Laboratory and Radiologic Findings in Pediatrics with COVID-19: A Systematic Review

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Abstract

Context: One of the emerging diseases that has spread in 2019 is COVID-19.

Objectives: The present systematic review (SR) was performed to evaluate the status of laboratory and radiological findings in the age group of children and adolescents with COVID-19.

Methods: In this SR study, three of the research team members conducted searches in SCOPUS, PUBMED, Science Direct, and ISI international sites. The keywords that were searched included children- pediatric- adolescents- coronavirus- COVID-19- Novel coronavirus SARS-CoV-2-epidemiology- diagnostic findings- laboratory findings- CT SCAN- computed tomography- percentage of lymphocyte- alanine aminotransferase- white blood cell count (WBC). The combination of search keywords with AND as well as OR was performed. For analysis, descriptive data reporting was performed using EndNote software.

Results: The analysis of the laboratory and radiology findings of 197 patients of 12 studies included in the SR study showed notable changes in the lung CT scan and laboratory ranges that confirm the COVID-19 infection in these patients.

Conclusions: This systematic review provides information on the laboratory and radiology findings of children and adolescents with COVID-19 for the health care team.

Keywords: COVID-19, Coronavirus, Pediatric, Laboratory, Radiologic, Systematic Review

1. Context

Children and adolescents have a number of physiological, psychological, and social needs, one of which is their health (1-3). However, their health may be affected by diseases such as cancer (4), cardiovascular disease (5), thalassemia (6, 7), liver disease (8), rickets (8), and orthopedic diseases (9). They may also be exposed to various diseases that threaten their lives, like other age groups (6, 7, 9).

In order to maintain the health of patients, it is essential to diagnose the disease promptly and take appropriate proceedings to treat it (10, 11). For treating a disease, the disease must first be properly diagnosed, and the medical team must have knowledge about its laboratory and radiologic findings (12-14). Many of the diagnostic findings of various diseases can be extracted from reference books or articles and. But in emerging diseases, it is necessary to inform the nurses and the physicians about its diagnostic strategy (15-17).

It is important to pay attention to infectious diseases in children (18). One of the emerging diseases that has spread in 2019 is COVID-19 (19, 20). Nurses and physicians have enough knowledge about the laboratory and radiologic findings of previous infectious diseases, but COVID-19's laboratory and radiology findings are not fully available due to their emergence (21-23). Children and adolescents also don't self-report about illness and clinical symptoms for

reasons such as lack of awareness, inadequate health literacy, and other factors affecting younger age. For this reason, laboratory and radiological findings are more important (24-26).

2. Objectives

The present SR study was performed to evaluate the status of laboratory and radiological findings in patients with COVID-19 in the age group of children and adolescents worldwide.

3. Methods

3.1. Study Protocol

The study protocol is based on the SR (PRISMA) study protocol (27). Two members of the team performed the search, and in the event of a dispute between the two, the third person searched again, and the conclusion was made in consultation with all members of the research.

3.2. Inclusion Criteria

Inclusion criteria were according to PICO: 1- Population (published articles about COVID-19), Intervention (laboratory and radiological diagnostic procedures in children and adolescents), comparison (alanine aminotransferase, percentage of lymphocytes, WBC, CRP, and CT), outcome (studies on diagnostic findings in COVID-19).

3.3. Exclusion Criteria

1) Articles containing incomplete information; 2) meta-analysis articles; 3) qualitative studies; 4) duplicates; 5) lack of connection with the purpose of the research.

3.4. Search Strategy

Three of the research team searched all articles from 2019 to 2020 at SCOPUS, PUBMED, Science Direct, ISI international sites. The keywords that were searched included children- pediatric- adolescents- coronavirus-COVID-19- Novel coronavirus SARS-CoV-2-epidemiology- diagnostic findings- laboratory findings- CT SCAN- computed tomography- percentage of lymphocyte- alanine aminotransferase- white blood cell count (WBC). The combination of search keywords with AND as well as OR was performed (Table 1).

3.5. Data Extraction

The checklist included demographic data of extracted articles and information about Alanine aminotransferase, percentage of lymphocytes, WBC, CRP, and CT (Figure 1).

3.6. Statistical Analysis

Descriptive reporting was performed using EndNote software.

4. Results

In the initial search, 197 articles were extracted, of which 88 were eliminated in the first step, evaluation of the title and abstract of the article. Also, 84 articles overlapped in the search results, and 13 articles did not meet the inclusion criteria. Finally, 12 articles entered the SR phase (Figure 1). According to the findings, 12 articles were extracted, of which 8 articles were related to the original articles, and 4 articles were related to the articles of case series. Also, COVID-19 disrupts the laboratory range of WBC and other variables in the study, and these changes confirm infection in these patients.

5. Discussion

This study is the first SR study in the world to evaluate the laboratory and radiologic findings of COVID-19 in children and adolescents. According to the findings, this infection in these age groups creates changes in their CT, which confirmed the lung infection of these patients. Studies in the adults with COVID-19 also demonstrates these changes, as shown in the study of Ai et al. (36). In the study of Bernheim et al. (37) infection caused by COVID-19 leads to changes in the lung CT of these patients and is consistent with the results of this study.

