Establishing the Learning Curve for Single Port Robotic Transanal Minimally Invasive Surgery (SP rTAMIS)

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INTRODUCTION

- A novel single-port robot offers solutions to challenges of transanal surgery.
- Increased complexity has been a barrier to adopting robotic technique.
- We report the number of Single Port Robotic Transanal Minimally Invasive Surgery (SP rTAMIS) procedures required to reach the learning curve using the SP robot.

Docked SP Robot



METHODS

- Analysis of a prospective database of 40 consecutive patients who underwent SP rTAMIS between October 2018 and August 2021.
- Learning curves by pathology and lesion size were calculated using cumulative sum (CUSUM) analysis.
- CUSUM analysis is the running total of the differences between each data point and the mean of all data points.
- Operative time for each case was designated x_i and the mean operative time was designated u (Figure 1).
- CUSUM values were plotted and a best fit polynomial curve was applied.
- The curve is split into three phases: Phase 1 is initial learning, Phase 2 is proficiency, and Phase 3 is mastery.

Figure 1 – **Cumulative Sum Analysis Equation**

$$\mathrm{CUSUM_{OTn}} = \sum_{i=1}^{n} xi - \mu$$

RESULTS

Figure 2 – **CUSUM of Operative Time for Benign Neoplasms**

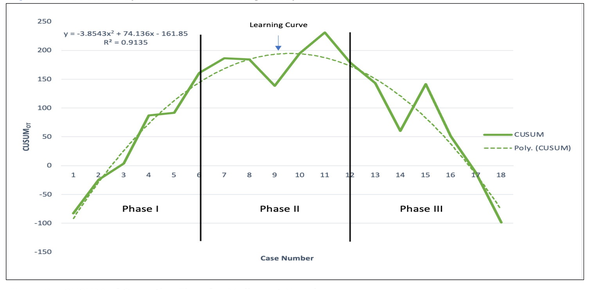


Figure 3 – **CUSUM of Operative Time for Malignant Neoplasms**

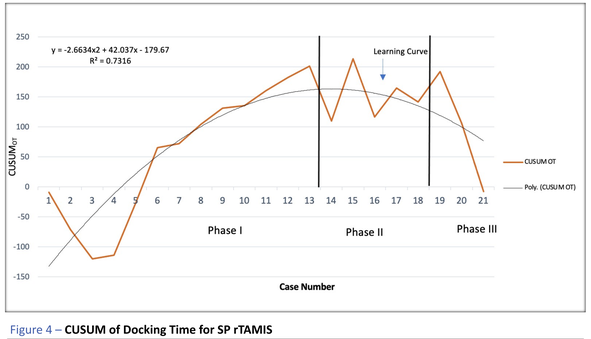
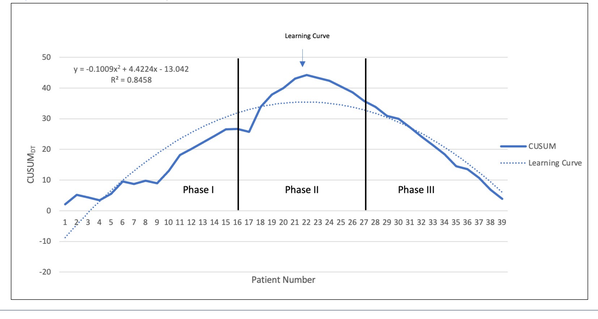


Figure 4 – **CUSUM of Docking Time for SP rTAMIS**



RESULTS

Table 1 –**Average operative time (minutes) for each phase of the learning curve**

Average Time(min)	Benign(n=18)	Malignant(n=21)	0-3 cm(n=14)	>3-4 cm(n=13)	>4 cm(n=12)
Overall	178.2	215.6	152.7	189.8	224.2
Phase-I	210.3	231.5	161.3	203.5	234.8
Phase-II	195	206.8	153.8	216.5	246
Phase-III	136	166	144.8	126.7	177.3
Learning Curve	9th case	16th case	7th case	8th case	7th case

SP rTAMIS dissection



- Average docking time for SP rTAMIS was 4.9 minutes (1-13). The learning curve was reached at the 20th case.
- The learning curve was reached at the 9th case for benign neoplasms and the 16th case for malignant lesions.
- Average operation time was not significantly different between benign and malignant lesion (p=0.07).
- There was a significant difference for lesions 0-3 cm versus >4 cm (p=0.03). However, the learning curve was reached at the 7th or 8th case for all sizes.

CONCLUSION

- The learning curve for SP rTAMIS is relatively short, 7-8 cases, regardless of lesion size.
- Operative time was longer for malignant than benign disease.
- Docking times were short for all phases of the learning curve (within 4 minutes).
- More patients and multi-institutional studies will be needed to confirm the results of this study.