Coinfection and Other Clinical Characteristics of COVID-19 in Children

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abstract

BACKGROUND AND OBJECTIVES: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a newly identified pathogen that mainly spreads by droplets. Most published studies have been focused on adult patients with coronavirus disease 2019 (COVID-19), but data concerning pediatric patients are limited. In this study, we aimed to determine epidemiological characteristics and clinical features of pediatric patients with COVID-19.

METHODS: We reviewed and analyzed data on pediatric patients with laboratory-confirmed COVID-19, including basic information, epidemiological history, clinical manifestations, laboratory and radiologic findings, treatment, outcome, and follow-up results.

RESULTS: A total of 74 pediatric patients with COVID-19 were included in this study. Of the 68 case patients whose epidemiological data were complete, 65 (65 of 68; 95.59%) were household contacts of adults. Cough (32.43%) and fever (27.03%) were the predominant symptoms of 44 (59.46%) symptomatic patients at onset of the illness. Abnormalities in leukocyte count were found in 23 (31.08%) children, and 10 (13.51%) children presented with abnormal lymphocyte count. Of the 34 (45.95%) patients who had nucleic acid testing results for common respiratory pathogens, 19 (51.35%) showed coinfection with other pathogens other than SARS-CoV-2. Ten (13.51%) children had real-time reverse transcription polymerase chain reaction analysis for fecal specimens, and 8 of them showed prolonged existence of SARS-CoV-2 RNA.

CONCLUSIONS: Pediatric patients with COVID-19 presented with distinct epidemiological, clinical, and radiologic characteristics from adult patients. Nearly one-half of the infected children had coinfection with other common respiratory pathogens. It is not uncommon for pediatric patients to have prolonged fecal shedding of SARS-CoV-2 RNA during the convalescent phase.

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WHAT'S KNOWN ON THIS SUBJECT: Severe acute respiratory coronavirus 2 is a newly identified pathogen that mainly spreads by droplets. Most published studies have been focused on adult patients with coronavirus disease 2019, but data concerning pediatric patients are limited.

WHAT THIS STUDY ADDS: Children with coronavirus disease 2019 presented with distinct clinical characteristics from adult patients. Notably, coinfection with other respiratory pathogens were common in pediatric patients, highlighting the importance for the screening of severe acute respiratory syndrome coronavirus 2.

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During the last 3 months, we faced the fast-growing outbreak of coronavirus disease 2019 (COVID-19) that swept through China and rapidly spread to all over the world. The etiologic agent, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was identified as a novel pathogen highly contagious to the general population, with a relatively high mortality rate. By the end of April 2020, >3 million confirmed cases of COVID-19 were reported in over 200 countries and regions globally, causing >200 000 deaths.[1] Currently, the epidemic center has been shifted to the United States and Europe. In early studies on COVID-19, Chinese researchers[2–5] have provided first-hand knowledge and valuable treatment experiences for other countries to learn from, but most of the studies were targeted at adult patients. The majority of publication on pediatric cases of COVID-19 during the early stage of the disease were case reports or studies with a relatively small sample size.[6–11] To determine the spectrum of the disease in children, we collected and analyzed epidemiological, clinical, laboratory, and radiologic data of 74 pediatric COVID-19 cases in 2 locations of northern and southern China. We hope our study will be used to further the understanding of SARS-CoV-2 infection in children and provide an insight to treatment strategies and prophylactic control of the disease.

METHODS

Data Sources

From January 20 to February 27 of 2020, we retrospectively reviewed electronic medical records of 74 pediatric COVID-19 cases admitted in the Qingdao Women and Children's Hospital and Wuhan Children's Hospital, including data recorded during hospitalization and the follow-up period. Baseline information (sex, age, weight, time of onset, time of diagnosis by SARS-CoV-2 nucleic acid test, and date of admission and discharge), epidemiological history, clinical manifestations, laboratory and radiologic findings, treatment, outcome, and follow-up data were recorded with standardized data collection forms. This study was approved by the institutional review board of the ethics committee of the Qingdao Women and Children's Hospital (QFELL-KY-2020-11), and written informed consent was obtained from patients' legal guardians before enrollment.

