Radiology: Cardiothoracic Imaging

Differences in Clinical and Imaging Presentation of Pediatric Patients with COVID-19 in Comparison with Adults

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Original Research

Summary

Compared to adults, pediatric patients with COVID-19 showed distinctive characteristics in clinical presentation and CT imaging. Pediatric patients tend to have milder clinical symptoms, fewer CT findings, and lesser extent of disease in the lungs. Moreover, peribronchial distribution and bronchial wall thickening, less frequent findings in the adult population with COVID-19, were more commonly seen in pediatric patients.

Key Points:

1. Fever was less prevalent in pediatric patients than in adults (6/14, 42.9% vs 39/47, 83%; $p = 0.008$).
2. Compared with adults, pediatric patients had a lower rate of positive CT findings and milder clinical grade ($p = 0.004$, $p = 0.001$ respectively).
3. CT features did not differ in two groups, except for bronchial wall thickening, which was more common in pediatric patients ($p = 0.048$).

Abstract

Background: Although Coronavirus Disease 2019 (COVID-19) affects patients from all age groups, clinical and radiological features of COVID-19 have been mainly described in adults.

Objective: To characterize and compare the initial clinical and imaging features of COVID-19 in pediatric and adult patients undergoing chest computed tomography (CT).

Materials and Methods: A total of 61 patients, consisting of 47 adults (18 years old or older) and 14 pediatric patients (younger than 18 years old) with laboratory-confirmed COVID-19 by real-time reverse transcriptase polymerase chain reaction (RT-PCR) between January 25, 2020 and February 15, 2020 were enrolled in this study. All patients underwent chest CT within 3 days after the initial RT-PCR. The clinical presentation, serum markers, and CT findings were assessed and compared between the adult and pediatric patients.

Results: Fever was less common in pediatric patients than in adults (6/14, 42.9% vs 39/47, 83%; $p = 0.008$). Leukopenia or normal, lymphopenia or normal, and increased or normal C-reactive protein were common in both groups with no difference ($p > 0.05$). Compared with the adults, pediatric patients had a lower rate of positive CT findings and a milder clinical grade ($p = 0.004$, $p = 0.001$ respectively). On chest CT, the number of pulmonary lobes involved was reduced in pediatric patients when compared to adults

($p = 0.012$). Subpleural distribution of lung opacities was a dominant feature in both groups, whereas bronchial distribution was more common in the pediatric group ($p = 0.048$). Among the CT features in adults, ground-glass opacities (GGO) were the most common finding (24/43, 53.5%), followed by GGO with consolidation (14/43, 27.9%). In pediatric patients, GGOs accounted for 42.9% (3/7), bronchial wall thickening occurred in 28.6% (2/7), and GGOs with consolidations and nodular opacities in 14.3% (1/7). However, these CT features did not differ in two groups, except for bronchial wall thickening, which was more commonly found in pediatric patients ($p=0.048$). Additionally, the semi-quantitative scores of lung involvement were higher in adults than in pediatric patients (8.89 ± 4.54 vs 1.86 ± 2.41, $p < 0.001$).

Conclusions: Compared to adults, pediatric patients with COVID-19 showed distinctive clinical and CT. Pediatric patients tend to have milder clinical symptoms, fewer positive CTs, and less extensive involvement on imaging. Bronchial wall thickening was relatively more frequent on CT images from pediatric patients with COVID-19 in comparison with adults.

Abbreviations

COVID-19 = coronavirus disease 2019

WHO = the World Health Organization

CCDC = The Chinese Center for Disease Control and Prevention

SARS = severe acute respiratory syndrome

MERS = Middle East respiratory syndrome

PT-PCR = reverse-transcription–polymerase chain- reaction

GGO = ground glass opacity

Introduction

In December 2019, several cases of an unexplained respiratory disease emerged in Wuhan, China, with clinical presentation resembling viral pneumonia. Deep sequencing analysis of respiratory samples revealed a novel coronavirus (SARS-CoV-2), and the disease it causes was subsequently named Coronavirus Disease 2019, COVID-19[1]. Cases of COVID-19 cases rapidly increased China and globally[2-4]. On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic [29].

Similar to other pneumonias caused by coronaviruses, such as severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS)[5-7], COVID-19 patients also present with fever, cough, dyspnea and pulmonary parenchymal opacities on chest radiographs[8-10]. Reports of

SARS in 2003 showed that all age groups were susceptible, but children appeared to be less affected by the disease, with fewer and less severe cases[11]. The exact number of children worldwide affected by SARS is not known because of incomplete age classification in reported cases. It was estimated that only about 5% of people affected were under the age of 18, with no child deaths reported (WHO SARS surveillance team)[12, 13]. Recently, epidemiological, clinical, and radiological imaging studies of COVID-19 have emerged, but almost all of them have focused on adult cases, with only a few reporting findings in children[8-10, 14]. In this study, we conducted a retrospective analysis of the clinical and radiological features of COVID-19, further comparing the differences between pediatric and adult patients.

Materials and Methods

Patients

Our Institutional Review Board approved the study and waived the requirement for informed written consent. In this study, we reviewed a convenience sample of 62 consecutive patients with COVID-19 diagnosed between January 25, 2020 and February 15, 2020 at four tertiary medical units from Guangzhou, China. Inclusion criteria for this study were as follows: (a) patients with COVID-19 confirmed by real-time polymerase chain reaction (RT-PCR) on nasopharyngeal swabs; (b) patients with a

chest computed tomography (CT) scan obtained within 3 days from the initial swab test. Suboptimal CT image quality, as judged by the CT readers, was the single exclusion criterion. One patient was excluded due to excessive motion artifacts on CT. Thus, a total of 61 patients were included and were divided into two groups: patients under 18 years of age were included in the *pediatric* group, while patients with 18 years of age or older were included in the *adult* group. According to COVID-19 guidelines (Trial Version 6) released by the National Health Commission of the People's Republic of China[15], the patients were subdivided into four clinical severity groups: mild, common, severe and fatal types.

