Archives of Anesthesiology and Critical Care (Autumn 2025); 11(4): 481-485.

Available online at http://aacc.tums.ac.ir

Research Article

Investigation of the Clinical Manifestations of COVID-19 in Critically Ill Children Admitted to the Pediatric Intensive Care Unit of Firouzabadi Hospital in 2020-2021

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ARTICLE INFO

Article history:
Received 25 December 2024
Revised 16 January 2025
Accepted 30 January 2025

Keywords:
COVID-19;
Pediatrics;
Clinical manifestations

ABSTRACT

Background: Considering the epidemiological importance of COVID-19 disease, the high percentage of hospitalization, and the need to prevent morbimortality caused by this disease in children, this study was undertaken to determine the clinical manifestations of COVID disease in critically ill children who need hospitalization in a pediatric intensive care unit (PICU).

Methods: In this retrospective cross-sectional study, the population included critically ill children with COVID-19 who were hospitalized in the PICU of Firozabadi Hospital (Tehran, Iran) between 2020 and 2021. The study patients were examined in terms of clinical manifestations, laboratory results, course of the disease, and duration of hospitalization. From the patients' clinical records, the required information was extracted based on the variables and recorded in a pre-designed form. The obtained data were finally entered into SPSS software version 26 for statistical analysis.

Results: Among 80 patients examined, 44 (55%) were male, and 36 (45%) were female. The average age of the examined patients was 9.9±5.3 years (1-18 years). In terms of COVID-19 symptoms, the fever had the highest frequency in 65 patients (81.3%), followed by gastrointestinal, respiratory, and neurological symptoms in 41 (51.3%), 39 (48.8%), and 29 (36.3%) cases, respectively. Also, 13 (16.2%) patients had an underlying disease, and 17 (21.3%) patients died from COVID-19. Investigating the relationship between the underlying disease and patients' deaths showed to be statistically significant (P = 0.002); in other words, having an underlying disease was significantly associated with a high mortality percentage (53.8% vs. 14.9%).

The authors declare no conflicts of interest.
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DOI: 10.18502/aacc.v11i4.19358

Conclusion: This study suggest that children with underlying diseases show higher mortality from COVID-19; therefore, it is necessary to prioritize the provision of medical services to children with underlying diseases in health system policies and patient management.

Introduction

A new SARS-CoV-2 (severe acute respiratory syndrome coronavirus-2) virus, formally called coronavirus disease 2019 (COVID-19) by the WHO, is a member of the beta coronavirus family that is transmitted to humans and causes severe lower respiratory tract infections [1]. The disease is highly contagious; on average, each infected person can infect at least three other people [2]. COVID-19 was first found in December 2019 in Wuhan, China, and then spread rapidly worldwide, affecting 206 countries with nearly 300,000 approved patients—11,000 deaths by April 3, 2020 [3]. Iran, Germany, China, Italy, the United States, and Spain are among the countries most affected by COVID-19. In February 2019, for the first time in Iran, in Qom City, the disease was officially declared and rapidly spread to 31 Iranian provinces, suffering the worst complications of the COVID-19 epidemic [4].

Although most COVID-19 cases have modest symptoms at first, some patients require hospitalization in the pediatric intensive care unit (PICU) due to severe respiratory distress [5]. The clinical manifestations of COVID-19 in critically ill pediatric cases present a unique and challenging scenario for healthcare professionals [6]. In severely ill patients admitted to the PICU, the spectrum of COVID-19 manifestations extends beyond respiratory distress, encompassing a range of multi-systemic symptoms [7]. Unraveling the nuances of these manifestations not only contributes to the scientific understanding of the disease but also guides healthcare providers in devising targeted interventions tailored to the special needs of pediatric patients [8].

This study aimed to provide important insights into the clinical presentation of COVID-19 in critically ill children referred to the PICU as the globe struggles to address the ongoing problems faced by the epidemic of the disease. Through shedding light on the complexities of COVID-19 in this susceptible population, our objective is to facilitate informed decision-making, improve patient outcomes, and ultimately contribute to the global effort to mitigate the impact of this unprecedented public health crisis.