Determination of Exposure History

Detailed epidemiological data of all case patients were collected and classified according to whether the case patients were household contacts of confirmed adult patients, the sequence of infection within the families, and whether the infected children transmitted the virus to others.

Laboratory Confirmation

Confirmation of COVID-19 was based on a positive result for real-time reverse transcription polymerase chain reaction (RT-PCR) testing of SARS-CoV-2 in nasopharyngeal swabs by hospital laboratory and was double confirmed by the local Centers for Disease Control and Prevention using the same RT-PCR protocol. A final decision on COVID-19 diagnosis was made according to World Health Organization interim guidance.[12]

Diagnosis Classification

According to the experts' consensus statement on the diagnosis, treatment, and prevention of 2019 novel coronavirus infection in children issued by the Group of Respirology of the Chinese Pediatric Society,[13] patients were classified into 5 types (Table 1): asymptomatic infection, acute upper respiratory tract infection, mild pneumonia, severe pneumonia, and critical cases (acute respiratory distress syndrome and severe acute respiratory syndrome [SARS]). Mild pneumonia was further subgrouped into subclinical type and clinical type on the basis of the clinical manifestations.

Statistical Analysis

Categorical data were expressed as a number and percentage, and continuous data were expressed as a median with a range or interquartile. Statistical analyses were performed by using SAS software (SAS 9.4; SAS Institute, Inc, Cary, NC).

Role of the Funding Source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of this article. The corresponding authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

RESULTS

Basic Characteristics

None of the 74 infected children had comorbidities. Detailed data of the baseline characteristics of the patients are listed in Table 2, and the time line of disease progression including the date of admission, diagnosis, and discharge and the final date of follow-up are shown in Fig 1.

Epidemiological Characteristics

Complete information of exposure history was collected from 68 of the 74 patients (91.9%). Except for 3 sporadic cases, 65 (65 of 68; 95.6%) case patients were household contacts of adults whose symptoms developed earlier and the last confirmed case within the family, including 18 (27.7%) being the second infected family member, 23 (35.4%) being the third, 14

TABLE 1 Definitions of Clinical Types of COVID-19 in Children

	Diagnostic Criteria
Asymptomatic infection	Positive RT-PCR test results for SARS-CoV-2
	Without manifestations of clinical symptoms
	Without abnormal chest imaging findings
Acute upper respiratory tract infection	Upper respiratory symptoms (eg, fever, cough, pharyngeal pain, nasal congestion, fatigue, headache, and myalgia)
	Without signs of pneumonia by chest imaging or sepsis
Mild pneumonia	Without symptoms (subclinical type) or with fever or respiratory symptoms such as cough (clinical type)
	With chest imaging indicating pneumonia
	Without reaching the criteria of severe pneumonia
Severe pneumonia	Meeting any of the following criteria:
	Increased respiratory rate: ≥70 times/min (<1 y) or ≥50 times/min (≥1 y) (after ruling out the effects of fever and crying)
	Oxygen saturation <92%
	Hypoxia: assisted breathing (moans, nasal faring, and 3 concave signs), cyanosis, and/or intermittent apnea
	Disturbance of consciousness: somnolence, coma, or convulsion
	Food refusal or feeding difficulty, with signs of dehydration
Critical cases	Those who meet any of the following criteria and require ICU care:
	Respiratory failure requiring mechanical ventilation (eg, ARDS, persistent hypoxia that cannot be alleviated by inhalation through nasal catheters or masks)
	Septic shock
	Combined with other organs failure

ARDS, acute respiratory distress syndrome.

(21.5%) being the fourth, 9 (13.9%) being the fifth, and 1 (1.5%) being the sixth. There has been no evidence revealing the virus was transmitted from children to others.