In the studies included in this SR study, there is an increase in the level of CRP in patients with COVID-19, which is consistent with the results of Yang et al. (38), and Li et al. (39) studies in the adults with COVID-19 with an increase in CRP. Other changes in laboratory variables such as alanine aminotransferase, percentage of lymphocytes, and WBC are the same as the other studies in this area in other age groups (40-42).

One of the limitations of this study is the variation in laboratory units that did not allow the meta-analysis to provide more comprehensive data. Another limitation of this study is the small sample size in the studies. It should be noted that in this study only articles published in English were examined, so it is suggested to do an SR study on the Chinese-language articles given the fact that the epicenter of COVID-19 was in China.

Table 1. Characteristics of Studies Entered Into the SR[a]

	Author	Age	Country	Number	CT	CRP	WBC	Percentage of Lymphocyte	Alanine Aminotransferase
1	Xia et al. (28)	Pediatric	China	20	chest CT: Chest CT with abnormality = 20% (4); pulmonary lesions (bilateral) = 50% (10); pulmonary lesions (unilateral) = 30% (6); pulmonary lesions: Null = 4 (20); unilateral = 6 (30); bilateral = 10 (50)	$\leq 3 = 13$ (65); $> 3 = 7$ (35)	$< 5.50 = 4$ (20) (decreased); $5.50 - 12.20 = 14$ (70) (normal); $> 12.20 = 2$ (10) (increased); the unit of measurement was WBC $\times 10^9$/L.	$< 45 = 7$ (35) (decreased); $45 - 65 = 10$ (50); $> 65 = 3$ (15) (increased)	$\leq 40 = 15$ (75); $> 40 = 5$ (25) (increased) (ALT, IU/L)
2	Zheng et al. (29)			25	In 8 (32) of the patients, it was normal, in 5 (20) of the patients, there was unilateral involvement and in 12 (48) of the patients, there was bilateral involvement.	14.5 (0.93 - 25.04) (mg/L)	6.2 (4.30 - 9.85) (10^9/L)	2.19 (1.15 - 3.31) (10^9/L)	12 (10 - 13) (U/L)
3	Chen et al. (30)	Pediatric	China	12	infectious disease	11.51 (2.39) (mg/L)	6.33 (1.78), cells, 10^9/L		
4	Chen et al.	< 18 years	China	31	The findings of the primary Chest-Xray and CT was ground-glass, high-density shadows or hazy patchy shadows that generally were in the subpleural field.	> 8 mg/L = 4 (12.9)	$< 5 \times 10^9$/L = 12 (38.7); $> 12 \times 10^9$/L = 1 (3.2)	$< 1.1 \times 10^9$/L = 0 (0); $> 3.2 \times 10^9$/L = 8 (25.8)	> 45 U/L = 2 (6.5)
5	Cai et al.	children	China	10	unilateral patchy infiltrate = 4 (40)	7.5 mg/L	7.35×10^9/L	Unilateral patchy infiltrate = 4 (40)	-
6	Ma et al. (31)	children	China	50	Overall, patients with CT rates were 43 (86), local patchy shadowing rate of 16 (32), ground-glass opacity rate of 29 (58), bilateral patchy shadowing rate of 9 (18) and interstitial rate abnormalities were 3 (6).	-	In the evaluation of patients, 8 (16) had thrombocytopenia and 10 (20) had lymphopenia. Also, 4 (8) patients had lymphocytosis, and 8 (16) had thrombocytosis.	-	-
7	Qui et al. (32)	Children	China	36	Infectious disease	5 (2) had a level of less than 8 mg/L	Unit of measurement: (4 - 10 $\times 10^9$ cells per L); WBC Rate: 6 1 (2 -1)	Unit of measurement: 1 1 - 3 = 2 $\times 10^9$ cells per L); Lymphocytes Rate: 2 -4 (0·8);	21 (14) have a level less than 40 U/L
8	Du et al. (33)	Children	China	14	Infectious disease	Unit of measurement: 0.068 to 8.2 mg/L; CRP rate: 9.05 $\pm$ 15.81	Unit of measurement: 4 -10 $\times 10^9$/L; WBC rate:5.93 $\pm$ 2.52	Unit of measurement: 0.8 - 4 $\times 10^9$/L; lymphocytes rate: 3.68 $\pm$ 2.04	-
9	Sun et al. (34)	Pediatric	China	8	Of the 8 children studied, 6 were children with bilateral pneumonia. Also, 2 of them had unilateral pneumonia. Further examination of these CTs showed that 6 of them had ground-glass opacity, 7 patients had multiple patch-like shadows, and one had pleural effusion.	In 8 patients studied were: 6.48 - 57.9 - 103 - 0.75 - 27.02 - 1 - 9.9 - 0.5. Unit of measurement: 0 - 3 mg /L	-	In patients under study were: 0.69 - 1.96 - 2.7 - 6.41 - 3.6 - 4.04 - 1.7 - 2.8; Unit of measurement: 1.15 - 4 $\times 10^9$/L	In patients under study were: 58 - 6 6 - 36 - 100 - 55 - 9 - 16 - 8; Unit of measurement: 15 - 46 U/L
10	Liu et al. (2020) (35)	children	China	4	The result of CT one was normal, one with single consolidation, one with single pure GGO, and one in multiple consolidation.	In 3 patients, it was normal, and in one, it was Increased.	In 3 patients, it was normal, and in one, it was decreased.	Lymphocyte count was increased in 2 patients and normal in two patients. Increased lymphocyte ratio in 2 patients, normal in one patient and in one patient, was deceased.	-
11	Li et al. (35)	children	China	5	Patchy ground-glass opacities = 60% (3); Normal = 2 (40)	It was evaluated in 5 patients and was equal: 9.4, 0.6, 0.2, 0,7, 0.9; CRP at presentation, mg/L (normal reference values 0 - 3)	WBC was evaluated in 5 patients and were:9.2, 14.8, 15, 6.6, and 5.3. The unit of measurement was WBC $\times 10^9$/L (normal reference values 4.5 - 11)	-	-
12	Liu et al. (27)	Children	China	6	In 4 patients, there was bilateral lung involvement. In one patient, the lung was healthy and in one patient NA.	-	-	-	-

