Clinical presentation and CT features in pediatric patients with COVID−19 infection

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Short title: Pediatric patients with COVID−19 infection

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Article total word count: 2064

Abstract

Background: The aim of this study includes to discuss the clinical, laboratory, and chest computed tomography (CT) in pediatric patients with 2019 novel coronavirus (COVID−19) infection.

Material and Methods: The clinical, laboratory, and chest CT features of 17 pediatric inpatients with COVID−19 infection confirmed by pharyngeal swab COVID−19 polymerase chain reaction(PCR). All clinical and laboratory data

have been recorded and analyzed during march-june 2020 . Chest CT have been performed to all Covid 19 PCR confirmed patients and radiologicall view have been noted.

Results: Seventeen pediatric patients with a history of close contact with COVID−19 diagnosed family members included to the study. Fever (10/17, 58%) and cough (13/17, 76%) were the most common symptoms. For laboratory findings, c reactive protein elevation (15/17, 88%) seem to be the most finding. A total of 4 patients presented with unilateral pulmonary lesions (4/17, 23%), 9 with bilateral pulmonary lesions (9/17, 52%) and 13 cases showed bilateral diffuse covid pattern on chest CT (13/17, 76%). Non-spesific consolidation with was observed in 8 patients (8/17, 47%), ground−glass opacities were observed in 11 patients (11/17, 64%), nodules were observed in 7 patients (7/17, 41%), and tiny nodules were observed in 2 patients (2/17, 11%).

Conclusion: In pediatric patients with positive COVID−19 nucleic acid test from pharyngeal swab samples; the early detection of lesions by CT can be efficient; in management and early treatment for pediatric patients. However; early chest CT screening and COVİD-19 PCR testing together can be more efficent in diagnose.

Keywords: Covid-19, viral pneumenia, chest computed tomography (CT), childeren.

Introduction

A pneumonia epidemic broke out in Wuhan and then spread to other Chinese cities and several countries resectively in december 2019. A new type of coronavirus announced by the Chinese Center for Disease Control and Prevention on January 7, 2020 [1]. Finally; on february 11, 2020, the International Committee on Taxonomy of Viruses (ICTV) proposed to name the new virus SARS-CoV-2 and the WHO named the disease caused by SARS-CoV-2 infection COVID-19 [2,3]. As of today, 8 months after the onset of epidemic, China's domestic COVID-19 epidemic has been well controlled contravarsiouly the epidemic spreaded to many countries worldwide[4]. Lately; the virus outbreak in countries of Europe and America are severely affected at this moment, which means that COVID-19 has evolved from an epidemic to pandemic. From the early days of the outbreak to this moment; the disease showed that there were to less cases in children under the age of 15 [5]. Soon afterwards, laboratory-diagnosed cases from all over China through January 29, 2020, indicated that 0.9% of patients were aged below 15 years, which means that COVID-19 can be spread within the whole age spectrum [6].

In this study; clinical and imaging features of pediatric patients with COVID−19 infection were presented in a series of 17 cases who have been identified by the pharyngeal swab COVID−19 nucleic acid test.

Material and Methods

Seventeen pediatric inpatients with COVID−19 infection confirmed by pharyngeal swab COVID−19 nucleic acid test from march to june 2019 in our university hospital were included in this study. All the patients are in accordance to the Diagnosis and Treatment Protocol for COVID−19 by the National Health Commission.

Clinical data including demography information, contact history, previous history, clinical symptoms, laboratory findings, and coinfection which defined as a concurrent infection of a patient with two or more pathogens simultaneously.

The chest computed tomography (CT) were obtained from all subjects, as the plain chest X−ray cannot exclude the existence of pulmonary lesions, especially for the patients without symptoms and mild cases. For all the patients, noncontrast chest CT studies were performed on SOMATOM Definiton AS 128 unit (Siemens medical system; Siemens, Germany) with the following parameters: 12 0 kV, 100 to 150 mA, 0.6−mm collimation, and 1:1 pitch. The scanning range covered from lung apex to diaphragm on axial plane taken under free breathing with the patients in the supine position. CT images were reconstructed with 3 or 4 mm collimation with a standard algorithm and then sent to the picture archiving and communication system (PACS) for analyzing. CT images were evaluated using a lung window with a window level of −600 HU a window width of 1500 HU, and the soft−tissue window with a window level of 40 HU and window width of 300 HU. All the images were stored in PACS and reviewed by experienced pediatric radiologists. The CT features were evaluated as follows: (a) ground−glass opacities, (b) consolidations with surrounding halo sign, (c) nodules, (d) fine mesh shadow, (e) pleural effusion, (f) lymphadenopathy, (g) unilateral or bilateral, (h) subpleural or nonsubpleural, and (i) residual fiber strips. Pharyngeal swab samples of all the subjects in this group were collected, and the COVID−19 RNA was identified by a reverse transcription−polymerase chain reaction. The protocol for this retrospective study was approved by the Ethics Committee of Istinye University Medical Park GOP Hospital and the written informed consent was waived for emerging infectious diseases.