CT Acquisition

The median time from symptom onset to CT scan was 5 days, ranging from 1 to 14 days. Chest CT examinations were obtained using multi-slice helical CT scanners (Philips Brilliance 64-slice CT, Philips, Amsterdam, Netherlands; Aquilion ONE, Toshiba Medical Systems, Otawara, Japan; GE Healthcare, Milwaukee, WI, USA; SIEMENS SOMATOM Definition CT scanner, Siemens Healthineers; Erlangen, Germany) without intravenous contrast material. The scanning range was set from the level of thoracic inlet to the lowest costophrenic angle. The imaging parameters were as follows. Adults: tube voltage, 120KV; effective mAs, 180-400mAs; collimation, 0.625 mm or 0.5mm; pitch, 0.8 or 1; reconstruction algorithm,

filtered back projection; reconstruction slice thickness, 1 mm; interslice gap, -0.2 mm. The estimated effective radiation dose in adults ranged from 2.8 mSv to 3.5 mSv. Children: tube voltage, 100-120 KV; mA, automatic exposure control; collimation, 2.0 mm; pitch, 1; reconstruction algorithm: iterative-based reconstruction; reconstruction slice thickness, 0.5 mm; interslice gap: 0 mm. The estimated effective radiation dose in pediatric patients ranged from 0.8 mSv to 1.2 mSv. During the clinical examination, 10% chloral hydrate (5-10mg /kg) was given to children under 3 years of age or those unable to cooperate (orally administered 30 minutes before the scan) to ensure the calm breathing during the scan.

CT Analysis

The CT scans were independently reviewed by two radiologists (DDC and AMC, with 5 and 18 years of thoracic radiology experience, respectively), who were blinded to the clinical information. Any discrepancies in the interpretation were resolved by consensus reading. The distribution of lung opacities was recorded as peripheral (predominantly involving the outer 1/3 of the lungs), central (predominantly involving the inner 2/3 of the lungs), central and peripheral (no clear predominance), or peribronchial (predominantly along the bronchovascular bundles). CT images were assessed for the presence of pure ground-glass opacity (GGO), GGO with consolidation, pure consolidation, nodules, bronchial wall

thickening, reticular or linear opacities, lymphadenopathy, and pleural effusions [16]. A semi-quantitative lung severity score was used to assess the extension of pulmonary involvement. Each of the 5 lung lobes was visually scored from 0 to 5 as: 0 - no involvement, 1 - 1%-25% involvement, 2 - 26%-50% involvement, 3 - 51%-75% involvement, 4 - 76%-100% involvement. The total CT score was the sum of the individual lobar scores and ranged from 0 (no involvement) to 20 (maximum involvement)[10].

Statistical Analysis

The statistical analyses were performed in R (version 3.5.1, http://www.Rproject.org) and Python (version 3.5.6, http://www.python.org). Continuous variables were presented as mean ± standard deviation and categorical data were presented as the percentage of the total, unless otherwise specified. The chi-square test or Fisher's exact test were used for testing differences in categorical data between groups. The Kruskal-Wallis H-test was used for testing differences in ordinal variables. A two-tailed p-value < 0.05 indicated statistical significance.

Results

Demographics

The clinical and laboratory data of the 61 patients are summarized in **Supplemental Table**. The comparison between adult and pediatric

patients is shown in **Table 1**. The age among the 61 patients ranged from 2 months to 81 years (mean, 39.9 ± 23.9 years). There were 14 patients in the pediatric group (aged from 2 months to 10 years, mean: 4.7 ± 3.4 years) and 47 patients in the adult group (aged from 20 to 81 years, mean: 50.34 ± 16.00y). The male-to-female ratios in the pediatric and adult groups were respectively 28:21 and 8:6. No significant difference was found between the two groups in gender composition (p = 0.871).

Presenting Clinical Symptoms

Patients exhibited various symptoms on admission, including fever (45/61, 73.8%), fatigue (24/61, 39.3%), cough (18/61, 29.5%), runny nose (5/61, 8.2%) and diarrhea (2/61, 3.3%). In adults, fever was the dominant symptom (39/47, 83%), followed by fatigue (21/47, 44.7%), cough (12/47, 25.5%), runny nose (3/47, 6.4%), and diarrhea (2/47, 4.3%). In the pediatric group, fever and cough were both see in 42.9% (6/14), while fatigue and runny nose were seen in 21.4% (3/14) and14.3% (2/14) of the patients, respectively. Overall, fever was less common in pediatric patients than in adults (6/14, 42.9% vs 39/47, 83%; p = 0.008).

Laboratory Markers

The prevalence of leukopenia, lymphopenia, and increased C-reactive protein in adults were 46.9%(22/47), 27.7%(13/47), and 40.4%(19/47),

while in the pediatric patients they were 28.6%(4/14), 21.4%(3/14), and 28.6%(4/14), respectively. There were no significant differences between the two groups ($p = 0.226$, $p = 0.905$, $p = 0.422$ respectively).

Clinical Severity

Mild, common, and severe cases accounted for 8.5% (4/47), 83.0% (39/47) and 8.5% (4/47) of the cases in adult group, respectively, as well as accounted for 50% (7/14), 50% (7/14)and 0% (0/14) of the cases in the pediatric group, respectively. No fatalities were seen in both groups. There was a significant difference between the two groups in the clinical classification ($p < 0.001$), with no severe cases seen in the pediatric group.

CT Positivity

CTs were abnormal in 91.5% (43/47) of adult patients, compared with 50% (7/14) in pediatric patients, resulting in a statistically significantly difference ($p = 0.004$).

