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Original Article

Clinical profile and outcomes of children with COVID-19: A single-center prospective study

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Abstract

Objective

The aim was to study the epidemiology, clinical profile, and outcomes of children with coronavirus disease-2019 (COVID-19) admitted in our hospital.

Methods

This prospective study was conducted at the tertiary care dedicated hospital of COVID-19 in North India between April 1, 2021 and June 30, 2021. A total of 36 children less than or equal to 18 years of age who tested positive for SARS-CoV-2 by RT-PCR from nasopharyngeal swab were enrolled. The details pertaining to age, sex, clinical symptoms, severity of the disease, radiography abnormalities, and laboratory investigations were recorded. The outcomes were mortality, discharged patients, and complications.

Results

The mean age was 8.5 years, with 72.22% males. Majority (47.22%) had a history of household contacts. The mean duration of symptoms after admission was 3.03 ± 5.34 days. The chief clinical symptoms were fever (91.67%), cough (38.89%), and upper respiratory infection (33.33%). Radiographic findings were abnormal in 12 (33.33%) patients. D-dimer was deranged in 17 (89.47%) patients. C-reactive protein was positive in all patients. The mean duration for RT-PCR to become positive was 3 ± 5.53 days from the day of admission. Severity wise, 72.22% had mild infection, 8.33% had moderate, and 19.44% had severe disease. The most common complications seen were pneumonia (19.44%), shock (13.89%), and disseminated intravascular coagulation (5.56%). The mean duration taken to being asymptomatic after symptoms was 5.12 ± 3.5 days. A total of three deaths were reported, and rest of them were discharged. The mean days of discharge were 8.76 ± 8.4 days.

Conclusion

In COVID-19, respiratory involvement is primary with mild presentation commonly. Children portray good recovery with low mortality.

Keywords: Children, COVID-19, outcomes, severity

Introduction

The SARS-CoV-2 (severe acute respiratory syndrome-coronavirus-2), which causes coronavirus disease (COVID-19), has spread around the world, posing significant challenges to the health care system of all countries. The main causes of COVID-19's massive impact include a lack of preparedness for an unprecedented and unexpected spread, the pathogen's intrinsic virulence and contagiousness, asymptomatic spreaders, a lack of immunity and an efficient vaccine, and the lack of proven and effective antiviral medications [1].

In India, the first adult case of COVID-19 infection in Kerala was reported on January 27, 2020 in a woman who returned from China; however, the number of cases rapidly climbed to 34.2 million as on October 29, 2021. Worldwide, significantly less number of children were reported to be affected by

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COVID-19. According to the WHO-China joint mission report, children below 18 years of age were accountable for ~2.40% of 55 924 laboratory confirmed cases of COVID-19 in China, with majority being cases of household contacts of positive cases [2].

In India, a relatively higher incidence was reported in children; according to Indian Council of Medical Research (ICMR) laboratory surveillance network, 3.60 and 8.10% of total cases were reported in the age group 0–9 years and 10–19 years, respectively, in the early phase of pandemic, that is, between January 22, 2020 and April 30, 2020 [3]. As per latest data of ICMR, national and international data showed that 2–3% of children with COVID-19 required hospitalization in wave 1/2. However, for meeting the surge in India, ~5% of children with COVID infection are estimated to require hospitalization [4]. The American Academy of Pediatrics reported that as of October 21, 2021, ~6.3 million children were COVID-19 positive since the onset of the pandemic, which accounted for 16.5% (6 295 648/38 080 641) of all cases. Children ranged from 1.6 to 4.3% of the total cumulated hospitalizations, and 0.1–2.0% of the child COVID-19 cases led to hospitalization [5]. The severity of COVID-19 illness among children appears to be milder in comparison with adults [6–10]. In spite of the Ministry of Health and Family Welfare (MOHFW), India providing daily report about total and state-wise tally of COVID-19 cases, there is a lack of data related to the epidemiology as well as clinical characteristics of COVID-19 among children.

There is variation in symptoms, severity, and outcomes of COVID-19 infection in children of different countries. Therefore, local data related to 'epidemiology, clinical presentation, investigations, treatment modalities, and outcomes' would be helpful for planning clinical services such as screening, testing, isolation, and intensive care facilities for managing children in COVID-19 pandemic. Thus, this study was conducted to assess the clinical characteristics and outcome of children with confirmed COVID-19 admitted to their tertiary center.

