Current Status of Minimally Invasive Cholecystectomy: Umbrella Review and Our Single Surgeon Experience

Yoon Kyung Lee, MD[1]; Alessandro Martinino, MD[2]; Roberto Secchi, MD[3]; Daniel Tomey, MD[1]; Rodolfo Oviedo, MD, FACS, FASMBS, FICS[1]

[1]Houston Methodist Hospital; [2]Sapienza University of Rome; [3]Universidad Anahuac Queretaro

Background/Introduction

Cholecystectomy can be performed open or using minimally invasive approaches, laparoscopic or robotic-assisted. Robotic surgery is an advanced extension of laparoscopy with sophisticated tools that increase the ergonomic advantage for surgeons including better camera control with 3-D visualization, articulation of instrument, and control of multiple arms[1]. This allows surgeons to perform procedures that may be difficult to conduct with conventional laparoscopy.
Despite these advantages, robotic surgery has been associated with increased cost and longer operating room time[2,3]. Published systematic reviews and meta-analyses reported discordant results regarding the superiority of laparoscopic versus robotic-assisted cholecystectomy.

Purpose/Objectives/Hypothesis

The goal of our study is to explore the difference in patient outcomes between cholecystectomies performed robotically and laparoscopically through an umbrella review of the published literature. We also analyzed our single surgeon experience to compare patient outcomes between robotic and laparoscopic cholecystectomies.

Methods

An umbrella review was performed of published systematic reviews and meta-analyses using PubMed, Cochrane, and EMBASE databases on August 15, 2022. We further report on our single-surgeon experience. A single institution retrospective chart review was performed of patients that underwent a laparoscopic or robotic-assisted cholecystectomy by a single surgeon from November 2020 to June 2022.

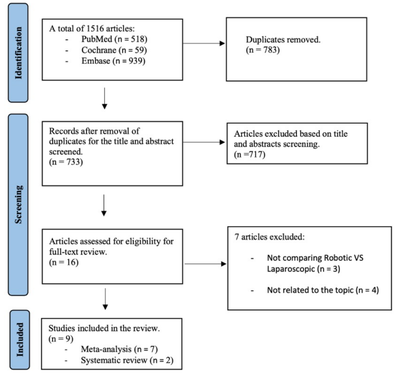


Figure 1. PRISMA Diagram

Result

- 7 meta-analyses and 2 systematic reviews were included in the final analysis. Not all meta-analyses reported all the categories analyzed.
- 5 of the 7 meta-analyses reported less operative time for laparoscopic cholecystectomies with differences ranging from 0.42 to 31.22 minutes.
- 2 of the 7 meta-analyses reported reduced length of stay for robotic-assisted cholecystectomy with differences ranging from 0.73 to 0.26 days.
- 2 of the 7 meta-analyses reported that laparoscopic cholecystectomies were associated with reduced development of incisional hernias with an odds ratio of 4.23 or average relative risk of 3.33.
- No differences on intraoperative complication rates, open conversion rates, estimated blood loss, postoperative complication rates, readmission rates, and postoperative pain scores.
- From our institutional data, a total of 103 patients who underwent a minimally invasive cholecystectomy were identified.
- Patients were older in the robotic-assisted group than laparoscopic (44.78 vs 57.02, p<0.001).
- There was no statistically significant difference in operative time (120.67 min vs 121.3 min), need for postoperative ERCP (6.56% vs 11.90%), readmissions, 30-day mortality, and 30-day morbidity between laparoscopic and robotic-assisted.