CT Analysis

The imaging characteristics of 50 patients with positive CT findings, and the comparisons of CT features between pediatric and adult patients are displayed in **Table 2**. The number of pulmonary lobes involved by parenchyma opacities was significantly higher in adults when compared to the pediatric group ($p < 0.001$). Bilateral lung involvement was seen in

83.7% (36/43) of the adults and in 57.1% (4/7) of the pediatric group, which was not significantly different (p = 0.262). Subpleural distribution was the most common pattern in both groups, occurring in 67.4% (29/43) of the adults and 57.1% (4/7) of the pediatric patients. Peribronchial distribution was seen in 28.6% (2/7) of the pediatric group, versus 2.3% (1/43) in the adult group (p = 0.048).

In adults, GGO were the most common feature (24/43, 53.5%), followed by GGO with consolidations (12/43, 27.9%). In the pediatric group, GGO accounted for 42.9% (3/7), bronchial wall thickening occurred in 28.6% (2/7), and both GGO with consolidations and nodules occurred in 14.3% (1/7) of the CTs. Other abnormalities, such as mediastinal lymphadenopathy and pleural effusions were rare in both adults (respectively 2.3%, 1/43, and 4.7%, 2/43,) and pediatric patients (0%, 0/14, both). In addition, lung severity scores in adults (8.89 ± 4.54) were significantly higher than that in pediatric patients (1.86 ± 2.41) ($p < 0.001$).

Discussion

Fever, fatigue, cough, runny nose, and diarrhea were the most common clinical manifestations in our cohort of adults and pediatric patients with COVID-19. These symptoms are in concordance with previous reports in SARS and MERS, also caused by coronaviruses[6, 17, 18]. However, we noted that fever was relative less common in pediatric

patients (42.9% vs 83%). Of note, about half of the pediatric patients had no systemic symptoms, except for mild upper respiratory symptoms such as cough and runny nose; some pediatric patients were asymptomatic. Similar findings were reported in a previous study in SARS[19]. This clinical picture is indistinguishable from other viral infections of the upper respiratory tract, thus posing a diagnostic challenge for the pediatric patients with COVID-19. In addition, two adult patients only presented with diarrhea, while it was not seen in pediatric cases.

Most of the patients in both groups presented normal leukocyte/lymphocyte counts and elevated C-reactive protein, unlike in a previous study that reported that 73% prevalence of leukopenia in adults with COVID-19[20]. We speculate that this discrepancy could be due to differences in patient population and interval between disease onset and hospital presentation. Although the laboratory findings are not specific for viral pneumonia, the lack of leukocytosis may be helpful to distinguish COVID-19 from common bacterial infections. According to the clinical severity classification proposed by the COVID-19 guidelines (Trial Version 6) in China[15], pediatric patients were more likely to have milder clinical presentation than adults, with a higher proportion of normal CTs (50% versus 8.5%, respectively), and less extensive disease on imaging. Therefore, healthcare systems should consider judicious utilization of routine chest CT for assessing COVID-19 in the pediatric population,

balancing the potential risks posed by ionizing radiation against the most common scenario of milder clinical and radiologic disease. Currently, the Society of Thoracic Radiology and the American College of Radiology do not support the use of chest CT for routine screening of COVID-19 [30 31].

In accordance with several recent reports on COVID-19 CT findings [10, 21, 22], in the adult and pediatric groups, pulmonary opacities involved both lungs and multiple lobes, in a predominant peripheral distribution. Although peribronchial distribution was uncommonly seen in both populations, it was relatively more frequent in the pediatric group. In addition, bronchial wall thickening was also more prevalent in the pediatric group. The explanation for these observations is still unclear, and could be related to differences in distribution of the coronavirus infection along the respiratory epithelium between the two groups or to occurrence of co-infection. Further studies focusing on histologic findings of COVID-19 may shed light on these differences.

COVID-19 shares common CT findings with other coronavirus infections, such as SARS, MERS[12, 23, 24]. Notably, the pediatric population generally displayed a milder and slightly diverse range of CT manifestations when compared to adults. None of these manifestations are specific for COVID-19; therefore, differentiation from other viral and opportunistic pneumonias are needed based on clinical and laboratorial workup [25-28]. Exposure history and access to RT-PCR testing is essential

for making the diagnosis of COVID-19.

There were several limitations in our study. First, the sample size is small in the pediatric group, which can limit the study power. Second, we could not control for geographic factors, as our subjects were from different medical centers, or for CT scanning parameters. However, we assume that these observations may reflect the most typical scenario encountered across centers worldwide. Third, we only analyzed the clinical and CT manifestations at initial medical center presentation. Further studies including clinical follow ups are needed to determine if the observations in the pediatric group are sustained throughout the course of disease. Last, given the retrospective nature of the study, we were not able to determine the presence or impact of co-infection on the observed CT findings.

In summary, pediatric patients with COVID-19 have relatively milder clinical symptoms, a higher prevalence of negative CTs, and decreased disease extension on imaging than adults. These observations should be heavily weighted when balancing the risk-benefit ratio for using chest CT in the pediatric population with COVID-19. Currently, most of the imaging societies and the Centers for Disease Control and Prevention do not recommend routine screening for COVID-19 with chest CT, and the confirmatory diagnosis relies on RT-PCR. Although peribronchial distribution of the lung opacities and bronchial wall thickening are atypical

CT findings in COVID-19, there were relatively more frequent in the pediatric population.

References

[1] WHO. Novel coronavirus – China. Jan 12, 2020. http://www.who. int/csr/don/12-january-2020-novel-coronavirus-china/en/ (accessed Jan 19, 2020).

[2] WHO. Novel coronavirus – Thailand (ex-China). Jan 14, 2020. http://www.who.int/csr/don/14-january-2020-novel-coronavirusthailand/en/ (accessed Jan 19, 2020).

