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Magnitude of SARS-CoV-2 Infection and Outcome in Paediatric Surgical Inpatients during the First Wave of Pandemic at a Tertiary Care Children's Hospital in India

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ABSTRACT

This study was conducted at a tertiary care centre of Delhi, to assess the magnitude of SARS-CoV-2 disease and outcome in paediatric surgical inpatients. All the admitted patients were evaluated excluding outpatients and minor procedures. Out of 312 operated patients 2.88% patients were SARS-CoV-2 positive and out of 167 non-operative patients 6.58% were SARS-CoV-2 positive. These patients received standard care as per guidelines using standard protective measures and were discharged home. Only 1 death occurred due to perforation peritonitis with sepsis. The overall prevalence of SARS-CoV-2 in paediatric surgical patients was 4.17% and SARS-CoV-2 positive patients had similar outcomes as compared to non-SARS-CoV-2 patients.

KEYWORDS: children, SARS-CoV-2 infection, surgery, pandemic

INTRODUCTION

After the declaration of corona virus disease (SARS-CoV-2) as a global pandemic by WHO on 11 March 2020, there were nationwide lockdowns, international travel restrictions and curtailment of all the elective surgical procedures to stop the spread of the disease [1]. India had implemented nationwide lockdown on 25 March 2020 and there was phased unlocking from 1 June [1]. Different surgical and medical facilities across the world developed guidelines for decision making for resumption of work [2]. According to Chinese centre for Disease Control and Prevention, children are less susceptible and constitute 2.16% of all confirmed cases [3]. As the children are either asymptomatic or mild symptomatic, they are less likely to be tested and the true prevalence may be different. The prevalence of SARS-CoV-2 infection in general paediatric population in India is reported as 1–5% [4]. However, till date there are no studies from India regarding magnitude of SARS-CoV-2 infection in paediatric surgical patients. The purpose of this study was to analyse the magnitude and outcome

of SARS-CoV-2 infection in paediatric surgical inpatients from a tertiary care children's hospital.

SUBJECTS AND METHODS

This was a prospective observational study conducted during SARS-CoV-2 pandemic (during first wave from March 2020 to September 2020) in a tertiary care hospital in North India after obtaining institutional ethical clearance (LHMC/IEC/2021/03/29). All the children (0–18 years) admitted in the paediatric surgical ward including those who underwent surgery were included in the study. Data of last 1 year regarding the number of broad type of surgical procedure were also collected from the hospital records to compare the change in type of surgical procedure in pre pandemic and during the pandemic period. Outpatients and patients undergoing minor surgical procedures were excluded. The surgical ward beds were reorganized into green and orange zones and patients were segregated based on their SARS-CoV-2 infection status to avoid further transmission. As routine testing for all inpatients was recommended as per hospital policy therefore, all the patients who were admitted underwent RT-PCR or CBNAAT assay to detect SARS-CoV-2 infection and initially kept in orange zone or suspect area. Emergency surgeries were performed without waiting for the test results and after getting report they were shifted to designated zones. Those who were admitted for elective procedure, based on the report either shifted to green zone if they were negative for SARS-CoV-2 infection, or sent for home isolation if they turned out positive and were asymptomatic or mildly symptomatic having fever, flu like symptoms and oxygen saturation more than 95% at room air. Those who were positive for SARS-CoV-2 infection and moderately symptomatic requiring oxygen support, shifted to dedicated SARS-CoV-2 ward where the care was being delivered by paediatric surgeons in conjunction with paediatricians. A separate operating room was designated for confirmed or suspect cases and surgeries were performed using standard level 3 personal protective equipment (PPE). Level 1 PPE was used in green zones, level 2 in orange zone and level 3 PPE was used in SARS-CoV-2 positive red zone.

The management of SARS-CoV-2 positive patients was according to the available guidelines. Asymptomatic or mildly symptomatic patients were given supportive treatment such as antipyretics and vitamin supplements, and those who were moderately symptomatic were given injectable antibiotics, oxygen support, nebulization, chest physiotherapy, steroids and mechanical ventilation if required along with vitamin supplements.

