

# POST-COVID X-RAY CHANGES OF THE LUNG IN CHILDREN

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## ABSTRACT

In this article, post-coronavirus lung complications in children are discussed on the basis of X-ray studies. This study was done at the Iashvili Central Children's Hospital Tbilisi. COVID-19 can lead to many secondary conditions, lungs are the most commonly affected organ for patients with SARS-CoV-2 infection, persistent respiratory signs and symptoms following acute COVID-19 are not uncommon, although are notably less common in pediatric patients compared with adults. The symptoms include cough and dyspnea. The time to improvement depends on the premorbid condition and the severity of the illness. Some of these symptoms can last for 3, 4 months or longer. We studied 175 children, who had been infected with covid for 3 months or more. 80 (46%) children had severe COVID-19 pneumonitis with acute respiratory failure. Patients who have had a covid infection, and respiratory changes and had remaining cough, shortness of breath during exertion, shortness of breath - accounted for 28% - 49 patients. Patients who, according to anamnestic data, had a temperature reaction during the period of treatment at the clinic - 46 patients (26%) were found in this group. All patients underwent radiological examination. None of the patients underwent CT examination. It was found that in the case of post-covid syndrome, radiological changes do not always indicate a severe course of the disease. In the case of clinical recovery, X-ray changes appear in the 4th week of the disease and in a longer period. X-ray examination should be performed based on clinical symptoms. X-ray changes are manifested in the roots and central fields, in the form of small-focal infiltrates of low transparency, unlike other types of viruses, the changes continue in the post-COVID period. The severe course of the disease does not always mean the manifestation of post-COVID syndrome and vice versa. In case of a mild course of the disease, it is possible to develop polyorganic damage of various degrees.

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**KEYWORDS:** COVID-19, Donut sign, Interstitial pneumonia, X-ray, Infiltration, Hyperpneumatization, Hypovascularization.

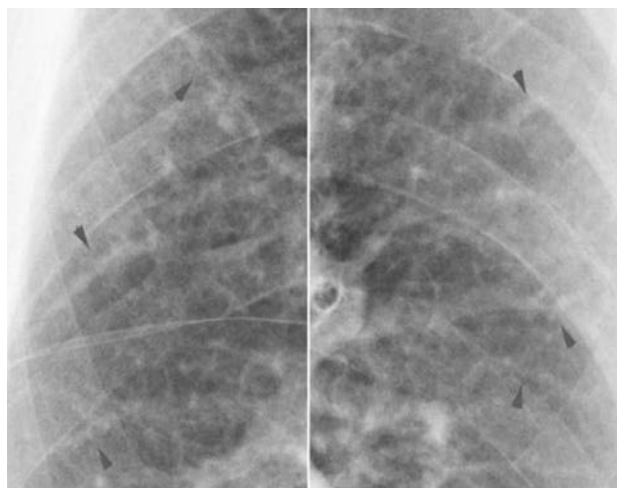
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Despite the fact that the coronavirus infection in children is relatively milder than in the adult population, in the later period the disease can cause polyorganic damage, which we call post-covid complications. Post-coronavirus syndrome includes new, recurring, or ongoing symptoms and conditions that appear 4 or more weeks after a coronavirus infection. The World Health Organization adopted a consensus definition of pediatric PASC (Pediatric post-acute sequelae of the severe acute respiratory syndrome) defined by one or more physical symptoms. These symptoms may change, disappear, or reappear and persist for at least 12 weeks after the initial diagnosis of SARS-CoV-2 [3, 5]. Literary data on changes in the respiratory system as a result of prolonged covid infection are scarce [1]. Although the severe disease is less common in children and adolescents than in the adult population, COVID-19 can cause secondary, mild-to-severe, and in some cases, long-lasting, chronic lesions [2]. According to the data of radiologists in England, 42.6% of patients had various types of symptoms for 60 days or more after the onset of the disease. The prolonged course in children aged 2-11 years was 12.9% and in children aged 12-16 years 14.5% [2]. Our goal was to detect the radiological changes of lung damage in the post-covid period in both the severe and mild course of the disease. We think sharing our data by comparing radiological and clinical data will not be without interest. 175 patients aged 8 months to 17 years with various types of respiratory complaints were under our observation and was referred to us in the months of September - June 2021-2022. All of them had been infected with the

