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Concordance of Pre-Procedure Testing With Time of Surgery Testing for SARS-CoV-2 in Children

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Abbreviations:

COVID-19: coronavirus disease 2019

SARS-CoV-2: severe acute respiratory syndrome coronavirus 2

RT-PCR: reverse transcriptase polymerase chain reaction

PPE: personal protective equipment

ENT: ear nose throat

GI: gastrointestinal

Contributors Statement Page

Dr. Lin conceptualized and designed the study, collected data, carried out the analysis, drafted the initial manuscript, reviewed, and revised the manuscript.

Dr. Elikplim conceptualized and designed the study, designed the data collection instruments, collected data, and reviewed and revised the manuscript.

Dr. Sobilo collected data, and reviewed and revised the manuscript.

Dr. Young, Dr. Harris, and Dr. John conceptualized and designed the study, coordinated and supervised data collection, and reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Introduction

Surgery in patients with COVID-19 is associated with increased mortality and complications.¹ Procedures may generate aerosols or require endotracheal intubation, increasing risk of occupational exposure of healthcare workers. As medical centers navigate aerosol generating procedures, pre-procedure testing is important for patient and provider safety. Testing for severe acute respiratory syndrome coronavirus 2 virus (SARS-CoV-2) immediately before the procedure would yield the most accurate results. However, scheduling logistics and inadequate turnaround times often necessitate pre-procedure testing several days in advance. Thus, patients may have negative pre-procedure testing, yet have active viral replication at the time of surgery. Although patients are instructed to monitor for symptoms after testing, symptom reporting is likely to be insensitive in children, since most have mild or no symptoms.²⁻⁴ The purpose of this study was to determine whether pre-procedure testing up to 3 days prior to surgery was concordant with testing performed at the time of surgery in children.

Methods

Children presenting for surgery at the Children's Hospital of Philadelphia (CHOP) are required to have a RT-PCR-based nasopharyngeal SARS-CoV-2 test within 3 days of surgery. From July 10, 2020 to October 9, 2020, a convenience sample of patients under the age of 18 who had negative pre-procedure testing and lacked symptoms of COVID-19 had nasopharyngeal samples taken after anesthesia induction. Pre-procedural samples taken 1-3 days prior to surgery, as well as at the time of surgery, were analyzed for the presence of SARS-CoV-2 with a CHOP in-house laboratory developed RT-PCR assay, which has a 6-10 hour turnaround time. The N2 primer and

probe used in the assay are the same as the Centers for Disease Control-developed assay and authorized by the United States Food and Drug Administration. The cycle threshold for a positive test was 40. The limit of detection for this assay is approximately 20,000 copies/mL, and the specificity was 100% as determined through wet testing against common respiratory pathogens and by in silico analysis. Pre-procedural samples taken on the day of surgery were analyzed by our in-house lab for the presence of SARS-CoV-2 with the Xpert Xpress SARS-CoV-2 assay from Cepheid Inc. (Sunnyvale, CA), a RT-PCR rapid assay with a 45 minute turnaround time. This test targets the E and N2 genes of SARS-CoV-2 and contains an exogenous processing control. It has a limit of detection of 0.01 plaque-forming units/mL, with a reported negative percent agreement of 95.6%. (<https://www.fda.gov/media/136314/download>)

The study was approved by the Institutional Review Board (IRB 20-017635) and informed consent was obtained from guardians. Race and ethnicity were self-reported by parents/guardians during surgery registration. Race and ethnicity of this cohort are described because minorities have higher reported rates of SARS-CoV-2 infection⁵ and racial/ethnic composition may affect overall positivity rates and likelihood of exposure to SARS-CoV-2 between time of pre-procedural testing and time of surgery. Time of surgery test results were compared to pre-procedure results with Pearson's chi-squared test.

Results

241 pediatric surgical patients were included in this study, with a mean (SD) age of 7.2 (5.5) years (range 7d – 18 y). Gender, race, and ethnicity are described in table 1. 12 surgical procedure types were identified. 10.8% of patients had pre-procedure testing on day of surgery,

27.4% one day prior, 54.8% two days prior, and 7.1% three days prior to surgery (Table 1).

There was 100% concordance of testing with all subjects with negative pre-procedure testing having negative time of surgery SARS-CoV-2 RT-PCR ($p < 0.01$).

Discussion

In this cohort of asymptomatic children with negative pre-procedure testing, there was 100% concordance with time of surgery testing. The vast majority (93%) of subjects had testing performed within 2 days of their surgery. This data should be interpreted in the context of community prevalence.⁶ With any test, the negative predictive value will decrease with increased prevalence. During the three-month period of this study, inpatient and outpatient testing positivity rates in our pediatric healthcare network ranged from 1.1-4.5%. In an area of relatively low community transmission, pre-procedure testing of children within 2 days of surgery appears to be a reasonable strategy for balancing the safety of patients and staff with logistical testing and surgical scheduling issues.

There are several limitations to our study. We retested a subset of patients undergoing surgery, due to need for consent and testing resource availability. However, we believe we captured a representative cross-section of ages and surgical procedure types. Our study also does not address the sensitivity of nasopharyngeal RT-PCR testing for SARS-CoV-2.

As pediatric specialists grapple with how to make procedures safer in the setting of COVID-19, testing guidelines must evolve based on the patient population, community prevalence, and

logistical realities. A negative test cannot rule out SARS-CoV-2 infection, and use of appropriate PPE remains essential.

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Table 1: Demographics

Characteristic	No. (%)
Age, mean (SD), y	7.2 (5.5)
Male	139 (57.7%)
Race	
White	159 (66%)
Black	34 (14.1%)
Asian	7 (2.9%)
Multi-racial	4 (1.7%)
Unknown	37 (15.4%)
Ethnicity	
Hispanic	26 (10.8%)
Non-Hispanic	212 (88%)
Unknown	3 (1.2%)
Surgical procedure type ¹	
ENT	83 (34.4%)
General Surgery	37 (15.4%)
Plastics	23 (9.5%)
Urology	22 (9.1%)
Dental	21 (8.7%)
Neurosurgery	17 (7.1%)
Pulmonary	15 (6.2%)
GI endoscopy	13 (5.4%)

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Orthopedic	12 (5.0%)
Oral and maxillofacial surgery	2 (0.8%)
Oncology	1 (0.4%)
Transplant	1 (0.4%)
Pre-procedure SARS-CoV-2 testing ²	
0 days prior to surgery	26 (10.8%)
1 day prior to surgery	66 (27.4%)
2 days prior to surgery	132 (54.8%)
3 days prior to surgery	17 (7.1%)

¹May have more than 1 procedure per surgical case, with sum greater than 100%

²Testing 0 days prior to surgery with Xpert Xpress SARS-CoV-2 RT-PCR rapid assay. Testing 1-3 days prior to surgery and at time of surgery with CHOP in-house developed RT-PCR assay.

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