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Association Between the SARS-Cov2 Pandemic and Pediatric Surgical Consultations



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ABSTRACT

Introduction: The purpose of this study was to evaluate changes to acute pediatric surgical needs during the early phase of the SARS-Cov2 (COVID-19) pandemic.

Methods: We performed a retrospective cohort study of all in-hospital pediatric surgery consultations placed through the consult paging system at a single institution. We compared both median and absolute differences for emergency department (ED), operative, and hospital outcomes between March, April, and May of 2019 versus 2020.

Results: There were 225 in-hospital pediatric surgery consults in 2019 and 123 in 2020. Overall, mean age was 8.4-y (standard deviation = 6.4) and 60% were male. Initial vitals were similar between years and a similar proportion of patients underwent laboratory and imaging tests. In 2020, children spent a median of 1.1-h fewer in the ED (95% confidence interval = -2.2, -0.1) and 0.9-h fewer in the ED before surgical consultation (95% confidence interval = -1.5, -0.3) compared to 2019. Patients required significantly more procedures in the ED in 2020 ($n = 16$, 14.3%) than 2019 ($n = 13$, 6.2%) ($P = 0.02$), most commonly laceration repairs. In 2019, 46 children (20.4% of all consults in 2019) presented with appendicitis and 27 children (22.0% of all consults in 2020) in 2020. Complicated appendicitis was more common in 2020 ($n = 12$, 44.4%) than 2019 ($n = 9$, 19.6%) ($P = 0.02$). Two children (7.4%) were managed nonoperatively with a drain in 2020 compared to none in 2019 ($P = 0.13$). Median time from surgical consultation to surgery, median operative time, and median time to discharge was similar for children with appendicitis in both years.

Conclusions: The early phase of the pandemic was associated with more efficient triaging in the ED, but more ED procedures and more complex surgical pathology.

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Introduction

The SARS-Cov2 (COVID-19) pandemic has had broad reaching effects on healthcare systems around the world. In the United States, patients with low-acuity conditions were advised to avoid the emergency department (ED) during the first wave of the pandemic to minimize the spread of the virus and to allow the prioritization of higher acuity patients. As a result of these recommendations and widespread fear of the virus, the initial stages of the pandemic saw a pronounced decrease in the number of adult patients seeking emergency care for a range of pathologies, including stroke, myocardial infarction, and chronic obstructive pulmonary disease.¹⁻⁴ Delays in treatment can increase the morbidity and mortality of these conditions and may have significant public health consequences.

An emerging body of evidence suggests that there has been a parallel decrease in ED visits among children^{5,6}; however, data relating to the impact of the COVID-19 pandemic on pediatric surgical emergencies is limited and conflicting. Some studies have suggested that children with appendicitis have presented with more advanced pathology during the pandemic compared to pre-pandemic⁷; similar findings have been documented among adults.⁸ However, other studies have shown no delay in presentation for testicular torsion among pediatric patients.⁹ Given these differing results, we hope our study will contribute to existing literature and further clarify surgical patterns and trends.

The purpose of this study was to evaluate changes to acute in-hospital pediatric surgical needs during the early phase of the pandemic. Assessing these changes in healthcare system utilization is essential to gaining a better understanding of community needs and anticipating future public health consequences. We hypothesized there would be fewer consultations, but the pathology would be more severe and more likely to need acute surgical intervention.

Methods

We performed a retrospective cohort study of all in-hospital pediatric surgery consultations placed through the consult paging system at UMass Chan Medical School-Baystate, a 720-bed, tertiary care, regional, academic medical center currently serving a population of approximately 850,000 people in western Massachusetts. The protocol was approved by the UMass Chan-Baystate Institutional Review Board and was exempt from review. Identifiers for eligible encounters were uploaded to a REDCap database, hosted by the Tufts Clinical and Translational Science Institute (Grant Number UL1TR001064) for abstraction from the electronic medical record. Records were randomly assigned to two of four co-investigators (J.S., H.G.) for abstraction. Since Massachusetts did not shut down until one week after the World Health Organization officially declared SARS-Cov2 a global pandemic on March 11, 2020, patients were eligible for inclusion from March 18th through May 31st for both 2019 and 2020. Repeat consultations and consultations placed from outside hospitals were excluded. Patients were grouped and compared based on the year of consultation.