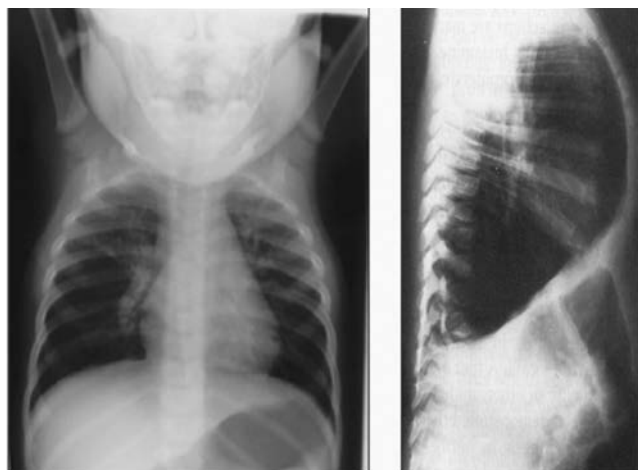
coronavirus disease confirmed by the PCR test. The said test was negative for COVID-19 infection during the treatment period. We conditionally divided the patients into 3 groups. The first group: the patients had a history of severe or moderate transmitted COVID-19 pneumonia and were considered recovered. The reason for referring patients of this group was an offensive cough and various non-respiratory complaints: general weakness, easy fatigue, drowsiness and others. 80 patients joined this group - 46%. The second group: patients who have undergone a COVID-19 infection, after which respiratory changes remained; Cough, shortness of breath during exertion, shortness of breath. This group comprised 49 patients, 28%. The third group. Patients with a history of COVID-19 infection had repeated temperature reactions during their visit to the clinic, but a negative PCR test. 46 patients were found in this group - 26%. These patients were hospitalized. All patients underwent radiological examination. None of them underwent conducted a CT study to assess the clinical condition. Hospitalized patients with acute respiratory complaints were subjected to radiological examination upon entering the clinic and on the 6-7th day of the disease, taking into account the clinical condition. The patients of the first group, who transferred the acute form of COVID-19 pneumonia, had a bothersome cough when entering the clinic, had X-rays: Enhanced vascular image in the medial fields with thickening of the bronchial walls, the so-called "donut sign", increased pneumatization and hypovascularization in the periphery, decreased pneumatization in the lower fields, low location of the diaphragmatic arches, therefore, a decrease



**Fig-1.** Patient A. Hyperpneumatization and hypovascularization in the periphery, decrease of the cardiothoracic index.



**Fig-2.** Patient B. The interstitial image is enhanced by a reticular-nodular pattern and interlobular pleural reaction.



**Fig-3.** Patient C. (Frontal and lateral projection) Hyperpneumatization, impoverished vascular picture, structureless root, lowered diaphragmatic arches, reduced cardiothoracic index (0.4% and less).

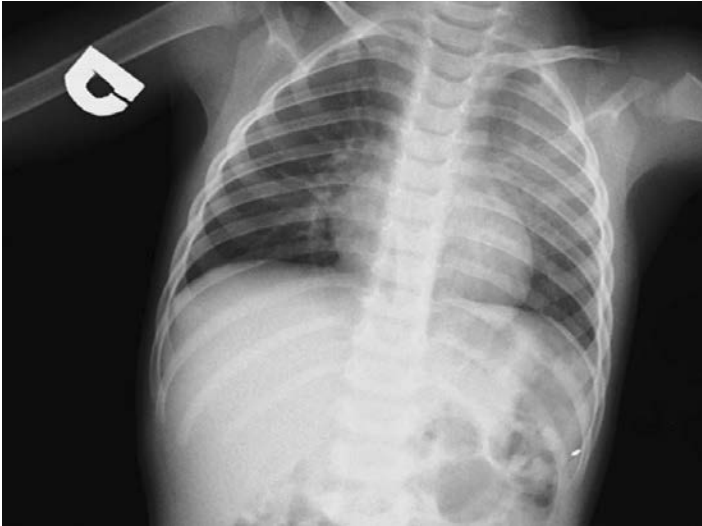


**Fig-4.** Patient D. Hyperpneumatization, impoverished vascular picture, structureless root, lowered diaphragmatic arches, reduced cardiothoracic index (0.4% and less).

