

Learning Curve in Robotic Colorectal Surgery

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Introduction

- Steep uptake of robotics in colorectal surgery
- The pace that surgeons gain competency in robotics is important to understand

Aim & Hypotheses

- Construct robotic learning curve of an experienced laparoscopic colorectal surgeon performing a variety of colorectal procedures
- Intra-operative and post-operative events compared among learning curve phases

Hypothesis: Learning curve will show three distinct phases corresponding to surgeon’s attainment of surgical proficiency with reduction in operative time and adverse outcomes.

Methods

- Retrospective review of a prospective database of 111 subsequent colorectal procedures performed by a single colorectal surgeon
- Preoperative, Operative, and Postoperative variables recorded
- Learning curve was generated from the CUSUM graph of surgical console time
- Continuous and categorical variables were compared between the three phases

Results

- Three Phases were Identified:
 - Learning phase (case 1-13)
 - Competency phase (case 14-83)
 - Mastery phase (case 84-111)
- Variables Significantly Different Across Phases:
 - Surgical Console Time
 - Length of Stay

Results

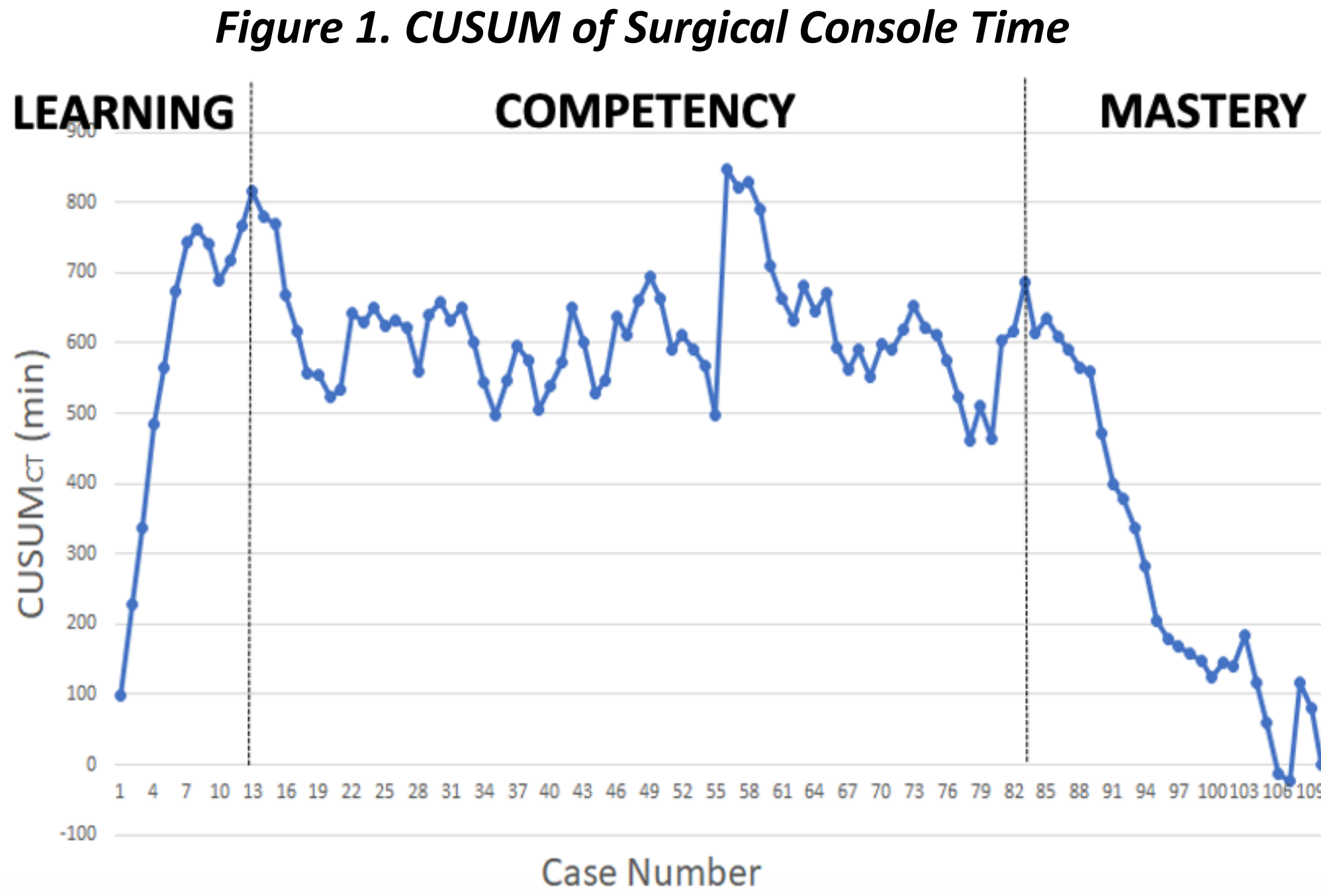
Table 1: Preoperative Variables & Types of Surgeries

