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Robotic Paraesophageal Hernia Repair: Why We Do It

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ACHQC Quality Improvement Summit 2023

Disclosures

- None

Who Am I?

- Foregut/MIS Surgeon at Prisma Health – Greenville, SC
- Advanced GI/Foregut Fellowship, USC/Keck
- General Surgery Residency, Univ of Hawaii
- Practice 90% foregut, 10% hernia
  - 80% laparoscopic, 20% robotic
  - Shifting more towards the robot

Outline

- Robot vs Lap Hiatal Hernia Repair
- Cost Effectiveness
- Resident/Fellow Training
- Other Applications

Robotic Surgery Pros

- Improved visualization
- Dexterity of wristed instruments
- Variety of instruments and functionality
- Third arm assist
- Ability to teach

Robotic Foregut Surgery is Good!

Robotic Versus Laparoscopic Approach to Hiatal Hernia Repair: Results After 7 Years of Robotic Experience

Sean C. O'Connor, MD[1], Matthew Mallard, MD[1], Shivani S. Desai, BS[2], Francisco Couto, MD[1], Matthew Gottlieb[3], Alex Ewing, PhD[4], William S. Cobb, MD[2], Alfredo M. Carbonell, DO[2], and Jeremy A. Warren, MD[2]

- Retrospective review single institution 2006-2019
- 6 surgeons performing cases
- Transition to robotics in 2012

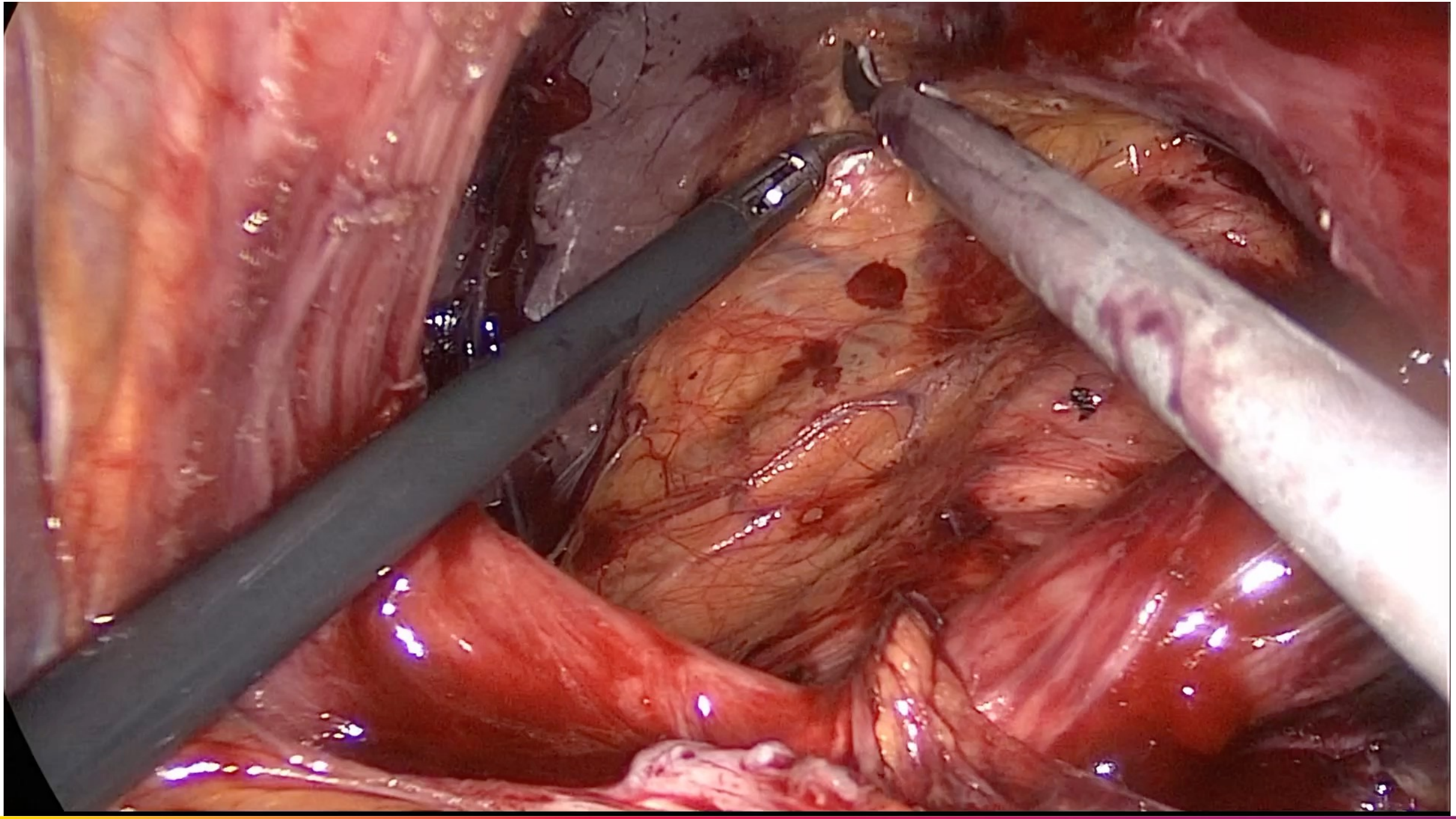
- Op times equivalent
- No difference in peri-op complications or long term outcomes (reflux, dysphagia, pain)
- Longer follow up in lap group
- Robotic recurrence rate less than laparoscopic: 13.3% vs 32.8%