Our primary outcome of interest was the absolute number of surgical consultations placed each year. Secondary outcomes included the median amount of time spent in the ED, the median time until surgical consultation, median hospital length of stay, the proportion of patients requiring a hospital admission, a procedure, or an operative intervention, and the primary discharge diagnosis. Time spent in the ED until surgical consult was defined as the time from the initial ED vital signs until the time the consultation was placed through the paging system. Total time spent in the ED was defined as initial ED vital signs until time of discharge or admission order. Additional outcomes for patients with appendicitis included the operative time and the final clinical classification, which is described as simple, gangrenous, ruptured, or ruptured with associated abscess. Complicated appendicitis is defined as any patient with a gangrenous appendix, ruptured appendix, or ruptured appendix with an abscess in the surgeon's operative report.

Statistical analysis

We initially described the distribution of variables between years. Categorical variables were analyzed using logistic regression and reported using frequencies and percentages, while continuous variables were analyzed using quantile regression and reported using mean and standard deviation or median and interquartile range. We utilized the Stata command `-margins-` to estimate both median and absolute differences between years and associated 95% confidence intervals for our primary and secondary outcomes. Statistical significance was set at a two-sided alpha less than 0.05. Data were analyzed using g STATA 16 (StataCorp, College Station, TX).

Results

A total of 348 in-hospital pediatric surgical consultations were placed during our study period: 225 of those consultations (64.7%) occurred in 2019 compared to only 123 (35.3%) in 2020. The breakdown by month for 2019 showed 43 consults in March (19.1%), 83 consults in April (36.9%), and 99 consults in May (44.0%). Comparatively, 2020 had 11 consults in March (8.9%), 43 consults in April (35.0%), and 69 consults in May (56.1%). In each year, the majority of consults were placed from the ED with only 30 consults (13.6%) coming from already admitted patients in 2019 and 18 consults (15.3%) in 2020. There were 7760 total pediatric ED visits from March 1- May 30, 2019 compared to only 2880 during the same dates in 2020. Overall, the mean age at presentation was 8.4 y (standard deviation = 6.4) and 60% of patients ($n = 206$) were male. Over 80% of patients ($n = 278$) were white and over one-third ($n = 123$) were Hispanic. Differences in baseline characteristics between groups are summarized in [Table 1](#).

Among pediatric surgery consultations called from the ED, initial vital signs were similar between years and mean values fell within normal limits. A similar proportion of patients underwent laboratory and imaging tests in 2019 and 2020. Following evaluation in the ED, 28.7% of all patients ($n = 97$)

Table 1 – Patient demographics and clinical characteristics of all surgical consultations.

Variable	2019 n = 225	2020 n = 123
n (%)	225 (64.7)	123 (35.3)
Age in years, mean (SD)	8.5 (6.5)	8.3 (6.2)
Male sex, n (%)	133 (59.9)	73 (60.3)
Race, n (%)		
White	172 (77.8)	106 (87.6)
Black	34 (15.4)	13 (10.7)
Asian	3 (1.4)	2 (1.7)
Other or unknown	12 (5.5)	0 (0.0)
Ethnicity, n (%)		
Hispanic	84 (37.8)	39 (32.2)
Non-hispanic	136 (61.3)	82 (67.8)

* There were two missing values for ethnicity in 2019, none in 2020.

were discharged home, while the remainder were admitted to the hospital. In both years, the most common admitting service was pediatric surgery, admitting nearly 40% of all patients. There were no differences in the proportion of patients requiring hospital admission ($P = 0.47$), pediatric intensive care unit admission ($P = 0.53$), or mechanical ventilation between years ($P = 0.87$); however, in 2020, children spent a median of 1.1-h fewer in the ED (95% CI = $-2.2, -0.1$) and 0.9-h fewer in the ED before surgical consultation (95% CI = $-1.5, -0.3$) compared to 2019 (Table 2).

