


Universal COVID-19 pre-procedural swabs in children in a developing country: A comparison of findings over two transmission waves

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Abstract

Aim: The Coronavirus disease (COVID-19) pandemic has strained healthcare systems worldwide. Some institutions have implemented additional precautionary measures such as pre-procedural swabbing (PPS) to reduce transmission in patients and healthcare workers. We evaluate our experience with universal pre-procedural screening for COVID-19 in low-risk pediatric patients.

Methods: We performed a retrospective review of patients aged 18 years and below who underwent severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) real-time reverse transcription-polymerase chain reaction (rRT-PCR) assay swabs in our center over two waves (1st May 2020 to 31st July 2020 and 1st April 2021 to 30th June 2021). We included patients who underwent rRT-PCR for SARS-CoV-2 prior to any procedures requiring general anesthesia and were deemed low risk for COVID-19 according to our institutional screening criteria. All study patients were followed up for 14 days post-procedure.

Results: Of 2065 swabs done for patients aged 18 years and below during the study period, 645 (31.2%) were pre-procedural swabs. Patients were aged 4.2 years (median, interquartile range: 1.6 years–9.8 years). Two patients (0.3%) tested positive for COVID-19 by PPS, detected during Period 2 – both had risk criteria which were overlooked by healthcare workers. Within 14 days post-procedure, 10 patients had unscheduled readmissions and 15 required repeat rRT-PCR, all of which were negative.

Conclusions: In patients deemed low risk for COVID-19 infection according to our screening criteria, routine pre-procedural swabbing returns a low positive rate. Our findings can guide screening protocols at institutions that provide surgical services during the COVID-19 pandemic.

Keywords

COVID-19 testing, preoperative care, pediatrics, real-time reverse transcription-polymerase chain reaction

Introduction

In the months since the start of the global pandemic in early 2020, much has been written on the differences between adult and pediatric manifestations of COVID-19. The overwhelming wealth of data in the adult population contrasts with the relatively sparse data on children, with many pediatric COVID-19 guidelines drawing heavily from recommendations made for adults.

Among key differences are that children are more likely to be asymptomatic carriers of COVID-19, and more likely to experience a milder course of the infection compared to

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adults and can thus contribute to community spread of COVID-19.^{1,2}

One of the challenges in pediatric surgical services during the pandemic has been maintaining the balance between reducing the risk of viral exposure to anesthetic and surgical teams, while continuing to provide much needed surgical procedures. Universal preoperative screening processes such as questionnaires, swab tests, and pre-operative isolation, have been implemented in centers worldwide to ensure that elective surgery can continue safely. According to a multi-center study, the detection of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in children preoperatively was 0.58% and the majority of them were asymptomatic.³ Another study reported that only 0.1% of pediatric patients within 14 days of their operation had to be readmitted for symptoms that were likely attributable to SARS-CoV-2.⁴ We have previously published our early experience with routine pre-procedural swabs (PPS) in children during the early days of the pandemic.⁵ In this study, we aim to compare and contrast our experience with universal preoperative and pre-procedural swabbing (PPS) for COVID-19 in children undergoing surgery with low risk of having the infection across 3-month-periods in 2020 and 2021. These 2 periods coincide with infection waves in our country.

Methods

This was a cross sectional study using retrospectively collected data that was retrieved from electronic records in our hospital, which is a university-affiliated academic medical center. We collected the data of all patients aged 18 years and below who underwent SARS-CoV-2 real-time reverse transcription–polymerase chain reaction (rRT-PCR) assay swabs in our center over 2 periods in the pandemic:

1. Period 1: 1st May 2020 to 31st July 2020
2. Period 2: 1st April 2021 to 30th June 2021

Both these periods were during times of heightened federally mandated lockdowns, the first coinciding with the first wave of the pandemic in our country, while the second was during a massive surge in the number of positive cases due to the Delta variant.

Our institution serves a densely populated urban area which experienced high community transmission during the study periods.

Study participants and eligibility criteria

We reviewed all patients 18 years or below who had a pre-procedural swab for any procedure requiring general anesthesia, such as surgery or imaging. We collected the following data: demographic details, procedure, swab test results, any repeat unscheduled visits within 14 days post swab, and results of any repeat swabs within 14 days of the index swab.

As part of our hospital protocol, all patients undergoing any procedures requiring general anesthesia were evaluated for the symptoms and risk factors for COVID-19 using a standard checklist, which included the following questions.

1. Presence of COVID-19-related symptoms—fever, cough, sore throat, shortness of breath, coryza, and loss of or reduced sense of smell.
2. High-risk contact in the preceding 14 days
 - a. direct contact with anyone confirmed or suspected to have COVID-19.
 - b. attendance at mass gathering events, such as conferences, places of worship, large weddings.
 - c. international travel from another country

They were then grouped as ‘low-risk’ if they did not fulfill the criteria above and considered eligible for our study.

