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Original Article,

Robot assisted Laparoscopic Cholecystectomy- A Comparative study

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Abstract

Background- Robotic surgery has recently grown in acceptance and usefulness in general surgery, and it may offer superior results to laparoscopic surgery in some gastrointestinal operations.
Objectives- To assess if the use of robot assistance during laparoscopic cholecystectomy is warranted when compared to traditional laparoscopic cholecystectomy.
Methods- It was a retrospective record based study. All patients undergoing robotic or laparoscopic cholecystectomy between 2019 and 2022 at a single academic medical center were captured using institutional data. A total of 110 robotic surgeries were done and 1200 Laparoscopic cholecystectomies was done during the study period. The bulk of cases were primarily handled by two acute care general surgeons, who also conducted robotic and laparoscopic cholecystectomies. The institutional Clinical Data Repository provided the financial information. The study was approved by Institutional Ethics Committee. Age, sex, race, body mass index (BMI), and comorbid conditions of the patient were examined prior to surgery. SPSS was used for analysis.
Results- A total of 1310 patients were identified who underwent robotic or laparoscopic cholecystectomy between 2019 and 2022 among them Robotic-assisted approach was used in 9.1% (n = 110) of cases. There were no demographic differences in age, sex, race, and body mass index (BMI). Type II diabetes mellitus, hypertension, and CHF disease were statistically significantly different between groups. Mean age (Robotic: 41 [29-56] vs. Laparoscopic: 43 [30-54] years, p = 0.11) and BMI (Robotic: 28.4 [26.6-32.4] vs. Laparoscopic: 29.2 [27.5-33.4]) were similar between groups. both operative duration was greater and hospital cost were greater in robotic-assisted cholecystectomy and it was statistically significant ($p<0.05$), but hospital duration of stay and 90-day related readmission rates were less in robotic-assisted cholecystectomy which was significant; 30-day readmission rates were similar between both groups.
Conclusion- When compared to laparoscopic cholecystectomy, robotic cholecystectomy has longer operating times and higher hospital costs, but it is also related with shorter hospital stays and a lower readmission rate within 90 days after the index procedure. Before exploring robotic cholecystectomy, hospitals and surgeons must weigh the enhanced clinical outcomes against the time and money necessary.

Keywords: Cholecystectomy, Robotics; laparoscopy, cost,readmission.

Introduction:-

Laparoscopic cholecystectomy is one of the most frequently performed procedures. 1 Laparoscopic cholecystectomy has been regarded as the gold standard of surgical treatment for gallstone disease since the 1990s. 2,3 Robotic surgery has recently grown in acceptance and usefulness in general surgery, and it may offer superior results

to laparoscopic surgery in some gastrointestinal operations. 4 Although robotic cholecystectomy has been shown to be a safe and effective operation, there isn't much clinical evidence to suggest that it should be preferred to laparoscopic cholecystectomy. 5

The capacity for intraoperative fluorescence imaging of the biliary system, increased tool articulation, higher precision, and a three-dimensional perspective are some of the technological benefits that proponents of robotic cholecystectomy mention. Moreover, there may be a lower likelihood of conversion to an open operation following a robotic cholecystectomy. 6 Several studies have shown that robotic cholecystectomy has disadvantages, including longer operating times and higher costs. 7 However prior researches has also shown that the surgical time for a robotic and laparoscopic cholecystectomy is comparable.8 There is currently minimal evidence that individuals receiving robotic cholecystectomy have better clinical results than those undergoing laparoscopic cholecystectomy.

By comparing the results of the two surgical methods, this study sought to assess if the use of robot assistance during laparoscopic cholecystectomy is warranted. When compared to traditional laparoscopic cholecystectomy, we predicted that robotic cholecystectomy would result in better clinical outcomes but also cost more money.

