Robotic Surgery for the Gastrointestinal Surgeon

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Conflict of Interest

- None

Current Status

- Applications in urology, gynecological surgery, cardiothoracic surgery, ENT, neurosurgery, and general surgery
- Da Vinci surgical systems have been purchased by hundreds of hospitals in the US and around the world
- General surgeons have been hesitant to incorporate RS into everyday use

Impediments

- Lack of high quality data regarding efficacy/benefit
- Cost
- Lack of access in the OR
- High turnover times/inefficiency
- Need for training (individual/team)

Potential advantages

- Improved ergonomics
- Magnified 3D visualization
- More precise manipulation
- Improved articulation compared to standard laparoscopy
- Improved patient outcomes (complications, pain, LOS, RTW, etc.)
- Patient demand

Experience Prior to 2011

- Porcine and dry lab training followed by two Heller myotomies 2007
- Massive increase in the number of robotic prostatectomies and hysterectomies at OSUMC
- Renewed interest in robotic surgery for pancreatectomies

Robotic Cholecystectomy

- Best described of all general surgical procedures
- Safe
- Limited number of steps
- Utilized by other institutions
- Team building

Getting started with robotics in general surgery with cholecystectomy: the Canadian experience

- Surgeons wanted to complete a series of robotic cholecystectomies prior to performing advanced procedures
- 16-robotic 20-laparoscopic
- No significant complications
- 91 vs 41 min
- 14 vs 11 min turnover
- Time did not improve with experience

Cochrane Review

- Six randomized controlled trials identified with data for 431 patients (212 RALC, 219 HALC)
- Only one trial reported morbidity and mortality (40 patients, no differences)
- All trials at high risk for bias
- No differences in conversion (64/1000 vs 71/1000) or operating times (60 min vs 55 min)
- RALC does not seem to offer any advantage over HALC
- Quality of data poor
- Further trials with a low risk of bias needed

Cost Analysis

- Annals of Surgery 2008
- To compare safety and costs of robotic-assisted and laparoscopic cholecystectomy
- Prospective case-matched controlled methodology

TABLE 1. Patient Characteristics Preoperative [Mean (SD)]

	Robotic-assisted	Laparoscopic
Number	50	50
Mean age(SD) (yrs)	53.2 (±17.3)	51.7 (±15.9)
Inflammation histologically: acute/chronic/both	2/41/7	2/40/8
ASA: 1/2/3	13/31/6	13/31/6
Surgical experience (junior/experienced surgeon)	15/35	15/35
Gender: male/female	12/38	13/37
Mean BMI (m/kg^2, SD)	28.2 (±6.0)	27.7 (±8.4)
Median Charlson Index (range)	0 (0–6)	0 (0–4)
Median CRP preop (range)	3 (0–68)	2.5 (0–97)
Mean Leucocytes preop (SD)	6.5 (±2.0)	7.1 (±2.8)

ASA indicates American Society of Anesthesiologist; BMI, body mass index.

TABLE 2. Intraoperative and Postoperative Outcome Parameters

	Robotic-assisted	Laparoscopic	Adjusted *P**
Mortality	0	0	Not estimable
Minor complications	0	0	Not estimable
Major complications (%)	2	2	0.96†
Conversion rate (%)	0	0	Not estimable
Gallbladder preparation: not opened/opened	38/12	41/9	0.25†
Concrements in bladder: no/yes	3/47	2/48	0.73†
Hospital stay (days): mean (SD)	4.58 (1.9)	4.84 (2.2)	0.40‡
Anesthesia time (min): mean (SD)	168.0 (49.9)	166.9 (35.8)	0.86‡
OP time skin to skin: mean (SD)	54.6 (31.6)	50.2 (29.2)	0.54‡

*Adjusted for age, $(\text{age-mean})^2$, gender, operator, leucocytes pre OP, and Charlson categories.

†Multiple logistic regression model.

‡Multiple linear regression model.

TABLE 3. Costs in US$: Mean (SD)

	Robotic-assisted	Laparoscopic
OR		
Surgery	698.3 (404.6)	641.7 (372.6)
Anesthesiology	1052.5 (328.1)	1045.6 (224.2)
Consumables (constant)	1126.1	495.0
Amortization (constant)	1275.0	38.3
Ward		
Preop lump sum (constant)	850.6	850.6
Additional costs preop	106.0 (74.2)	98.7 (74.5)
X-ray rate (à 118.0 SFR)	60%	54%
ECG rate (à 74.3 SFR)	72%	70%
Postop lump sum (day of operation, constant)	809.1	809.1
Postop lump sum (à 942.97 SFR/d): mean (SD)	2068.0 (1493.7)	2276.3 (1754.2)
Total cost: mean (SD)	7985.4 (1760.9)	6255.3 (1956.4)