Clinical Features

Diagnosis and Classification

There was only 1 case of severe pneumonia among the 74 infected children, and the rest consisted of 20 cases of asymptomatic infection, 24 acute upper respiratory tract infection cases, and 29 mild pneumonia cases, accounting for 27.0%, 32.4%, and 39.2%, respectively. Thirty (40.5%) children did not have clinical symptoms and were identified by SARS-CoV-2 nucleic acid screening tests, and 20 of them were finally confirmed as asymptomatic carriers, whereas 10 children were classified as subclinical mild pneumonia patients.

Clinical Manifestations

Cough (32.4%) and fever (27.0%) were the most common symptom at the onset of disease. Other symptoms included fatigue, chest congestion, anorexia, diarrhea, dyspnea, headache, and expectoration, whereas myalgia, pharyngalgia, dizziness, and myalgia were rare (Table 2). Except fever, all the positive signs were related to the respiratory system, including rhonchi and crackles in 16 cases (21.6%). No children showed neurologic or gastrointestinal symptoms. The most severe case was a 13-year-old boy with body weight of 85 kg who presented with high fever and cough at onset of the disease; his fever lasted for 3 days, with a highest body temperature of 39.8°C. During hospitalization, he suffered from dyspnea with low proximal oxygen saturation of 92% on room air and had bilateral diffuse breath sounds of crackles for 5 days.

Laboratory Findings

As shown in Table 3, all patients underwent tests of complete blood count, C-reactive protein (CRP), and procalcitonin. There were 23 case patients (31.1%) with abnormal leukocyte count, being increased in 19 case patients (25.7%; with a highest level of 15.35×10^9/L) and reduced in 4 cases (5.4%), with a bottom level of 2.90×10^9/L. Abnormal lymphocyte count was found in 10 case patients (13.5%), among whom 6 (8.1%) had an increased number of lymphocytes (highest value 9.03×10^9/L) and 4 (5.4%) had a reduced number of lymphocytes (lowest value 0.80×10^9/L). CRP was increased in 13 case patients (17.6%), with a highest serum level of 39.0 mg/L. Elevation of procalcitonin was observed in 2 case patients (2.7%), with a highest level of 0.75 μg/L. The erythrocyte sedimentation rate (ESR) was measured for 14 (18.9%) patients, and 5 (5 of 14; 35.7%; 12–25 mm/hour) of them had accelerated rates. Of 74 case patients, 34 (46.0%) were screened for common respiratory pathogens, and 19 (19 of 34; 51.4%) had coinfection, including 11 case patients coinfected with mycoplasma pneumoniae (MP), 2 with MP and respiratory syncytial virus (RSV), 2 with MP and Epstein-Barr virus (EBV), 2 with cytomegalovirus (CMV), 1 with CMV and EBV, and 1 with MP, influenza A

TABLE 2 Basic and Clinical Characteristics of the Study of Children Infected With SARS-CoV-2

	n (%) or Median (Range)
Basic characteristics	
Sex, *n* (%)	
Female	30 (40.5)
Male	44 (59.5)
Age, y, median (range)	6.00 (0.10–15.08)
≤3 mo, *n* (%)	7 (9.5)
3–6 mo, *n* (%)	4 (5.4)
6–12 mo, *n* (%)	5 (6.8)
1–3 y, *n* (%)	12 (16.2)
3–10 y, *n* (%)	31 (41.9)
>10 y, *n* (%)	15 (20.3)
Wt, kg, median (range)	24.0 (4.2–87.0)
Symptoms at onset, *n* (%)	45 (60.8)
Cough, *n* (%)	24 (32.4)
Fever, *n* (%)	20 (27.0)
Temperature, *n* = 20, °C, median, (range)	38.6 (37.6–40.1)
≤38.0, *n* (%)	2 (10.0)
38.1–39.0, *n* (%)	10 (50.0)
>39.0, *n* (%)	8 (40.0)
Fatigue, *n* (%)	5 (6.8)
Chest congestion	4 (5.4)
Anorexia	3 (4.1)
Diarrhea	3 (4.1)
Dyspnea	2 (2.7)
Headache	2 (2.7)
Expectoration	2 (2.7)
Myalgia	0 (0)
Pharyngalgia	0 (0)
Dizziness	0 (0)
Myalgia	0 (0)
Clustering of the symptoms, *n* (%)	
1	28 (37.8)
≥2	16 (21.6)
Clinical types, *n* (%)	
Asymptomatic infection	20 (27.0)
Acute upper respiratory tract infection	24 (34.4)
Mild pneumonia	29 (39.2)
Clinical type	19 (25.7)
Subclinical type	10 (13.5)
Severe pneumonia	1 (1.4)
Critical cases	0 (0)