Methods

This prospective study was conducted at the COVID-19 hospital of a tertiary care referral center of North India, after taking approval from the Institutional Ethical Committee. The research complies with the guidelines for human studies and was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. The study was conducted after a written informed consent. The study population included children of less than or equal to 18 years of age, who were confirmed as positive for SARS-CoV-2 by RT-PCR between April 1, 2021 and June 30, 2021. The samples taken from patients were nasopharyngeal swabs. The study site is a designated health care facility for COVID-19-infected patients, where all types of patients including severe ones (adults as well as children) are referred.

The sample size was based on the study of Nallasamy *et al*. [11] who observed a mortality rate of 3%. Taking this value as reference, the minimum required sample size with 6% margin of error and 5% level of significance was 32 patients. To reduce margin of error, the total sample size was taken to be 36.

On the basis of severity of illness, patients were admitted in the isolation ward, high dependent unit, or ICU [12]. The COVID-19 severity was divided into three categories on the basis of clinical and/or radiological features: mild, moderate, and severe [13]. Mild disease was defined as 'presence of only upper respiratory symptoms,' whereas moderate cases were defined as 'presence of involvement of lower respiratory system (clinical or radiological signs of pneumonia) but no signs of severe hypoxemia or pneumonia'' and severe disease was defined as 'presence of clinical features of severe pneumonia and/or hypoxemia (SpO_2 < 90% on room air), severe diarrhea, and dehydration.'

The study population included all moderate and severe cases and those mild cases (1) that were admitted for some other reason and became positive during the hospital stay and (2) for whom health care services were not easily accessible. Laboratory investigations included complete blood count, liver function test, renal function test, C-reactive protein (CRP), D-dimer, and RT-PCR. Children with pneumonia were given antibiotics. On a case-by-case basis, steroids and other medicines were administered. Data related to age, sex, history of contact, type of contact, immunization records, comorbidities, clinical features, and laboratory investigations were collected. The severity of the illness, respiratory involvement, findings of chest imaging, type of respiratory support, antibiotics, steroids, and vasoactive medications were all taken into consideration. The length of hospital stay, recovery (discharge), and mortality were the monitored outcomes.

Data related to follow-up RT-PCR testing were collected. Discharge of patients was done when the patient became asymptomatic and had negative RT-PCR test results.

RT-PCR test was performed on nasopharyngeal swabs that were immersed as well as transported in viral transport medium. Extraction of RNA was done, and RT-PCR was done according to the standard National Institute of Virology, Pune, protocol [3].

Statistical analysis

The presentation of the categorical variables was done in the form of number and percentage. On the contrary, the quantitative data were presented as the means ± SD and as median with 25th and 75th percentiles (interquartile range).

The data entry was done in the Microsoft EXCEL (Washington, United States - 700064) spreadsheet, and the final analysis was done with the use of the Statistical Package for the Social Sciences (SPSS) software, version 21.0; IBM Manufacturer, Chicago, IL.

Results

A total of 36 children with COVID-19 admitted to hospital were included in the study. The mean age was 8.5 ± 6.8 years. Overall, 72.22% were males. Majority of children (n = 17, 47.22%) had history of household contacts with one or more affected members in the family. History of contact with hospital was present in eight (22.22%) patients. Primary illness was COVID-19 in 25 (69.44%) patients; other illnesses are shown in Table 1. The mean duration of symptoms after admission was 3.03 ± 5.34 days.

Table 1: Distribution of demographic characteristics of study participants

Demographic characteristics	Frequency	Percentage
Age (years)		
Mean±SD	8.5±6.8	
Median (25th-75th percentile)	8 (0.96-16)	
Range	0.02-18	
Sex		
Female	10	27.78
Male	26	72.22
Type of contact		
Unknown	11	30.56
Hospital	8	22.22
Household	17	47.22
Primary illness		
COVID	25	69.44
Anemia	1	2.78
Hepatosplenomegaly	1	2.78
B-cell ALL with febrile neutropenia	1	2.78
Hemophilia A with hemarthrosis right knee	1	2.78
CSF prove meningitis	1	2.78
Osteomyelitis with Staph septicemia	1	2.78
Global developmental delay with seizure disorder	1	2.78
Fresh seizures	1	2.78
G6PD deficiency	1	2.78
Hydrocephalus	1	2.78
Brain abscess with hydrocephalus	1	2.78
Severe anemia/congestive cardiac failure	1	2.78
Seizure	1	2.78
Neonatal hyperbilirubinemia	1	2.78
Late preterm	1	2.78
Infant of diabetic mother	1	2.78
Respiratory distress syndrome	1	2.78
Early-onset sepsis	1	2.78
Myelomeningocele	1	2.78
Congenital hydrocephalus with shunt meningitis	1	2.78
Date of symptoms after admission		
Mean±SD	3.03±5.34	
Median (25th-75th percentile)	1 (1-1.5)	
Range	1-26	

ALL, acute lymphoblastic leukemia; CSF, cerebrospinal fluid.