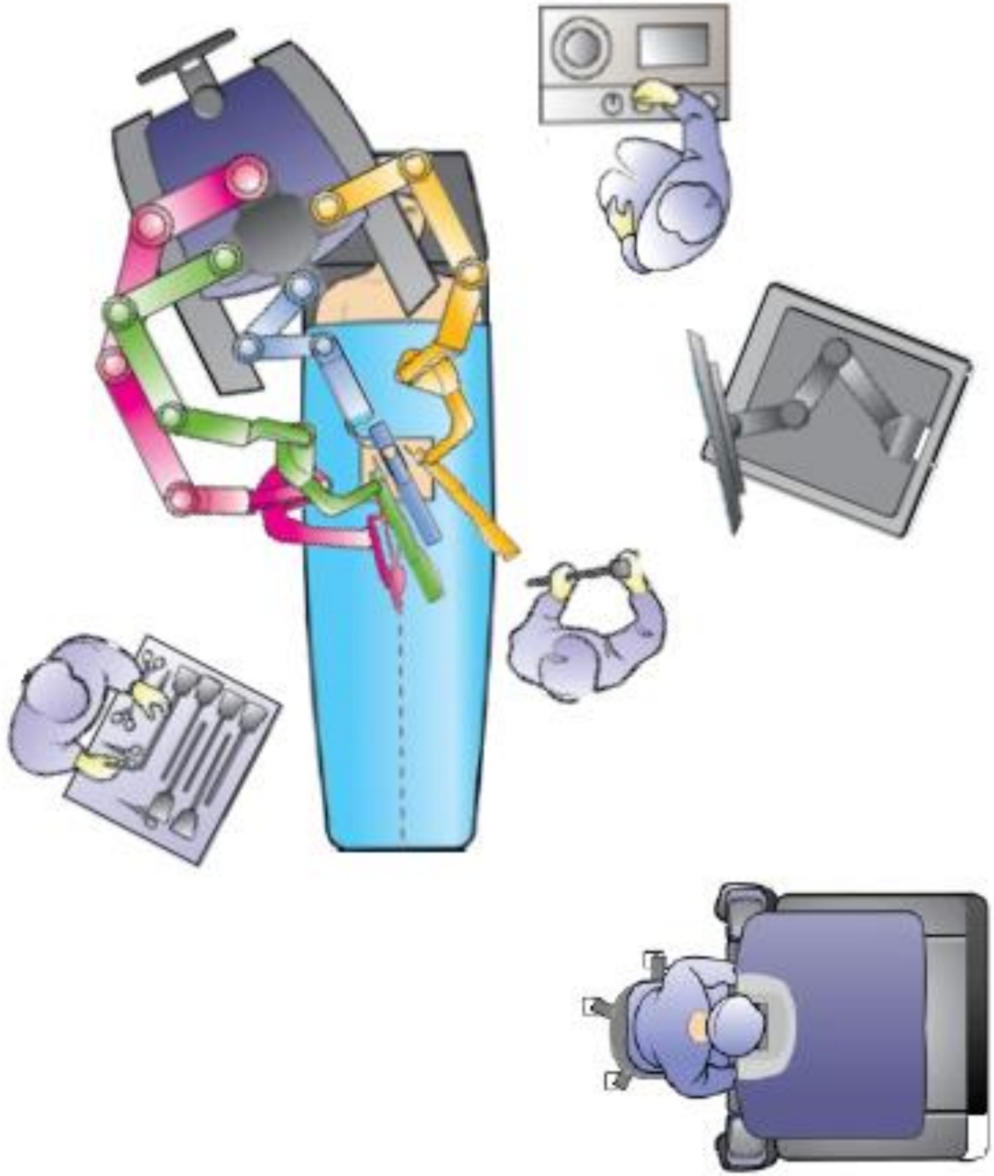
TABLE 4. Cost Difference (US$) Between Robotic-assisted and Laparoscopic Operation Method