Results

Seventeen pediatric patients with a history of close contact with COVID−19 diagnosed family members included to the study. Fever (10/17, 58%) and cough (13/17, 76%) were the most common symptoms. The clinical features of pediatric patients with COVID−19 infection were displayed in Table 1.

TABLE 1. The clinical features of pediatric patients with COVID−19 infection	
Characteristic	**Number (%)**
Sex	
Boy	9 (53%)
Girl	8(47%)
Age	
2<	3(17%)
2-5	2(11%)
5-10	4(23%)
10>	8(47%)
Contact history	
Yes	10 (59%)
No	7 (41%)
Symptom	
Cough	11 (64%)
Tachypnea	4 (29%)
Fever	9 (52%)
Nasal discharge	4 (23%)
Diarrhea	3 (17%)
Fatigue	2 (11%)
Cardiac arrhythmia	1 (5%)
Other(otit,abdominal pain…)	3(17%)

For laboratory findings, c reactive protein elevation (15/17, 88%) seem to be the most finding. The laboratory features of pediatric patients with COVID−19 infection were displayed in Table 2.

TABLE 2. The laboratory features of pediatric patients with COVID−19	
Parameter	**Number of patients(%)**
WBC	
<5.0	4 (29%)
5.0-12.0	2 (11%)
>12.0	11 (64%)
CRP	
<5 mg/ml	2 (11%)
>5 mg/ml	15 (88%)
ALT	
>40 U/L	7 (41%)
40-80 U/L	6 (35%)
>80 U/L	4 (29%)
Troponin T	

<2 ng/ml	13 (76%)
>2 ng/ml	4 (29%)

Abbreviations: WBC:white blood cell; CRP:C−reactive protein; ALT: alanine aminotransferase.

A total of 4 patients presented with unilateral pulmonary lesions (4/17, 23%), 9 with bilateral pulmonary lesions (9/17, 52%) and 13 cases showed bilateral diffuse covid pattern on chest CT (13/17, 76%). Non-spesific consolidation with was observed in 8 patients (8/17, 47%), ground−glass opacities were observed in 11 patients (11/17, 64%), nodules were observed in 7 patients (7/17, 41%), and tiny nodules were observed in 2 patients (2/17, 11%).

The CT imagining features of pediatric patients with COVID−19 infection were displayed in Table 3

TABLE 3 The CT imagining features of pediatric patients with COVID−19 infection

Features	**Number of patients (%)**
Pulmonary involvement	
Focal	2 (11%)
Unilateral diffuse	3 (17%)
Bilateral diffuse	12 (70%)
Subpleural lesions	15 (88%)
Nonspesific consolidation	2(11%)
Ground−glass opacification	12 (70%)
Nodules	1 (5%)

For CT imaging findings; The lesion density was heterogeneous, accompanied by ground−glass opacities and pleural thickening. (Figure 1A) 12 year old girl. After 5 days, thE opacity in ground glass density in the posterior basilar segment of the right lower lobe increased in size. (Figure 1B). There were no other accompanying thoracic findings in CT imaging of this 12 years old girl patient.

In an other 16-year-old male patient the first CT imaging finding was observed with an increase in subpleural ground glass density in the left lower lobe posterior segment. (Figure 2A) When looked at once, that is, after 2 to 4 days, density began to decrease and contour clarity began to disappear. (Figure 2C) The lesion size and density increased significantly 6 days after this diagnosis. (Figure 2C) After 14 days (24 days after the first detection) taken for the 4th

time, the lung parenchyma is observed normally. (Figure 2D). The VRT (volume rendering technique) images of the same patient were similar in discuss. (Figure 3A,3B,3C,3D) The VRT imagining of chest is more valuble to view ground- glass consalidation and other findings of COVİD-19 pneumonia in childeren. This is the first report in literature discussing VRT imagining in this age group of COVİD-19 pneumonia.

