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Minimally invasive surgical exposure among US and Canadian pediatric surgery trainees, 2004-2016

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ABSTRACT

Background: Minimally invasive pediatric surgery has increased in breadth and complexity over the past several decades, with little data on minimally invasive surgery (MIS) training in US and Canadian pediatric surgery fellowship programs.

Methods: We performed a time series analysis of Accreditation Council for Graduate Medical Education pediatric surgery fellow case logs from 2003 to 2016. Proportions of cases performed in an MIS fashion as well as per-fellow MIS case averages were recorded over time.

Results: There was a 30.9% increase in average number of MIS cases per fellow over the study time period. Twenty-three recorded procedures included MIS and open options (17 abdominal, three thoracic, and three genitourinary). The proportion of cases performed using a minimally invasive approach increased by an average of 29.0%, 14.6%, and 47.0% for each of these categories, respectively. Significant variability was observed in specific cases such as laparoscopic and open inguinal hernias, ranging from 0 to 85 and nine to 152 per trainee, respectively, in the final year of data collection. When examining pyloromyotomy, a high-volume procedure with a known increase in the MIS approach, the proportion of cases performed MIS increased by 83.3%. The minimum and maximum number of cases per fellow recorded ranged from 0 to 114 during the eight years in which MIS pyloromyotomy was recorded.

Conclusions: MIS case exposure among graduating US and Canadian pediatric survey fellows increased substantially during the study period. More granular data, however, are needed to better define the current operative experience and criteria for determination of competency in advanced MIS.

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Introduction

Technological advances in the field of medicine have made surgery not only safer for patients but increasingly accessible over the past century.[1,2] Following the introduction of safer anesthetic option, the movement toward less invasive and minimally invasive surgical (MIS) approaches has had the most profound impact on how surgical care is approached. Although slightly slower to gain popularity in pediatric surgery, there has been a definite shift toward using minimally invasive approaches in common pediatric and neonatal procedures in the past decade.[3-5]

With the widespread implementation of MIS throughout multiple subspecialties, new obstacles for ensuring adequate preparation of trainees have been identified.[6] Based on generally low case volumes and a movement toward increased specialization across all field of medicine, regionalization, or decreasing the number of providers caring for a specific condition, has been discussed.[7,8] While there are potential benefits for patient care and provider specialization, significant concerns have been raised with respect to the trainee experience with increasing numbers of training programs and fellowship positions.[9,10] Within the field of pediatric surgery, limitations in exposure to adequate procedure volume are exacerbated not only by the rarity of certain surgical conditions but also by limitations in equipment size and availability.[11] Furthermore, there is considerable variability in case volume by hospital and, consequently, expected variability in the experience of trainees.

The purpose of this study is to evaluate the experience and variability with MIS in US and Canadian pediatric surgery fellowship programs based on trainee case logs.

Methods

The study protocol and use of the Accreditation Council for Graduate Medical Education (ACGME) pediatric surgical resident and fellow case logs were reviewed by the Institutional Review Board of the State University of New York, University at Buffalo and exempt from formal approval.

Data source

The ACGME fellow surgical volumes were obtained from the publically available case log national data report for the years 2003 to 2016, inclusive.[12] The national data report is organized by current procedural terminology code by body system groups (skin/soft tissue/musculoskeletal, head and neck, thoracic/diaphragm, cardiovascular, abdominal, hernia repair, genitourinary, liver/biliary, trauma, and endoscopic procedures). Case logs are typically completed by the resident or fellow; depending on the specific program, the training program director will attest to the case log accuracy with or without detailed review. Procedures were included if they had both open and MIS options. The cases included are summarized in Appendix 1, with specification for cases only available for certain years (Appendix 1). Several cases were included in initial analysis based on anecdotal experience with minimally invasive approaches regardless of whether they were included in the national data report. MIS options were predominantly coded after 2008 and therefore, where relevant, analysis was limited to 2008-2016.

Statistical analysis

Total cases were recorded, and descriptive analyses were performed to quantify proportions of cases performed in an MIS fashion as well as per-fellow MIS case averages over time. Cases were compared by major body system including major abdominal, major thoracic, and genitourinary procedures using linear regression to evaluate for significant trends. Individual cases were also compared to evaluate mean, minimum, maximum, and interquartile range for cases performed per resident. All statistical analyses were performed using Microsoft Excel 2010 and IBM SPSS Statistics Software 24.

Results

Over the course of the study, the total number of pediatric surgery trainees increased by 62.5% with an average of approximately 34 trainees per year at 33 programs. The number of training programs also increased by 54.2%, from 24 to 37 programs over the course of the study. As noted, cases were identified for inclusion based on procedure code for laparoscopic as well as open procedures. A total of 23 procedures included MIS and open options (17 abdominal, three thoracic, and four genitourinary procedures).

The average number of cases recorded per fellow within the categories of interest increased by 30.9% over the study time period (Fig. 1). Within the major categories evaluated, including only procedures with both open and MIS options (Appendix 2), there was an increase in total number of cases performed for abdominal and thoracic cases by 181.6% and 37.0%, respectively, with an increase in the average cases per trainee by 73.3% for abdominal ($R^2 = 0.78$) and 37.4% increase in average thoracic cases ($R^2 = 0.40$). For genitourinary cases, excluding hernias, there was a smaller increase of 15.4% in total average number of cases per trainee over the course of the study ($R^2 = 0.24$). Linear regression performed for average open and average MIS cases in each of the major categories showed a strong correlation in increasing MIS cases over time for abdominal cases ($R^2 = 0.93$) and genitourinary cases ($R^2 = 0.79$) with minimal change in MIS thoracic cases ($R^2 = 0.01$).

Within each of the major categories represented, the proportion of cases logged as having been performed using a minimally invasive approach was evaluated (Fig. 2). Despite a decrease in average number of thoracic cases performed per trainee, the proportion of cases logged as minimally invasive as opposed to open increased by 43.0%, 26.9%, and 16.3% for abdominal, thoracic, and genitourinary operations, respectively. The trend toward increasing percentage of cases performed MIS was confirmed by linear regression with strong correlation over time for abdominal, thoracic, and genitourinary operations ($R^2 = 0.87$, $R^2 = 0.84$, and $R^2 = 0.85$, respectively). The total number of minimally invasive operations also increased substantially from 1586 to 11,029 for abdominal cases and 375 to 671 for thoracic cases. Inguinal hernias were