and B, and RSV. Other routine laboratory testing revealed no obvious abnormality. Ten (13.5%) children had RT-PCR analysis for SARS-CoV-2 in fecal specimens, and viral RNA results remained positive in stools of 8 convalescent patients after respiratory specimens revealed negative results. The time needed for SARS-CoV-2 RNA results in fecal specimens turning negative after negative conversion in nasopharyngeal swabs ranged from 5 to 23 days, with a median of 11 days. At the time of writing, 3 children still had fecal RNA detectable, and the longest lagged behind for 23 days.

Radiologic Findings

Four (5.4%) children only had a chest computed tomography (CT) examination once, which was done on admission and did not reveal any abnormalities. The other 70 (94.6%) children included in this study had a chest CT examination both at the day of admission and day of discharge. Radiologic changes were found in 37 (50.0%) patients, with 8 (8 of 37; 21.6%) cases in the left lung, 13 (13 of 37; 35.1%) cases in the right lung, and 16 (43.2%) cases bilaterally. Of the 37 case patients with abnormal chest CT findings, 30 case patients (81.1%) had clinical symptoms, and 7 (7 of 37; 18.9%) showed no symptoms during the whole course of illness. There were only 9 case patients (9 of 74; 12.2%) who showed typical changes of COVID-19 on chest CT imaging, including patches of ground-glass opacity, mainly distributed near the pleura (Fig 2). Changes in CT imaging of the other 28 case patients were nonspecific for SARS-CoV-2 infection (Fig 3). No large area of white lung, pleural effusion, and pneumothorax was found among the patients. The patient with the most severe clinical symptoms only showed abnormalities on CT imaging resembling that of common viral pneumonia (Fig 4).

Treatment and Outcomes

All 74 case patients were treated according to the experts' consensus statement on the diagnosis, treatment, and prevention of 2019 novel coronavirus infection in children issued by the Group of Respirology of the Chinese Pediatric Society,[13] including interferon inhalation, administration of antiviral drugs, and traditional Chinese medicine. Fifteen patients with confirmed MP infection were treated with azithromycin orally or intravenously, and the other 12 children received empirical antibiotic therapy. Only the 13-year-old with a severe case was given systematic corticosteroids for 5 days and γ-globulin for 3 days. No patient required mechanical ventilation, except 1 child with a severe case who received noninvasive ventilation for 5 days. All 74 patients were discharged on the basis of the tentative fifth or sixth edition of the *Diagnosis and Treatment Protocol for COVID-19* (issued by the National Health Commission of the People's Republic of China)[14,15] with good prognosis.

