Comparative Analysis of Operative Outcomes of Laparoscopic and Robotic Cholecystectomies: A 5-Year Single Center Study

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BACKGROUND

Despite the SAGES Safe Cholecystectomy Program enhancing patient safety in laparoscopic cholecystectomies, bile duct injuries (BDIs) remain a non-zero event. The clinical benefit of robotically assisted cholecystectomies has been questioned. In the context of a robust robotic resident training program, we sought to compare operative outcomes between open (OC), laparoscopic (LC) and robotic (RC) cholecystectomies. We hypothesized similar incidences of bile duct injuries, salvage procedures, and conversion to open surgery.

RESEARCH QUESTION

- Does incidence of Bile duct injury (BDI) vary with surgical modality?
- How does the surgical modality impact other postoperative outcomes?

METHODS

A 5-year retrospective review at a university-affiliated academic hospital with 2,345 cholecystectomies from January 2018 to 2023 was conducted. Data included patient demographics, diagnosis, comorbidities, surgical modality, and complications. Strasberg class A-E BDIs, need for salvage procedures, and conversion to open were compared between the groups.

A. Incidence of Bile Duct Injuries:

Variables	No Bile Duct injury (n=2,316)	Bile Duct injury present (n=29)	Univariate		Multivariable	
			OR (95% CI)[1]	p-value	OR (95% CI)[2]	p-value
Surgical Approach Robotic Laparoscopic Open	 779 (33.6) 1,514 (65.4) 23 (0.99)	 5 (17.2) 21 (72.4) 3 (10.3)	 REF 2.16 (0.81, 5.75) 20.3 (4.57, 90.2)	 0.12 <0.001	 REF 1.53 (0.54, 4.31) 9.72 (2.01, 46.9)	 0.42 0.005
Age, years (mean, SD)	44.9 (17.5)	58.8 (15.4)	1.04 (1.02, 1.07)	<0.001	1.04 (1.01, 1.06)	0.001
Gender (female, %)	1,653 (71.4)	14 (48.3)	0.37 (0.18, 0.78)	0.009	0.61 (0.28, 1.31)	0.21
BMI, kg/m^2 (mean, SD)	31.4 (1.3)	29.4 (9.13)	0.96 (0.91, 1.02)	0.22		
Hx of Abdominal Surgery (yes, %)	703 (30.4)	11 (37.9)	1.41 (0.65, 3.06)	0.38		
Diabetes (yes, %)	379 (16.4)	11 (37.9)	3.12 (1.46, 6.67)	0.003	1.75 (0.78, 3.90)	0.17
Hypertension (yes, %)	631 (27.3)	10 (34.5)	1.41 (0.65, 3.04)	0.38		
Obesity (yes, %)	210 (9.07)	1 (3.45)	0.36 (0.048, 2.65)	0.31		
Smoker (yes, %)	16 (0.69)	1 (3.45)	5.13 (0.66, 40.1)	0.12		
Length of Surgery, hours (mean, SD)	1.70 (9.01)	2.77 (1.21)	1.00 (0.98, 1.02)	0.59		
ICG (n, %)	162 (6.99)	6 (20.7)	3.47 (1.39, 8.63)	0.008	2.31 (0.98, 5.97)	0.084
Surgery Type (Elective,	900 (38.9)	5 (17.2)	0.33 (0.12, 0.86)	0.024	0.39 (0.13, 1.10)	0.075

B. Secondary outcomes:

Variables	OC (n=26) N%	LC (n=1 535) N%	RC (n=784) N%	p-value[1]
Bleeding	3 (11.5)	49 (3.19)	17 (2.17)	0.023
Fluid/biloma	0 (0.0)	3 (0.20)	7 (0.89)	0.067
ERCP after the surgery	2 (7.69)	83 (5.41) [a]	13 (1.66)	<0.001
Bile leak from cystic duct	2 (7.69)	43 (2.80)	25 (3.19)	0.23
Estimated Blood Loss, ml (mean, SD)	276.2 (316.5) [b, c]	34.4 (61.4) [a]	27.1 (61.2)	<0.001
Pain score (mean, SD)	53.3 (30.5)	46.9 (26.3) [a]	55.9 (24.8)	<0.001
Hospital length of stay (mean, SD)	6.34 (4.38) [b, c]	2.48 (3.11) [a]	1.86 (4.22)	<0.001
Conversion to Open Surg	-	23 (1.50) [a]	2 (0.26)	

RESULTS

- There were no differences in the baseline characteristics of the patient population across the groups in terms of sex, BMI and pre-existing medical conditions.
- **The incidence of all types of BDIs in LC and RC cohort was 21% and 3% respectively.**
- **The Incidence of Strasberg E BDI (requiring operative intervention) in RC in the last five years was zero, vs. five in LC.**
- Patients in the OC cohort had a longer hospital length of stay (2.47 (1.19) hrs) than LC (1.43 (0.67) hrs) and RC (2.26(15.4)hrs).

CONCLUSION

- Robotic-assisted cholecystectomies were associated with a lower risk of BDI requiring surgical effectiveness, as compared to open and laparoscopic cholecystectomies.
- As we venture forward, it is imperative that the surgical community continues to evaluate, innovate, and adapt to the evolving landscape of surgical technology, ensuring the highest standards of patient care and safety.