Impact of Transitioning to Xi on Robotic Learning Curves for Foregut Procedures

Joseph Lim DO, Shawn Cudworth BS, Juan Malo MD, Amelie Medley, Joseph Buell MD, Houssam Osman MD, Dhiresh Rohan Jeyarajah MD
Department of Surgery, Methodist Richardson Medical Center, Methodist Health System

Introduction

- Robotic learning curve are an important metric when it comes to surgeon's education, and can provide other surgeons a tentative extrapolated baseline for their own learning curve.
- With introduction of the Xi System by Da Vinci, improved efficiencies from its Si counterpart led to shorter operating times.
- However, this upgrade's impact on learning curves has not been investigated for foregut procedures.

Methods

- 85 patients who underwent robotic trans hiatal esophagectomies (RE) and 52 patients who underwent robotic heller myotomy (RHM) from 2014 to 2021 were included in this learning curve study.
- Both procedures were performed by the same surgeon at a high-volume tertiary community center.
- Robotic surgeries were transitioned to Xi at December of 2014.
- Cumulative sum analysis (CUSUM) of operating time generated each learning curves.
  - $C_i = \sum_{j=1}^{i} x_j - \bar{\mu}$
- The 3-phase surgical learning theory was implemented when visually analyzing the CUSUM curve.
- 3 Phases of Learning
  - Phase I – Initial Learning
    - First major slop decrease
  - Phase II – Optimization
    - Following first major slope decrease to maximum peak
  - Phase III – Mastery
    - Maximum peak afterwards

Results



Figure 1 CUSUM analysis of operative time for Robotic Heller Myotomy. Black dotted line shows transitions between different phases, with each phases labeled. Red dotted line shows when Xi was implemented. Red circle highlights the area of change impacted by the learning curve.

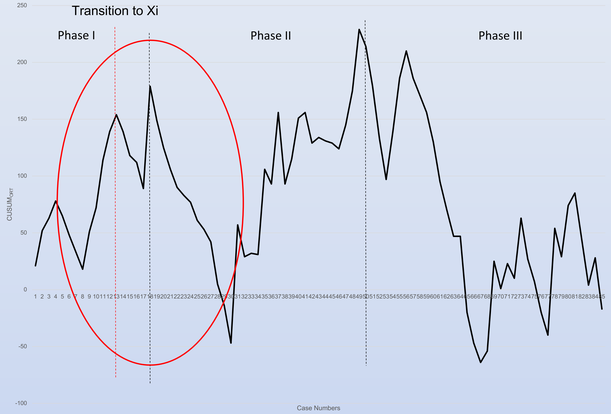


Figure 2 CUSUM analysis of operative time for Robotic Esophagectomy. Black dotted line shows transitions between different phases, with each phases labeled. Red dotted line shows when Xi was implemented. Red circle highlights the area of change impacted by the learning curve.

Discussion

- For RHM, phase I completed at 5 cases and phase II completed at 18 cases, suggesting that true RHM mastery required 18 cases.
- For RE phase I completed at 18 cases, and phase II completed at 56 cases, suggesting that true RE mastery required 56 cases.
- Xi transition occurred in just before Phase II of the learning for both cases. Soon after Xi implementation, there was a sharp decrease in operating time for both surgeries for both RHM (linear trendline value of y = -8.17+164.5) and RE (linear trendline value of y = -15.7+169.5) potentially signaling mastery.
- However, upon continuation of the data, the operating time started to increase. This general uptrend continued until the 56th case where it began to decrease, followed by oscillation of the CUSUM curve, suggestive of mastery/phase III.

Conclusion

- Transition from Si to Xi can lead to false assurance of a completed learning curve, especially for foregut procedures such as esophagectomies and heller myotomy.
- When establishing a CUSUM learning curves, it is crucial to gather enough data point to properly visualize the different phases of learning.

References

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