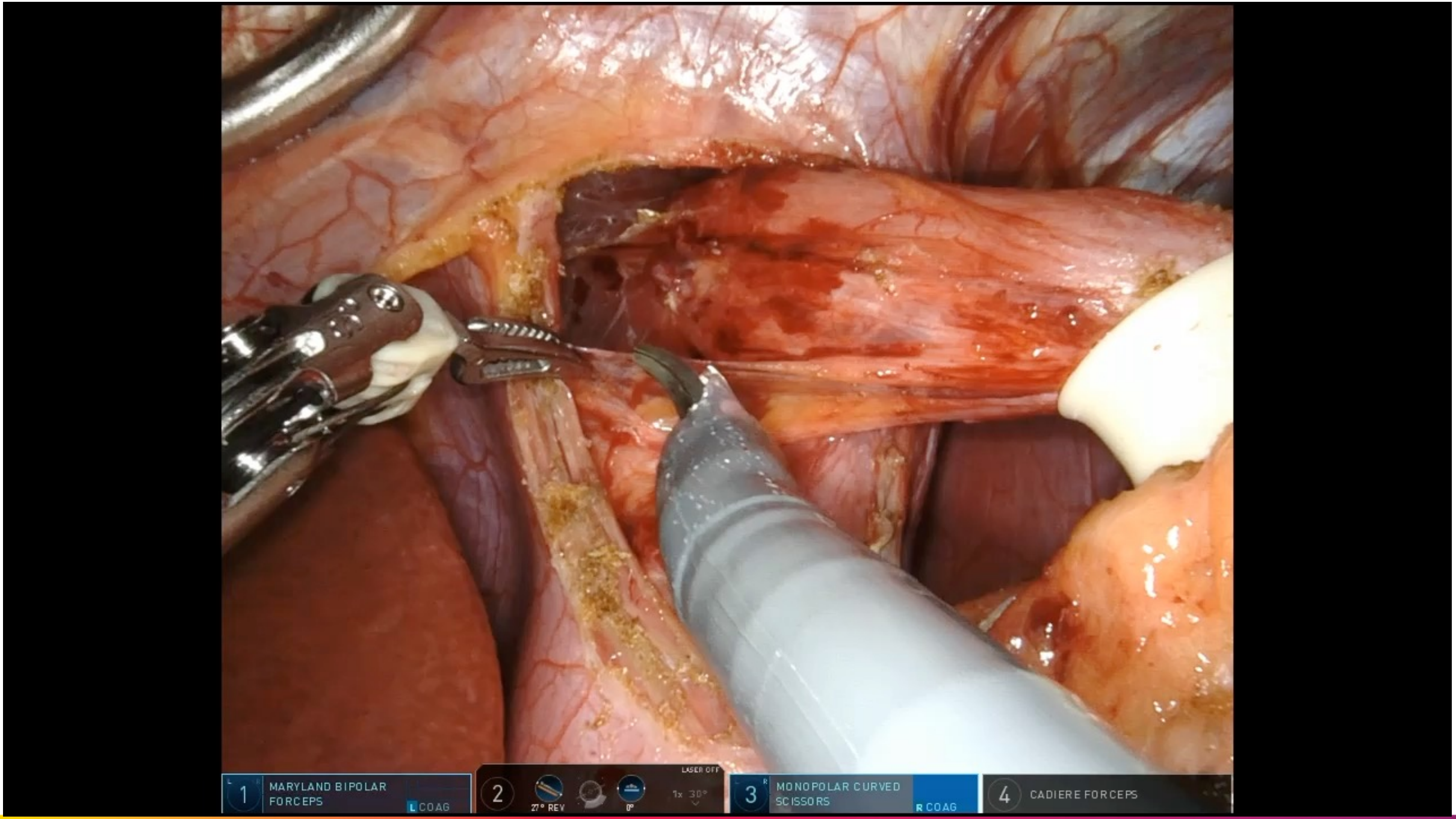
Robot-assisted hiatal hernia repair demonstrates favorable short-term outcomes compared to laparoscopic hiatal hernia repair

