

# Features of detection of latent tuberculosis infection and tuberculosis in children from household contacts within a household (clinical case)

Yu. V. Myronchuk<sup>1</sup>\*, O. O. Pushnova<sup>2</sup>, L. I. Chernyshova<sup>2</sup>, O. V. Dvizov<sup>2</sup>

<sup>1</sup>Zaporizhzhia State Medical and Pharmaceutical University, Ukraine, <sup>2</sup>PNE "Zaporizhzhia Regional Clinical and Diagnostic Center of Phthysiatry and Pulmonology" ZRC, Ukraine

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

## Ключові слова:

туберкульоз, діти, домогосподарства, невакциновані, комп'ютерна томографія.

## Key words:

tuberculosis, children, households, unvaccinated, CT scan.

Надійшла до редакції / Received: 01.05.2023

Після доопрацювання / Revised: 17.05.2023

Схвалено до друку / Accepted: 19.05.2023

Конфлікт інтересів: відсутній.

Conflicts of interest: authors have no conflict of interest to declare.

\*E-mail: yashmayulya92@gmail.com

**Aim:** to demonstrate the features of detection and diagnosis of latent tuberculosis infection and pulmonary tuberculosis in children from household contacts based on own clinical observation.

**Materials and methods.** A clinical case of own observation of pulmonary tuberculosis and latent tuberculosis infection in children from household contacts who were treated in the paediatric department of the clinical base of the Phthysiatry and Pulmonology Department of Zaporizhzhia State Medical and Pharmaceutical University on Public Non-Profit Enterprise of the "Zaporizhzhia Regional Clinical and Diagnostic Center of Phthysiatry and Pulmonology" of Zaporizhzhia Regional Council.

**Results.** Children from household contacts were examined at ages: 8 months, 2, 3, 5 and 7 years, after their mother was diagnosed with tuberculosis (TB). All children showed an increase in tuberculin skin test, at the X-ray of the thoracic cavity organs (TCO) no changes were detected in any child. Taking into account the age of the children and their constant residence with the index patient, a decision was made to conduct an additional examination using CT scan of the TCO. Thus, three children were diagnosed with pulmonary tuberculosis – primary tuberculosis complex, and two were infected. After receiving the results of the culture test in the gastric lavage, the youngest child was found MBT, which was resistant to first-line drugs, namely isoniazid and rifampicin, which required a treatment regimen adjustment. It should be noted that the youngest girl, who was not vaccinated, had the most widespread process in the lungs compared to other children.

**Conclusions.** Monitoring and screening of children who have been in contact with the index patient within the household maximises the detection of additional cases of latent tuberculosis infection and pulmonary TB. The most at-risk groups are those who not vaccinated with BCG vaccine and children under 5 years of age. Early detection and timely prescription of anti-TB therapy is the key not only to effective treatment, but also to preventing the transmission of TB infection.

**Modern medical technology. 2023;(2):50-57**

## Особливості виявлення латентної туберкульозної інфекції та туберкульозу в дітей із родинного контакту в межах побуту (клінічний випадок)

Ю. В. Мирончук, О. О. Пушнова, Л. І. Чернишова, О. В. Двізов

**Мета роботи** – на прикладі власного клінічного спостереження показати особливості виявлення та діагностики латентної туберкульозної інфекції та легеневого туберкульозу в дітей з осередкового контакту.

**Матеріали та методи.** Описано клінічний випадок із діагностики легеневого туберкульозу та латентної туберкульозної інфекції в дітей із сімейного контакту, які перебували на лікуванні в дитячому відділенні Комунального некомерційного підприємства «Запорізький регіональний фтизіопульмонологічний клінічний лікувально-діагностичний центр» Запорізької обласної ради, що є клінічною базою кафедри фтизіатрії і пульмонології Запорізького державного медико-фармацевтичного університету.