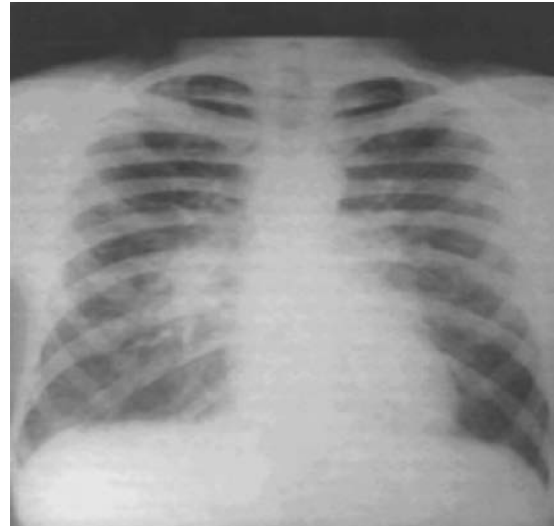
in the cardiothoracic index, which could be the cause of pathological changes in the cardiovascular system [4].

The main reason for referring patients to the second group was cough, which continued after the transfer of the disease. Radiologically, hyperpneumatization, impoverished vascular picture, structureless root, lowered diaphragmatic arches, reduced cardiothoracic index (0.4% and less) were noted in all patients [4].

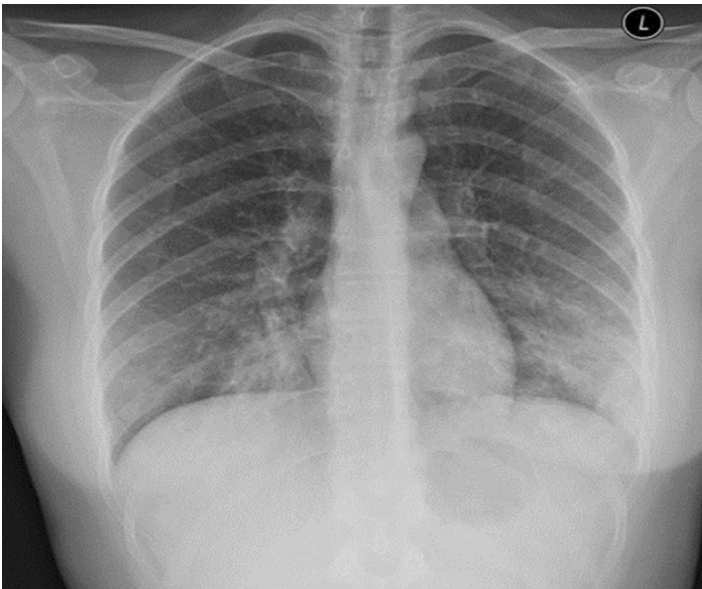
In case of acute clinical course with patients of the third group, radiological changes developed gradually, pneumatization decreased and infiltration of weak intensity appeared in the central and lower fields, with a non-structural vascular picture. Repeated X-ray examination was carried out on the 5th-6th day of the disease depending on the clinical symptoms. Infiltrative changes became intense, spread to the periphery and basal segments, the process was bilateral and



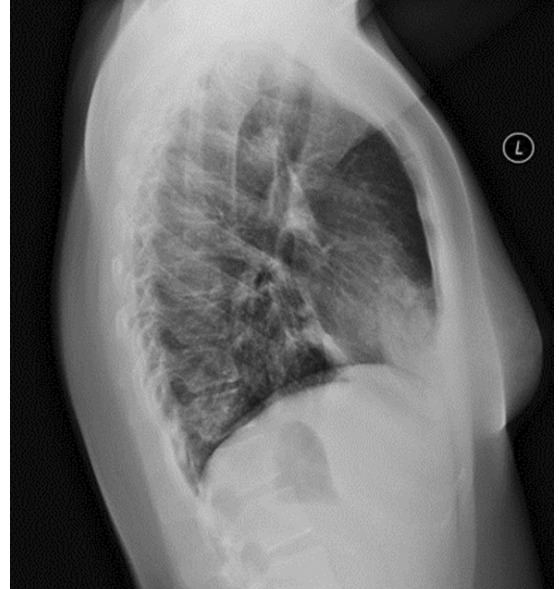
**Fig-5.** Patient D. Infiltration of weak intensity appeared in the left upper field.



