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The Integration of Adult Acute Care Surgeons into Pediatric Surgical Care Models Supplements the Workforce without Compromising Quality of Care

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Abstract

Acute care of children remains a challenge due to a shortage of pediatric surgeons, particularly in rural areas. In our institutional norm, all cases in patients age six and older are managed by dedicated general surgeons. The provision of care to these children by these surgeons alleviates the impact of such shortages. We conducted a five-year retrospective analysis of all acute care pediatric surgical cases performed in patients aged 6 to 17 years by a dedicated group of adult general surgeons in a rural tertiary care hospital. Demographics, procedure, complications, outcomes, length of stay, and time of consultation/operation were obtained via chart review. Elective, trauma related, or procedures performed by a pediatric surgeon were excluded. Descriptive statistics are reported. A total of 397 cases were performed by six dedicated general surgeons during the study period. Mean age was 11.5 ± 3.1 years. In all, 100 (25.2%) were transferred from outlying facilities and 52.6 per cent of consultations/operations occurred at night (7P–7A), of which 33.2 per cent occurred during late night hours (11P–7A). On weekends, 34.0 per cent occurred. Appendectomy was the most commonly performed operation ($n = 357, 89.9\%$), of which 311 were laparoscopic (87.1%). Others included incision/drainage (4.5%), laparoscopic cholecystectomy (2.0%), bowel resection (1.5%), incarcerated hernia (0.5%), small bowel obstruction (0.5%), intra-abdominal abscess drainage (0.3%), resection of intussusception (0.3%), Graham patch (0.3%), and resection omental torsion (0.3%). Median length of stay was two days. Complications occurred in 23 patients (5.8%), of which 22(5.5%) were the result of the disease process. These results parallel those published by pediatric surgeons in this age group and for the diagnoses treated. Models integrating dedicated general surgeons into pediatric call rotations can be designed such that quality of pediatric care is maintained while providing relief to an overburdened pediatric surgical workforce.

The provision of acute surgical care to patients remains a challenge in the United States. The reasons for this are multifactorial, but center primarily around the lack of availability of specialized pediatric surgeons, combined with a lack of specialized pediatric care facilities. In addition, it is not uncommon for practicing pediatric surgeons to restrict the number of days they are available for call, or to restrict the types of cases or ages of patients they agree to cover in an effort to combat burnout in this exceptionally distressing surgical specialty.¹ As a technique to provide call coverage for pediatric surgical acute care emergencies, some institutions have turned to general surgeons to provide this service.^{1, 2} The literature is mixed with respect to the effectiveness and quality of patient care provided with this strategy, with some authors reporting inferior outcomes of common acute care operations performed in children by general surgeons,^{3–5} whereas others have reported equivalent outcomes linked more to the specific surgeon's volume of pediatric surgery in his or her practice, and of the types of cases performed.^{2, 6, 7} Other authors have focused on the setting in which the care is rendered—dedicated children's hospital vs general hospital—and its subsequent effect on outcomes in children.⁸

We have adopted a strategy at our institution—a rural tertiary care hospital—in which all patients six years and older are managed by a group of dedicated nontrauma general surgeons skilled in minimally invasive and acute care general surgery. All receive a salary subsidy from the institution for providing this additional service. All patients five years of age and younger are managed by one of the two on-call pediatric surgeons who are members of our teaching faculty. The following retrospective analysis examines the results of this program after its first five years of implementation.

Methods

We retrospectively examined all emergent/urgent nontrauma surgical cases performed on children aged 6 to 17 years between January 1, 2009 and January 1, 2014 at Charleston Area Medical Center (CAMC) and performed by a West Virginia University Physicians of Charleston (WVU-PC) general surgeon. Pediatric trauma patients were not included, because they are cared for by dedicated trauma surgeons at our institution. CAMC is a regional referral and academic medical center composed of four hospitals, included one free-standing hospital specializing in the care of women and children. WVU-PC General Surgery is the physician practice for the WVU Charleston Division School of Medicine, Section of General Surgery faculty. Patients were excluded if their admission or procedure was due to trauma or if the surgical procedure was elective or not related to an acute care diagnosis. Procedures performed by fellowship trained pediatric surgeons were also excluded. The list of patients for inclusion was generated using WVU-PC billing records for procedures performed during the study period.