Statistical analysis used

Data were coded and recorded in MS Excel spreadsheet program. SPSS v23 (IBM Corp.) was used for data analysis. Descriptive statistics were elaborated in the form of means ± standard deviations and medians or IQRs for continuous variables, and frequencies and percentages for categorical variables. Group comparisons for continuously distributed data were made using independent sample '*t*' test when comparing 2 groups. If data were found to be non-normally distributed, appropriate non-parametric tests in the form of Wilcoxon Test were used. Chi-squared test was used for group comparisons for categorical data. Statistical significance was determined at p value <0.05.

RESULTS

A total of 479 patients were treated over a period of 7 months from March 2020 to September 2020. Male to female ratio was 1.7 : 1 and median age was 2.5 years (IQR 0.5–7) including neonates (17.74%), infants (22.13%), children 1 to 5 years (24.21%) and older children 6 to 10 years (35.9%). Emergency surgeries, elective surgical procedures and non-operative admissions like only chemotherapy, constituted 45%, 20% and 35%, respectively (Table 1). A total of 312 (65.17% of total admissions) patients were operated out of which emergency surgeries outnumbered (69.23% of all operated) the elective surgeries (30.76% of all surgeries). Types of surgeries included abdominal (52.88%), urological procedures (17.3%), thoracic (12.17%), reconstructive (1.6%), laparoscopic (1.2%) and miscellaneous (14.74%). Comparison of pre- and post-pandemic profile of surgeries is discussed in Table 2. No correlation was observed between type of surgical procedure and SARS-CoV-2 positivity.

Proportion of SARS-CoV-2 positivity in patients with emergency admission was 3.24%, in

Table 1. Details of operated and non-operated patients

		Total operated ($n = 312$)	SARS-CoV-2 positive out of operated (%)	Non-operated ($n = 167$)	SARS-CoV-2 positive out of non-operated (%)
Gender ratio (M : F)		2.06 : 1	2 : 1	1.3 : 1	1.7 : 1
Age distribution					
Age	Neonate	80 (25.64%)	0	5 (2.99%)	0
	Infant	75 (24.03%)	1 (1.3)	31 (18.56%)	6 (19.3)
	Child 1–5 years	70 (22.43%)	3 (4.2)	46 (27.54%)	3 (6.5)
	Child >5 years	87 (27.8%)	5 (5.7)	85 (50.89%)	2 (2.3)
Total		312	9 (2.88)	167	11 (6.58)
Patient distribution based on type of surgery					
Emergency (45.1%)		216 (69.23%)	7 (3.24)	–	–
Elective (20.0%)		96 (30.76%)	2 (2.10)	–	–
Non-operative (34.86%)		–	-	167	11 (6.58)
Total		312	9 (2.88)	167	11 (6.58)

Table 2. Comparison of types of surgeries to pre-pandemic period

Types of surgeries	Pre pandemic (1 year data) *N* (%)	During pandemic *N* (%)
Thoracic	93 **(6.2)**	38 (12.17%)
Laparotomy	468 **(31.3)**	165 (52.88)
Laparoscopic	83 **(5.5)**	4 (1.28)
Urology	380 (25.48)	54 (17.30)
Reconstructive	85 (5.92)	5 (1.60)
Miscellaneous[a]	382 (25.6)	46 (14.74)
Total	1491 (100)	312 (100)

[a]Miscellaneous: hernia, hydrocele, cyst excision, biopsy and circumcision.

elective surgery was 2.1% and in non-operated patients was 6.6% giving an overall magnitude of 4.17% positivity. Types of surgeries that were required in SARS-CoV-2 positive patients were laparotomy in 6 patients, soft tissue sarcoma excision in 1 patient and herniotomy in 1 patient. In SARS-CoV-2 positive patients, male to female ratio was 2 : 1 and median age was 1.75 years (IQR 0.67–2.25; Table 3). The SARS-CoV-2 infection status in most of the patients (35%) became evident after surgery, except in 2 cases the status was known preoperatively. None of the patients was symptomatic for SARS-CoV-2 infection and parents were not tested.