Basem G. Soliman[1] · Duc T. Nguyen[3] · Edward Y. Chan[1,2] · Ray K. Chihara[1] · Leonora M. Meisenbach[1] · Edward A. Graviss[3] · Min P. Kim[1,2]

- Retrospective database review
- 151 lap vs 142 robotic HH repairs
- 2012-2017, all on Xi for robot cases
- Robotic group: more revisions, LINX
- Lap group: more Toupets
- Significant findings: Longer OR time, shorter LOS, fewer post-op complications all favoring robotic approach

	Total ($N=293$)	Laparoscopic ($n=151$)	Robot ($n=142$)	*P* value
Operative detail				
Procedure time (min), median (IQR)	169.0 (142.0, 208.0)	158.0 (132.0, 188.0)	186.5 (152.0, 232.0)	<0.001
Unanticipated surgical approach conversion	1 (0.3)	0 (0.0)	1 (0.7)	0.48
Postoperative events occurred	38 (13.0)	29 (19.2)	9 (6.3)	0.001
Initial visit to ICU	9 (3.1)	7 (4.6)	2 (1.4)	0.17
Unexpected return to OR	4 (1.4)	3 (2.0)	1 (0.7)	0.62
Atelectasis requiring bronchoscopy	1 (0.3)	1 (0.7)	0 (0.0)	1.00
Pneumonia	5 (1.7)	4 (2.6)	1 (0.7)	0.37
Respiratory failure	1 (0.3)	1 (0.7)	0 (0.0)	1.00
Initial ventilation support > 48 h	1 (0.3)	1 (0.7)	0 (0.0)	0.33
Other pulmonary event	7 (2.4)	6 (4.0)	1 (0.7)	0.12
DVT requiring treatment	1 (0.3)	1 (0.7)	0 (0.0)	1.00
Any other GI event	2 (0.7)	0 (0.0)	2 (1.4)	0.23
Postoperative transfusion PRBC	5 (1.7)	3 (2.0)	2 (1.4)	1.00
Urinary tract infection	2 (0.7)	2 (1.3)	0 (0.0)	0.50
Urinary retention	12 (4.1)	9 (6.0)	3 (2.1)	0.14
Discharged with Foley catheter	6 (2.0)	4 (2.6)	2 (1.4)	0.45
Surgical site infection	1 (0.3)	1 (0.7)	0 (0.0)	1.00
Other infection requiring IV antibiotics	4 (1.4)	2 (1.3)	2 (1.4)	0.95
Other events requiring OR with general anesthesia	1 (0.3)	0 (0.0)	1 (0.7)	0.48
Unexpected admission to ICU	1 (0.3)	0 (0.0)	1 (0.7)	0.48
Length of stay (days), mean (±SD)	1.5 (±1.6)	1.8 (±1.5)	1.3 (±1.8)	0.003
Readmission within 30 days of discharge	11 (3.8)	6 (4.0)	5 (3.5)	0.84
Mortality	0 (0.0)	0 (0.0)	0 (0.0)	NA

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MARYLAND BIPOLAR FORCEPS
L COAG
2
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LASER OFF
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MONOPOLAR CURVED SCISSORS
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4
CADIERE FORCEPS

Robotic Foregut Surgery Cons

- Operative time
- Learning curve for experienced surgeons and trainees
- Accessibility and cost
- Increased complications?

Robotic Foregut Surgery is Bad!