Information regarding the individual patients and procedures performed was obtained from hospital electronic medical records. Variables examined included patient age and gender, transfer status, hospital length of stay, and whether the procedure was performed in our health system's pediatric/women's hospital. In addition, we captured time and day of the week of the surgical consult and subsequent procedure. Any surgical complications were recorded and classified as being either disease specific (*e.g.*, pelvic abscess after removal of

a ruptured appendix) or procedure specific (such as iatrogenic bladder injury during trocar insertion). All aspects of the study were reviewed and approved by the CAMC/WVU-Charleston Division Institutional Review Board.

Data analysis was performed using SPSS Statistics 19.0. Basic descriptive statistics, such as means and standard deviations for continuous variables and proportions and frequencies for categorical variables, were used to analyze patient, procedure, and outcome characteristics. The continuous variables of length of stay and time between consult and surgery were not normally distributed therefore, for these variables, the median values with interquartile ranges (IQRs) were reported.

Results

A total of 397 acute surgical cases were performed in pediatric patients (< 6 years) by a practice of six general surgeons during the study period. Mean age at time of surgery was 11.5 ± 3.1 years and 58.2 per cent of patients were male. In all, 100 of these children (25.2%) were transferred from outlying medical facilities (Table 1). In all, 96.5 per cent of all procedures were performed at our health system's dedicated pediatric/women's hospital. The median length of stay for all cases performed was two days (IQR: 1–3). The median length of stay for nonperforated appendicitis was one day (IQR: 1–3). The median stay for perforated appendicitis was four days for IQR of 3–5 days (Table 2).

A total of 209 (52.6%) of the pediatric consults/surgeries occurred at night (defined as 7P–7A), with 132 (33.2%) occurring during late night/early morning hours (defined as 11P–7A). Slightly over one-third (34.0%) of all pediatric surgical consults occurred during weekend hours (defined as Friday 7P–Monday 7A). The median time between emergency room surgical consult and start of operative procedure was two hours (IQR: 1–3) (Table 3).

Appendectomy was the most commonly performed operation ($n = 357$, 89.9%), of which 311 were laparoscopic (87.1%). A total of 60 (16.8%) of these procedures were in patients diagnosed with perforation at initial presentation. Eight appendectomies (2.2%) were deemed to be negative by intraoperative assessment, and were confirmed to be so on final pathological evaluation. Other acute care procedures performed in the series included incision/drainage of soft tissue abscess (4.5% of patients), laparoscopic cholecystectomy for acute cholecystitis (2.0%), small bowel resection (1.5%), repair of incarcerated hernia (0.5%), lysis of adhesions for small bowel obstruction (0.5%), intra-abdominal abscess drainage due to delayed presentation of appendicitis (0.3%), reduction of intussusception (0.3%), Graham (omental) patch of perforated duodenal ulcer (0.3%), and partial omentectomy for omental torsion (0.3%) (Table 4).

There were no mortalities in the series. Complications were rare, with all observed complications occurring postappendectomy. Complications occurred in 23 patients overall (5.8%). Of these, 22 (5.5%) of the 23 complications were the result of the nature of the disease process. Only one patient (0.3%) experienced a procedural complication—an injury to the dome of the bladder during trocar insertion. All complications in the series and their method of treatment are described in Table 5. Pediatric surgical consultation with a

fellowship trained pediatric surgeon, although available, was not required on any patient in the series.

Discussion

Significant challenges exist today in the provision of surgical care to the acutely ill child. The pediatric surgical workforce, compared with that of other surgical specialties, is in particularly short supply on a national level.⁹ In addition, the distribution of pediatric surgeons tends to center in states with larger populations and in major urban centers, making this problem even more significant in rural states and smaller communities.¹⁰ As a result of these shortages, as many as 40 per cent of all pediatric operation occurred in nonpediatric general hospitals by nonpediatric surgeons.⁴

As important as having access to care through provision of on-call services is however, equally so is the quality of care provided. A recently published consensus paper from the Task Force for Children's Surgical Care, an ad hoc group of thought leaders in related disciplines, delineated the key resources required for the provision of optimal pediatric surgical care based on a comprehensive review of recently published literature. They then further proposed that institutions who care for children be designated as basic, advanced, or comprehensive based on the number of suggested resources available.¹¹ The consensus of the authors was that several distinct groups of patients would benefit the most from specialized pediatric care environments. This was most significant in neonates, infants, those requiring intensive care support, those undergoing complex specialized procedures (such as pediatric cardiac surgery), and those with significant injuries or comorbid conditions.¹¹ The role of the general surgeon was not specifically addressed, other than a category of provider designated as a "general surgeon with pediatric expertise" was stated to be sufficient to provide a basic level of care. Such a provider was described as a general surgeon with >25 pediatric (<18 years of age) cases yearly and with ongoing continuing education in the care of children.¹¹ No suggestion was made that care provided for basic, "garden variety," acute care surgical problems was inferior if provided by a general surgeon with pediatric expertise.