In terms of procedural and operative needs for the pediatric surgical consultations, significantly more patients required a procedure in the ED in 2020 ($n = 16, 14.3\%$) compared to 2019 ($n = 13, 6.2\%$) ($P = 0.02$). The most common procedure performed was a laceration repair. In addition, a total of 79 patients (35.1% of patients in 2019) required an operation in 2019 compared to 55 patients (44.7%) in 2020 ($P = 0.0381$). Appendicitis comprised nearly 30% of final discharge diagnoses among patients admitted in both 2019 and 2020 and was the most common indication for surgery in each year. Complicated appendicitis was more common in 2020 ($n = 12, 44.4\%$ of appendicitis cases in 2020) than 2019 ($n = 9, 19.6\%$ of appendicitis cases in 2019) ($P = 0.02$). Most notably, there were more cases of ruptured appendicitis ($n = 6, 22.2\%$) and ruptured appendicitis with abscess ($n = 3, 11.1\%$) in

2020 compared to 2019 ($n = 6, 13\%$ and $n = 2, 4.3\%$, respectively) (Table 3). Consequently, two children (7.4% of consults in 2020) were managed nonoperatively with a drain in 2020 compared to none in 2019 ($P = 0.13$). Median time from surgical consultation to surgery, median operative time, and median time to discharge were similar for children with appendicitis in both years.

Discussion

This retrospective cohort study of 348 patients is one of the first studies to our knowledge to examine acute pediatric surgical needs in the early stages of the COVID-19 pandemic. We found that the early stages of the pandemic were associated with an absolute decrease in the number of pediatric surgical consultations, but more advanced manifestations of acute appendicitis and increased total number of operations. In addition, we found that ED care was more efficient, with patients spending significantly less time in the ED overall, and prior to pediatric surgery consultation in 2020 than during the same months in 2019. Trends in surgical consultations from the ED also suggest that pediatric surgery was being consulted more frequently for simple laceration repairs or incision and drainage compared to prior years.

One potential explanation for the decline in pediatric surgical consultations is the well-documented overall decrease in pediatric ED visits in both our institutional and nationwide.^{10,11} This may be related to public health messaging advising patients to stay at home to reduce the burden on local hospitals. Additional contributors may include fear of contracting the virus in the hospital, an abundance of potentially unnecessary ED visits in prior years, and a decline in the spread of communicable diseases during school closures.¹²⁻¹⁴ For those patients who did not present to the ED, it is likely that they either improved on their own, reported to urgent care, or did not require a surgical consult to begin with. It is unlikely that patients presented to clinic or other outpatient settings as these clinical settings were restricting in-person visits at this time. This overall decline in pediatric ED visits supports our finding of an absolute decrease in the number of pediatric surgical consultations.

The same reluctance to seek medical care that may have led to a decrease in ED visits, likely contributed to the delay in

Table 2 – Length of stay, time to consult, and operative time for pediatric surgical consultations.

Outcome	2019	2020	Median/Absolute difference (95% CI)
Total surgical consultations, n (%)	225 (64.7)	123 (35.3)	-102.0 (-138.6, -65.4)
Total number of operations, n (%)	79 (58.9)	55 (41.1)	-24.0 (-46.7, -1.31)
Total time in ED (in hours), median (iqr)	5.0 (4.9)	3.9 (4.7)	-1.1 (-2.2, -0.08)
Total time in ED prior to surgical consultation (in hours), median (iqr)	2.9 (3.4)	2.0 (2.9)	-0.9 (-1.5, -0.3)
Time from surgery to discharge, median (iqr)	19.1 (53.8)	22.4 (100.2)	3.1 (-13.0, 19.1)
Operative time (in minutes), median (iqr)	53.0 (25.5)	55.0 (31.0)	2.0 (-7.9, 11.9)
Time from surgical consult to surgery (in hours), median (iqr)	10.1 (12.4)	13.8 (17.4)	3.5 (-1.4, 8.5)
Admission from ED n (%)	154 (70.0)	87 (73.7)	0.037 (-0.06, 0.14)

Table 3 – Appendicitis outcomes for pediatric surgical consultations.

