

Laparoscopic Appendectomy: a Junior Trainee's Learning Curve

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ABSTRACT

Background: Appendectomy has traditionally been a training operation for junior surgical trainees. With the increased incidence of laparoscopic appendectomy, concern has increased about the safety of this far more technically demanding procedure in the hands of junior surgical trainees. The learning curve of a junior surgeon is presented.

Methods: Consecutive patients having laparoscopic appendectomy were studied. A 3-port Hasson technique was used. Patient demographics, conversion rate and reason for conversion, operation times, number of complicated cases (retrocecal position, dense adhesions, perforated/gangrenous/abscess associated appendicitis), and postoperative complications were recorded. The moving average and cumulative sum (CUSUM) methods were used to delineate the learning curve.

Results: Forty patients were studied. Median age was 24 (IQR: 18, 40). Twenty-nine (72.5%) patients were female. Data were not available for 3 patients (6%); the remaining patients form the basis of this study. A statistically significant improvement occurred in operating time between group 2 and group 3, $P < 0.0001$ (95% CI, 21.23 to 47.99). The CUSUM plot demonstrates that the learning curve was surmounted by 20 cases performed.

Conclusions: Laparoscopic appendectomy is a safe procedure for junior trainees, and the learning curve stabilizes by 20 cases performed.

INTRODUCTION

Open appendectomy has traditionally been a training operation for junior surgical trainees. With the increased incidence of laparoscopic appendectomy (LA), there has been concern about the safety of this far more technically demanding procedure in the hands of junior surgical trainees.^{1,2} The learning curve of a UK surgical registrar in the first year of training is presented.

METHODS

From May 2005 to November 2006, consecutive patients with suspected appendicitis were taken to the surgical theater with the intent to perform LA. A 3-port technique was used, with 10-mm ports inserted in the infraumbilical and suprapubic positions and a 5-mm port in the left iliac fossa. The first puncture was open and infraumbilical. The appendix was skeletonized by using mono-polar hook diathermy, and appendectomy was performed between preformed ligatures, 2 placed proximally on the appendix base and 1 distally. The appendix was removed either through a 10-mm port or via a retrieval bag. Peritoneal lavage was performed where evidence was present of peritoneal contamination, and fascial closure of all 10-mm port incisions was achieved with delayed absorbable suture material.

Patient demographics, conversion rate and reason for conversion, operation duration, number of complicated cases (perforated/gangrenous/abscess-associated appendicitis), and postoperative complications were recorded. This study is a single trainee learning curve evaluation. The moving average and cumulative sum methods were used to delineate the learning curve. For the moving average analysis, the series of 40 patients consecutively operated on was divided into 4 groups of 10 patients each.

Statistical Analysis

The moving average method for operating time has been described in constructing learning curves for attaining new procedural skills.³

The cumulative sum (CUSUM) method is a statistical process developed to assure quality in a continuous process

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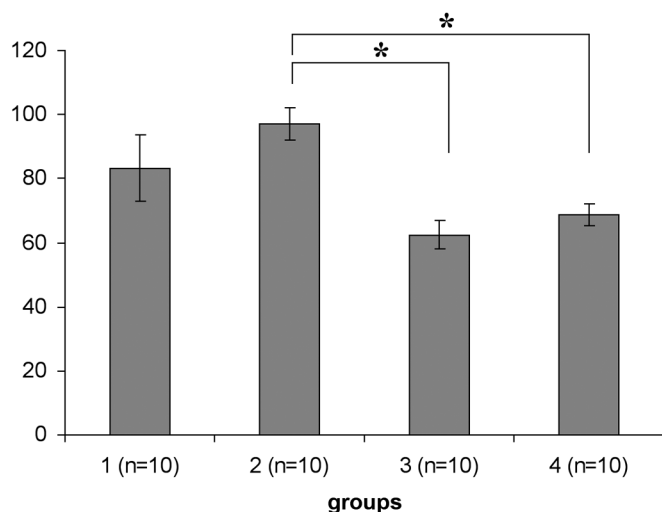