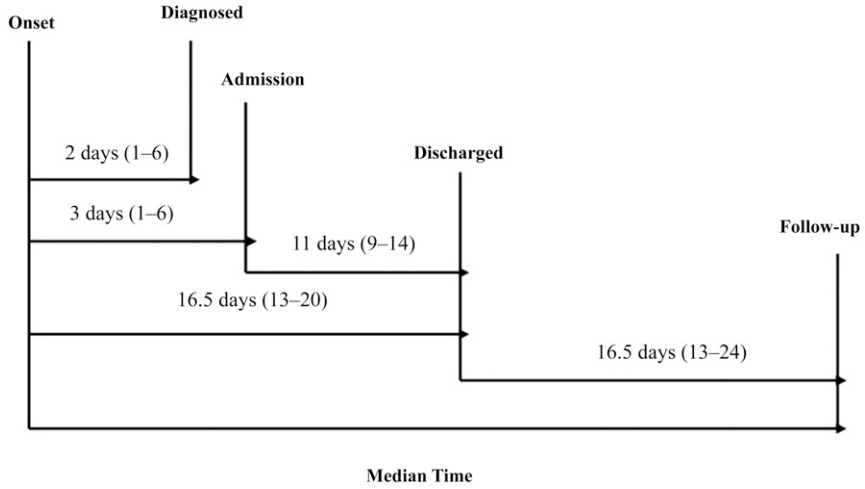

FIGURE 1
Time line of COVID-19 cases after onset of illness. The interval time was expressed as median with interquartile range.

Follow-up Results

After being discharged from the hospital, all patients remained in quarantine at designated sites for 14-day medical observation and then sent for home confinement for another 2 weeks. At the time of writing, the median follow-up period of patients in this study was 16.5 (10–42) days. No convalescent patients discharged from the hospital showed clinical manifestation during the study period, but 3 of the 8 cases with prolonged fecal shedding of SARS-CoV-2 still had positive results by using RT-PCR analysis until the last day of follow-up.

TABLE 3 Laboratory Findings of the Study of Children Infected With SARS-CoV-2

	n (%) or Median (Range)
White blood cell count	
0–6 mo, $\times 10^9$/L, median (range)	7.43 (3.27–13.20)
6 mo–6 y, $\times 10^9$/L, median (range)	8.22 (2.90–15.35)
≥6 y, $\times 10^9$/L, median (range)	6.80 (3.25–10.50)
Leukopenia, *n* (%)	4 (5.4)
Lymphocyte, $\times 10^9$/L	
0–6 mo, median (range)	4.74 (1.91–8.10)
6 mo–6 y, median (range)	4.14 (0.80–9.03)
≥6 y, median (range)	2.29 (0.86–4.54)
Lymphopenia, *n* (%)	4 (5.4)
CRP, mg/L, median (range)	1.9 (0.0–39.0)
Abnormal, *n* (%)	13 (17.57)
Procalcitonin, μg/L, median (range)	0.10 (0.03–0.75)
Abnormal, *n* (%)	2 (2.7)
ESR, mm/h, median (range)	18 (12–25)
Abnormal, *n* (%)	5 (35.7)
Coinfection, *n* (%)	19 (51.4)
Mycoplasma	16 (84.2)
RSV	3 (15.8)
EBV	3 (15.8)
CMV	3 (15.8)
Influenza A and B	1 (5.3)

DISCUSSION

The newly issued *Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19)* revealed the attack rate in individuals <18 years of age was only 2.4%, and no death was reported in this age group.[16] According to the data released by the Chinese Centers for Disease Control and Prevention,[17] 416 cases were reported among children 10 years old and younger (with no cases of death), accounting for 0.9% of total COVID-19 cases. Data from local health authorities revealed the attack rate among children ranged from 4.9% to 7.6%.[18,19] In evidence so far, it has been implied that children are less severely affected by COVID-19, their cases resembling that of SARS, which emerged 17 years ago.[20] Familial clustering is one of the common features of COVID-19 in children.[7,9,10,21] Among the 74 pediatric case patients included in this study, 68 had a definite exposure history, and 65 (95.59%) were household contacts of adults whose symptoms developed earlier. There has been no evidence showing the virus was transmitted from children to others. However, the relatively low attack rate of COVID-19 in children might be explained by the stringent implementation of home confinement and nationwide school closure as required by the Chinese governments. During the outbreak, public activities were discouraged, and children spent most of their days at home with strengthened protection from caregivers.

