotic approach is largely attributable to the additional setup and docking time required for the robotic system, which is particularly relevant in centres where robotic surgery experience is still in developing stage. In contrast, Gantschnigg *et al.*¹⁵ reported comparable operative times between both groups (RC 60.2 min vs LC 62.0 min, $p = 0.58$), and Ghanem *et al.*¹⁶ also found similar operative durations (64.8 vs 65.0 min, $p = 0.945$), which suggest that with increasing surgical experience and better team coordination, this time difference may diminish considerably.

Intraoperative blood loss was comparable between the two groups (40.88 ± 17.33 ml in LC vs 43.10 ± 15.32 ml in RAC, $p = 0.506$), which is consistent with the broad conclusion of Chabot *et al.*¹⁷ who reported comparable blood loss between robotic and laparoscopic approaches across multiple procedures in their umbrella review. Both techniques offer magnified visualisation of the operative field that allow precise dissection and adequate haemostatic control, which likely explains why blood loss remain similar regardless of the surgical platform used.

Wound complications was recorded in 5 patients (10.4%)

in LC group and 2 patients (4.2%) in RAC group, however this difference did not reach statistical significance ($p = 0.435$). Willuth *et al.*¹⁸ reported significantly lower complication rates in robotic group (25.6% vs 65.0%, $p = 0.006$), and Kawka *et al.*¹⁹ also found higher complication rate in LC group (14.3% vs 3.8%), although not statistically significant, both these findings are in general agreement with the trend observed in present study where robotic approach was associated with numerically fewer wound complications. The more precise and stable instrument movements in robotic surgery may reduce inadvertent tissue trauma at port sites, which could partly explain this trend, though the small sample size in present study may have limited the ability to detect a statistically significant difference.

Some of the limitations of the current study include the following. To begin with, it was carried out at a single center; this implies that its results can be applied to the wider group of surgical patients in limited ways. Additionally, the number of patients enrolled in the study was rather low at 96, thus limiting the capacity of the study

to make conclusions on some of the measures like complications. Finally, there is no information on long-term follow-up outcomes like complication and recurrence rates.

CONCLUSION

This current research has found that both laparoscopic and robot-assisted cholecystectomies are safe and successful techniques used in managing gallstones disease with similar results as far as operative blood loss, pain scores, and complications. Robot-assisted procedures took a significantly longer time compared to laparoscopic technique, which is most probably due to more complicated preparation process of robot-assisted surgery rather than to disadvantages of this surgical procedure itself.

Disclaimer: None

Acknowledgment: Author want to thank medical staff of department. They keep records very carefully and manage patient data in proper way, this help a lot in this study work.

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