[a] Values are expressed as No. (%), or mean $\pm$ SD, or median (IQR).

6. Conclusions

This SR provides information on the laboratory and radiologic findings of children and adolescents with COVID-19 for the health care team.
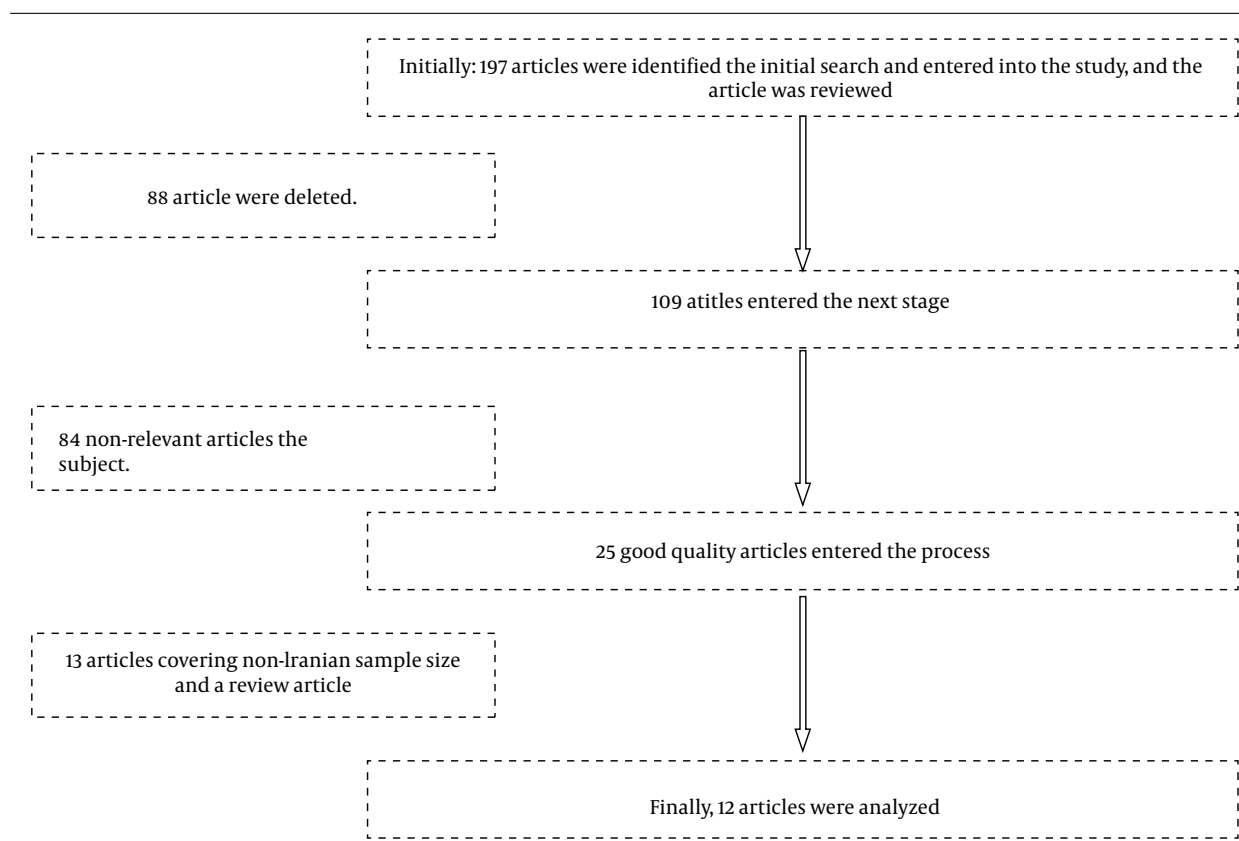
Footnotes

Figure 1. Flowcharts for SR

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