Discussion

The outbreak of Covid-19 started in Wuhan city, Hubei province, China, where the firstly announced cases in adults with pneumonia of unexplained etiology on December 31, 2019. A local seafood and animal market was defined to be as a potential source. Afterwards; main transmission route to cause outbreak was defined through respiratory droplets or direct contact from symptomatic and asymptomatic humans infected with Covid-19. [7] Covid-19 has spread to other Chinese cities and internationally and caused a global pandemic.

COVID− 19 viral pneumonia is an acute infectious respiratory disease caused by a coronavirus subtype SARS-CoV-2. From december 2019 to this moment, 24.355.000 total comfirmed cases, 830.155 deaths and 16.889.000 recovered cases had been confirmed worldwide as WHO (World Health Organization) up to date records, while the actual number would be larger with noncofimed asymptmatic cases. [8] The virus is a highly contagious disease andcan be transmitted by an infected person or an asymptomatic carrier through respiratory droplets. Respiratory droplets are the main route of transmission, but can also be transmitted by contact and digestive tract. [9] After contact to infected person; The incubation period is about 1 to 14 days, and is supposed could be up to 24 days. Even most of the cases are mild, especially people over 60 years old or those with underlying diseases are more likely to develop the severe disease of lower repiraturary system involvement. [10] The clinical manifestations of

children patients are similar to those of adults, such as fever and cough. A few children have diarrhea and runny nose, but the overall symptoms are relatively mild. Its think to be that the COvid-19 infection have a mild and weak clinical progress in childeren. Conversly to this data; in this study we presented 17 cases those all are under 17 years old with 3 of them under 2 years old cases of Covid-19 infection with severe diseases.

In previous literatüre Chest CT findings in children were similar to those in adults, and most of them were mild cases. [11,12] In our study; the typical manifestations were unilateral or bilateral subpleural ground−glass opacities, and consolidations with surrounding halo sign. As bilatarelly consolidations of lungs sign account for up to 70% cases, they should be considered as typical signs in pediatric patients. Pleural effusion was seen in 4 cases. In Wei and et al study; the data for pleural effusion account zero. [13] Lesions could be still visible on chest CT when two consecutive nucleic acid tests were negative. The CT imaging of COVID−19 infection should be differentiated with other virus pneumonias, such as respiratory syncytial virus, influenza virus, parainfluenza virus, and adenovirus with its spesific radiological signs. [14] In addition, it should be differentiated from atypic bacterial pneumonia such as mycoplasma pneumonia and chlamydia pneumonia. However, multiple agents can overlap chest CT manifestations of pneumonia caused by COVID−19 presenting more serious and complex imaging manifestations which could not be diagnostic, so epidemiological and etiological examination should be combined to make the final decision.

Recently; only a few studies have conducted on chest CT signs of COVID-19 in children age group. [15,16,17] Even normal findings on chest CT; some of pediatric patients manifest a severe clinical disease of COVID-19 pneumonia.

The CT manifestations of COVID-19 in pediatric patients are diverse and lack specificity. Some mild pediatric patients with COVID-19 show [18,19].

In pulmunary involvement cases; focal unilateral or bilateral diffuse, subpleural lesions, nonspesific consalidation, ground-glass opacification and nodules are the most presentations.

Pediatric patients with COVID-19 tend to present less lobular involvement with an increase in subpleural ground glass density in the left lower lobe posterior segments (Fig. 1a,2a). Additionally;some other findings like nodular ground-glass opacification consolidation, consolidation with ground-glass opacification and interlobular septal thickening can also be observed in the pediatric patients [20]. All radiological findings have been summarized in Table 3.

Overall, rarely in pediatric cases, bilateral diffuse lung consolidation can occur and is called as “white lung” [16]. In resolving stage, lung lesions will be completely resolved or only remain minimal linear opacities (Fig.2d,3d). In some cases either can be a presentation of similiar to those other viral agents

With patchy opacity along the bronchial vasculer structure manisfasting as bronchopneumonia. [16]

Case differantial diagnosis should be more carefully done while pediatric patients have definite epidemiological history but atypical CT findings . Xia et al reported, underlying coinfection is very common in pediatric patients (9 of 20, 45%), Pleural effusion was reported in several pediatric patients [21].