Figure 1. Operating times by moving average method for consecutive groups of 10 patients (mean ± SEM): group 1 = 83.16 ± 10.37; group 2 = 97.11 ± 5.13; group 3 = 62.5 ± 4.5; group 4 = 68.75 ± 3.24. *P < 0.0005.

and has been applied to constructive learning curves for acquisition of new procedural skills.^{4,5} The CUSUM value is a mixture of sequential increments (1-s) and decrements (s), corresponding to failure and success at the task being examined. Boundary lines on the CUSUM plot are based on acceptable and unacceptable failure rates and the defined type 1 (false positive) and type 2 (false negative) error rates. The CUSUM plot may cross an acceptable boundary line (from above) or an unacceptable boundary line (from below). Previously described CUSUM formula and graphical representation were used.⁶

Type 1 and type 2 errors were defined as 0.1.⁷ For purposes of analysis, the acceptable failure rate was considered 10%, and the unacceptable failure rate was considered 30%.

Data are presented as mean ± standard error of mean (SEM) or median, interquartile range (IQR). Statistical analysis was performed using the Student *t* test. Data were

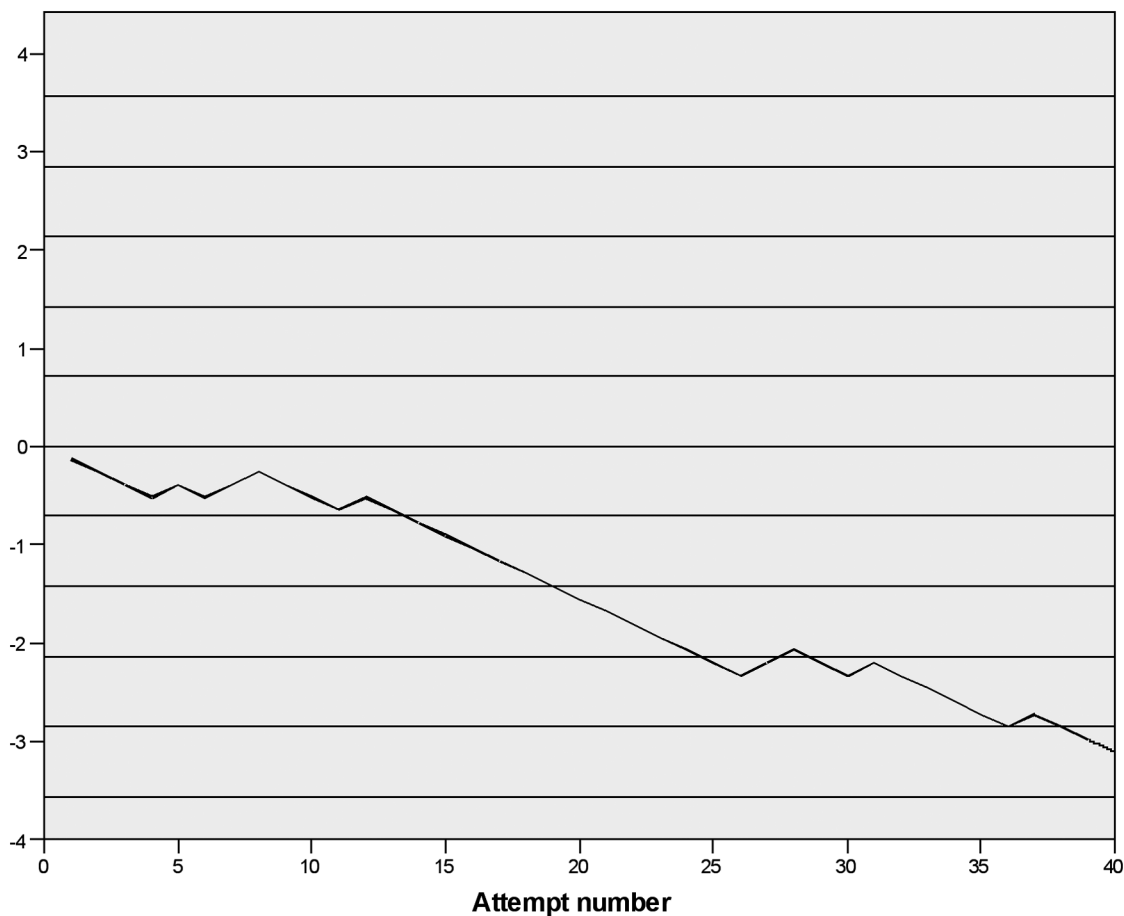


Figure 2. CUSUM plot for conversion to open appendicectomy. Solid horizontal lines represent threshold values. Two threshold values crossed by 20 cases indicating learning curve plateau.

analyzed using Microsoft Excel (version 2003, Microsoft Corp, Redmond, WA, USA) and SPSS for Windows (version 15, SPSS Inc, Chicago IL, USA).

RESULTS

Forty patients were studied. Median age was 24 (IQR: 18, 40). Twenty-nine (72.5%) were female. Data were not available for 3 patients (6% due to missing records); the remainder form the basis of this study.

In Group 1, one procedure was converted to open due to the preference of the consultant surgeon responsible for the patient. The negative appendectomy rate was 6 (15%).

Operating time decreased from 97.11 ± 5.13 minutes in group 2 to 62.5 ± 4.5 minutes in group 3 ($P < 0.0001$; 95% CI 21.23 to 47.99), which remained unchanged in group 4.

Overall conversion rate to open surgery was 20%; all cases converted were of acute appendicitis with peritonitis secondary to perforation of the appendix. The rate of complicated appendicitis was 47.5% (19 cases).

CONCLUSION

The prevalence of complicated appendicitis (perforation or abscess) in our series was high at 19 (47.5%). Other reports of experience with LA report far lower incidences of complicated appendicitis, for example 10%.⁸ The high rate of conversion to open surgery (20%) may reflect the high incidence of complicated appendicitis.