The chief clinical symptom was fever in 33 (91.67%) patients, followed by cough (38.89%), upper respiratory infection (33.33%), respiratory distress (27.78%), vomiting (22.22%), diarrhea and dehydration in 13.89%, and encephalopathy in 8.33% patients (Table 2).

Radiographic findings were abnormal in 12 (33.33%) of the study participants (Fig. 1).

D-dimer was deranged in 17 (89.47%) patients. CRP was positive in all patients. Ultrasound abdomen showed hepatosplenomegaly in one (3.85%) patient. Laboratory investigations were deranged in majority of children, as shown in Table 3.

The mean duration for RT-PCR to become positive was 3 ± 5.53 days from the day of admission (Table 4).

The most common complications seen in patients were pneumonia (19.44%), shock (13.89%), DIC (5.56%), and miscellaneous in 8.33% patients (Table 5). The severity classification of COVID-19 was as follows: mild (n = 26, 72.22%), moderate (n = 3, 8.33%), and severe (n = 7, 19.44%) (Fig. 2).

The mean number of days taken to being asymptomatic after symptoms was 5.12 ± 3.5. The mean days of discharge and mortality days were 8.76 ± 8.4 and 1.67 ± 0.58, respectively (Table 6). A total of three deaths were reported.

Discussion

In the present study, the epidemiology, clinical profile, and outcomes of children with COVID-19 admitted to the dedicated tertiary care hospital were studied.

It was found that the primary source of infection was household contact (47.22%) with one or more affected members in the family, which was consistent with an Indian study by Nallasamy *et al*. [11] This may be owing to the fact that during this pandemic with lockdown, schools and outdoor activities

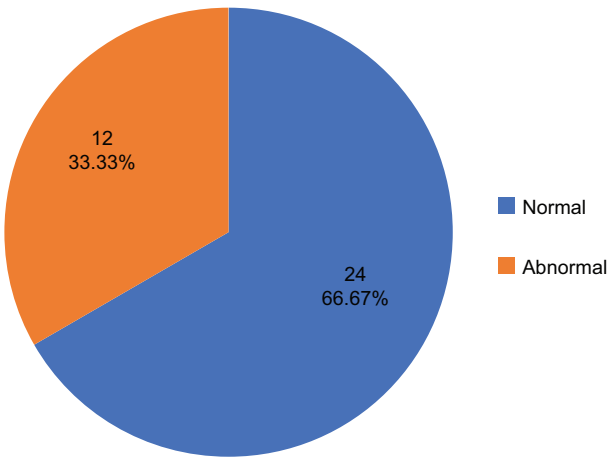

Figure 1: Distribution of radiographic findings of study participants.

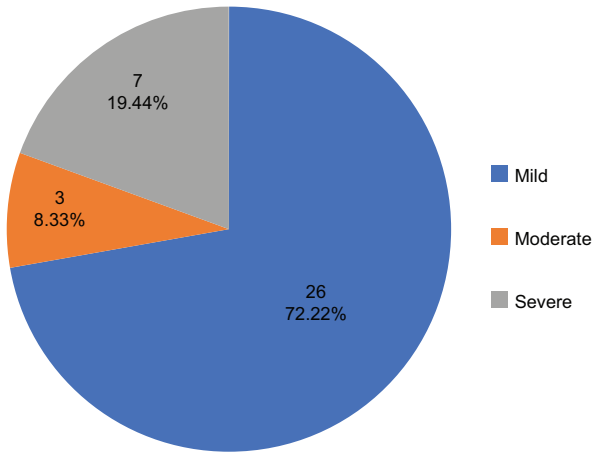

Figure 2: Distribution of severity.

Table 2: Distribution of clinical symptoms of study participants

Clinical symptoms	Frequency	Percentage
URI	12	33.33
Cough	14	38.89
RD	10	27.78
Diarrhea	5	13.89
Vomiting	8	22.22
Pain abdomen	3	8.33
Fever	33	91.67
Dehydration	5	13.89
Encephalopathy	3	8.33

RD, respiratory distress; URI, upper respiratory infection.

were closed. Thus, the main source of infection among children was household contact [14].