Methods

In this retrospective study, the participants included critically ill patients with COVID-19 who had been hospitalized in the PICU of Firouzabadi Hospital from 2020 to 2021. According to Javanian et al.'s study in 2020 [9] and the sample size formula, 80 children were selected. The protocol was approved by the Ethics Committee of the Iran University of Medical Sciences (Tehran, Iran; ethical code: IR.IUMS.FMD.REC.1401.320). Exclusion criteria included patients over 18 years old and those who did not have sufficient information about their hospitalization history in their medical files. All the study patients were examined in terms of clinical manifestations, laboratory results, comorbidity, and duration of hospitalization. The required information was extracted from the patients' clinical records based on the variables reported herein and recorded in a pre-designed form. The obtained data was entered into SPSS software version 23 and statistically analyzed.

Data Analysis

The results for quantitative, and categorical variables were reported as mean and standard deviation (mean ± SD), and percentages respectively. Mean, SD, and minimum and maximum range were used to display quantitative variables, and for qualitative variables, frequency and percentage of frequency were employed. The Kolmogorov-Smirnov test assessed the normality of data distribution. Parametric (independent t-test) and non-parametric tests were utilized for data with normal and non-normal distributions, respectively. The chi-square test was used to compare qualitative variables. A significant level of less than 0.05 was considered statistically significant. SPSS version 23 software was used to analyze the data statistically.

Results

The mean (SD) age of all the subjects was 9.9±5.3 years, ranging from 1 to 18 years. Among 80 patients examined in the present study, 44 (55%) and 36 (45%) cases were men's and women's, respectively. Also, 13 (16.2%) patients had underlying diseases, and 2 (2.5%) patients had epilepsy. The following disorders were present in one patient (1.3%): ventricular septal defect, solitary kidney, Down syndrome, failure to thrive, end-stage renal disease, status epilepticus, asthma, myopathy, superior mesenteric artery, choanal atresia, and Mediterranean fever. Regarding COVID-19 symptoms, fever had the highest frequency in 65 patients (81.3%; Figure 1). By physical examination, we observed that fever and tachypnea had the highest frequency in 65 (81.3%) and 38 (47.5%) patients, respectively (Figure 2).

Based on imaging findings, pulmonary involvement was observed in 39 (48.8%) patients, and based on the

result of the PCR test for COVID-19, 58 (72.5%) cases had a positive result.

Examining laboratory (CBC) findings among patients showed the highest frequency was related to leukocytosis (17.5). Erythrocyte sedimentation rate increased in 30 (37.5%) cases, and C-reactive protein increased in 38 (47.5%) cases. Also, there was an elevation in D-dimer level in 16 (20%) patients and an increase in LDH in 5 (6.3%) patients (Table 1).

In the investigation of the mortality among patients examined, 17 (21.3%) died from COVID-19. Examining the relationship between the underlying disease and patients' death from COVID-19 was indicated to be statistically significant (P = 0.002). In other words, having an underlying disease was significantly associated with a high mortality percentage (53.8% versus 14.9%).

Discussion

The present study aimed to determine the clinical manifestations of COVID-19 disease in critically ill children who need to be hospitalized in the PICU department. The results of the present study showed that the highest frequencies of COVID-19 symptoms were related to fever, followed by gastrointestinal, respiratory, and neurological symptoms, respectively. In addition, 13 (16.2%) patients had an underlying disease, and 17 (21.3%) patients died from COVID-19. In examining the relationship between the underlying disease and a patient's death due to COVID-19, a statistically significant relationship was observed, which suggests that having an underlying disease is significantly associated with a high mortality percentage. In a study by Guo et al. in China, fever (77.9%) and cough (32.4%) were the main symptoms of COVID-19 in children [10]. In the study by Shahbaznejad et al. (11) in Iran, fever was reported in 81%, respiratory symptoms in 79%, digestive symptoms in 47%, and neurological complaints in 29% of patients. Our study's high percentage of gastrointestinal symptoms can be rooted in the statistical population because, in Shahbazanjad et al.'s study [11], all hospitalized patients were examined.

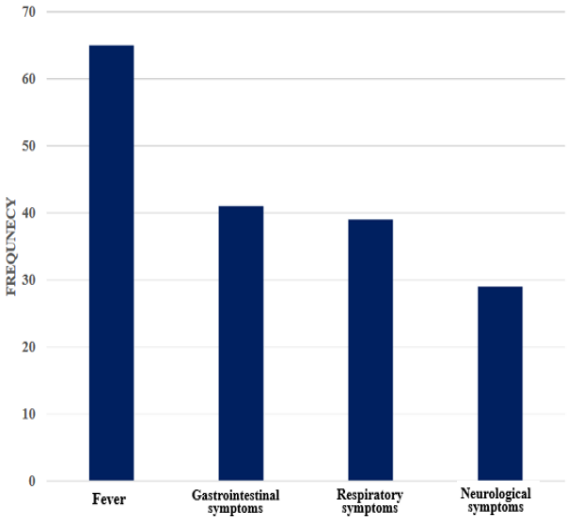

Figure 1- Frequency distribution of COVID-19 symptoms among patients.

