

The effect of Covid-19 on pediatric surgical case volume

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Keypoints

This study demonstrated how the pediatric surgical case volume of one hospital was affected by the policy changes in response to the pandemic and how concomitant COVID-19 infection affected outcomes in patients who proceeded with surgery.

Abstract

Introduction

The COVID-19 pandemic has had an unprecedented effect on hospital systems. Policy changes lead to decreased hospital visits as well as surgical case volume. The literature on pediatric surgical case volume during the pandemic is sparse. Throughout the country, hospitals sought various policies to preserve personal protective equipment and other hospital resources, and to minimize avoidable peri- and postoperative sequelae due to COVID-19 infection. Our hospital first placed a hold on all elective surgeries. Later, all elective cases required a preoperative negative COVID test prior to proceeding. We sought to review the sequelae of our hospital's policy in response to COVID-19. We identified trends in surgical case volume and cancellations due to a positive COVID-19 test. We also reviewed postoperative outcomes of cases with a positive test.

Material and Methods

This study was approved by the institutional IRB. Data was retrospectively collected on all surgical cases at our children's hospital between March 2019 and March

2021. We marked the start of the COVID-19 pandemic as March 2020, when elective cases were suspended. A required preoperative negative COVID-19 test was implemented in May 2020. We identified pre-operative COVID-19 test results, the posted urgency of each case and 30-day outcomes from medical records.

Results

From March 2019 to March 2021, we identified 25,496 completed surgeries and 3,503 cancellations. 12,024 cases proceeded during the first year of the pandemic, which appeared lower, compared to pre-pandemic case numbers. Of those, 2,785 (23%) cases were considered urgent or emergent. The average number of completed monthly cases fell from a pre-pandemic number of 1,123 to a pandemic number of 925. When comparing to a pre-pandemic month, average monthly case volume declined by 19%, with the largest decline noted to be 66%. There was a monthly average of 189 total cancellations between March 2020 and March 2021. 34 (18%) of those were for a positive preoperative COVID test. A total of 139 surgeries commenced despite concomitant COVID-19 infection. 25 (18%) had identifiable respiratory symptoms

documented preoperatively. 13 (9 %) were deemed to have a respiratory complication afterward. Of those, three patients (2%) had a prolonged, and one (1%) had an unexpected reintubation. The remaining nine (6%) patients had a prolonged oxygen requirement.

Conclusion

The COVID pandemic left operating rooms struggling to determine how to safely provide care to patients. This study demonstrated how the policies of one hospital affected the operating room case volume and how concomitant COVID infection affected outcomes in those that proceeded with surgery.

Keywords

COVID-19, policy, surgical volume, respiratory complications

Introduction

The COVID-19 pandemic resulted in a reduced workforce across all sectors with an unprecedented challenge for healthcare systems (1). Throughout the country, hospitals sought various policies to preserve personal protective equipment and other hospital resources, and to minimize avoidable peri- and post-operative sequelae due to COVID-19 infection. Recommendations regarding surgical practice during the start of the pandemic included cancellation of elective or non-emergent cases, redeployment of operating room (OR) staff to other areas with surged capacity, and repurposing ORs as critical care areas (2). Also, fear amongst the public led to decreased hospital visits as well as surgical case volume. The effect on cardiac surgical volume and its associated costs was studied in the University of Pittsburgh, with findings revealing significant estimated reduction in case volume, loss in hospital revenue and cumulative backlog of patients (3). Shao Et al. with the University of Alabama found that their surgeries became increasingly outpatient but that patients undergoing emergent surgery were more likely to be septic at time of procedure, although with similar outcomes when compared to pre-pandemic cases (4). A study at the University of Manitoba found an increased risk of respiratory complications in pediatric

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patients with upper respiratory infection who underwent endotracheal anesthesia by 11-fold (5). The effect of the pandemic on surgical case volume has been poorly studied in the pediatric setting and our aim was to further assess the degree of impact of COVID-19 on surgical case volume at our pediatric tertiary care center. On March 11, 2020, COVID-19 was declared a pandemic by the World Health Organization (WHO). On March 13, 2020, the president declared a national health emergency (6). Two days later, the governor of our state did the same (7). Our hospital first placed a hold on all elective surgeries due to an amendment to an executive order from the governor (8). Later, in May of 2020, all cases deemed elective required a preoperative negative COVID-19 test prior to proceeding due to hospital policy based upon the guidance of the governor's amendment to that order (9). Our primary aim was to assess the degree of impact of the COVID-19 pandemic upon surgical case volumes at our tertiary pediatric hospital. Our secondary objective was to investigate the outcome of patients who underwent surgery despite testing positive for COVID-19.