In the present study, the chief clinical symptoms were fever, cough, upper respiratory infection, respiratory distress, vomiting, diarrhea, dehydration, and encephalopathy. This is consistent with the findings by Nallasamy *et al*. [11], where the chief complaints among symptomatic children were fever and respiratory symptoms, followed by gastrointestinal symptoms. Similar symptoms were reported in other studies worldwide [15–18]. In a systematic review conducted by Meena *et al*. [19], which included 27 studies, it was found that main symptoms were fever (in 41–58% of the patients), cough (39–51%), rapid breathing (6–17%), and gastrointestinal symptoms, specifically diarrhea (in 6–13% children).

In the present study, most of the children presented with mild disease (72.22%), and three children had moderate disease. Seven children had severe disease (19.44%). Similarly, most of the children were asymptomatic (58%) and mild (23%) in an Indian study [11]. Nearly 16% of children had severe or critical illness, which is nearly equal to that of our study. A variation is noted in severity of the disease in different studies that depended on type of cohort (community-based or hospital-based) and criteria of hospital admission. However, in all studies, there were less number of severe and critical cases, present in ~1% to 5% of children [20,21].

The severe illness was found among infants and children with underlying respiratory or cardiovascular comorbidities. In a study by Dong *et al*. [13], conducted in China, the number of severe cases was 10.6% and critical cases was 7.3% for less than 1 and 1–5 years age groups in comparison with 3–4% for old age children. Dayal [22] mentioned in their study that similar to adults, in the presence of underlying comorbidities, there is an increase in the risk of severe disease and requirement of intensive care unit admission among pediatric patients. Young children, specifically infants, are at an increased risk of severe disease as well as mortality.

It was observed that the mean number of days taken to being asymptomatic after symptoms was 5.12 ± 3.5 days, with the range being 2–14 days. Previous studies related to virological evaluation of COVID-19-infected patients demonstrated SARS-CoV-2 RNA persistence in nasopharyngeal samples for nearly 2-week duration [23,24]. Nallasamy *et al*. [11] also found that the median time for RT-PCR to become negative was 16 days, which is consistent with the findings from a study conducted in Delhi on adult patients [25].

Although it is unclear if persistent RT-PCR positivity correlates with infectivity, these findings, together with the fact that the majority of children are asymptomatic, raise concerns about children being possible carriers and at risk of infecting the population. Laboratory investigations were deranged in a majority of the patients. CRP was positive in 18 cases. However, TLC and platelet counts were deranged in 13 and 5 children, respectively. D-dimer was deranged in 17 (89.47%) children.

In comparison, in the study by Nallasamy *et al*. [11], the majority of children were not investigated as they were asymptomatic. The majority of baseline tests were unremarkable. Lymphopenia and increased CRP were seen in one and three children, respectively. No difference was found in outcomes of children in whom investigations were not done. The authors suggested that laboratory testing should only be performed when necessary, and pediatricians should use laboratory investigations judiciously.

Laboratory abnormalities have been observed in children with critical illness in accordance with underlying organ dysfunction or, more commonly, in COVID-19-associated hyperinflammatory syndromes ('PIMS-TS/MIS-C'), a delayed presentation characterized by prominent gastrointestinal and cardiac manifestations and elevated inflammatory biomarkers. As the pandemic continues to spread, this syndrome may become more important. In addition, still there is no definite treatment of COVID-19 [26]. There is lack of standard data regarding treatment.

Three children died in the present study, and the mean duration of discharge was 8.76 days. In the study by Nallasamy *et al*. [11], one (3%) child died. The median