Materials and Methods:-

It was a retrospective record based study. All patients undergoing robotic or laparoscopic cholecystectomy between 2019 and 2022 at a single academic medical center were captured using institutional data. A total of 110 robotic surgeries were done and 1200 Lap chole was done during the study period.

The bulk of cases were primarily handled by two acute care general surgeons, who also conducted robotic and laparoscopic cholecystectomies. The institutional Clinical Data Repository provided the financial information. The study was approved by Institutional Ethics Committee. Age, sex, race, body mass index (BMI), and comorbid conditions of the patient were examined prior to surgery. Also, the operating room duration and surgical technique, 30 and 90-day postoperative results, and inflation-adjusted hospital costs were examined. Patients undergoing laparoscopic and robotic-assisted cholecystectomy were compared. Based on personal choice and the patient's preoperative features, the operating surgeon decided on the surgical strategy.

Operative time, length of stay, readmission rates after 30 and 90 days, and hospital costs were the study's main outcomes. Patients were propensity score matched 1:10 based on pertinent comorbidities and demographics for comparison in order to account for variations in baseline comorbidities. Together with intraoperative variables and postoperative results, we compare preoperative parameters between the groups.

Statistical Analysis:-

The statistical analysis was performed using SPSS for windows version 22.0 software (Mac, and Linux). The findings were present in number and percentage analyzed by frequency, percent, and Chi‑squared test. Chi‑squared test was used to find the association among variables. The critical value of *P* indicating the probability of significant difference was taken as <0.05 for comparison.

Results:-

Table 1- Demographic details and Morbidity of study participants

Variables	Robot (110)	Lap Chole (1200)	p-value
Age	41 (29-56)	43 (30-54)	0.11
Gender Males	55	720	0.21
Females	55	480	
BMI	28.4 (26.6-32.2)	29.2 (27.4-33.4)	0.11
Smoking	54	411	0.01*
Type 2 DM	32	328	0.01*
Hypertension	42	399	0.01*
COPD	11	211	0.11
CHF	27	277	0.01*

As per table 1 a total of 1310 patients were identified who underwent robotic or laparoscopic cholecystectomy between 2019 and 2022 among them Robotic-assisted approach was used in 9.1% (n = 110) of cases. There were no demographic differences in age, sex, race, and body mass index (BMI). Type II diabetes mellitus, hypertension, and CHF disease were statistically significantly different between groups, with all three comorbidities being more common in the laparoscopic group all groups are well-matched with no differences in prevalence of preoperative comorbidities, including type II diabetes mellitus, hypertension, chronic obstructive pulmonary disease, obstructive, chronic heart failure, and smoking status. Mean age (Robotic: 41 [29-56] vs. Laparoscopic: 43 [30-54] years, p = 0.11) and BMI (Robotic: 28.4 [26.6-32.4] vs. Laparoscopic: 29.2 [27.5-33.4]) were similar between groups. The most common comorbidities in the entire cohort were hypertension, type II diabetes mellitus, and tobacco use.

Table 2- Operative outcomes between groups

Variables	Robot (110)	Lap Chole (1200)	p-value
Operative duration (minutes)	175 (150-250)	160 (140-220)	0.01*
Hospital stay (days)	4.1 days	5.4 days	0.01*
Hospital Cost	10000$	5000$	0.01*
30 day readmission	2.1	2.1	0.11
90 day readmission	4.7%	4.9%	0.01*

As per table 2 both operative duration was greater and hospital cost were greater in robotic-assisted cholecystectomy and it was statistically significant ($p<0.05$), but hospital duration of stay and 90-day related readmission rates were less in robotic-assisted cholecystectomy which was significant; 30-day readmission rates were similar between both groups.

Table 3- Post-Operative complications

Variables	Robot (110)	Lap Chole (1200)	p-value
Fever	11	126	0.21
Wound infection	07	27	0.11
Abdominal pain	57	490	0.11
Nausea and Vomiting	42	300	0.22
Wound hematoma	00	02	0.33

As per table 3 post operative complications are not significant in both methods, however abdominal pain was found to be most common complication followed by nausea and vomiting.

