Adopting Single-Incision Laparoscopic Appendectomy in Children: Is it Safe During the Learning Curve?

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Introduction

Minimal invasive surgery is widespread in training and practice. Laparoscopic appendectomy is the gold standard for treatment of acute appendicitis. Single incision laparoscopy is an alternative approach and has gained widespread acceptance. However, there is minimal data on the outcomes during the adoption of this technique in the era of wide laparoscopic experience in training and practice. Studies have shown a learning curve exists when transitioning to single incision surgery. This study evaluates the learning curve of contemporarily trained surgeons adopting SILS appendectomy, and more specifically, the safety of the operation during the early portion of this learning curve.

Methods

A retrospective review of 953 consecutive pediatric patients, ages less than 18, who underwent an appendectomy at the Children's Hospital of Illinois from 2005 to 2018 was performed. Both acute and perforated appendicitis were included. A subgroup analysis was then performed for the technique of single incision laparoscopy; a total of 418 were included. Specifically, the SILS approach utilized a commercially available multiport trocar. The adoption of this technique by new partners in the group was evaluated. Variables collected included age, gender, height, weight, diagnostic modality, antibiotic usage, operative technique, and operative duration. Outcomes measured included length of operation, length of anesthesia time, and complication rate (surgical site infection) (Table 1). These numbers were compared using a log logistics and a Loess smoothing model.

Results

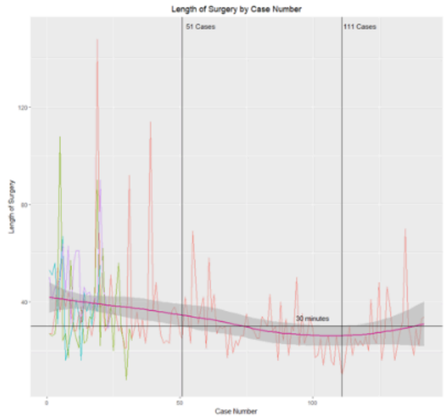
A total of 418 single incision laparoscopic appendectomies were reviewed. Surgeons performed between 1 and 142 single site appendectomies. A trend to faster operative times was observed for all surgeons as case numbers increased. Using statistical modeling for operative time, the odds of still being operated on decreased by 0.997 for each additional case. Based on a 95% confidence band using a Loess smoothing method and this experienced time as the standard, we expect adopting surgeons to reach this experienced level after 51 cases (Figure 1). During this early SILS appendectomy learning curve, there was no significant difference in complication rate when compared to conventional multi-port laparoscopy (Table 2).

TABLE 1. SURGERY CHARACTERISTICS

	All data	*Non-SILS*	*SILS*
No. of surgeries	953	535	418
Unique surgeons	27	16	17
Perforations	221 (0.23)	135 (0.25)	86 (0.21)
Conversions	6 (0.01)	5 (0.01)	1 (0.00)
Length of operation (minutes) Median and IQR	37 ± 21	42 ± 22	30 ± 16
Any complication	104 (0.17)	61 (0.29)	43 (0.10)

Parentheses indicate proportion of surgical characteristics in relation to total number.
IQR, interquartile range; SILS, single-incision laparoscopic surgery.

Figure 1. Trend of Operating Time by Surgeon



Conclusions

As expected, the more single incision cases performed, the shorter the operative times. More importantly, we did not find an increase in complications during this learning stage of single incision appendectomies in either perforated or non-perforated appendicitis. When compared to a surgeon specifically trained in SILS appendectomy, the learning curve eventually hits an inflection point and plateau when a surgeon has reached the experienced level. We conclude that the adoption of SILS appendectomies is safe even in the learning curve of the technique given contemporary minimally invasive training/practice.

TABLE 2. SUMMARY OF SAMPLE BY SURGEON

Surgeon	*SILS performed*	*Conversion*	*Perforated*	*Operating room time Median (first–third quartile)*	*Complication rate*
A	142	1	33	29 (11)	9% (13)
B	138	0	20	27 (17)	10% (14)
C	34	0	6	32 (18.8)	15% (5)
D	32	0	7	28.5 (15)	9% (3)
E	24	0	12	45 (11)	8% (2)
F	20	0	4	37.5 (20.5)	5% (1)
G	10	0	2	29 (8.5)	10% (1)

Parentheses indicate number of cases with complication.
SILS, single-incision laparoscopic surgery.

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3. Angus AA, Sahi SL, McIntosh BB. Learning curve and early clinical outcomes for a robotic surgery novice performing Table 4. Complications by Condition of Appendix and Surgery Technique Non-SILS SILS No complication Complication No complication Complication Nonperforated appendix 144 (0.83) 29 (0.17) 308 (0.93) 22 (0.07) Perforated appendix 2 (0.06) 31 (0.94) 66 (0.77) 20 (0.23) Parentheses indicate proportion of surgical characteristics in relation to total number. SILS, single-incision laparoscopic surgery. 4 ESPARAZ ET AL. Downloaded by Memorial Sloan Kettering from www.liebertpub.com at 06/20/19. For personal use only. robotic single site cholecystectomy. Int J Med Robotics Comput Assist Surg 2014;10:203–207.
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