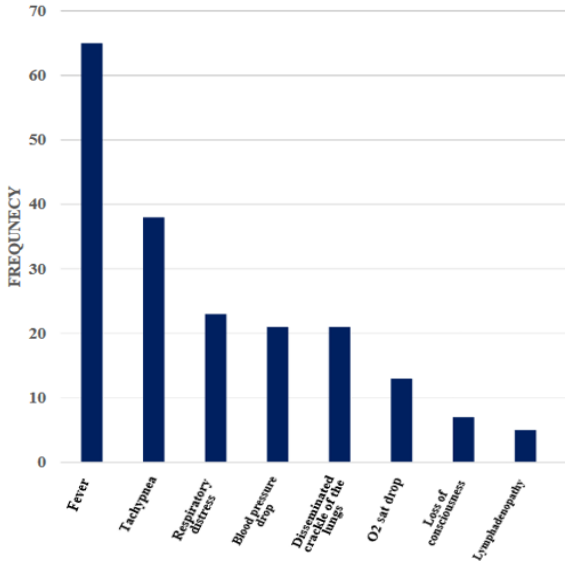

Figure 2- Frequency distribution of physical examination among patients.

Table 1- Laboratory findings among patients

Laboratory parameter		Frequency	Percentage
CBC	Leukocytosis	14	17.5
	Leukopenia	5	6.3
	Thrombocytosis	3	3.8
	Thrombocytopenia	1	1.3
	Leukocytosis± Thrombocytosis	4	5
	Leukopenia± Thrombocytopenia	2	2.5
Increase in ESR		30	37.5
Increase in CRP		38	47.5
Increase in D-dimer		16	20

Increase in LDH	5	6.3

In contrast, in our study, only patients hospitalized in PICU were evaluated. Other studies have reported that gastrointestinal symptoms, including vomiting and diarrhea, in patients with COVID-19 are more frequent in pediatric patients than in adults.

Physical examination findings in the present study revealed that fever had the highest frequency in 65 (81.3%), tachypnea in 38 (47.5), respiratory distress in 23 (28.8%), hypotension in 21 (26.3%), diffuse lung crackles in 21 (26.3%), decreased O_2 sat in 13 (16.3%), and decreased level of consciousness in 7 (8.8%) patients. Imaging findings also demonstrated COVID-19 involvement in 39 (48.8%) patients. COVID-19 PCR test results identified 58 patients (72.5%) with a positive result. In the study by Guo et al., 30% of patients had abnormal chest radiology [10]. Also, in the study of Saeed et al. in 2020, of 10 patients examined, six patients were confirmed by PCR test to have COVID-19 [12]. In another study, 5 out of 10 patients had underlying chronic diseases and died [11]. Morand and colleagues reported that younger age, underlying pulmonary conditions, and immune system defects are the factors associated with worse outcomes in children with COVID-19 [13].

The current study also has several limitations. First, the study design's retrospective nature could present constraints and inherent biases related to using historical medical records. Second, the results may not be as broadly applicable to a larger pediatric population due to the single-center emphasis of the study on critically ill patients admitted to the PICU at Firozabadi Hospital. The evolving nature of the virus may introduce temporal biases, influencing the relevance of the findings to the current state of the pandemic. Future studies are needed to incorporate data from recent periods to capture the ongoing dynamics of the disease.

Conclusion

The findings of our study display that fever and gastrointestinal and respiratory symptoms are the most common symptoms of COVID-19-infected children admitted to PICU. Moreover, gastrointestinal manifestations in these children are more frequent than in adults. Overall, children suffering from underlying diseases show a higher mortality percentage than those infected with COVID-19. Therefore, in the health system's policies and patient management, the provision of medical services to children with underlying diseases should be prioritized.

Acknowledgments

We want to express our special thanks for the cooperation and support of all the Deputy of Iran University of Medical Sciences, Tehran, Iran personnel.

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