[3] WHO. Novel coronavirus – Japan (ex-China). Jan 17, 2020. http://www.who.int/csr/don/17-january-2020-novel-coronavirusjapan-ex-china/en/ (accessed Jan 19, 2020).

[4] WHO. Novel coronavirus – Republic of Korea (ex-China). Jan 21, 2020. http://www.who.int/csr/don/21-january-2020-novelcoronavirus-republic-of-korea-ex-china/en/ (accessed Jan 23, 2020).

[5] Ksiazek TG, Erdman D, Goldsmith CS, et al. A novel coronavirus associated with severe acute respiratory syndrome. N Engl J Med. 2003. 348(20): 1953-66.

[6] de Groot RJ, Baker SC, Baric RS, et al. Middle East respiratory syndrome coronavirus (MERS-CoV): announcement of the Coronavirus Study Group. J Virol. 2013. 87(14): 7790-2.

[7] Kuiken T, Fouchier RA, Schutten M, et al. Newly discovered coronavirus as the primary cause of severe acute respiratory syndrome. Lancet. 2003. 362(9380): 263-70.

[8] Chaolin H, Yeming W, Xingwang L, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet (London, England). 2020. 395(10223).

[9] Shi H, Han X, Zheng C. Evolution of CT Manifestations in a Patient Recovered from 2019 Novel Coronavirus (2019-nCoV) Pneumonia in Wuhan, China. Radiology. 2020: 200269.

[10] Chung M, Bernheim A, Mei X, et al. CT Imaging Features of 2019 Novel Coronavirus (2019-nCoV). Radiology. 2020 : 200230.

[11] Leung CW, Chiu WK. Clinical picture, diagnosis, treatment and outcome of severe acute respiratory syndrome (SARS) in children. Paediatr Respir Rev. 2004. 5(4): 275-88.

[12] Assiri A, Al-Tawfiq JA, Al-Rabeeah AA, et al. Epidemiological, demographic, and clinical characteristics of 47 cases of Middle East respiratory syndrome coronavirus disease from Saudi Arabia: a descriptive study. Lancet Infect Dis. 2013. 13(9): 752-61.

[13] Hon KL, Leung CW, Cheng WT, et al. Clinical presentations and outcome of severe acute respiratory syndrome in children. Lancet. 2003. 361(9370): 1701-3.

[14] Yicheng F, Huangqi Z, Yunyu X, Jicheng X, Peipei P, Wenbin J. CT Manifestations of Two Cases of 2019 Novel Coronavirus (2019-nCoV) Pneumonia. Radiology. 2020.

[15] China National Health Commission. Diagnosis and treatment of pneumonitis caused by new coronavirus (trial version 6). Beijing: China National Health Commission, 2020. http://www.nhc.gov.cn/yzygj/s7653p/202001/4294563ed35b43209b31739bd0785e67.shtml (accessed Feb 5, 2020).

[16] Hansell DM, Bankier AA, MacMahon H, McLoud TC, Müller NL, Remy J. Fleischner Society: glossary of terms for thoracic imaging. Radiology. 2008. 246(3): 697-722.

[17] Peiris JS, Lai ST, Poon LL, et al. Coronavirus as a possible cause of severe acute respiratory syndrome. Lancet. 2003. 361(9366): 1319-25.

[18] Lee N, Hui D, Wu A, et al. A major outbreak of severe acute respiratory syndrome in Hong Kong. N Engl J

Med. 2003. 348(20): 1986-94.

[19] Hon K, Leung CW, Cheng W, et al. Clinical presentations and outcome of severe acute respiratory syndrome in children. The Lancet. 2003. 361(9370).

[20] Fengxiang S, Nannan S, Fei S, et al. Emerging Coronavirus 2019-nCoV Pneumonia. Radiology. 2020 .

[21] Lei J, Li J, Li X, Qi X. CT Imaging of the 2019 Novel Coronavirus (2019-nCoV) Pneumonia. Radiology. 2020 : 200236.

[22] Kanne JP. Chest CT Findings in 2019 Novel Coronavirus (2019-nCoV) Infections from Wuhan, China: Key Points for the Radiologist. Radiology. 2020: 200241.

[23] Paul NS, Roberts H, Butany J, et al. Radiologic pattern of disease in patients with severe acute respiratory syndrome: the Toronto experience. Radiographics. 2004. 24(2): 553-63.

[24] Ooi GC, Khong PL, Müller NL, et al. Severe acute respiratory syndrome: temporal lung changes at thin-section CT in 30 patients. Radiology. 2004. 230(3): 836-44.

[25] Dela CCS, Wunderink RG. Respiratory Viral and Atypical Pneumonias. Clin Chest Med. 2017. 38(1): xiii-xiv.

[26] Gong L, Zhang CL, Zhen Q. Analysis of clinical value of CT in the diagnosis of pediatric pneumonia and mycoplasma pneumonia. Exp Ther Med. 2016. 11(4): 1271-1274.

[27] Wang Q, Zhang Z, Shi Y, Jiang Y. Emerging H7N9 influenza A (novel reassortant avian-origin) pneumonia: radiologic findings. Radiology. 2013. 268(3): 882-9.

[28] Bai L, Gu L, Cao B, et al. Clinical features of pneumonia caused by 2009 influenza A(H1N1) virus in Beijing, China. Chest. 2011. 139(5): 1156-1164.

[29] WHO Director-General's opening remarks at the media briefing on COVID-19https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

[30] ACR Recommendations for the use of Chest Radiography and Computed Tomography (CT) for Suspected COVID-19Infection. https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection (Accessed on 03/22/2020).

[31] Society of Thoracic Radiology/American Society of Emergency Radiology COVID-19 Position Statement, March 11, 2020. https://thoracicrad.org/

Data Supplement.

Clinical presentations of 47 adults and 14 pediatric patients.

