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Short report

The prevalence and predictors of pulmonary lesions in paediatric patients with coronavirus disease 2019 – a brief report

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Abstract

Purpose: There are currently only scarce data available describing imaging manifestations in children with COVID-19. The aim of this study was to analyse pulmonary lesions on chest radiography (CXR) in paediatric patients infected with SARS-CoV-2 and to compare the CXR results with clinical and laboratory data.

Material and methods: In this prospective single-centre study we included 118 consecutive paediatric patients with COVID-19. CXR was performed in 107 patients. Clinical and laboratory evaluations were performed on the same day as CXR, immediately (0 to 2 days) after the COVID-19 diagnosis had been established.

Results: Pulmonary lesions were found in 24/107 (23%) children, including 14/24 (58%) with bilateral abnormalities. Compared to patients with normal CXR, children presenting with pulmonary lesions were significantly younger (7.0 ± 4.5 vs. 9.5 ± 4.5 years, $p = 0.03$) and more commonly presented with an elevated D-dimer level (6/24, 25% vs. 5/81, 7%; $p = 0.008$). Almost half (46%) of the children with pulmonary lesions were asymptomatic, and 11/60 (18%) of all asymptomatic patients presented with abnormal CXR.

Conclusions: Pulmonary lesions in the course of COVID-19 are more common in younger children and those presenting with an elevated D-dimer level. A significant proportion of asymptomatic COVID-19 patients develop CXR abnormalities.

Key words: chest radiography, children, coronavirus disease 2019 (COVID-19), pulmonary lesions.

Introduction

Chest imaging plays an important role in the management of paediatric patients with coronavirus disease 2019 (COVID-19) caused by the 2019 novel severe acute respiratory syndrome coronavirus (SARS-CoV-2) [1]. Chest radiography (CXR) and chest computed tomography (CT) are essential for evaluating disease severity and progression, associated complications, and treatment response [2]. CXR is the most commonly utilized modality for the identification and follow-up of lung abnormalities in COVID-19 patients [3]. However, there are currently only limited and scarce data available describing imaging manifestations in children with COVID-19 [1]. Thus, the aim of this study was to analyse the frequency of pulmonary lesions on CXR in paediatric patients infected with SARS-CoV-2. In addition, we compared the CXR results with clinical and laboratory data to identify predictors of pulmonary abnormalities in children with COVID-19.

Material and methods

In this prospective single-centre study performed in a tertiary health care department dedicated to COVID-19 care, we included all consecutive patients aged 0 to < 18 years with CO-

VID-19. SARS-CoV-2 infection was confirmed by a real-time polymerase chain reaction (RT-PCR) on a nasopharyngeal swab performed using a certified method. Clinical and laboratory evaluations were performed on the same day as CXR, immediately (0 to 2 days) after the COVID-19 diagnosis had been established. According to the patients' age and cooperation, CXR was performed in either supine position (in infants) or upright position (in older children) using PA/AP projection. CXR was reviewed by experienced radiologists, blinded to clinical and laboratory data.

Statistical analysis

Categorical variables were compared using the χ^2 test, and continuous variables were compared using the Mann-Whitney test. A two-sided p-value of < 0.05 was considered significant. All statistical analyses were performed using MedCalc Statistical Software version 19.1.1 (MedCalc, Ostend, Belgium).

Ethical approval

The investigation was performed in accordance with the ethical standards outlined in the 1964 Declaration of Helsinki and its later amendments. The local ethics committee approved this study and the management protocol for paediatric patients with COVID-19.

Results

Patient characteristics

Between 16 March 2020 and 2 July 2020, 118 paediatric patients (aged 9.0 ± 4.5 years) were diagnosed with COVID-19. None of them presented with a severe course of the disease.

Among these patients, CXR was performed in 107 children. In the remaining cases, in 2 children the parents did not give permission for CXR, and in 9 asymptomatic patients at the beginning of the pandemic CXR was not performed according to the contemporary local recommendations. After 25 March 2020, all patients, irrespective of their clinical presentation (including asymptomatic children), were qualified for CXR.

Pulmonary lesions and their predictors

Pulmonary lesions were found in 24/107 (23%) children, including 14/24 (58%) with bilateral abnormalities. The most commonly described lesions included patchy consolidation with lower lung distribution (in 15/24 [63%] cases), peribronchial thickening (6/24 [25%]), peribronchial consolidation (4/24 [17%]). In 1 case, parenchymal consolidation was found, and in 1 patient a pleural effusion was described.

Predictors of pulmonary lesions were analysed in 105 patients. Two patients were excluded from this part of the analysis due to severe bacterial coinfections, which significantly influenced the laboratory evaluation. A comparison of the clinical and laboratory presentations between children with and without pulmonary abnormalities is presented in Table 1. Children presenting with CXR abnormalities were significantly younger compared to the group without pulmonary lesions (7.0 ± 4.5 vs. 9.5 ± 4.5 years, $p = 0.03$). The elevated D-dimer level was the only laboratory predictor of the presence of the pulmonary lesions: it was observed in 6/24 (25%) children with abnormal CXR compared to 5/81 (7%) patients without pulmonary lesions ($p = 0.008$). Other laboratory abnormalities or the presence of clinical symptoms (cough and/or fever) did not correlate with the presence of pulmonary abnormalities (Table 1).