When any criteria from the above checklist was fulfilled, the patient was then classified as a ‘Person Under Investigation’ and further precautionary steps were taken to avoid healthcare worker (HCW) transmission. They were considered not eligible for this study and further investigations were done according to an institutional workflow for suspected COVID-19 cases.

For patients going for emergency surgery, negative swab results were not required before the surgery but influenced and guided the post-operative management. For elective surgeries, negative swab results were needed before the surgery.

Categorization of types of surgery according to urgency

We applied the definitions below which were based on government-issued guidelines by the Ministry of Health of Malaysia to classify the type of surgery and their priorities.

1. Elective surgery
 - a. Malignancy - case requiring operative procedure within 1 month after diagnosis is made and patient is fully optimized
 - b. Non-Malignancy - Case requiring operative procedure within 3 months, failing which it becomes an emergency.
2. Emergency surgery
 - a. Acute Emergency - Patient requires immediate operation
 - b. Emergency - Patient is hemodynamically stable but condition will become life-threatening or patient morbidity will increase if the operative procedure is not carried out
 - c. Urgent - Patient requires an operative procedure within 24 h, failing which the patient will experience increased risk of morbidity
 - d. Semi-urgent - Patient requires an operative procedure within 1 week, failing which the patient will experience increased risk of morbidity.

Procedure and protocol for pre-procedural swabbing

Once deemed ‘low risk,’ patients are brought with a parent to an isolation negative pressure room for the swab. A designated team of trained medical personnel performs the swab in pairs. They don personal protective equipment (PPE), which consists of fit-tested disposable N95 respirators, face shields, long-sleeved gowns, double-layered gloves, and protective

footwear to achieve maximum contact, droplet and airborne isolation protection.

SARS-CoV-2 RNA (ribonucleic acid) detection

Respiratory samples, primarily combined oronasopharyngeal swab samples, were tested for SARS-CoV-2 by real-time reverse transcription polymerase chain reaction (rRT-PCR) using the Allplex™ SARS-CoV-2 Assay, which detects the envelope (E), nucleocapsid (N), RNA-dependent RNA polymerase (RdRp) gene and spike (S) genes. The rRT-PCR results were interpreted according to the manufacturer's instructions.

The cost of one test was approximately MYR90 in our centre. Turnaround time for a standard test was between 4 and 10 hours, depending on the timing of the test runs, which were performed in batches through the day balancing cost with efficiency. There was an option to run a rapid test with a 1 hour turnaround time, for which there were institutional guidelines on the appropriate indications. There were no nosocomial SARS-CoV-2 infections amongst paediatric patients during both study periods.

Follow-up

We looked through the records to check if any additional swabs or readmission to the hospital took place within 2 weeks post-procedure. All patients were followed up for 2 weeks post-procedure to assess COVID-19-related symptoms, considering an incubation period of up to 14 days.

Ethical approval

The study was approved by the Medical Research Ethics Committee of University of Malaya Medical Center (MREC ID NO:2021123-9746) and conducted in accordance with the Declaration of Helsinki. According to the institutional ethical review board, this study was considered exempt from requiring consent from human subjects.

Data analysis

We performed a descriptive analysis, with data presented as median (interquartile range) and proportions described as *n* (%).

Results

A total of 2065 swabs were collected for patients under 18 years old during period 1 and period 2 cumulatively. Period 2 (April 2021 to June 2021) saw a 3-fold increase in the total number of swabs compared to Period 1 (May 2020 - July 2020). In period 1, 83.4% of the total swabs were classified as pre-procedural swabs, while in period 2, the proportion of swabs classified as pre-procedural swabs decreased to 15.9%. (Table 1). This was commensurate with a time when Malaysia was facing a surge in cases due to the Delta variant. Also, the number of elective cases was curbed due to intense pressure on healthcare services. The median age for patients in our study was 4.2 years (interquartile range: 1.6 years–9.8 years) (Table 2). The highest number of

patients came from the primary school age category (6–12 years old) for both periods. There were more male patients for both periods at 61.7% in May 2020–July 2020 and 67.6% in April 2021–June 2021. The most common specialty requesting for pre-procedural swabs was general pediatric surgery for the two periods, comprising a total of 211 patients, followed by Orthopedics (141) and Neurosurgery (57). Procedural cases (surgery or endoscopy) dominated the study with 91.1% (357) and 95.7% (242) for both periods. Elective surgery took up most of the surgeries for both periods.