SARS-CoV-2 positive patients who underwent surgery had a hospital stay of 7.11 ± 4.42 days and it was comparable to operated non-SARS-CoV-2 patients (9.36 ± 7.95 days, $p = 0.397$). Complications and mortality were not significantly higher in the SARS-CoV-2 positive cases as compared to SARS-CoV-2 negative patients ($p = 0.559$, $p = 0.780$, respectively; Table 4). The only SARS-CoV-2 positive patient who died had peritonitis with overwhelming sepsis and received mechanical ventilation.

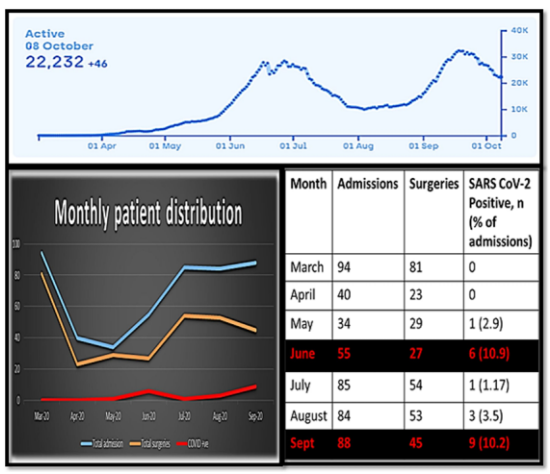
The pattern of SARS-CoV-2 infection closely followed peaks of infection in Delhi and during peaks nearly 10% of admitted children were infected. The first peak lasted till July 2020

Table 3. Demographic details of all admitted patients and all SARS-CoV-2 positive patients

	All patients ($n = 479$)	SARS-CoV-2 positive ($n = 20$)
Total patients	479	20 (4.17%)
Gender ratio (M : F)	1.7 : 1	2 : 1
Median age (years)	2.5 (IQR 0.5–7)	1.75 (IQR 0.67–2.25)
Neonate	85 (17.74%)	0
Infant	106 (22.13%)	7 (35%)
Child 1–5 years	116 (24.21%)	6 (30%)
Child >5 years	172 (35.9%)	7 (35%)

Table 4. Outcomes of operated SARS-CoV-2 and operated non-SARS-CoV-2 patients

Outcomes	SARS-CoV-2 (−) ve	SARS-CoV-2 (+) ve	*p* value
Duration of stay (mean ± SD) days	9.36 ± 7.95	7.1 ± 4.42	0.397
Complications (SSI, sepsis)	19/303 (6.2%)	1/9 (11%)	0.559
Mortality	26/303 (8.6%)	1/9 (11%)	0.790



Month	Admissions	Surgeries	SARS CoV-2 Positive, n (% of admissions)
March	94	81	0
April	40	23	0
May	34	29	1 (2.9)
June	55	27	6 (10.9)
July	85	54	1 (1.17)
August	84	53	3 (3.5)
Sept	88	45	9 (10.2)

Fig. 1. Monthly patient distribution of COVID patients following peaks of infection in Delhi. Daily COVID cases graph of Delhi taken from https://bing.com/covid/local/delhi_india?vert=graph on 8th oct 2020.

and the second peak was in September 2020 (Fig. 1).

DISCUSSION

Comparing the demographics between SARS-CoV-2 and non-SARS-CoV-2 patients, there were no significant difference between their age and sex distribution. The magnitude of SARS-CoV-2 infection in paediatric surgical patients in the current series was 4.17% which is higher as compared to western data where the reported prevalence in general paediatric population and paediatric surgical population is 0–2% (Table 5) [5, 6]. The higher magnitude can be explained by the fact that our centre is a tertiary care hospital catering to large part of North India working at full capacity during the pandemic. However, it is comparable to Indian data released by the ICMR study group which reported 3.6% SARS-CoV-2 positivity in children [7]. In another study from our institute Kapoor, *et al.* [8], reported a prevalence of 9.27% SARS-CoV-2 positivity in cases admitted in paediatric medicine wards.