In this study, we included clinical, laboratory, treatment, and outcome data of 74 pediatric cases of COVID-19 from 2 children's hospitals within and beyond the epidemic center (from southern China and northern China, respectively). All patients were discharged from the hospital after recovery and were managed for 14 days. Clinical presentations of infected children were distinct from those of adult patients. Except for 1 critically ill patient, 20 (27.03%) case patients were asymptomatic

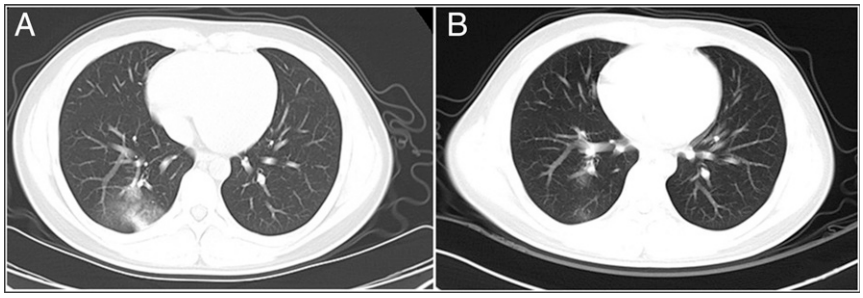

FIGURE 2
Chest CT images from a 2-year-old boy. A, The image revealed ground-glass opacity near the pleura of the lower lobe of the right lung on day 2 after symptom onset. B, The lesion almost was absorbed after 12 days of treatment.

carriers of SARS-CoV-2, and 53 (71.62%) were mild to moderate cases with various manifestations. Among adult patients, fever (83.0%–98.6%) and cough (59.4%–82.0%) were the most common and predominant symptoms,[2–5] whereas fever and mild cough only accounted for 27.03% and 32.43%, respectively, of symptoms at disease onset and during hospitalization in our pediatric patients, a proportion much lower than that of adult patients. Additionally, fatigue, headache, nausea, and gastrointestinal symptoms were not common among infected children. Nearly one-half of the children were not admitted to a hospital for symptoms; they were found to have positive results for SARS-CoV-2 by using RT-PCR analysis during quarantine after family members had been diagnosed with COVID-19.

Laboratory findings of pediatric patients were also different from those of adult patients. Previous studies have revealed leukopenia, lymphopenia, and increased serum levels of CRP in the majority of adult patients.[2–5] Only one-third of the 74 pediatric case patients in our study had abnormal leukocyte and/or lymphocyte counts, among whom 19 (25.68%) had increased and 4 (5.41%) had a decreased number of leukocytes; 6 (8.11%) had elevated lymphocytes, and 4 (5.41%) had reduced lymphocytes. Moreover, abnormal leukocyte and lymphocyte counts were slightly away from reference limits. Given that children <6 years of age have higher lymphocyte counts than adults, these indexes should be interpreted with caution. No clear pattern was found in changes of other inflammation-related variables, such as CRP, procalcitonin, and ESR.

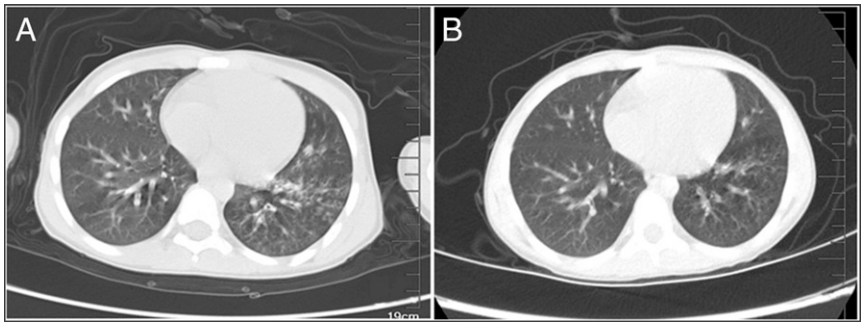

FIGURE 3
Chest CT images from a 7-year-old girl. A, The image revealed bilateral nonspecific multiple patches along the bronchovascular bundle on day 5 after symptom onset. B, The lesion was absorbed after 8 days of treatment.