In this series, the rate of negative appendectomy was low (6 of 40; 15%). This may be explained by a tendency in our hospital to initially observe patients presenting with suspected appendicitis. This high threshold for operating may also explain the unusually high rate of complicated appendicitis seen in this series.

A large retrospective review⁹ of cases found that a clinical course of 48 to 72 hours is associated with a 34% incidence of gangrenous or perforated appendicitis compared with 4% for an interval of less than 12 hours. Another retrospective review¹⁰ reports an increased perforation rate, incidence of abscesses, and length of postoperative stay associated with a waiting time between admission to operation of greater than 24 hours. We suggest an aggressive approach to operative management should continue to be the gold standard in the era of LA.

Operation time stabilized to 62.5 ± 4.5 minutes in the third quarter of this series. This compares favorably with that

reported from the American residency program (95.7 min).¹¹

The appendix was removed in all patients in this series. Although it has been suggested that LA may reduce the negative appendectomy rate, a comparison of macroscopic to histological findings demonstrated that a normal-looking appendix was microscopically inflamed in 25.6% of cases.¹²

LA has become commonplace in the management of acute appendicitis; the improved intra-abdominal visualization being particularly useful for the female patient. Although the potential for severe complications exists, the procedure is safe. We suggest that the advent of LA should not alter indications for operating on patients with right iliac fossa pain.

The learning curve of an experienced laparoscopic surgeon suggests that 20 cases represents the number needed to gain competence.¹² The consensus statement from the education committee of the European Association of Endoscopic Surgery states that LA should be part of the resident's curriculum and recommends that at least 20 cases are needed for accreditation in general surgery.¹³

Our series demonstrates a similar learning curve in a single UK surgical trainee. LA is a safe procedure for junior trainees, and the learning curve may stabilize by 20 cases performed. Further data from multiple trainees is required to confidently conclude that LA can be introduced early in training without compromising patient care.

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