**Fig-6.** Patient E. Infiltration appeared in the central field, of the right lung.



**Fig-7.** Patient F. Infiltration appeared in the lower fields, with a non-structural vascular picture.



asymmetric, with predominantly unilateral damage.

Since during a viral infection the process develops in the epithelium and the interstitial adjacent to it, changes in the case of viral pneumonia occupy the central part of the lungs. In the case of coronavirus disease, the infiltration process on radiographs spreads from the central parts of the lung to the periphery and in the lower fields. On repeated radiographs,

it became intense. The resolution of clinical symptoms and the improvement of the radiological picture occurred gradually, however, complete resolution could not be achieved, radiological changes remained on the 4th week of the disease and for a longer period. The mentioned X-ray changes were not observed in all patients. Some of the patients, despite the severe clinical course, had no pathological changes on the radiographs [6,7].



A different X-ray picture is found in children under one year of age. During the prolonged temperature reaction, the radiological picture of low transparency included the area of the roots and the central fields in the form of small focal infiltrates, the so-called ground glass syndrome. The resolution of radiological changes occurred more slowly than in adults. Unfortunately, due to the short period of time, we do not have the results of the study for a longer period.

In conclusion:

-In the case of post-covid syndrome, radiological changes do not always indicate a severe course of the disease. In the

case of clinical recovery, X-ray changes appear in the 4th week of the disease and in a longer period.

- X-ray examination should be performed based on clinical symptoms. X-ray changes are manifested in the roots and central fields, in the form of small-focal infiltrates of low transparency, unlike other types of viruses, the changes continue in the post-COVID period.

- The severe course of the disease does not always mean the manifestation of post-COVID syndrome and vice versa. In case of a mild course of the disease, it is possible to develop polyorganic damage of various degrees.

### References

1. Bossley CJ, Kavaliunaite E, Harman K, Cook J, Ruiz G, Gupta A. Post-acute COVID-19 outcomes in children requiring hospitalisation. *Sci Rep.* 2022;12(1):8208. Published 2022 May 17. doi:10.1038/s41598-022-12415-x
2. Götzinger F, Santiago-García B, Noguera-Julián A, et al. COVID-19 in children and adolescents in Europe: a multinational, multicentre cohort study. *Lancet Child Adolesc Health.* 2020;4(9):653-661. doi:10.1016/S2352-4642(20)30177-2
3. Kompaniyets L, Bull-Otterson L, Boehmer TK, et al. Post-COVID-19 Symptoms and Conditions Among Children and Adolescents - United States, March 1, 2020-January 31, 2022. *MMWR Morb Mortal Wkly Rep.* 2022;71(31):993-999. Published 2022 Aug 5. doi:10.15585/mmwr.mm7131a3
4. Denina M, Pruccoli G, Scolfaro C. et al. Sequelae of COVID-19 in hospitalized children: a 5 months follow-up. *Pediatr Infect Dis J.* 2020; 39: e458-e459
5. Götzinger F, Santiago-García B, Noguera-Julián A et al. COVID-19 in children and adolescents in Europe: a multinational, multicentre cohort study. *Lancet Child Adolesc Health.* 2020; 4: 653-661
6. Nalbandian A, Sehgal K, Gupta A, et al. Post-acute COVID-19 syndrome. *Nat Med.* 2021;27(4):601-615. doi:10.1038/s41591-021-01283-z
7. WHO. Clinical management of COVID-19: interim guidance 27 May 2020. World Health Organization, Geneva 2020

**РЕЗЮМЕ****Постковидные рентгенологические изменения  
лёгких у детей**Стуруа Д. Г.<sup>1,2</sup>; Джоджуа Н. Дж.<sup>1</sup>; Дундуа Т.Т.<sup>3</sup><sup>1</sup>Детская центральная больница им. М. Иашвили, Тбилиси, Грузия<sup>2</sup>Высшая медицинская школа АИЕТИ им. Д.Твилдиани, Тбилиси, Грузия<sup>3</sup>Университет Грузии, Тбилиси, Грузия