Typical radiologic changes in adult patients with COVID-19 include multifocal areas of ground-glass shadows and bilateral infiltration, and dynamic changes could be observed with disease progression. Chest CT examination was conducted at admission and repeated on the day of discharge according to the *Diagnosis and Treatment Protocol for COVID-19* (tentative fifth, sixth, and seventh editions) issued by the National Health Commission of the People's Republic of China.[14,15,22] However, pediatric case patients with COVID-19 lacked the typical changes in chest imaging.[11] Among the 74 case patients in this study, only 9 (12.2%) showed radiologic abnormalities of ground-glass opacity, whereas the other 28 case patients only showed atypical changes of bronchopneumonia and common viral pneumonia. Nearly one-half of the case patients did not show any radiologic changes during course of the disease. The role of chest CT in the diagnosis and management of COVID-19 in children still needs to be determined. Because neither the sensitivity nor specificity of RT-PCR tests, by using respiratory specimens, was satisfactory at the early stage of the outbreak, chest CT served as an indispensable complement in the clinical setting. However, further assessment should be considered for routine use of chest CT in asymptomatic children and those with mild disease, considering the substantial radiation exposure associated with the examination.

The exact reason for the milder nature of the disease in children is still unclear. One possible explanation is that their immature immune system is less likely to

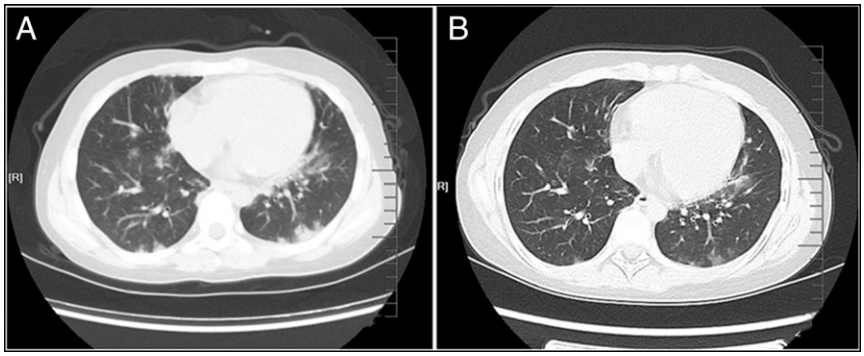

FIGURE 4

Chest CT images from a 13-year-old boy with severe illness. A, The image revealed bilateral nonspecific multipatchy consolidation opacity near the pleura on day 6 after symptom onset. B, The lesion was absorbed after 11 days of treatment.

mount an excessive inflammatory response and cytokine storm, as observed in adult patients.[23] Relatively stronger humoral responses in children may also contribute to this youthful resilience. Innate immunity reacts more rapidly in response to pathogen invasion than adaptive immunity. Moreover, children generally have fewer comorbidities, making them more resilient to SARS-CoV-2 infection. Most pediatric patients had relatively mild disease with good prognosis, which could also be seen in children infected with SARS-CoV and other respiratory viruses. Compared to that of pediatric patients, the mortality rate of seasonal flu in adults is nearly 10 times higher.[24] Several studies have revealed that children with SARS only presented with fever, cough, and nasal congestion and seldom developed into the third phase of SARS (characterized by acute respiratory distress syndrome). Accordingly, it is difficult to distinguish children with SARS from those with infection with other common respiratory viruses.[25–27] Nonspecific clinical, radiologic, and laboratory characteristics of children with SARS-CoV-2 infection makes them indistinguishable from those with other childhood illnesses, raising the possibility of underdetection of asymptomatic carriers. A comprehensive evaluation of epidemiological exposure and nucleic acid testing results would be warranted to guide decision-making in clinical settings.