Material and methods

This study was approved by the IRB (#14735). Data was retrospectively collected on all surgical cases at our tertiary children's hospital between March 2019 and March 2021. The start of the COVID-19 pandemic was marked as March 2020. On May 2020, the hospital began a policy requiring a negative preoperative COVID-19 test for all patients scheduled for elective surgery. The data collected included all completed and cancelled cases for each month, patients' surgery date, cancellation status, cancellation reason, specialty, COVID-19 test result, urgency of case, and cases that proceeded despite a preoperative positive COVID-19 test. The 30-day outcomes of those that proceeded despite a concomitant positive COVID-19 test result were obtained through electronic medical record review and further classified into prolonged oxygen requirement, prolonged intubation, and unexpected re-intubation or other non-respiratory complication. The average yearly and monthly case numbers were determined

and the percent change between the pandemic month and the same month before the pandemic (March 2020) was calculated. The total cancellations and cancellations due to a positive COVID-19 test were compared by year and month. The 30-day outcomes were analyzed, and the percentage with postoperative respiratory complications were obtained.

Results

We identified 25,496 completed cases and 3,503 cancellations between March 2019 and March 2021. 13,472 procedures proceeded the year prior to the start of the pandemic and 12,024 cases proceeded during the first year of the pandemic, which was a 10.7% decline. 2,851 (21%) and 2,785 (23%) of the completed surgeries were classified as urgent or emergent in 2019 and 2020, respectively.

When comparing a month’s volume during the pandemic to the same month before, the average monthly number of completed procedures dropped from 1,123 to 925. This was consistent with an average 19% decline in case volume (Figure 1).

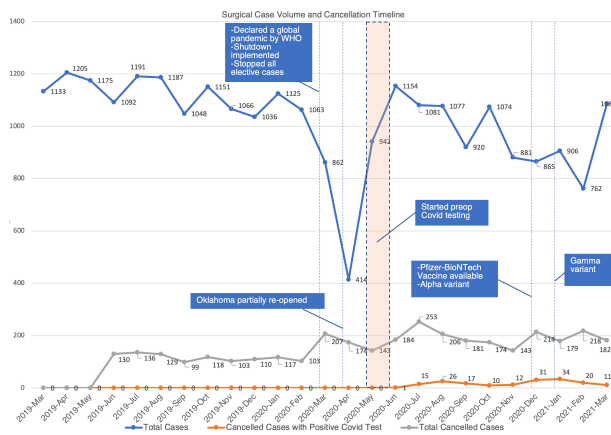


Figure 1. Surgical case volume, cancellations, and cancellations due to positive COVID-19 test between March 2019 and March 2021

The largest drop in case numbers was noted to be 66% between April 2019 (1,205) and April 2020 (414). Procedures increased by 26% between March 2020 (862) and March 2021 (1,086) (Table 1).

Change in Pediatric Surgical Case Volume Between Pre-Pandemic and Pandemic Months				
Pre-Pandemic Month	Case Number	Pandemic Month	Case Number	% Change
2019-Mar	1133	2020-Mar	862	-24%
2019-Apr	1205	2020-Apr	414	-66%
2019-May	1175	2020-May	942	-20%
2019-Jun	1092	2020-Jun	1154	6%
2019-Jul	1191	2020-Jul	1081	-9%
2019-Aug	1187	2020-Aug	1077	-9%
2019-Sep	1048	2020-Sep	920	-12%
2019-Oct	1151	2020-Oct	1074	-7%
2019-Nov	1066	2020-Nov	881	-17%
2019-Dec	1036	2020-Dec	865	-17%
2020-Jan	1125	2021-Jan	906	-19%
2020-Feb	1063	2021-Feb	762	-28%
2020-Mar	862	2021-Mar	1086	26%

Table 1. Change in pediatric surgical case volume by month.

There was a total of 3,503 cancellations between March 2019 and March 2021. 1,045 and 2,459 cancellations occurred over the course of 9 months preceding the pandemic and during the first year of the pandemic, respectively. The average monthly number of canceled procedures was 116 leading up to the start of the pandemic compared to 189 during the first pandemic year, which was a 62.9% increase. Cancellations were most commonly due to patient request, change in patient’s health status, COVID-19, no need for surgery, and unknown reasons (Table 2). The total number of cancellations due to a positive pre-operative COVID-19 test during the first pandemic year was 438 (18%) whereas the monthly average of canceled cases was 34 (18%). The pediatric surgery, urology, and otolaryngology services had the highest number of cancellations in the time leading up to the start of the pandemic, with 163 (15.6%), 116 (11.1%), 106 (10.1%) cancellations, respectively (Figure 2). The same three services remained on the podium in the same order for number of cancelled procedures during the first year of the pandemic (Figure 3).