В статье на основе рентгенологических исследований обсуждаются посткоронавирусные легочные осложнения у детей. Исследование было проведено в Центральной детской больнице имени Иашвили в Тбилиси. COVID-19 может привести ко многим вторичным заболеваниям, легкие являются наиболее часто поражаемым органом у пациентов с инфекцией SARS-CoV-2, стойкие респираторные признаки и симптомы после острого COVID-19 не редкость, хотя у педиатрических пациентов они встречаются заметно реже по сравнению со взрослыми. Симптомы включают кашель и одышку. Время до улучшения зависит от преморбидного состояния и тяжести заболевания. Некоторые из этих симптомов могут длиться 3-4 месяца или дольше. Мы изучили 175 детей, которые были инфицированы covid в течение 3 месяцев и более. У 80 (46%) детей был тяжелый пневмонит COVID-19 с острой дыхательной недостаточностью. Пациенты, перенесшие covid-инфекцию и респираторные изменения и имевшие сохраняющийся кашель, одышку при физической нагрузке, одышку - составили 28% - 49 пациентов. В этой группе были обнаружены пациенты, у которых, по анамнестическим данным, наблюдалась температурная реакция в период лечения в клинике - 46 пациентов (26%). Всем пациентам было проведено рентгенологическое обследование. Ни один из пациентов не проходил компьютерную томографию. Было установлено, что в случае постковидного синдрома рентгенологические изменения не всегда указывают на тяжелое течение заболевания. В случае клинического выздоровления рентгенологические изменения появляются на 4-й неделе заболевания и в более длительный период. Рентгенологическое исследование следует проводить на основании клинических симптомов. Рентгенологические изменения проявляются в корнях и центральных полях, в виде мелкоочаговых инфильтратов низкой прозрачности, в отличие от других типов вирусов, изменения продолжают в постковидный период. Тяжелое течение заболевания не всегда означает проявление постковидного синдрома и наоборот. В случае легкого течения заболевания возможно развитие полиорганического поражения различной степени.

**Ключевые слова:** COVID-19, интерстициальная пневмония, X-ray, инфильтрация, гиперпневматизация, гиповаскуляризация.

## რეზიუმე

# ფილტვების პოსტკოვიდური რენტგენოლოგიური ცვლილებები ბავშვთა ასაკში

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<sup>3</sup>საქართველოს უნივერსიტეტი

SARS-CoV-2-ის ვირუსმა შეიძლება დამანგრეველად იმოქმედოს ადამიანის სხვადასხვა ორგანოზე (ფილტვები, გული, ღვიძლი, კუჭ-ნაწლავის ტრაქტი, ტვინი და ა.შ.). ინფიცირებულ პაციენტებს ყველაზე ხშირად ფილტვები უზიანდებათ. სტატიაში განხილულია პოსტკოვიდური ფილტვების გართულებები ბავშვებში რადიოლოგიური კვლევების შედეგების მიხედვით. აღნიშნული კვლევა ჩატარდა თბილისის მ. იაშვილის სახელობის ბავშვთა ცენტრალურ საავადმყოფოში. 3 თვის განმავლობაში COVID-19-ით ინფიცირებული 175 ბავშვი გამოიკვლიეს. 80 (46%) ბავშვს ჰქონდა COVID-19-ის მძიმე ფორმა - პნევმონია მწვავე რესპირატორული უკმარისობით. 28% - 49 პაციენტი, რომლებსაც ჰქონდათ კოვიდ ინფექცია და რესპირატორული ცვლილებები, ხველა და ქოშინი აღენიშნებოდათ ფიზიკური დატვირთვის დროს. პაციენტები, რომლებსაც კლინიკაში მკურნალობის დროს ანამნეზში ჰქონდათ ტემპერატურული რეაქცია, იყო 26% - 46 პაციენტი. დადგინდა, რომ პოსტკოვიდური სინდრომის დროს ფილტვებში რენტგენოლოგიური ცვლილებები ყოველთვის არ მიუთითებს დაავადების მძიმე მიმდინარეობაზე. კლინიკური გამოჯანმრთელების შემთხვევაში რენტგენოლოგიური ცვლილებები ვლინდება დაავადების მე-4 კვირას, ან უფრო მოგვიანებით. ძირითადი სიმპტომები ხველა და ქოშინია, რაც შეიძლება 3-4 თვე ან კიდევ უფრო დიდხანს გაგრძელდეს. გამოჯანმრთელების დრო დამოკიდებულია პრემორბიდულ მდგომარეობაზე და დაავადების სიმძიმეზე.

საკვანძო სიტყვები: COVID-19, პოსტკოვიდური ფილტვების გართულებები ბავშვებში, X-ray