From the total number of pre-procedural swabs taken in the first timeframe, all were negative. As for the second period of this study, there were 2 positive swabs out of 253 swabs (0.8%). Overall, the positive rate was 2 out of 645 swabs (0.3%). It was found that both patients had risk criteria for COVID-19 which were overlooked by healthcare workers initially. In the 10 patients who had unexpected readmission within 14 days post-procedure, none of them presented with symptoms suggestive of COVID-19 except for 1 patient in Period 2 who represented with fever and was diagnosed with acute tonsillitis. The repeated rRT-PCR swab for this patient turned out to be negative. (Table 3).

Discussion

Our results show that when patients are at low risk for COVID-19 infection according to our screening criteria, routine pre-procedural swabbing returns a low positive rate. This pattern remains even when there is dramatic escalation in community transmission.

To provide some context to our results, in the first period of study, there were 232 COVID-19 cases in children and adolescents in Malaysia, constituting 7.8% of total COVID-19 infections in the country. In the second period of our study, there were 77,177 COVID-19 cases among children and adolescents, accounting for 18.9% of total COVID-19 infections in the country.⁶

Our finding of a low positive rate (0.3%) from routine pre-procedural swabbing among pediatric patients is consistent with prior studies. In fact, in these 2 positive cases, it was eventually discovered that healthcare workers had overlooked positive epidemiological risk criteria.³ A multicenter study on universal preoperative screening from the United States reported that 0.93% among 1295 pediatric patients tested positive for COVID-19.⁷ A single-center study from a children's hospital in the United States reported that 1.4% of pre-procedural patients tested positive for COVID-19.⁸ Our previous study from Malaysia found that none of the 66 low risk, asymptomatic pediatric patients were positive for COVID-19 during pre-procedural swabbing with rRT-PCR.⁵ The decision to institute a universal pre-procedural swabbing protocol depends on the availability of local resources, transmission rates and sociocultural factors. The current study describes our experience in an urban, tertiary, academic center in Malaysia, an upper-middle-income country.

Some might question the value of performing routine PPS in view of the low positive rates. However, we believe that pre-procedural swabs can still be very useful as many pediatric patients with COVID-19 are either asymptomatic or present with mild unrecognized symptoms.⁹ There is evidence showing that children, even those asymptomatic or

Table 1. Number and percentage of pre-procedural swabs.

	May 2020–July 2020	April 2021–June 2021	Total
Total number of swabs done for patients under 18 years old	470	1595	2065
Number of swabs classified as pre-procedural swab (%)	392 (83.4)	253 (15.9)	645 (31.2)
Total number of individual patients who underwent pre-procedural swabbing	366	225	591

Table 2. Demographics of the patients who underwent pre-procedural swabbing based on number of swabs.

	May 2020–July 2020	April 2021–June 2021	Total
Age group			
Neonate (first 4 weeks of life) (%)	9 (2.3)	6 (2.4)	15 (2.3)
Infant (1 month–1 year) (%)	71 (18.1)	41 (16.2)	112 (17.4)
Toddler (1–3 years) (%)	82 (20.9)	52 (20.6)	134 (20.8)
Preschool (3–5 years) (%)	65 (16.6)	54 (21.3)	119 (18.4)
School age (6–12 years) (%)	107 (27.3)	70 (27.7)	177 (27.4)
Adolescent (13–18 years) (%)	58 (14.8)	30 (11.8)	88 (13.6)
Services			
General pediatric surgery (%)	132 (33.7)	79 (31.2)	211 (32.7)
Orthopedics (%)	93 (23.7)	48 (19.0)	141 (21.9)
Neurosurgery (%)	39 (9.9)	18 (7.1)	57 (8.8)
Otorhinolaryngology (%)	28 (7.1)	24 (9.5)	52 (8.1)
Ophthalmology (%)	22 (5.6)	18 (7.1)	40 (6.2)
Pediatric gastroenterology (%)	20 (5.1)	15 (5.9)	35 (5.4)
General pediatrics (%)	10 (2.6)	5 (2.0)	15 (2.3)
Oral & maxillofacial surgery (%)	18 (4.6)	12 (4.7)	30 (4.7)
Others ^a (%)	30 (9.2)	34 (13.4)	64 (9.9)
Gender			
Male, n (%)	242 (61.7)	171 (67.6)	413 (64.0)
Female, n (%)	150 (38.3)	82 (32.4)	232 (36.0)
Procedure			
Surgery/Endoscopy, n (%)	357 (91.1)	242 (95.7)	599 (92.9)
Imaging, n (%)	35 (8.9)	11 (4.3)	46 (7.1)
Setting			
Emergency, n (%)	68 (17.3)	59 (23.3)	127 (19.7)
Elective, n (%)	324 (82.7)	194 (76.7)	518 (80.3)

^aIncludes Pediatric Oncology, Dental, Plastic surgery, Anesthesiology, Breast Surgery, Medical, Hematopoietic Stem Cell Transplant, Obstetrics and Gynecology, Urology, Cardiothoracic surgery, Pediatric Endocrinology and Pediatric Neurology.