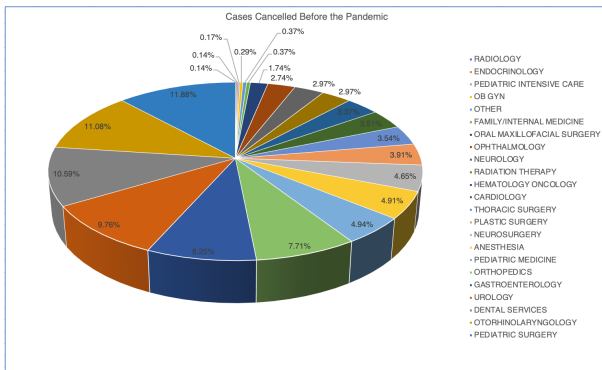


Figure 2. Cancelled cases leading up to the pandemic categorized by specialty.

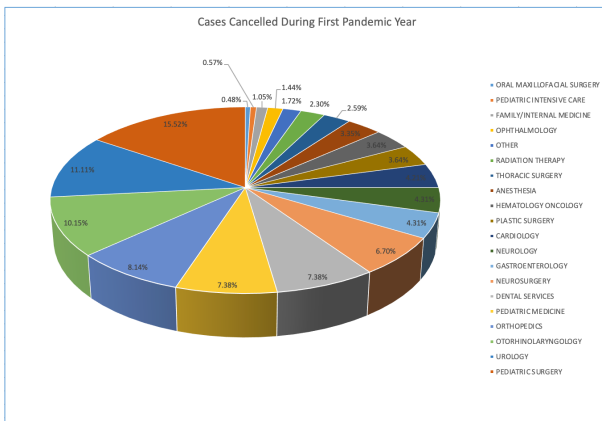


Figure 3. Cancelled cases during the pandemic categorized by specialty.

We looked back at a larger date range for cases that proceeded despite a positive COVID-19 test. During mandatory preoperative testing, there was a total of 139 patients that proceeded with surgery.

Of those cases, 42 (30%) were still classified as elective, 79 (57%) as urgent, and 18 (13%) as emergent. Of those with a documented COVID-19 infection that proceeded with surgery, 25 (18%) had documented identifiable respiratory symptoms pre-operatively.

32 (23%) of those had a complication, which was defined as requiring additional unexpected care within 30 days of surgery date.

We then subclassified these 32 patients' complications. Eight (6%) patients had an emergency department visit, 2 (1%) were re-admitted, and 8 (6%) required an additional procedure (Table 3). 13 (9%) were considered to have a respiratory complication, such as prolonged

oxygen requirement, prolonged intubation, or unexpected re-intubation, after surgery.

Nine (6%) patients had a lengthened oxygen requirement, three (2%) had a prolonged intubation, and one (1%) had an unexpected re-intubation (Table 4).

CANCELLATION REASON	CANCELLED CASES
CANCELLED BY PATIENT	535 (15.27%)
PATIENT MED STATUS CHANGE/PT ILL	467 (13.33%)
CANCELLED OR RESCHEDULED FOR COVID 19	438 (12.50%)
REASON UNKNOWN	414 (11.82%)
SURGERY NOT NEEDED	402 (11.48%)
PATIENT NO SHOW	177 (5.05%)
PATIENT/FAMILY ISSUES	135 (3.85%)
DUPLICATE APPOINTMENT	131 (3.74%)
SCHEDULING ERROR/WRONG PATIENT SCHEDULED	129 (3.68%)
INCLEMENT WEATHER	114 (3.25%)
MEDICAL CLEARANCE/LABS NEEDED	75 (2.14%)
PROCEDURE ALREADY DONE/PREVIOUSLY COMPLETED	63 (1.80%)
OTHER REASON	61 (1.74%)
CASE BUMPED BY EMERGENCY	56 (1.60%)
BY DOCTOR	53 (1.51%)
PATIENT NOT NPO	46 (1.31%)
EQUIPMENT MALFUNCTION/FAILURE	44 (1.26%)
PHYSICIAN EMERGENCY/UNAVAILABLE	30 (0.86%)
PREOP WORKUP/EVAL INCOMPLETE	26 (0.74%)
PAYMENT/INSURANCE AUTHORIZATION ISSUES	25 (0.71%)
STAFF UNAVAILABLE	21 (0.60%)
INADEQUATE PREP	16 (0.46%)
RESCHEDULED	14 (0.40%)
EQUIPMENT FAILURE/NOT AVAILABLE	11 (0.31%)
ABNORMAL LAB RESULTS	10 (0.29%)
PERMITS NOT SIGNED/UNAVAILABLE	10 (0.29%)

Table 2. Cancellations prior to and during pandemic categorized by reason.

Surgeries Performed Despite Concomitant COVID-19 Infection	n	%
Total Number of Patients	139	
Preoperative Symptoms	25	18%
Emergent	18	13%
Urgent	79	57%
Elective	42	30%
Complications*	32	23%
Respiratory	13	9%
Postoperative ED Visit	8	6%
Readmission	2	1%
Additional Procedure	8	6%

*Defined as requiring additional unexpected care within 30 days of surgery date.