Discussion:-

Colorectal surgery is one GI procedure that frequently uses robotic assistance. 9,10 In minimal access surgery, the robot has reportedly improved visualization, dexterity, and instrumentation. 9,10 While many institutions have used robotic surgery as a marketing strategy to boost their local market share, clinical evidence has not been used to support its usage in many procedures. The robot has since been used by surgeons to perform cholecystectomy, with results equivalent to those of the more common laparoscopic method, albeit there is little evidence to imply improved clinical outcomes. 6–8.

Like with any new technology, using the robot assistant effectively involves a substantial learning curve. 10,11 Gaining proficiency with the robot also requires a time and financial investment. Therefore, it is crucial to ascertain whether adopting the technology has any clinical advantages.

The current study discovered that robotic-assisted cholecystectomy takes longer and is related with higher hospital costs, but it also has some better clinical results when compared to laparoscopic procedures. The overall hospital cost was also found to be significantly higher compared to laparoscopic cholecystectomy with no change in complication rate in a prospective 1:1 case-matched analysis of 50 consecutive patients receiving robotic cholecystectomy. 8 This observation was confirmed in a single-center, retrospective review found that the robotic approach was associated with longer operating

times and higher costs, but that it was also associated with a lower rate of conversion to open surgery in 140 patients undergoing robotic cholecystectomy and 97 patients undergoing laparoscopic cholecystectomy. 12

Data on particular postoperative problems or whether readmissions were connected to or unconnected from the index procedure were not obtained for the current investigation. Nevertheless, Ayloo et al. found no difference in the rate of complications between the 147 laparoscopic and 179 robotic cholecystectomy patients in a single-center, retrospective assessment of 326 patients. Interestingly, this study also found no difference in the length of the operation, which was attributed to experienced surgeons and the large number of robotic surgeries that result in faster docking times. 7 Inevitably, the learning curve of robotic surgery adds to a portion of the prolonged operation time in the current study, and all procedures involved residents.

Robotically assisted cholecystectomy resulted in higher hospital costs. Also, the laparoscopic sample showed significantly more variation in operation time and hospital expenses than the robotic cohort did. Pre-operative diagnosis was not recorded in the data; therefore it is likely that more patients who required urgent surgery for acute cholecystitis underwent laparoscopic cholecystectomy rather than a robotic procedure due to staffing and resource limitations for the robot. 11,12 Acute cholecystitis patients are more likely to need a challenging dissection, which, if necessary, probably contributed to the sporadic longer operating times and higher hospital costs seen. A simple laparoscopic cholecystectomy can take substantially less time than a robotic cholecystectomy if the time needed to position and set up the robot is excluded. It would be challenging to find any statistically significant differences in a randomized controlled study, let alone in the retrospective, single-institution data recounted here, given the rarity of postoperative morbidities and mortalities following cholecystectomy. Preoperative diagnosis was not included in these data, despite the fact that patients were matched based on their demographics and comorbidities, leaving a lot of possibility for selection bias. Patients in the laparoscopic cohort stayed longer, which could be explained by a number of circumstances, such as the need to stay overnight, particularly if the procedure was complicated or the patient didn't live close by.

Conclusion:-

While longer operations were displayed, these should go shorter as surgeons, residents, and operating room staff continues to use the robot and become more proficient. Hospital expenses for robotic-assisted cholecystectomy were much higher, however this could be compensated by the higher cost of readmissions observed in the laparoscopic group. This study adds to the growing body of research indicating that robotic-assisted cholecystectomy can be justified on clinical grounds and that the drawbacks of longer operating times and higher costs may lessen over time. Although robotic surgery has a well-established niche in surgical oncology, this work contributes to the growing body of evidence supporting its application in minimally invasive, non-cancer-related procedures.

Conflict of Interest- None declared

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