			Exposure			Symptom					Lab		
Case no.	Age(Y/M)	Gender	Recent travel to Wuhan	Exposure to Infected patient	Unknown exposure	Fever	Myalgia or fatigue	Cough	Runny nose	Others	White cell($x10^9$/L)	Lymphocyte count($x10^9$/L)	C-reactive protein(mg/L)
Adult patients													
1	45Y	M	Y	N	N	Y	Y	N	N	N	3.18↓	1.07	1.14
2	29Y	M	N	Y	N	Y	Y	N	N	N	3.68↓	0.69↓	2.48
3	56Y	F	Y	N	N	Y	N	Y	Y	N	2.59↓	1.25	4.99
4	69Y	M	Y	N	N	Y	N	N	N	N	2.55↓	1.43	2.34
5	44Y	F	N	N	Y	Y	N	N	N	N	3.05↓	0.48↓	6.64↑
6	81Y	M	Y	N	N	N	N	Y	N	N	4.01	3.06	4.1
7	39Y	M	N	Y	N	Y	N	Y	N	N	2.44↓	1.03	7.43↑
8	67Y	M	N	Y	N	Y	N	N	N	N	3.53↓	1.07	1.14
9	73Y	F	Y	N	N	Y	Y	N	N	N	5.9	1.14	6.32↑
10	46Y	F	Y	N	N	N	N	Y	N	N	3.07↓	0.72↓	0.76
11	39Y	M	N	Y	N	Y	N	N	N	N	9.18	1.25	1.32
12	62Y	F	N	Y	N	Y	Y	N	N	N	3.57↓	0.39↓	8.09↑
13	68Y	M	Y	N	N	Y	N	N	N	N	4.59	1.23	1.73
14	59Y	M	Y	N	N	Y	Y	N	N	diarrhea	3.46↓	1.27	6.63↑
15	54Y	F	N	Y	N	N	N	Y	N	N	4.58	1.18	16.61↑
16	49Y	F	N	N	Y	Y	N	N	N	N	3.12↓	0.78↓	1.81
17	23Y	M	Y	N	N	Y	Y	N	N	N	4.08	0.95	1.25
18	40Y	F	N	Y	N	Y	N	Y	Y	N	2.07↓	1.13	13.4↑
19	72Y	M	N	Y	N	Y	N	N	N	N	3.96↓	1.21	0.92
20	66Y	F	Y	N	N	Y	Y	N	N	N	4.08	1.8	35↑
21	57Y	M	Y	N	N	Y	N	Y	N	N	6.26	1.15	11.7↑
22	64Y	M	Y	N	N	N	N	Y	N	N	1.27↓	4.19↑	1.29
23	56Y	F	N	Y	N	Y	Y	N	N	N	12.49↑	0.91	68.96↑
24	32Y	M	N	Y	N	Y	N	N	N	N	1.78↓	0.95	3.09↑
25	46Y	F	Y	N	N	Y	Y	N	N	N	10.05↑	0.64↓	12.15↑
26	20Y	M	Y	N	N	Y	Y	N	N	N	4.08	2.06	4.28
27	31Y	M	Y	N	N	Y	Y	N	N	N	3.57↓	0.69↓	3.09
28	49Y	F	Y	N	N	Y	N	N	N	N	3.76↓	1.98	18.16↑
29	53Y	M	N	Y	N	Y	Y	N	N	N	6.66	0.87	1.09
30	76Y	M	N	Y	N	N	N	Y	Y	N	4.42	2.34	0.86
31	38Y	M	Y	N	N	N	N	Y	N	N	3.43↓	0.72↓	23.65↑
32	28Y	F	Y	N	N	Y	Y	N	N	N	4.61	1.95	8.29↑
33	32Y	F	Y	N	N	Y	Y	N	N	N	5.94	1.38	4.37
34	67Y	M	Y	N	N	Y	N	N	N	N	7.37	2.18	2.98
35	68Y	F	N	Y	N	N	N	Y	N	N	2.91↓	0.61↓	19.08↑
36	56Y	M	N	N	Y	Y	Y	N	N	N	5.65	1.83	2.76
37	50Y	M	N	Y	N	Y	Y	N	N	N	3.86↓	0.79↓	3.46
38	29Y	F	Y	N	N	Y	Y	N	N	N	5.73	1.24	0.87
39	64Y	M	Y	N	N	Y	N	N	N	N	5.94	1.37	2.69
40	32Y	F	Y	N	N	Y	N	N	N	N	6.26	1.06	2.98
41	67Y	M	N	Y	N	Y	Y	N	N	N	6.26	2.17	6.87
42	30Y	M	N	Y	N	N	N	N	N	diarrhea	5.69	2.91	9.08↑
43	48Y	F	Y	N	N	Y	Y	N	N	N	11.46↑	0.28↓	10.63↑
44	53Y	M	Y	N	N	Y	Y	N	N	N	6.54	1.97	2.84
45	55Y	M	Y	N	N	Y	N	Y	N	N	2.98↓	0.17↓	2.05
46	23Y	F	Y	N	N	Y	N	N	N	N	4.38	1.09	4.18
47	61Y	M	N	Y	N	Y	Y	N	N	N	3.12↓	0.68↓	9.84↑
Pediatric patients													
1	3Y	M	Y	N	N	N	N	Y	N	N	9.26	2.09	2.89
2	5Y	F	N	Y	N	Y	Y	N	N	N	13.35↑	1.28↓	97↑
3	2M	M	Y	N	N	Y	N	N	N	N	8.13	3.17	3.09
4	10Y	F	Y	N	N	N	N	Y	N	N	4.24	3.28	28.7
5	8Y	F	N	Y	N	N	N	N	Y	N	6.57	2.13	3.87
6	4Y	M	Y	N	N	Y	Y	N	N	N	3.45↓	0.95↓	74.09↑
7	2Y	M	Y	N	N	N	N	Y	N	N	2.35↓	1.56	0.87
8	4Y	F	Y	N	N	N	N	Y	N	N	5.67	3.09	2.75
9	8M	M	N	Y	N	Y	Y	N	N	N	3.67↓	2.18	12.6↑
10	3M	M	Y	N	N	N	N	N	N	N	9.67	2.67	3.09
11	6Y	M	N	Y	N	Y	N	N	N	N	7.36	3.27	6.94
12	8Y	F	Y	N	N	N	N	Y	Y	N	3.28↓	1.45↓	18.96↑
13	10Y	F	Y	N	N	N	N	Y	N	N	9.05	2.91	7.37
14	5Y	M	Y	N	N	Y	N	N	N	N	5.98	3.08	3.96