- NIS database search 2010-2015
- 158,432 lap vs 9,897 robot
- Volume matters

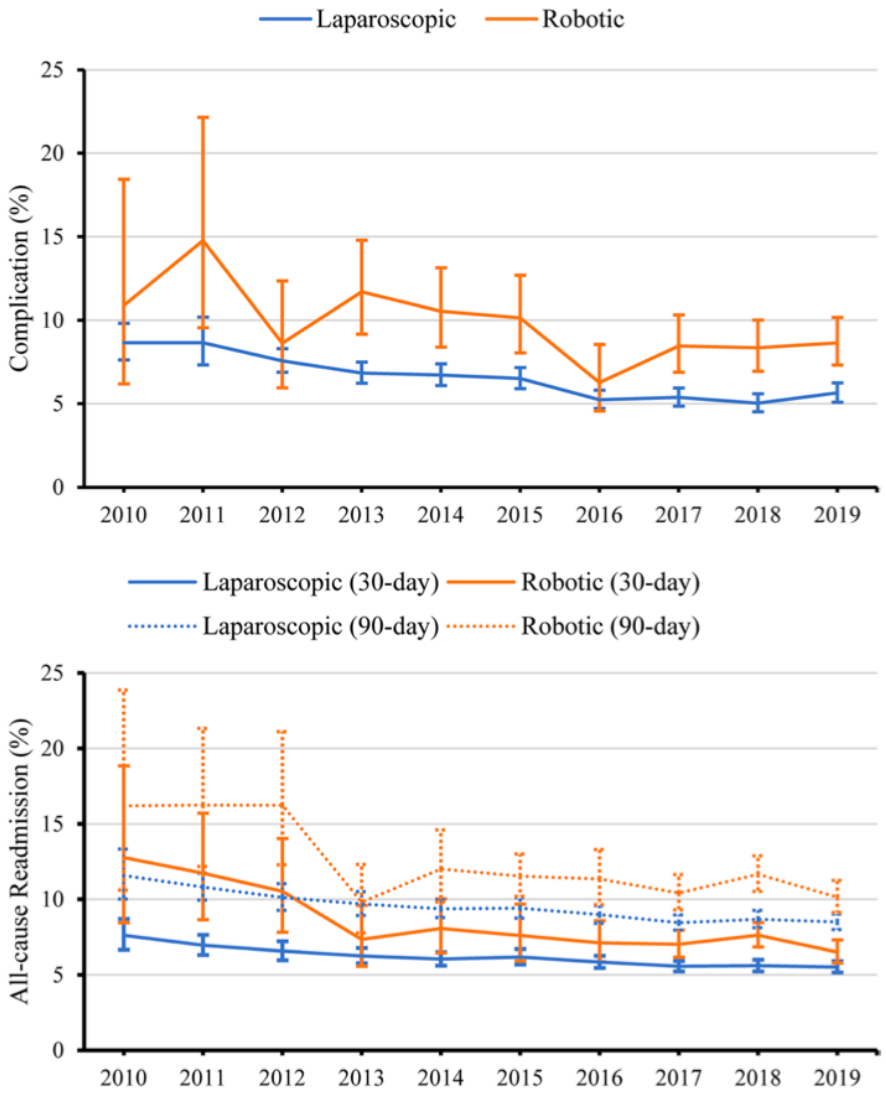
Complications Following Robotic Hiatal Hernia Repair Are Higher Compared to Laparoscopy

Marc A. Ward [1,2,3] · Salman S. Hasan [3] · Christine E. Sanchez [2,4] · Edward P. Whitfield [3] · Gerald O. Ogola [4] · Steven G. Leeds [1,2,3]

Table 3 Unadjusted comparison of complications outcomes between laparoscopic and robotic surgery for hernia repair patients: overall and by surgery volume