Even the gold standart is nucleic acid detection in diagnosis of COVİD-19, in suspecious cases those initial RT-PCR results show negative, chest CT may be supporttive for diagnosis and management especially in pediatric age group. Additionally Chest Ct can suggest the healing and resolve findings of lung involvement regarding the disease severness and follow up options. In this study the chest ct findings in 14th day of follow up have been completely recovered. (Figure 2d,3d). Sure the nucleic acid comfirmation test negativity can be used in

follow up; unfourtanetly it will not suggest any idea in those cases with pulmunary symptoms in childhood.

Conclusion

In some children; COVID−19 virus pneumonia has a severe clinical and radiological course and in chest CT can present characteristic changes of subpleural ground−glass opaciticitions and uni-bilateral consolidations which is so effective for follow up and evaluating the changes of lung lesions. In patients with positive COVID−19 nucleic acid test from pharyngeal swab samples and especially in course of cough and respiratuar other symptoms; the early detection of lesions by chest CT is very efficient to decide life-saving treatment for pediatric patients. In addition; Chest CT imaging is not sufficient enough alone to determine the COVID−19 pneumonia and early chest CT screening and COVİD-19 PCR testing together can be more efficent in diagnose.

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Figure legends:

Figure 1a-1b

12 year old girl. It was observed that opacity in ground glass density in the posterior basilar segment of the right lower lobe increased in size after 5 days. There were no other accompanying thoracic findings.

Figure 2a-2b-2c-2d

16-year-old male.The first imaging finding was observed with an increase in subpleural ground glass density in the left lower lobe posterior segment.(2a) When looked at once, that is, after 2 to 4 days, density began to decrease and contour clarity began to disappear. (2b) The lesion size and density increased significantly 6 days after this diagnosis. (2c) After 14 days (24 days after the first detection) taken for the 4th time, the lung parenchyma is observed normally. (2d)