The literature is divided on this complex issue. In 1992, the British Joint Commission on Higher Surgical Training recommended that general surgeons intending to undertake the care pediatric patients as part of their practice should spend at least six months training in a specialist pediatric surgical center.¹² Nakayama et al.,¹³ in a 2009 article addressing pediatric workforce shortages in the United States noted what they felt were deficiencies in current pediatric surgical case number requirements for general surgery residents—20 cases total. They also noted that, in many programs, pediatric rotations were conducted during the junior years of training.^{9, 13} Both of these were felt to be critical limitations to the usefulness of general surgeons in providing care to children. Data exist in the literature to support this point of view. Several studies have been conducted examining whether outcomes differ in children undergoing appendectomy performed by either a pediatric surgeon or a general surgeon.^{2, 4, 14, 15} Two of four such published studies showed shorter lengths of stay when the care provider was a pediatric surgeon,^{14, 15} one of the four demonstrated fewer complications in cases of perforated appendicitis if treated by a pediatric surgeon,¹⁵ and one

study demonstrated a lower negative appendectomy rate when treated by a pediatric surgeon.⁴ Of note, the positive effect of a pediatric surgeon on outcomes has generally been most pronounced in very young (<5 years of age) children.^{3, 11}

Conflicting literature also exists in support of the role of the general surgeon in this setting. Emil et al.,² in a series of 465 patients, found no specialty specific differences in outcomes for simple or complicated appendicitis treated by general or pediatric surgeons. Chen et al.⁶ also challenged the notion that pediatric specialists provided superior care, finding instead that—in pediatric cholecystectomy—surgeon volume, not specialty, was most the important factor affecting outcomes. Low-volume surgeons, regardless of specialty, had higher complication rates, longer lengths of stay, and higher costs. These data support the concept that high-volume general surgeons with advanced laparoscopic skills are indeed capable of providing results superior to low-volume pediatric surgeons in the treatment of pediatric patients. This concept was validated in a 2011 systematic review, which examined the role of surgical training on patient outcomes after pediatric surgery and determined that outcomes were most strongly linked to procedural volume rather than specialty. They also concluded that the centralization of procedures such as appendectomy was inappropriate based on the ability of general surgeons to effectively manage the problem.¹⁶

Hospital type (general vs specialized children's hospital) and its effect on outcomes in pediatric surgery have also been examined. Smink et al.,¹⁷ in a review of the 37,109 cases of appendicitis from the Kids Inpatient Database, found that low-volume hospitals (less than one pediatric appendectomy per week) were statistically more likely to misdiagnosis appendicitis that were high-volume pediatric facilities (more than three pediatric appendectomies per week). Whisker et al.⁸ demonstrated similar findings, with higher rates of negative appendectomy in general hospitals compared with pediatric hospitals (20% vs 4%), suggesting that pediatric facilities may have care pathways in place to allow a more precise diagnosis in the pediatric patient.⁸

Our care model represents a hybrid system that, in our experience, has served all parties well. CAMC/Women and Children's Hospital meets the proposed criteria for a "comprehensive" designation as set forth by The Task Force For Children's Surgical Care.¹¹ Specifically, the hospital has two fellowship trained pediatric surgeons, pediatric anesthesiologists, a level-IV neonatal intensive care unit, a pediatric intensive care unit with intensivists staffing, and pediatric radiology support, as well as the other required resources to meet the comprehensive designation as described.¹¹ Transfers to our facility are common, both because of the central location of our facility within the rural state of West Virginia, and the challenges of caring for children in outlying smaller rural facilities. This is true not only for complicated surgical problems, but for common diagnoses such as appendicitis as well. As a result, pediatric surgeons on our staff complained of significant burnout—more due to the unpredictability of their schedules and the sheer volume of the emergency work, not its complexity.