(Note：Normal reference range of white blood cell: $4x10^9$/L～$10x10^9$/L. Normal reference range of lymphocyte count: $0.8x10^9$/L～$4.0x10^9$/L (adult), $1.55x10^9$/L～

$4.8x10^9$/L(child))

Table 1. Comparison of clinical features and CT positivity between adult and pediatric patients (n=47, n=14)

Characteristic	Number of adult patient (%)	Number of pediatric patient (%)	P value
Gender(male)	28/47(59.6%)	8/14(57.1%)	0.871
Fever	39/47(83%)	6/14(42.9%)	0.008*
Fatigue	21/47(44.7%)	3/14(21.4%)	0.188
Cough	12/47(25.5%)	6/14(42.9%)	0.361
Runny nose	3/47(6.4%)	2/14(14.3%)	0.696
Other symptoms	2/47(4.3%)	2/14(14.3%)	1.0
Leukopenia	22/47(46.9%)	4/14(28.6%)	0.226
Lymphopenia	13/47（27.7%）	3/14（21.4%）	0.905
High C-protein	19/47(40.4%)	4/14(28.6%)	0.422
Clinical classification			0.001*
Mild	4/47(8.5%)	7/14(50%)	
Common	39/47(83.0%)	7/14(50%)	
Severe	4/47(8.5%)	0/14(0%)	
CT positive	43/47(91.5%)	7/14(50%)	0.004*

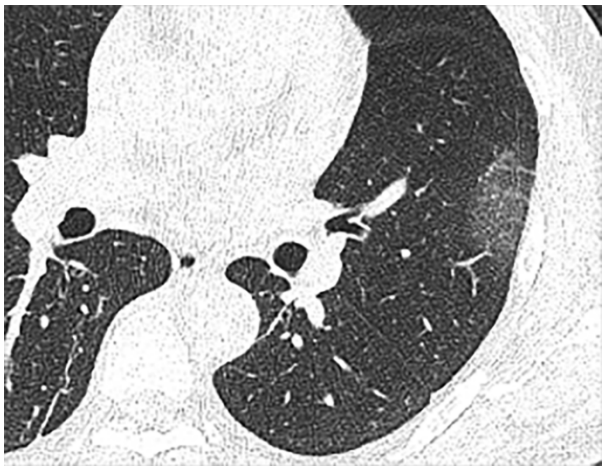
(Note: There were no fatal cases in both groups; data are presented as counts (percentage of the total); Chi-square test or Fisher's exact test were used for testing differences among nominal variables. The Kruskal-Wallis H-test was used for the ordinal variable. A two-tailed p-value < 0.05 indicated statistical significance.*P<0.05)

Table 2. Comparison of CT findings between adult and pediatric patients (n=43, n=7, CT negative in 4 adults and 7 children)

CT distribution and pattern	Number of adult patient (%)	Number of pediatric patient (%)	P value
Number of lobes involved			0.012*
1 lobe	6/43(14.0%)	3/7(42.9%)	
2 lobes	9/43(20.9%)	3/7(42.9%)	
3 lobes	20/43(46.5%)	1/7(14.3%)	
4 lobes	7/43(16.3%)	0/7(0%)	
5 lobes	1/43(2.3%)	0/7(0%)	
Bilateral Involvement	36/43(83.7%)	4/7(57.1%)	0.262
Opacity distribution			
Peripheral	29/43(67.4%)	4/7(57.1%)	0.918
Central	3/43(7.0%)	0/7(0%)	1.0
Both central and peripheral	11/43(25.6%)	1/7(14.3%)	0.864
Peribronchial distribution	1/43(2.3%)	2/7(28.6%)	0.048*
Opacity patterns			
Pure GGO	23/43(53.5%)	3/7(42.9%)	0.909
Consolidation	4/43(9.3%)	0/7(0%)	1.0
GGO with consolidation	12/43(27.9%)	1/7(14.3%)	0.766
Nodules	3/43(7.0%)	1/7(14.3%)	0.464
Bronchial wall thickening	1/43(2.3%)	2/7(28.6%)	0.048*
Reticular or linear opacities	1/43(2.3%)	0/7(0%)	1.0
Other findings			
Lymphadenopathy	1/43(2.3%)	0/7(0%)	1.0
Pleural effusion	2/43(4.7%)	0/7(0%)	1.0
Lung severity score	8.89±4.54	1.86±2.41	<0.001*

(Note: Data were presented as counts (percentage of the total) or mean ± standard deviation; Chi-square test or Fisher's exact test were used for the nominal variable. The Kruskal-Wallis H-test was used for the ordinal variable. A two-tailed p-value < 0.05 indicated statistical significance.*P<0.05)

Legends: Fig. 1 Chest CT findings in adult patients with COVID-19 on transaxial images. (a) Female, 36 years old, 1 day after symptom onset. Subpleural ground-glass opacity in left lower lobe; (b) Male, 54 years old, 4 days after symptom onset. Subpleural ground-glass opacity in left lower lobe with inter- and intralobular septal thickening (crazy paving) and a ground-glass nodule in the right lower lobe (arrow); (c) Male, 28 years old, 3 days after symptom onset. Subpleural ground-glass opacity in the left lower lobe with central consolidation; (d) Female, 49 years old, 7 days after symptom onset. Pure consolidation in right lower lobe; (e) Male, 42 years old, 6 days after symptom onset. Bilateral multifocal pure ground-glass opacities; (f) Male, 62 years old, 14 days after symptom onset, bilateral foci of consolidation in both lower lobes, with early linear opacities in a perilobular pattern (arrows).