Table 3. Results of pre-procedural swabbing in low-risk patients & their follow up based on number of swabs.

	May 2020– July 2020	April 2021– June 2021	Total	
Number of pre-procedural swabs done	392	253	645	
Number of positive results (%)	0 (0)	2 ^a (0.8)	2 (0.3)	
Number of patients with unexpected readmission in 14 days post-procedure	Symptoms suggestive of COVID-19 infection	1	1	
	Complications related to procedure	5	3	8
	Reasons unrelated to procedure	1	0	1
	Total (%)	6 (1.5)	4(1.6)	10(1.6)
Number of patients who underwent repeated rRT- PCR in 14 days post procedure	Symptoms suggestive of COVID-19 infection	0	1	1
	Additional pre-procedural swab as another procedure was required	3	9	12
	Interhospital transfer	1	0	1
	Surveillance swab due to contact with COVID-19 positive individual	0	3	3
	Total (%)	4 (1.0)	13(5.1)	17(2.6)

^aBoth positive patients had risk criteria which were overlooked by healthcare workers.

with mild symptoms, can increase the spread of infections among the population, and subsequently, the healthcare workers managing them. By detecting positive cases through pre-procedural swabs, preparations and isolation procedures can be done promptly for the contagious patients. There are also clear benefits to healthcare workers. COVID-19 infection amongst healthcare personnel has been shown to endanger their well-being, causing hospitalization and death.¹⁰ With the practice of pre-procedural swabbing, healthcare workers in the hospital can be protected from the risk of COVID-19 infection, especially from asymptomatic patients.¹¹

During the pandemic, the number of backlog cases has increased.¹² Effective pre-procedural COVID-19 swabbing protocols have been shown to be able to help resume surgical capacity for elective cases safely and enable the clearing of backlogged procedures.⁸ Pre-procedural swabbing enables surgical teams to identify patients with COVID-19 infections early before proceeding with their surgeries to avoid adverse surgical outcomes in patients with COVID-19.¹³

In the adult population, previous studies on universal pre-procedural swabbing have also been reported. An international cohort study by the COVIDSurg Collaborative on elective cancer surgery for adults showed the benefits of preoperative nasopharyngeal swabs before major surgeries.¹⁴ Previous data from a study on 1997 asymptomatic patients who presented for surgical procedures in the United States showed that the overall positive test rate was 0.35%. In patients lower than 18 years old, the positive test rate is 1.4%, compared to 0.7% among patients who are 18 years old or older.¹⁵ Results from previous studies on routine preoperative screening did not detect any patients with COVID-19, where pre-procedural swabbing was instituted in combination with self-isolation and the use of questionnaires.^{16,17}

However, there are also centers that do not practice routine, universal pre-procedural swabbing with rRT-PCR. A single center study from Spain reported that due to low availability, preoperative rRT-PCR tests were only done on 50% of cases during the first period of the study.¹⁸ This further highlights the unique logistical challenges that must be considered in implementing routine pre-procedural swabbing protocols.

An interesting development to monitor will be the impact of vaccination on pre-procedural swab positivity rate. It is conceivable that vaccine confidence may lead to changes in patterns of social interaction and an increase in asymptomatic transmission in the community. As a result, the epidemiological risk profile may shift, rendering our preoperative screening criteria less accurate in sifting out infected cases. Despite the increasing vaccination rate, breakthrough cases still can happen, particularly with new strains of the virus.¹⁹

We acknowledge the limitations of our study. This is a retrospective, single-center study. However, our center is a large academic center, situated at the heart of a highly populated urban population. Therefore, our results may be extrapolated to inform strategy and preparations for repeated waves of high transmission. Our study periods covered the timeframe when the Alpha and Delta variants of SARS-CoV-2 were dominant in the community. Hence, changes in prevailing SARS-CoV-2 variants may affect the applicability of our results. Our follow up data on readmission and

repeated rRT-PCR tests may not be adequate as our patients might have presented to another center after their procedure.

In conclusion, our findings indicate that in patients deemed low risk for COVID-19 infection according to our screening criteria, routine pre-procedural swabbing returns a low positive rate. Our findings can guide screening protocols at institutions that provide surgical services during the COVID-19 pandemic.

Author contributions

SAN conceptualized the study and obtained ethical approval. CYT, AMT, NA, SAZ, AS, SS contributed to data collection and analysis were performed by CYT and AMT. The first draft of the manuscript was written by CYT, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data availability

The data used in this study are available from the corresponding author on reasonable request.

Ethical approval

The study was approved by the Medical Research Ethics Committee of University of Malaya Medical Center (MREC ID NO:2021123-9746) and conducted in accordance with the Declaration of Helsinki.

Informed consent

According to the institutional ethical review board, this study was considered exempt from requiring consent from human subjects.

Declaration of conflicting interests

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