Table 3. Patients that proceeded with surgery despite positive COVID-19 test.

Respiratory Complications	n	%
Total Number of Patients	13	9%
Required O2 Postoperatively	9	6%
Prolonged Intubation	3	2%
Reintubated	1	1%

Table 4. Respiratory complications of patients who proceeded with surgery despite positive COVID-19 test.

Discussion

In December, there was also a slight increase in procedures performed when the Pfizer-BioNTech vaccine first became available to healthcare professionals. However, the overall number of completed surgeries (12,024) remained lower than pre-pandemic levels (13,472), with a drop observed during the Gamma variant wave in January 2021 (6). Other institutions experienced similar trends in surgical case volume during this period (10, 11). The overall case cancellations after March 2020 appeared higher than before March 2020. There was an average monthly increase of 73 cancellations (62.9%). The number of cancelled cases due to a positive COVID-19 test between March 2020 and May 2020 was nonexistent as readily available tests were scarce in that period. We hypothesize that the case volume at this time was still low due to less elective surgeries scheduled due to lower

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clinic volume and a high level of community caution. Once an acceptable test was distributed, the hospital began to request a negative pre-operative COVID-19 test prior to proceeding with surgery for all elective procedures (9). The cancellations due to a positive test accounted for 438 (18%) of the total cancellations during the first year of the pandemic, which may account for the increase in total cancellations when compared to before March 2020. Additional top cancellations reasons, such as patient request, patient illness or unknown reasons. We believe that many of the cancellations during the first pandemic year may have been related to fear of the hospital environment among the public. The monthly levels of cancellations also appeared to change with respect to our timeline events. For example, cancellations increased at the start of the pandemic, with halt of elective cases, with the enforcement of pre-operative COVID-19 testing, and with the rise of the gamma variant. There was a decrease in cancelled cases when the state of Oklahoma partially re-opened and when the vaccine became available (6-9). Levy Et al. found surgical volumes among all Maryland hospitals to be 55.8% lower in the second quarter of 2020 when compared to the second quarter of 2019, and by the fourth quarter of 2020, most service lines were within 15% of fourth quarter 2019 volumes. They also noted a partial rebound that stalled in the last quarter of 2020 (12). Another study in New Orleans also explored monthly case numbers during this period and found the largest reduction (77%) to be in April 2020 (13).

The specialties with the highest number of cancellations remained the same between 2019 and 2020, with pediatric surgery, urology, and otolaryngology at the top. This may differ by hospital, as seen in a Maryland hospital system where the orthopedic service was found to be most affected (12).

During the first pandemic year, the majority (121/139, 70%) of surgeries that were completed despite testing positive for COVID-19 preoperatively were classified as emergent or urgent. 23% (32) of the patients that proceeded with surgery with a concomitant COVID-19

infection had either a postoperative respiratory complication, an emergency department visit, a re-admission, or an additional procedure within 30 days after surgery. After chart review, over half (19, 59%) of these events were likely associated with the underlying illness that led to proceeding with surgery initially. For example, a cancer patient who underwent a port placement to initiate chemotherapy returned with chemotherapy-related adverse effects. For those that had a subsequent procedure, all cases were scheduled as staged or in response to the patient's original admission diagnosis and did not appear to be as result of a positive COVID-19 infection. For example, a patient underwent two additional incision and drainage procedures for necrotizing fasciitis. Kilgore Et al. studied the difference in morbidity or mortality in neurosurgery procedures between 2019 and 2020 and found no difference (13). 18% (25) of patients that proceeded to the operating room had documented pre-operative respiratory symptoms. However, only 9% (13) had respiratory complications postoperatively. This is considered low compared to the documented incidence of up to 28.1% of postoperative respiratory events in other studies (14, 15). Upon further review, only 6% (8) of patients had a prolonged oxygen requirement, which may be expected immediately after surgery based on other prior studies with documented similar rate (14). The literature on prolonged postoperative oxygen requirement in patients with upper respiratory infection is variable, with no difference to up to 20% increased risk reported (16, 17). 2% (3) and 1% (1) of patients had a prolonged intubation and re-intubation, respectively. The University of Columbia reported a 0.1% risk of re-intubation in a peri-operative population of over 28,000 pediatric patients (18). The incidence discrepancy may be attributed to our much smaller population and the nature of the patient's initial diagnosis.

Conclusion

The COVID-19 pandemic stunned the healthcare system with operating rooms struggling to determine how to safely provide care to patients. This study demonstrated how the pediatric surgical case volume of one hospital

was affected by the policy changes in response to the pandemic and how concomitant COVID-19 infection affected outcomes in patients who proceeded with surgery.

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No conflict of interest to declare.

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