	Total n=111	Learning (1-13) n=13	Competence (14-83) n=70	Mastery (84 –111) n=28	P-value
Mean Age	62.4	71.1	62.7	57.5	0.034
Male (%)	56 (50.4%)	6 (46.2%)	34 (48.5%)	16 (57.1%)	0.71
Mean BMI (kg/m²)	26.9	30.3	26.4	26.6	0.11
ASA Score					
1	4	0 (0%)	3 (75%)	1 (25%)	
2	59	3 (5.1%)	38 (64.4%)	18 (30.5%)	
3	47	10 (21.3%)	28 (59.6%)	9 (19.1%)	
4	1	0 (0%)	1 (100%)	0 (0%)	
Mean ASA Score	2.41	2.77	2.39	2.29	0.039
Types of Procedures					
Right Colectomy	25 (22.52%)	4 (30.77%)	15 (21.43%)	6 (21.43%)	
Left Colectomy	46 (41.44%)	5 (38.46%)	31 (44.29%)	10 (35.71%)	
Transverse Colectomy	2 (1.80%)	0	1 (1.43%)	1 (3.57%)	
Low Anterior Resection	23 (20.72%)	3 (23.08%)	14 (20%)	6 (21.43%)	
Abdominoperineal Resection	5 (4.50%)	1 (7.69%)	0	4 (14.29%)	0.28
Total Abdominal Colectomy	4 (3.60%)	0	3 (4.29%)	1 (3.57%)	
Rectopexy	6 (5.41%)	0	6 (8.57%)	0	

Table 2: Operative Variables & Postoperative Outcomes

	Total n=111	Learning (1-13) n=13	Competence (14-83) n=70	Mastery (84 –111) n=28	P-value
Mean total OP time (min)	231.3	282.7	219.7	236.5	0.051
Mean Console Time (min)	131.0	193.8	127.9	107.5	0.00016
Mean Estimated Blood Loss (mL)	100.3	150	100.1	77.7	0.10
Postoperative Complications (per patient)	Total	0.83	1.00	0.92	0.53
	GI**	0.37	0.61	0.37	0.25
Length of Stay (Days)	Mean	8.4	17.7	7.9	5.4
	Median	4.0	6.0	5.0	3.5
30-day Readmissions	10 (9.01%)	2 (15.38%)	4 (5.71%)	4 (14.29%)	0.28

Results/Discussion



- No significant difference in types of procedures across phases
- Mean ASA score and age was significantly different ($p=0.039$, $p=0.034$)
We believe these demographics do not directly correlate to the difficulty of the procedure

- Significant Operative Variables & Postoperative Outcomes (Table 2):**
 - Decrease in Mean Console Time
 - Decrease in Length of Stay
- As the surgeon progressed through the three phases, he displayed indicators of acquired skill and improved outcome**

Conclusions

- The learning curve was shown to have 3 phases:
 - Learning (1-13), Competency (14-83), Mastery (84-111)**
- With more case experience, the surgeon had a **lower average console time** and **decreased postoperative length of stay**
- This is one of the largest studies examining a wide variety of robotic colorectal procedures. This along with other similar work will in turn help guide stepwise training and credentialing for surgeons.