Table 3: Distribution of investigations of study participants

Investigations	*n* (%)	Mean±SD	Median (25th-75th percentile)	Range
Hemoglobin (g/dl)				
Normal	11 (30.56)	10.61±2.2	11 (9.475-12)	4-15
Deranged	25 (69.44)			
Total leukocyte count (/cm^3)				
Normal	23 (63.89)	10 667.5±3590.16	11 000 (7675-12 700)	4000-18 000
Deranged	13 (36.11)			
Platelet count (lakhs per cm^3)				
Normal	31 (86.11)	2.81±1.09	2.6 (2-3.5)	0.6-6
Deranged	5 (13.89)			
Urea (mg/dl)				
Normal (25-40)	20 (55.56)	38.97±8.79	40 (34-44)	23-66
Deranged	16 (44.44)			
Serum creatinine (mg/dL)				
Deranged	2 (5.56)	0.67±0.18	0.65 (0.5-0.8)	0.3-1.2
Normal (<0.9)	34 (94.44)			
Serum sodium (mEq/l)				
Normal (135-145)	30 (83.33)	139.39±4.52	138 (136-140.5)	134-153
Deranged	6 (16.67)			
Serum potassium (mEq/l)				
Normal (3.5-4.5)	29 (80.56)	4.21±0.32	4.2 (4.1-4.4)	3.2-4.9
Deranged	7 (19.44)			
Serum calcium (mg/dL)				
Normal (7-10)	35 (97.22)	9.03±0.61	8.9 (8.75-9.35)	7.8-10.4
Deranged	1 (2.78)			
Total bilirubin (mg/dL)				
Normal (0.2-0.8)	27 (75.00)	1.52±3.09	0.7 (0.6-0.825)	0.2-18
Deranged	9 (25.00)			
SGOT (U/l)				
Normal (5-40)	1 (2.78)	123.47±190.46	91 (48.75-120.75)	34-1171
Deranged	35 (97.22)			
SGPT (U/l)				
Normal (7-56)	19 (52.78)	111.36±169.88	55 (45-105.75)	33-1039
Deranged	17 (47.22)			
Serum albumin (g/dL)				
Normal (3.5-4)	19 (52.78)	3.82±0.33	3.9 (3.575-4.025)	3-4.4
Deranged	17 (47.22)			
Total protein (g/dL)				
Deranged	1 (2.78)	7.23±0.35	7.2 (7-7.4)	6.6-8.4
Normal (<8)	35 (97.22)			
USG abdomen				
Normal	25 (96.15)	–	–	-
Hepatosplenomegaly	1 (3.85)			
D-dimer (ng/ml)				
Deranged	17 (89.47)	1610.95±922.46	1324 (1000-2000)	496-4000
Normal (<500)	2 (10.53)			
Procalcitonin (ng/ml)				
Normal	3 (18.75)	–	–	-
Increased	13 (81.25)			
Interleukin 6				
Normal	5 (33.33)	–	–	-
Increased	10 (66.67)			
Ferritin (µg/l)				
Normal	4 (25.00)	–	–	-
Decreased	1 (6.25)			

Contd...

Table 3: Contd...

Investigations	*n* (%)	Mean±SD	Median (25th-75th percentile)	Range
Increased	11 (68.75)			
C-reactive protein				
Positive	18 (100.00)	–	–	-
Erythrocyte sedimentation rate (mm/h)				
Deranged	12 (70.59)	38.24±9.34	40 (30-44)	22-54
Normal (<30)	5 (29.41)			
PT/PTI				
Normal	18 (94.74)	–	–	-
Increased	1 (5.26)			

PT, prothrombin time; SGOT, serum glutamic oxaloacetic transaminase; SGPT, serum glutamic pyruvic transaminase; USG, ultrasound.

Table 4: Descriptive statistics of RT-PCR positive on which day of admission of study participants

Variable	Mean±SD	Median (25th-75th percentile)	Range
RT-PCR positive on which day of admission	3±5.53	1 (1-1)	1-26

Table 5: Distribution of complications of study participants

Complications	Frequency	Percentage
Pneumonia	7	19.44
Shock	5	13.89
Thrombosis	0	0
DIC	2	5.56
Miscellaneous	3	8.33

Table 6: Distribution of outcomes of study participants

Outcomes	Mean±SD	Median (25th-75th percentile)	Range
Asymptomatic on day after symptoms	5.12±3.5	4 (3-6)	2-14
Days of discharge	8.76±8.4	6 (3-11)	2-40
Mortality days	1.67±0.58	2 (1.5-2)	1-2

length of hospital stay was 15 days. Higher mortality rate was reported by Singh *et al.* [27] as the mortality rate of patients with SARS-CoV-2 was 11.4%.

As there is a dearth of studies in India that evaluated the clinical profile of children hospitalized with confirmed COVID-19, this study seems to be among the few studies that assessed pediatric patients with COVID-19. As this study included children with all types of severity of illness, it is a true representative of the disease among children. This study also included data related to follow-up RT-PCR results, which has public health implications. This study has the potential to give valuable information to health system policymakers in India to use this information for the development of preventive and treatment programs.

However, this study was limited owing to the small sample size and short duration of study. The present study is a hospital-based study done at a tertiary level referral health care facility. So, being a single-center study, its results cannot be generalized, and findings of this study are required to be validated on a larger sample size from a different setting.

Conclusion

In COVID-19 pandemic, most children with COVID-19 presented with mild illness and had a history of household contact. Severe disease was present among those with comorbidities. Most of the children recovered and were discharged from the hospital.

Sonam Chalotra: Concept, design, literature search, data analysis, manuscript preparation. Pooja Bharti: design, data acquisition, manuscript review. Alok Raina: design, data acquisition, manuscript review. Preeti Sharma: design, data acquisition, manuscript review

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Conflicts of interest

There are no conflicts of interest.

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