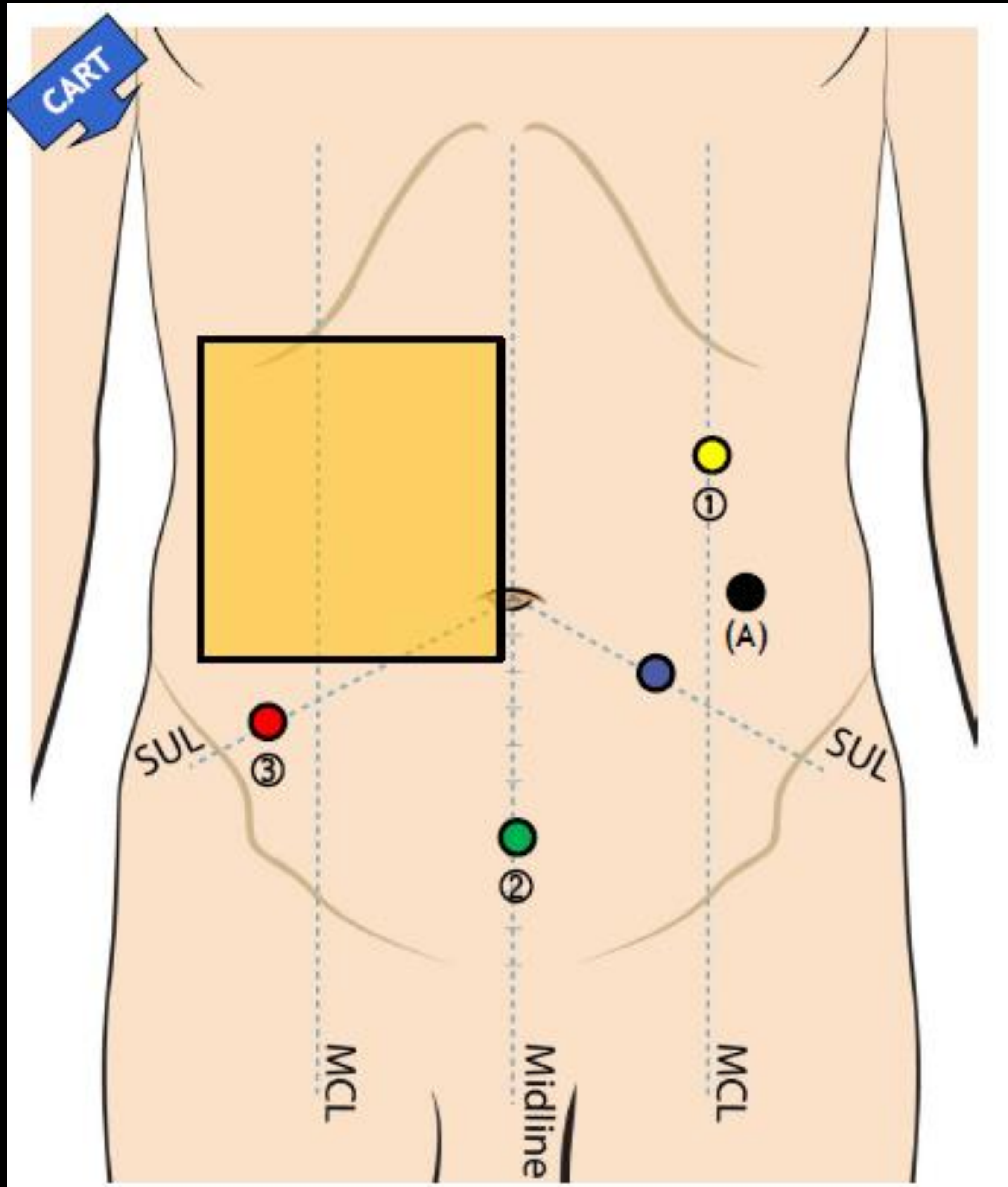
	Mean Cost Difference	95% CI
Unadjusted	1730.1	991.4–2468.7
Adjusted*		
n = 100	1628.2	854.6–2401.8
n = 98	1606.4	1076.7–2136.2

*Adjusted for age, $(\text{age-mean})^2$, gender, operator, leucocytes pre OP, and Charlson categories.

Procedure

- Supine position, arms tucked at side and padded after induction of anesthesia
- Antibiotics
- Bed turned so that it faces robot
- Veres needle (8 mm port on left, two 5 mm ports on right, periumbilical camera port)
- Docking
- Hook cautery dissection with visualization of triangle of Calot
- Extraction thru umbilical port with fascial closure under laparoscopic visualization