Outcome	2019 n = 46	2020 n = 27	Median/Absolute difference (95% CI)
Simple appendicitis, n (%)	37 (80.4)	15 (55.6)	–0.25 (–0.47, –0.029)
Complicated appendicitis n (%)	9 (19.6)	12 (44.4)	0.25 (0.029, 0.46)
Time from surgical consult to surgery for pts with appendicitis (in hours), median (iqr)	9.7 (12.4)	10.1 (9.3)	0.42 (–5.4, 6.3)
Operative time for pts with appendicitis (in minutes), median (iqr)	54.0 (21.0)	57.0 (19.0)	3.0 (–7.5, 13.5)
Time from surgery to discharge (for kids with appendicitis) (in hours), median (iqr)	15.9 (17.9)	19.4 (57.7)	3.4 (–13.1, 20.1)

n = 73 after excluding kids with no appendicitis.

presentation among children with appendicitis. More severe pathology suggests a delay in presentation to the ED after onset of symptoms.¹⁵ While appendicitis was the most common diagnosis in both 2019 and 2020, there were more cases of gangrenous appendicitis, ruptured appendicitis, and ruptured appendicitis with an associated abscess, in 2020 compared to 2019. Our findings align with other studies demonstrating more advanced cases of appendicitis in children during the pandemic, as well as a general delay in seeking treatment for emergency medical conditions among adult patients.^{1-4,7}

Despite more severe pathology and increased strain on health systems, pediatric surgical consult patients still spent significantly less time in the ED overall and less time waiting for surgical consultations. We suspect that fewer patients in the ED allowed present patients to be triaged more efficiently and to be seen faster.¹⁶ It is also possible that, in an attempt to keep beds open for large influxes of COVID 19 patients, the ED increased efforts to streamline care, thereby decreasing overall ED length of stay.

In terms of the increase in pediatric surgery consultations for laceration repairs in 2020 compared to 2019, a few explanations come to mind. First, the ED was occupied by higher acuity disease pathologies in 2020, necessitating certain procedures, such as laceration repairs and incision and drainage procedures, be offloaded onto consulting services. Second, the lacerations and abscesses may have been more complex in 2020 than in 2019, prompting more frequent surgical consultations. Finally, more pediatric patients with lacerations and abscesses may have presented to the ED for care, as many outpatient offices were closed during the early months of the pandemic or required extensive pre-screening to schedule an appointment. It is unlikely that the increase in ED procedures was related to limited odds ratio availability since the most common procedures, laceration repair and incision and drainage, do not usually require an odds ratio. Further investigation of these trends will allow us to better anticipate the needs of pediatric patients during future public health emergencies and to potentially alter outpatient office protocols to avoid unnecessary trips to the ED.

During future public health crises, it is critically important to identify a method for triaging patients so that those who need immediate care receive timely access to emergency services, while also maintaining open hospital beds for large influxes of patients. Among pediatric patients, one potential avenue for preventing a delay in care is to establish protocols

for pediatricians to evaluate patients with abdominal pain or other potentially surgical complaints via telehealth. There may be a need for increased public health messaging around contacting your primary care physician for advice on whether or not to seek emergency medical attention. Increasing patient communication with primary care physicians may encourage appropriate and timely use of emergency services. In addition, there may be a role for public health campaigns to provide clear messaging regarding concerning signs and symptoms that require immediate medical evaluation.

Limitations

One major limitation of this study is the small sample size from a single institution, which may limit the power and external validity of the study. It was also not possible to gather data on patients for whom we were not consulted, so it is unclear what happened to those patients. However, our institutional is the only pediatric emergency room in western Massachusetts and many outpatient clinics were strictly limiting in-person visits or converting entirely to telehealth, so it is unlikely patients were seeking care elsewhere. In addition, it was difficult for us to determine exactly when the patient was seen because we only have access to the time the consultation was placed and the time the note was written. This may lead to misclassification bias.

Conclusions

During the early stages of the COVID-19 pandemic, western Massachusetts saw a decline in pediatric surgical consultations; however, more consultations required a bedside procedure, and more patients were diagnosed with complicated appendicitis. While these trends may be due to a generalized reluctance to seek medical care related to quarantine orders and/or fear of contracting COVID-19 at the hospital, further investigation is needed to ensure whether patients are receiving adequate care during future pandemics or emergency situations.

Supplementary Materials

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jss.2022.06.019>.

Author Contributions

M.T. and H.G. contributed to study concept and design. J.E.S. and H.G. performed data acquisition. Analysis and data interpretation completed by A.P.C., H.G., and J.E.S. H.G. and J.E.S. drafted the manuscript and critical revision was performed by H.G., J.E.S., and M.T.

Disclosure

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