More attention should be drawn to children with COVID-19 who also have coinfection with other common respiratory pathogens. Among the 74 pediatric patients included in this study, 19 (51.35%) of the 34 children who were tested for common respiratory pathogens had coinfection; 8 (42.11%) children had ≥2 pathogens other than SARS-CoV-2 detected. This finding was consistent with our previous observation and also in line with studies of other researchers.[28,29] The high coinfection rate in children can be used to highlight the importance of SARS-CoV-2 screening, especially during the peak season for colds, influenza, and other respiratory ailments.

With the accumulating experience of COVID-19 management in China, an increasing number of researchers have reported positive RT-PCR results for fecal SARS-CoV-2 detection or isolation of viable virus from excretions.[30,31] Xiao et al[30] demonstrated that viral RNA could exist in stools of COVID-19 patients for ≥12 days. Previously, we found that RT-PCR testing results for SARS-CoV-2 remained positive in feces of 3 pediatric patients for ~4 weeks, a duration much longer than that of respiratory specimens (~2 weeks).[32] Here, we simultaneously conducted nucleic acid testing in nasopharyngeal swabs and fecal specimens for 10 of the 74 pediatric patients, and all of them had positive results in both samples. Eight children had fecal SARS-CoV-2 positive results from RT-PCR analysis after negative conversion of viral RNA in respiratory specimens. SARS-CoV-2 may present in the gastrointestinal tract for a longer time than the respiratory system, which appears to be more common among pediatric patients. However, there are limited data on comparisons with adult patients. Detection of viral RNA in feces of convalescent patients does not necessarily mean that the viruses are replication competent or infectious enough to be transmitted. However, the possibility of fecal-oral transmission cannot be ignored. The emerging disease brings new challenges to preparedness response and prophylactic control; in particular, massive efforts should be made at all levels to minimize the spread of the virus among children after the reopening of kindergartens and schools.

Thus far, there have been no clinically proven therapies and prevention options specific for COVID-19. The therapeutic strategies for pediatric patients are largely based on the experiences of adult patients. Standardized management should be considered for pediatric patients with COVID-19, more precisely, to symptomatic and asymptomatic carriers of SARS-CoV-2 who come from familial clusters. Treatment plans should also be tailored for children.[33] Standard care included administration of antipyretics and antiviral agents, interferon inhalation, and enhanced

nutrition support. Only 1 critically ill case was given a low dose of systemic corticosteroid for a short duration. Over one-half of the pediatric patients were merely under close surveillance and quarantine, and none of them had worsening of symptoms. The most "severe" symptom during their hospitalization and medical observation was the one at onset of the illness. More investigations are needed to determine the standardized treatment of pediatric patients with typical COVID-19 symptoms and to evaluate the efficacy of therapeutic drugs such as traditional Chinese medicine.

The rapidly evolving COVID-19 outbreak and the lack of specific containment measures in the early stage caused panic in the community and hospitals. In such cases, we failed to collect complete epidemiological information from 6 patients. Only blood routine, biochemical, and infection-related biomarkers were analyzed in this study because of different standards for laboratory testing between the 2 hospitals. We were unable to measure the viral loads or detect presence of SARS-CoV-2 in nasopharyngeal swabs and fecal specimens for all of our patients. We only screened common respiratory pathogens for children who were admitted to hospitals during the later stage of the outbreak. But we believe these 74 cases with complete medical records during hospitalization and follow-up period are good representatives of the pediatric patients with COVID-19 in China.

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ABBREVIATIONS

CMV: cytomegalovirus
COVID-19: coronavirus disease 2019
CRP: C-reactive protein
CT: computed tomography
EBV: Epstein-Barr virus
ESR: erythrocyte sedimentation rate
MP: mycoplasma pneumoniae
RSV: respiratory syncytial virus
RT-PCR: real-time reverse transcription polymerase chain reaction
SARS: severe acute respiratory syndrome
SARS-CoV-2: severe acute respiratory syndrome coronavirus 2

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