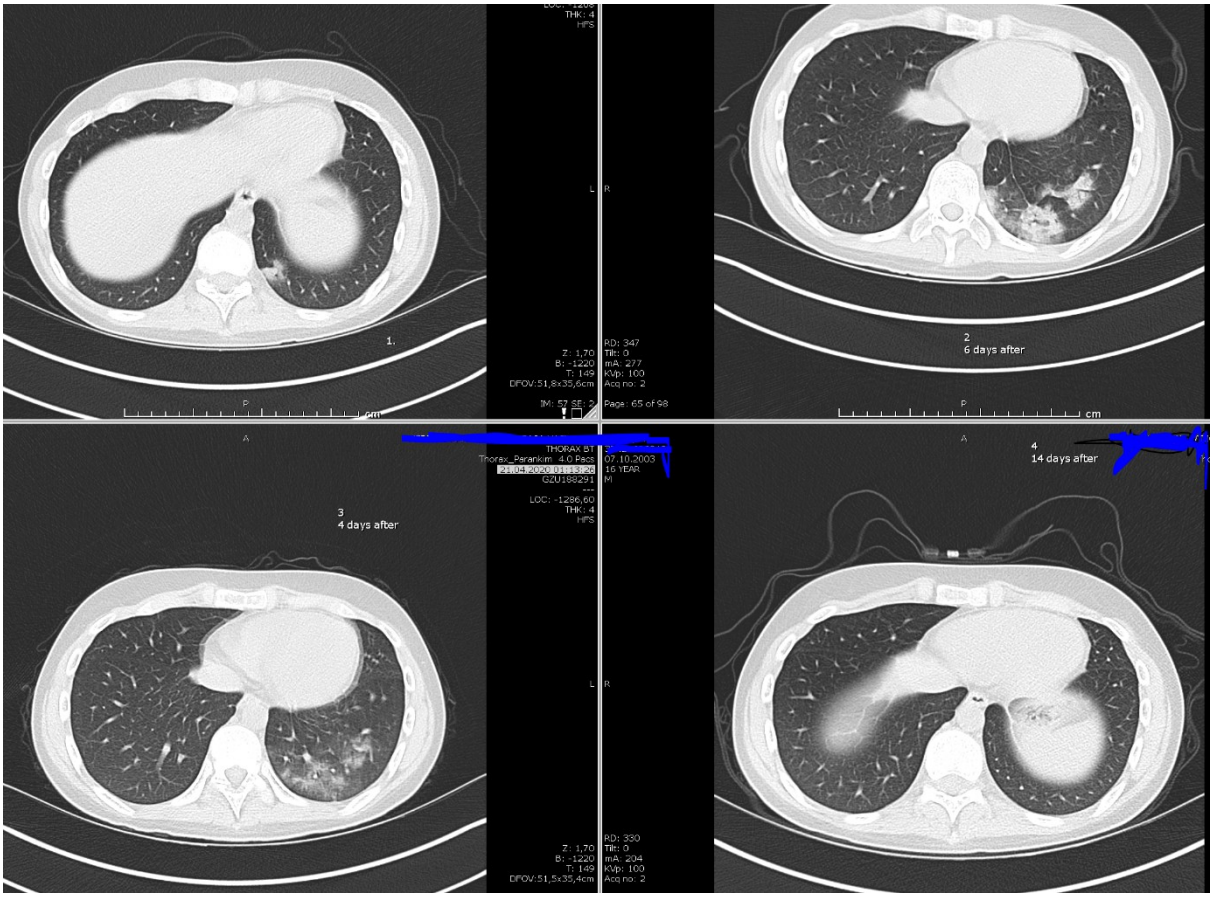
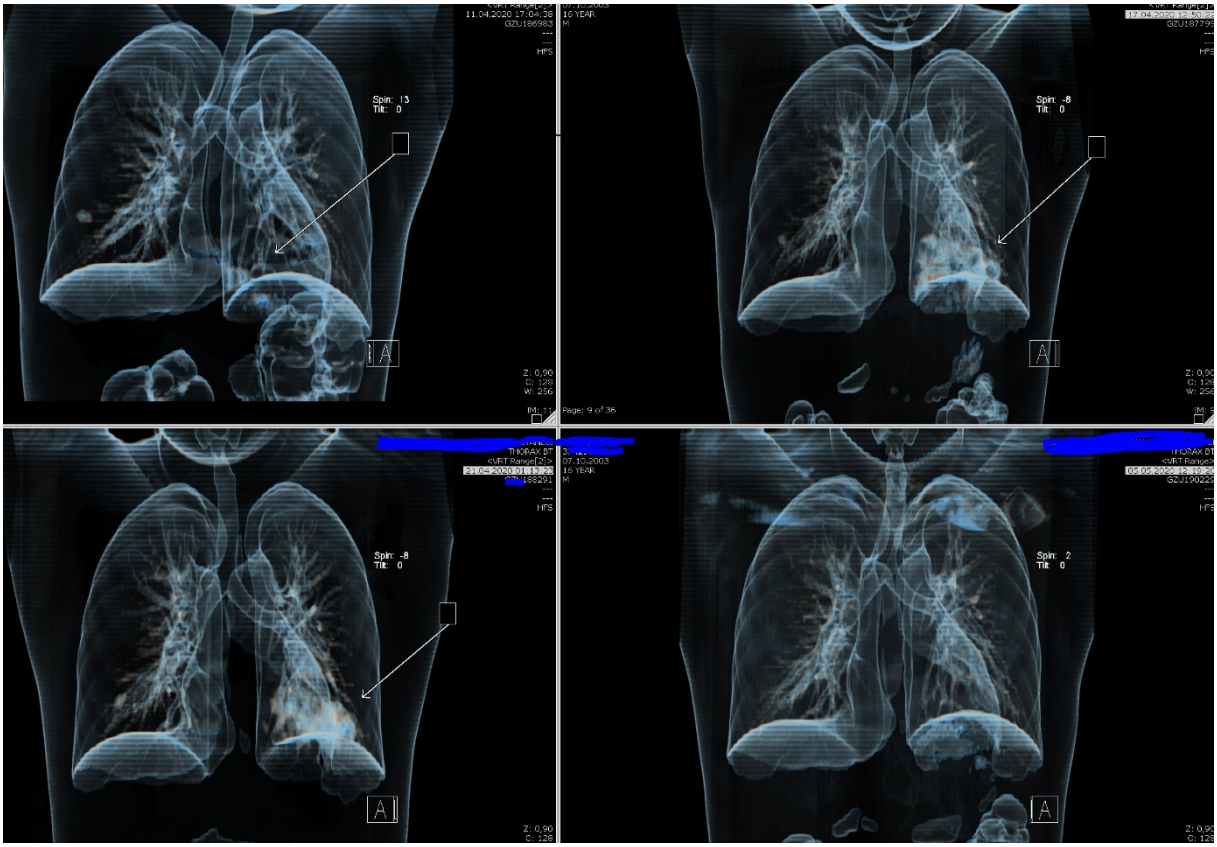


Figure 3a-3b-3c-3d

VRT (volume rendering technique) images of the same patient in Figure 2.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