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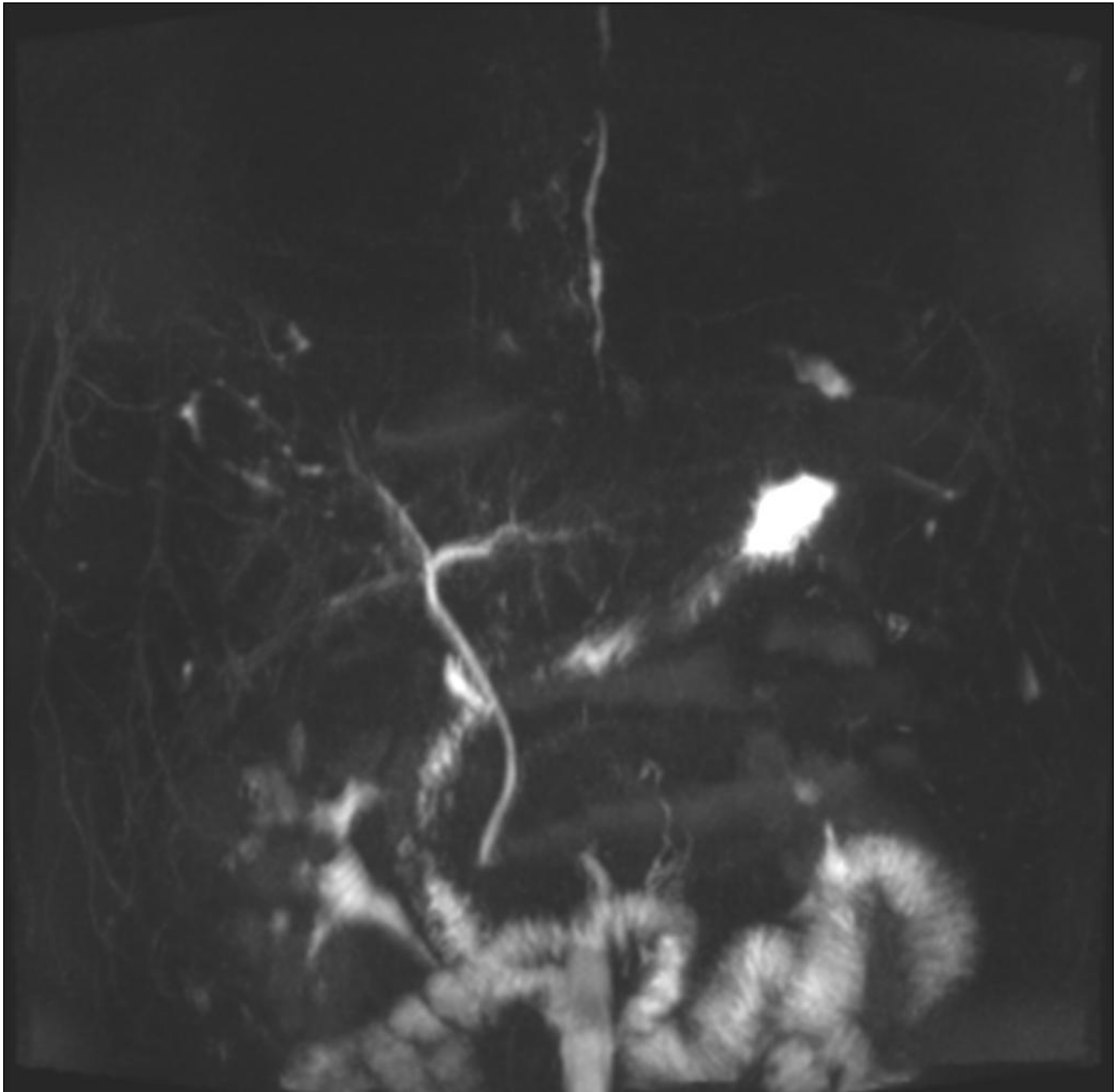

Table 1. Preoperative characteristics, operative outcomes and cost analysis

Preoperative Characteristics*	**LC (N=114)**	**RC (N=142)**	**p value****
Coronary artery disease, N (%)	17 (14.91%)	6 (4.23%)	**0.0038**
Symptomatic cholelithiasis, N (%)	54 (47.37%)	92 (64.79%)	**0.0054**
Acute cholecystitis, N (%)	14 (12.28%)	1 (0.7%)	**<0.0001**
Chronic cholecystitis, N (%)	9 (7.89%)	27 (19.01%)	**0.012**
Intraoperative cholangiography, N (%)	13 (11.4%)	2 (1.41%)	**0.0008**
Conversion to open, N (%)	7 (6.14%)	1 (0.7%)	**0.0238**
Blood loss (mL)	42.01	20.15	**0.012**
Length of surgery (min)	68	80	**0.0072**
Hospital stay (days)	1.35	0.55	**0.00012**
60-day readmission, N (%)	13 (11.4%)	6 (4.23%)	**0.0331**
Bile duct injury, N (%)	0	0	1
Bile leak, N (%)	1 (0.88%)	3 (2.11%)	0.631
Reoperation, N (%)	2 (1.75%)	2 (1.41%)	1
Total direct costs ($)	5142.42	4842.98	0.365

*Expressed as mean or total number (percentage); **Calculated with Student's t-test or Fisher's exact test

Closing Remarks

- Robotic general surgery procedures can be performed safely with training and patience
- The robotic platform may allow some surgeons to be able to perform procedures in a minimally invasive fashion that they would otherwise not be able to perform
- Cholecystectomy can be used to build confidence and experience prior to performing advanced procedures
- Cost is an issue
- Robotic GI surgery is becomingly increasingly performed and patient acceptance is good
- Robotic training should be incorporated into resident skills training programs