Mean age and gender distribution of SARS-CoV-2 patients were comparable to non-SARS-CoV-2 patients. Duration of hospital stay was comparable in operated SARS-CoV-2 patients and non-SARS-CoV-2 patients. Morbidity and mortality rates were not significantly higher in SARS-CoV-2 patients as compared to non-SARS-CoV-2 patients. These data are similar to that reported by Kapoor, *et al.* [8] from our institute, where they had observed that the presence of a comorbid illness in paediatric inpatients with SARS-CoV-2 infection did not impact the illness severity, length of hospitalization, ventilation requirement and mortality.

Table 5. Synopsis of various studies on magnitude of SARS-CoV-2

Study	Duration of study	Age (years)	*N*	Prevalence	95% CI
Sola, *et al.*	May 2020	0–18	33 041	0.65%	0.47–0.83
Lin, *et al.*	26 March–22 April 2020	0–19	1295	0.93%	N/A
ICMR COVID study group	22 January–30 April 2020	All age groups	1 021 518	3.6%	N/A
Dipti, *et al.*	1 March–31 December 2020	1 month–18 years	3180	9.27%	N/A
Our study	March–September 2020	0–18	479	4.17%	3.61–4.72

In the pre-pandemic times abdominal surgeries were 31.3%, urology 25.48%, thoracic surgeries were 6.2%, reconstructive surgeries were 5.7%, laparoscopic procedures were 5.5% and miscellaneous procedures were 25.6% (Table 2). During the pandemic the proportion of laparotomy were increased to more than 1.5 times (52.88%) from the pre-pandemic data (31.3%). This can be explained by the occurrence of post-COVID immune dysregulation leading to multisystem inflammatory syndrome in children (MIS-C) and its associated abdominal complications [9, 10]. At the time of the first pandemic wave the testing for COVID serology was neither well standardized nor easily available. Thus it was not possible for us to confirm the diagnosis of MIS-C in those children. The child who died of SARS-CoV-2 positivity was a 7-year female diagnosed with tubercular perforation peritonitis. The child was operated and kept in SARS-CoV-2 intensive care but she developed septicaemia and catecholamine resistant shock and did not survive. Whether MIS-C contributed to the disease pathogenesis and outcome is not clear and can be evaluated with a larger sample size.

The proportion of thoracic surgeries were also increased to almost double (12.17%) the pre-pandemic data (6.2%) as during pandemic all other government hospitals were converted into COVID care centres and this was one of the few institutes doing emergency neonatal surgeries including thoracic surgeries such as tracheoesophageal fistula, pulmonary malformations, etc.

The number of laparoscopic procedures were reduced proportionately (5.5% vs. 1.28%) due to avoidance of such procedures as per SARS-CoV-2 guidelines.

The limitation of this study is that status of the close relatives of the patients was unknown and all health care workers were not tested therefore implying an added risk for disease transmission. However, universal testing of patients, isolation of SARS-CoV-2 positive patients, separate operation theatre and appropriate level of protective gear used by the health care workers as the safety measures for reducing the risk of transmission were found effective during the SARS-CoV-2 outbreak. The results of this study will be helpful in planning and implementation of services for any subsequent waves of SARS-CoV-2 pandemic in the future.

CONCLUSIONS

Children with SARS-CoV-2 infection usually present with asymptomatic or mildly symptomatic infection. As the pandemic progressed, multiple post-infectious hyper immune complications mimicking surgical conditions have come into focus. Coexistence of asymptomatic SARS-CoV-2 infection with other surgical conditions may or may not influence outcome. A high magnitude of 4.7% SARS-CoV-2 positivity was found amongst paediatric surgical patients. There were no increased morbidity or mortality due to associated SARS-CoV-2 infection in paediatric surgical patients. With optimal utilization of existing infrastructure, universal testing protocol, testing based triaging and precautions as per recommended guidelines, it was feasible to deliver uninterrupted paediatric surgical care with good outcomes during the SARS-CoV-2 pandemic. This will be invaluable for any future management planning for further SARS-CoV-2 outbreak in paediatric patients.

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