Table 1. Studies included

TITLE	YEAR	JOURNAL	AUTHORS	ARTICLE TYPE	RCT/ NRCT/ MIXED
Robotic cholecystectomy versus conventional laparoscopic cholecystectomy: A meta-analysis.	2017	Surgery	Huang, Y. et al	Meta-analysis	Mixed
Efficacy of the Da Vinci surgical system in abdominal surgery compared with that of laparoscopy: a systematic review and meta-analysis.	2010	Annals of surgery	Maeso, S. et al	Meta-analysis	Mixed
Laparoscopic versus robotic cholecystectomy: A systematic review and meta-analysis of randomized controlled trials	2019	Br. J. Surg.	Imsirovic, A. et al	Meta-analysis	RCT
Robotic-assisted versus laparoscopic cholecystectomy for benign gallbladder diseases: a systematic review and meta-analysis	2018	Surgical Endoscopy	Han, C. et al	Meta-analysis	Mixed
Robotic Versus Laparoscopic Cholecystectomy: A Meta Analysis	2022	Surg. Endosc.	Aleuy, L. et al	Meta-analysis	Mixed
Single-incision robotic cholecystectomy versus single-incision laparoscopic cholecystectomy: A systematic review and meta-analysis.	2018	Medicine	Sun, N. et al	Meta-analysis	Mixed
Single-site robotic cholecystectomy versus multi-port laparoscopic cholecystectomy: A systematic review and meta-analysis	2018	Am. J. Surg.	Sun, N. et al	Meta-analysis	Mixed
Intraoperative and postoperative outcomes of robot-assisted cholecystectomy: a systematic review.	2021	Systematic reviews	Shenoy, R. et al	Systematic review	-
Laparoscopic surgery and robotic surgery for single-incision cholecystectomy: an updated systematic review	2021	Updates Surg	Wang, W. et al	Systematic review	-

Table 2. Institutional Data

	LAPAROSCOPIC (N=61)	ROBOTIC-ASSISTED (N=42)	P-VALUE
Age, mean (±SD)	44.78 (19-87)	57.02 (27-83)	<0.001
Sex, n (%)			0.909
Female	37 (60.66%)	25 (59.52%)	
Male	24 (39.34%)	17 (40.48%)	
BMI, mean (±SD)	32.37 (20.36-60.33)	29.37 (19.66-49.26)	0.040
ASA, n (%)			0.089
I	3 (4.92%)	1 (2.38%)	
II	37 (60.65%)	19 (45.24%)	
III	18 (29.51%)	19 (45.24%)	
IV	3 (4.92%)	3 (7.14%)	
Type of Cholecystectomy			<0.001
Emergent	48 (78.68%)	13 (30.95%)	
Planned	13 (21.32%)	29 (69.04%)	
Conversion to open	0 (0%)	0 (0%)	
Operative time (min)	120.67 (54-330)	121.3 (50-289)	0.946
Estimated blood loss (ml)	34.34 (0-200)	22.38 (0-100)	0.026
ICU admission	1 (1.64%)	1 (2.38%)	0.791
Length of stay (hours)	59.40 (2-1231)	17.78 (2-77)	0.095
Bile leak	0 (0%)	0 (0%)	
Abscess	0 (0%)	0 (0%)	
Surgical site infection	0 (0%)	0 (0%)	
Post-operative SBO	0 (0%)	0 (0%)	
Post-operative ED visit	12 (19.67%)	3 (7.14%)	0.165
Readmission (30 day)	6 (4.92%)	4 (9.52%)	0.959
Reoperation (30 day)	5 (8.20%)	1 (2.38%)	0.219
Post-operative need for ERCP	4 (6.56%)	5 (11.90%)	0.35
Blood transfusion within 30 days	0 (0%)	0 (0%)	
30 Day Morbidity	0 (0%)	1 (2.38%)	0.23
30 Day Mortality	1 (1.64%)	0 (0%)	0.409

*BMI: Body mass index
*ASA: American Society of Anesthesiologists Classification
*ICU: Intensive care unit
*SBO: Small bowel obstruction
*ED: Emergency department
*ERCP: Endoscopic retrograde cholangiopancreatography

Discussion

Minimally invasive surgery, whether it is robotic-assisted or not, has become an essential part of modern medicine. Adoption of new technology such as robotic surgery is often associated with a learning curve across the system from the technique itself to billing and reimbursement. Therefore, we must pay close attention to ensure benefits in patient outcomes. As the use of robotic surgery becomes more prevalent, access to robotic surgery will increase, cost will decrease, and hopefully improve patient outcome.

Conclusion

Robotic-assisted cholecystectomy is non-inferior to laparoscopic in many patient outcomes statistically and clinically. Laparoscopic cholecystectomies may be associated with a lower risk of incisional hernia development.

Disclosures

Dr. Rodolfo Oviedo is a consultant and speaker for WL Gore and TelaBio. Dr. Oviedo also serves as proctor for Intuitive Surgical. Dr. Yoon Kyung Lee received research support from Burroughs Wellcome Fund Physician Scientist Institutional Award to the Texas A&M University Academy of Physician Scientists.

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