In our system, the general acute-care surgeons chose to assume care of the patient at age six for two reasons. First, we acknowledge that published studies of outcomes showing superior results for pediatric surgeons demonstrated that the effect was most pronounced at <5 years

of age.³ Also, because appendicitis was to inevitably be the most common emergency procedure performed and that it is a comparatively rare diagnosis in children <5 years of age,¹⁸ it was felt that this approach would provide maximum impact toward reducing the call burden on the pediatric surgeons while maintaining excellent care to the patient. This proved to be the case, as 89.9 per cent of all cases performed in the series were appendectomies—25.2 per cent of which were transfers and the majority of which were done on nights or weekends. Overall, the outcomes have been outstanding. The median time from consult to operation was two hours, compared with 11 hours in recent series.² Using appendectomy as a benchmark, the negative appendectomy rate was 2.2 per cent, which is superior to the rates recently reported by both general and pediatric surgeons in recent series.^{2, 4, 8} Length of stay was one day for simple appendicitis and four days for complicated appendicitis, which, once again, excel in comparison to recently published series by both general and pediatric surgeons.^{5, 8} Although pediatric surgeons were available for consultation at any time, no such consults were required. We feel these outcomes are likely due to the combination of a highly motivated and capable group of on-call surgeons, combined with the resources of a dedicated, comprehensive children's hospital as described. We elected not to compare our results against those of the pediatric surgeons at our institution, since they were caring for a completely different age demographic and case mix, so this was felt to be of limited usefulness since it would likely have been an “apples to oranges” comparison.

Finally, both the department and hospital have benefited from the program. Transfers have been greatly facilitated by expansion of the workforce. The pediatric surgeons are less burdened and can focus their efforts on the most challenging patients and procedures. The general acute care surgeons, having been incentivized via a negotiated stipend, have increased their incomes at a cost to the department and hospital far below that of recruiting an additional pediatric surgeon.

Conclusions

This study demonstrates a creative solution to a widespread problem—maintenance of quality of care despite a shortage of pediatric surgeons and an overburdened pediatric workforce. Similar models could be developed to address workforce issues in other specialties. Further study of the quality of care delivered and the economic impact of such models is warranted.

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Table 1

Patient Characteristics

Age (years)	11.5 ± 3.1
Male	231 (58.2%)
Female	166 (41.8%)
Transferred from outlying facility	100 (25.2%)

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Table 2

Length of Stay (LOS)

Median LOS (entire series)	2 days (IQR: 1–3) (mean LOS 2.3 days)
Nonperforated appendicitis	1.7 days (IQR: 1–3) (mean LOS 1.6 days)
Perforated appendicitis	4 days (IQR: 3–5) (mean LOS 4.4 days)

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Table 3

Timing of Consults (Entire Series)

	Number (%)
Consult occurred 7P–7A	209 (52.6)
Consult occurred 11P–7A	132 (33.2)
Consult during weekend	136 (34.3)
Median time from ER consult to start of case	1.6 hours (mean 3.5 hours)

Table 4

Procedures Performed

	Number	Per cent
Appendectomy *	357	89.9
Incision and drainage of abscess	18	4.5
Laparoscopic cholecystectomy	8	2.0
Bowel resection	6	1.5
Laparotomy for small bowel obstruction	2	0.5
Drainage intra-abdominal abscess	1	0.3
Incarcerated hernia repair	2	0.5
Reduction of intussusception	1	0.3
Laparoscopic Graham patch (for perforated ulcer)	1	0.3
Partial omentectomy (for torsion)	1	0.3

The negative appendectomy rate was 2.2% (eight cases).

* Of the 357 appendectomies in the series: 311 (87.1%) were laparoscopic and 60 (16.8%) were for perforated appendicitis.

Table 5**Complications Encountered During the Study Period**

Disease-Specific Complications [n = 22(5.5%)]		
Number	Complication	Treatment
3	Ileus	Two patients were managed conservatively, one patient received a nasogastric tube
6	Wound infection	All six patients received antibiotics/local wound care. Two patients also received incision and drainage in OR.
1	Upper GI bleed	PPI, EGD with BICAP cautery
1	Pleural effusion	Chest tube insertion
9	Abscess (intra-abdominal)	Two patients received antibiotics only, three drained operatively, four drained with percutaneous approach
2	Small bowel obstruction	Reoperation
Procedure-specific Complications [n = 1(0.25%)]		
Number	Complication	Treatment
1	Bladder injury	Reoperation/repair of injury

OR, operating room; GI, gastrointestinal; PPI, proton pump inhibitor; EGD, esophagogastroduodenoscopy; BICAP, bipolar circumactive probe.