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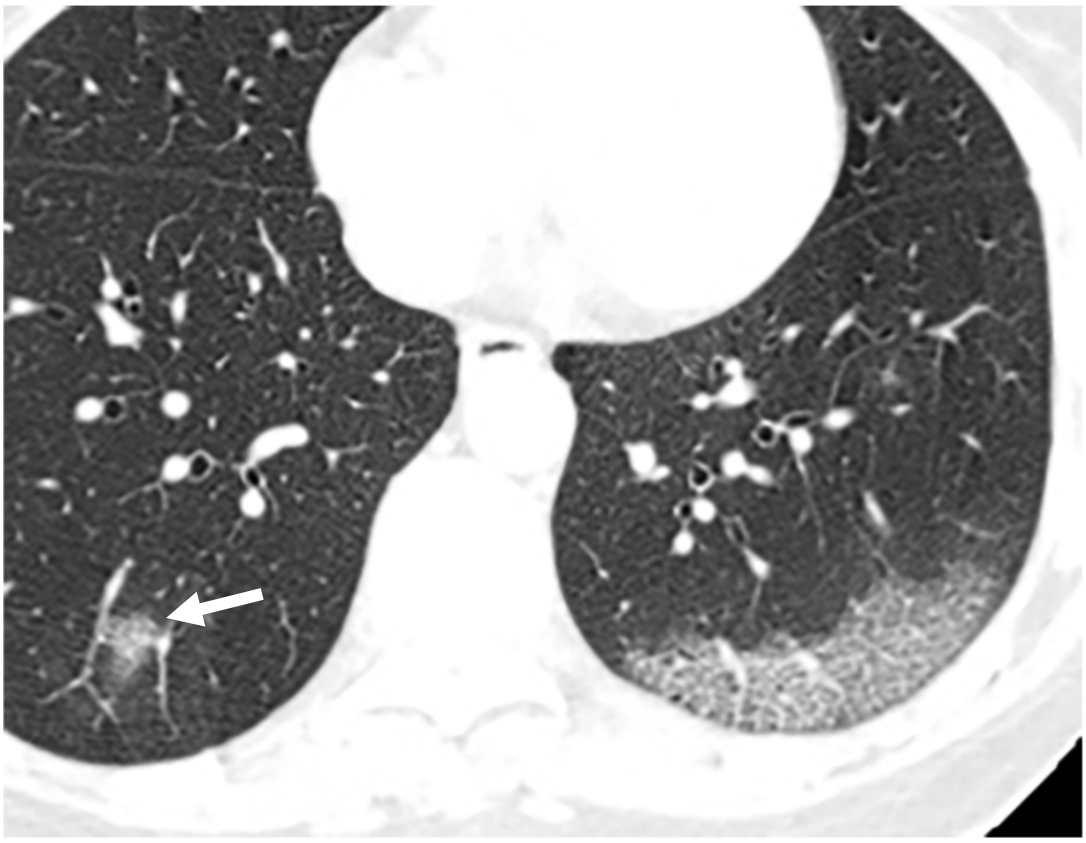

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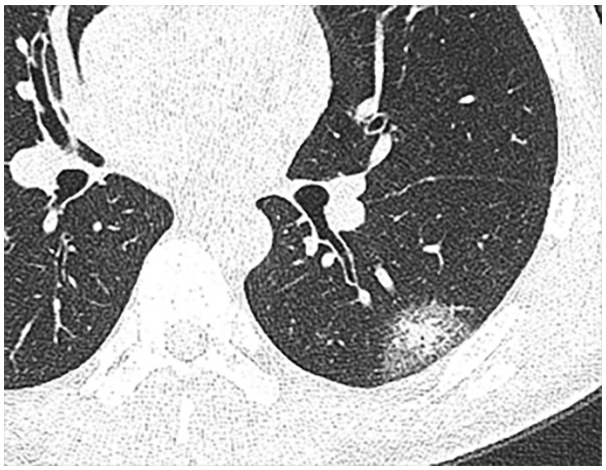

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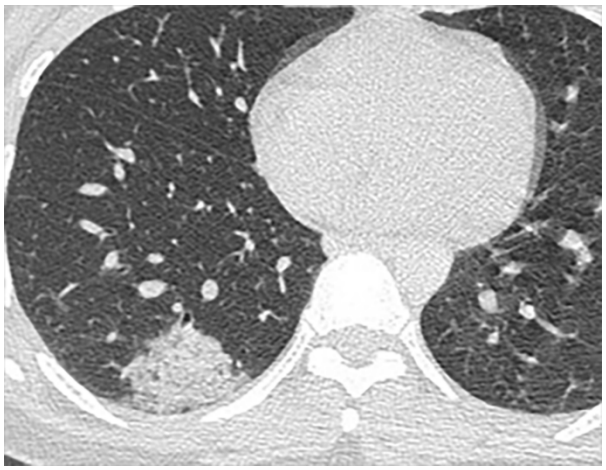