Table 1. Comparison of clinical and laboratory findings according to the presence of pulmonary lesions in chest radiography

Clinical or laboratory finding	Study group, $N = 105$	Patients with pulmonary lesions, $n = 24$	Patients without pulmonary lesions, $n = 81$	p-value
Age (years)	9.0 ± 4.5	7.0 ± 4.5	9.5 ± 4.5	0.03
Sex (Male/Female), n (%)	48 (46)/57 (54)	10 (42)/14 (58)	38 (47)/43 (53)	0.65
Presence of clinical symptoms, , n (%)	47 (45)	13 (54)	34 (42)	0.29
Cough, n (%)	24 (23)	7 (29)	17 (21)	0.40
Fever, n (%)	29 (28)	6 (25)	23 (31)	0.74
Saturation < 95%, n (%)	0	0	0	–
Abnormalities by auscultation, n (%)	1 (1)	0	1 (1)	0.58
Leukocytosis (> 12 000/mm³), n (%)	5 (5)	2 (8)	3 (3)	0.35
Leukopaenia (< 4000/mm³), n (%)	9 (9)	1 (4)	8 (10)	0.38
Elevated C-reactive protein (> 10 mg/l), n (%)	7 (7)	1 (4)	6 (7)	0.58
Elevated procalcitonin (> 0.05 ng/ml), n (%)	2 (2)	1 (4)	1 (1)	0.35
Elevated Interleukin-6 (> 7 pg/ml), n (%)	2 (2)	0	2 (3)	0.44
Elevated D-dimer (> 500 ng/ml), n (%)	5 (5)	6 (25)	5 (7)	0.008

Discussion

The role of imaging evaluation of children with COVID-19 is currently an area of intense discussion [2]. CXR is currently considered the most appropriate first imaging study in the evaluation of patients with SARS-CoV-2 infection [2,4]. The limited data available suggest that CXR in adults is less sensitive than CT for identifying pulmonary findings associated with COVID-19 [1]. However, due to infection control issues, lack of CT availability for children in many centres in the world, and increased radiation sensitivity in children, CXR is the most commonly used method for chest imaging in COVID-19 children [1,3]. The most commonly reported CXR and CT findings in adults with COVID-19 include bilateral patchy consolidation and ground-glass opacities with peripheral and lower lung predominance [1-3,5,6]. COVID-19, similarly to other viral pneumonias, typically leads to lung opacities in more than one lobe [3]. In our group of 107 children, 24% presented with pulmonary abnormalities similar to those observed in adults. More than half had bilateral lesions. In a recent systematic review of 49 studies, including 501 paediatric patients with COVID-19, 118 (23.6%) children presented with normal CXR, 105 (21%) with patchy lesions, 30 (6%) with ground-glass opacity, and 12 (2.4%) with consolidation [7]. In a case series of 10 paediatric patients with COVID-19 by Cai et al., the authors observed unilateral patchy opacities in 4 (40%) of cases [8]. In another study on 10 paediatric COVID-19 patients, chest CT revealed unilateral pneumonia in 3/10 patients and bilateral lesions in another 2/10 [9]. Xia *et al.*, who performed chest CT in 20 patients, described consolidation with surrounding halo sign in 50% of patients and concluded this could be considered as a typical sign in paediatric COVID-19 patients [6].

To our knowledge, this is one of the first studies correlating pulmonary lesions in COVID-19 paediatric patients with their clinical and laboratory presentations. Finding clinical or laboratory predictors of CXR abnormalities might be helpful in the qualification of SARS-CoV-2-infected children for chest imaging. Interestingly, we revealed that clinically asymptomatic children may have abnormal CXR: 46% of children with pulmonary lesions in our group were asymptomatic. In addition, 11/60 (18%) of all asymptomatic patients in this study presented with abnormal CXR, indicating that, in contrast with the recent International Expert Consensus Statement on Chest Imaging in Paediatric COVID-19 Patient Management, which recommended performing chest imaging only in patients with a moderate to severe course of the disease, asymptomatic patients may also benefit from CXR and receive proper treatment in the case of deterioration of clinical presentation [1]. In this study, we described patients during the first wave of the COVID-19 pandemic. At this time, children with pulmonary lesions were treated with azithromycin. However, since the second wave of the pandemic, macrolides have no longer been used for this indication.

Conclusions

Pulmonary lesions in the course of COVID-19 are more common in younger children and those presenting with an elevated D-dimer level. A significant proportion of asymptomatic COVID-19 patients develop CXR abnormalities.

Conflict of interest

The authors report no conflict of interest.

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