	Surgery volume											
	All			Low (<6)			Intermediate (6–20)			High (>20)		
	Laparoscopic (*n*=158,432)	Robotic (*n*=9897)	*p*-value	Laparoscopic (*n*=5122)	Robotic (*n*=370)	*p*-value	Laparoscopic (*n*=12,566)	Robotic (*n*=1449)	*p*-value	Laparoscopic (*n*=140,744)	Robotic (*n*=8079)	*p*-value
VTE	4302 (2.7%)	248 (2.5%)	0.58	201 (3.9%)	5 (1.4%)	0.26	387 (3.1%)	55 (3.8%)	0.52	3715 (2.6%)	189 (2.3%)	0.46
Wound	296 (0.2%)	20 (0.2%)	0.87	10 (0.2%)	0 (0.0%)	-	30 (0.2%)	10 (0.7%)	0.17	256 (0.2%)	10 (0.1%)	0.59
Infection	1725 (1.1%)	150 (1.5%)	0.08	79 (1.6%)	5 (1.4%)	0.89	251 (2.0%)	45 (3.1%)	0.22	1395 (1.0%)	100 (1.2%)	0.33
Esophageal perforation	457 (0.3%)	64 (0.6%)	0.01	54 (1.1%)	15 (4.1%)	0.03	110 (0.9%)	20 (1.4%)	0.39	293 (0.2%)	29 (0.4%)	0.19
Bleeding	3964 (2.5%)	278 (2.8%)	0.39	269 (5.2%)	30 (8.1%)	0.29	553 (4.4%)	55 (3.8%)	0.63	3143 (2.2%)	193 (2.4%)	0.67
Cardiac failure	4529 (2.9%)	297 (3.0%)	0.70	229 (4.5%)	20 (5.4%)	0.71	525 (4.2%)	55 (3.8%)	0.75	3775 (2.7%)	223 (2.8%)	0.85
Respiratory failure	2486 (1.6%)	240 (2.4%)	0.003	234 (4.6%)	5 (1.4%)	0.19	422 (3.4%)	65 (4.5%)	0.31	1830 (1.3%)	170 (2.1%)	0.01
Shock	220 (0.1%)	20 (0.2%)	0.47	19 (0.4%)	0 (0.0%)	-	49 (0.4%)	0 (0.0%)	-	152 (0.1%)	20 (0.2%)	0.11
Any complications	17,843 (11.3%)	1321 (13.3%)	0.005	967 (18.9%)	75 (20.3%)	0.77	2259 (18.0%)	225 (15.5%)	0.30	14,617 (10.4%)	1021 (12.6%)	0.004
Mortality	536 (0.3%)	40 (0.4%)	0.08	45 (0.9%)	10 (2.7%)	0.14	114 (0.9%)	15 (1.0%)	0.83	377 (0.3%)	15 (0.2%)	0.53

NRD database review 2010-2019



	Unadjusted				Adjusted	
	Laparoscopic (n = 459,214)	Robot (n = 58,650)	OR (95% CI)	p	aOR (95% CI)	p
Complication (overall)	6.8	9.3	1.4 (1.3–1.5)	< .001	1.3 (1.2–1.4)	< .001
VTE	0.1	0.1	1.2 (0.6–2.2)	0.590		
Wound	0.2	0.2	1.2 (0.9–1.7)	0.140		
Infection	0.4	0.6	1.5 (1.2–1.9)	< .001		
Esophageal perforation	0.3	0.5	2.0 (1.6–2.4)	< .001		
Bleed	1.9	1.7	0.9 (0.8–1.0)	0.141		
Shock	0.1	0.2	1.4 (1.0–1.9)	0.072		
Cardiac	1.0	1.2	1.1 (1.0–1.3)	0.049		
Renal	1.7	2.4	1.4 (1.3–1.6)	< .001		
Respiratory	3.4	5.5	1.6 (1.5–1.8)	< .001		
All-cause readmission						
30-day	6.1	7.4	1.2 (1.1–1.3)	< .001	1.2 (1.2–1.3)	< .001
90-day	9.4	11.2	1.2 (1.1–1.3)	< .001	1.2 (1.2–1.3)	< .001

Robotic Hiatal Hernia Repair Associated with Higher Morbidity and Readmission Rates Compared to Laparoscopic Repair: 10-Year Analysis from the National Readmissions Database (NRD)

Julie A. Klock[1] · Ryan W. Walters[2] · Kalyana C. Nandipati[3]

What About the Cost??