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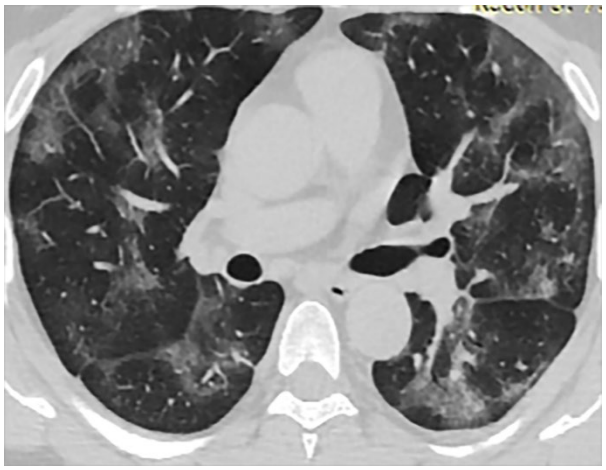

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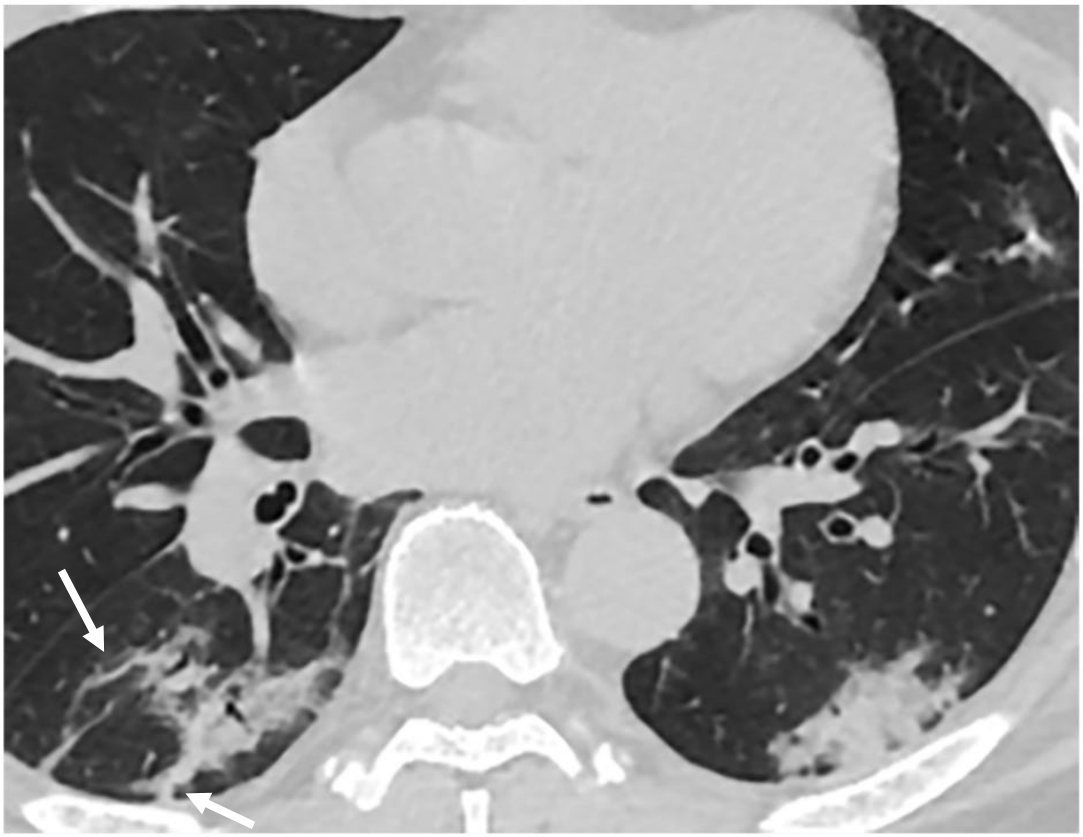
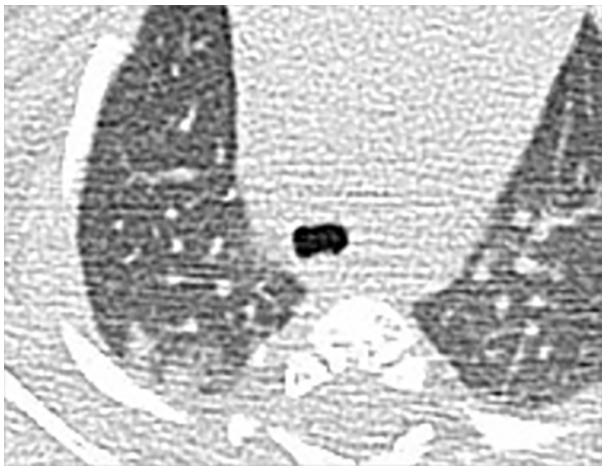
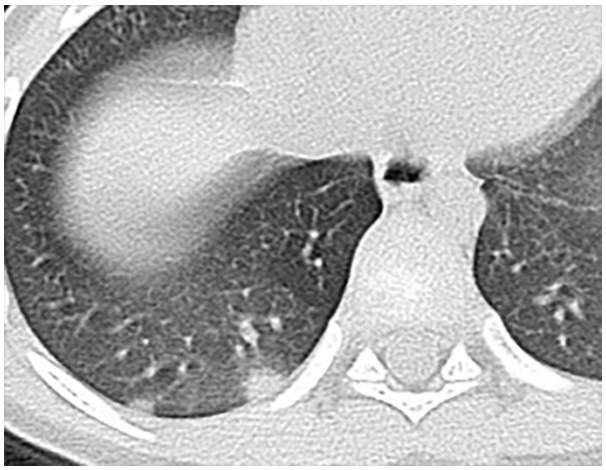


1f.

Fig. 2 Chest CT findings of pediatric patients with COVID-19 on transaxial images. (a) Male, 2 months old, 2 days after symptom onset. Patchy ground-glass opacities GGO in the right lower lobe; (b) Female, 4 years old, 4 days after symptom onset, two subpleural nodules in the right lower lobe; (c) Male, 8 months old, 6 days after symptom onset. Bronchial wall thickening and peribronchial ground-glass opacities and consolidation are noted in the left lower lobe.



2a



2b

2c