- Data review 2020-2021
- LOS, complication rates equivalent
- Robotic cost and charges higher but profits equivalent

Similar hospital profits with robotic-assisted paraesophageal hiatal hernia repair, despite higher or supply costs

Andrew Lekarczyk[1] · Hana Sinha[1] · Danielle Dvir[1] · Joshua Goyert[1] · Austin Airhart[1] · Rishindra M. Reddy[1,2]

Table 3 Costs

	Laparoscopic ($n=42$)	Robotic ($n=31$)	p value
Charge ($)	56,276 ± 17,622	63,997 ± 21,344	0.0461*
Payment ($)	22,898 (11,358)	22,670 (10,822)	0.466
Total Hospital Cost ($)	15,132 (5188)	15,043 (6,615)	0.476
Labor Cost ($)	6995 (3548)	6311 (4,030)	0.231
Supply Cost ($)	2021 (566)	2652 (817)	0.0003*
Fixed Direct Cost ($)	842.5 (1077)	981 (583)	0.244
Indirect Cost ($)	5273 (1358)	5098 (1612)	0.316
Net Income ($)	7938 (9863)	7462 (9764)	0.419

*Indicates a significant difference (p value < 0.05)

Maybe It Doesn't Matter?

Parameter	Composite	Study Group		p Value
		Conventional Laparoscopic	Robotic Assisted Laparoscopic	
Number of observations	58 (100%)	42 (72.4%)	16 (27.6%)	---
Patients with 1 or more complications	20 (34.5%)	15 (35.7%)	5 (31.3%)	0.749
Pneumothorax	6 (10.3%)	5 (11.9%)	1 (6.3%)	1.000
Infection	2 (3.4%)	2 (4.8%)	0 (0.0%)	1.000
Bleeding	2 (3.4%)	1 (2.4%)	1 (6.3%)	0.479
Perforation	1 (1.7%)	1 (2.4%)	0 (0.0%)	1.000
Dysphagia	0 (0.0%)	0 (0.0%)	0 (0.0%)	---
DVT/PE	0 (0.0%)	0 (0.0%)	0 (0.0%)	---
Myocardial infarction	0 (0.0%)	0 (0.0%)	0 (0.0%)	---
Other complications	16 (27.6%)	11 (26.2%)	5 (31.3%)	0.700
ICU admission	10 (17.2%)	5 (11.9%)	5 (31.3%)	0.119
ICU days	3.5 (1.75-5.5)	5.0 (2.5-8.5)	2.0 (1-2)	0.095
Mechanical ventilation	4 (6.9%)	1 (2.4%)	3 (18.8%)	0.060
Ventilator days	2.5 (1.0-4.0)	4.0	1.0	0.423
Hospital LOS	3 (2-4)	2.5 (1-4)	3 (2-5.75)	0.301
30-day readmission	7 (12.1%)	6 (14.3%)	1 (6.3%)	0.660
Mortality	0 (0.0%)	0 (0.0%)	0 (0.0%)	---
Discharged to hospice	1.7% (1)	1 (2.4%)	0 (0.0%)	1.000

*Presented as number (%) or median (IQR).
DVT = deep vein thrombosis, PE = pulmonary embolus, ICU = intensive care unit, LOS = length of stay.

Comparing Outcomes of Robotic-Assisted versus Conventional Laparoscopic Hiatal Hernia Repair

Marcus Tjeerdsma [1], Karson R Quinn [1], Stephen D Helmer [1], Kyle B Vincent [1]

- No significant difference in complications
- Morbidity and mortality rates in line with literature

Robotic Foregut Education

- More tools for performance analysis and improvement
- Increased resident satisfaction with training
- Learning curve: 40 cases for proficiency, 85 for mastery

The use of advanced robotic simulation labs to advance and assess senior resident robotic skills and operating room leadership competency: a pilot study

Britta J. Han[1] · William Sherrill III[2] · Michael M. Awad[1]

Cumulative summation analysis of learning curve for robotic-assisted hiatal hernia repairs

Emily L. Lin[1] · Agustin Sibona[1] · Jiahao Peng[2] · Pramil N. Singh[2] · Esther Wu[1] · Marcos J. Michelotti[1]

Resident/Fellow Training

- Robotics is a tool to train residents/fellows in advanced MIS
- This is a safe teaching case in a not so safe area
- Basic, intermediate, and advanced skills showcased
- Dual console for effective transition from teaching to autonomy
- Video storage, review, breakdown of case elements

Esophageal Potpourri

- Myotomies
- Diverticulectomy
- Leiomyoma and other tumor resections
- Diaphragmatic hernia
- Thoracic surgery combo cases

“A good tool improves the way you work. A great tool improves the way you think.” - Jeff Duntemann

- The robot is a surgical tool and should be used as such
- There are benefits to using this tool for foregut surgery
- We don’t need to ONLY use one tool
- The robot WILL drive evolving technology and education

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THANK YOU FOR YOUR TIME