**Результати.** Обстежили дітей із родинного контакту віком 8 місяців, 2, 3, 5 і 7 років після виявлення туберкульозу (ТБ) в їхньої матері. В усіх дітей визначили збільшення показників туберкулінової шкірної проби, але не виявили зміни за даними рентгенографії органів грудної порожнини (ОГП). Враховуючи вік дітей і постійне проживання з індексним пацієнтом, ухвалили рішення про дообстеження за допомогою комп'ютерної томографії ОГП. У результаті в трьох дітей виявили легеневий туберкульоз – первинний туберкульозний комплекс, а двоє – інфіковані. Після отримання результатів культурального дослідження в наймолодшій дитини виявили в ПВШ МБТ, яка була стійкою до препаратів I ряду, а саме ізоніазиду та рифампіцину, що зумовило необхідність корекції схеми лікування. Зазначимо,

що саме наймолодша дівчинка, яка не була вакцинованою, мала найпоширеніший процес у легенях порівняно з іншими дітьми.

**Висновки.** Відстежування та скринінг дітей, які контактували з індексним пацієнтом у межах домогосподарства, максимізує виявлення додаткових випадків латентної туберкульозної інфекції та легеневого ТБ. Найбільшою групою ризику є нещеплені вакциною БЦЖ та діти віком до 5 років. Раннє виявлення та своєчасне призначення протитуберкульозної терапії – не лише запорука ефективного лікування, але й запобігає передачі туберкульозної інфекції.

**Сучасні медичні технології. 2023. № 2(57). С. 50-57**

Tuberculosis is a serious danger to children's health. Today, this disease is still relevant, and the epidemiological situation in Ukraine is still difficult, mostly due to the large number of tuberculosis (TB) patients. Particular attention is focused on the most sensitive groups – children and teenagers. First and foremost, the problem of multidrug-resistant tuberculosis (MDR-TB) is still acute, as Ukraine is among the countries with a high burden of MDR / RIF-TB, which is reflected in the morbidity among children [1].

The effectiveness of contact testing and preventive therapy among children remains poorly researched, but identifying and prioritising risk groups in children is crucial in the fight against tuberculosis. That is why modern international guidelines focus on testing and treatment of latent tuberculosis infection (LTBI) in risk groups. In addition, these include infants, children under 5 years of age, and HIV-infected people, who have been in contact with a patient with pulmonary TB at the household level [2]. Thus, according to the WHO definition [3], a household contact is a person who has shared the same enclosed living space with the index patient (IP) for one or more nights and/or has frequently and systematically stayed in the same room for long periods during the day for 3 months prior to the start of the current course of treatment. It should also be noted that the person for whom the contact investigation is being carried out, the IP, may not be the source of the infection.

Belogortseva O. I. et al. [4] found that household contacts with relatives of patients with tuberculosis, especially those who are bacterial excretors, present the greatest danger to children. According to their study, among those in contact with a MDR+ patient, 55 % had drug-resistant TB (DR-TB). Furthermore, children at risk of multidrug-resistant TB and MDR-TB prevailed, accounting for 26.7 % and 11.3 %, respectively.

The meta-analysis by L. Martinez et al. [5] showed that among infants and young children, the risk of developing tuberculosis is very high. For example, children who tested positive for TB infection, had a significantly higher incidence than children who tested negative, mostly among children under 5 years of age. The majority of these cases were diagnosed after the beginning of the contact tracing and could not have been avoided through prevention. Therefore, the authors emphasise the need for early prevention through rapid diagnosis of adult TB cases. This is in line with the findings of other researchers H. E. Jenkins and C. M. Yuen [6], who indicate that children in the households of MDR-TB patients infected with tuberculosis are at high risk of developing MDR-TB in the future. Thus, according to their estimates,

household contacts studies can annually detect 39–50 % of the estimated number of children who develop MDR-TB.

Another meta-analysis also found higher rates of infection among children aged 0–4 years compared to children aged 10–14 years. The authors' findings suggest that focusing TB prevention efforts on household contacts is quite effective [7].

In the studies of B. T. Haerana et al. [8] noted that poor nutritional status, lack of BCG immunisation and high intensity of contact with TB patients, were the most significant predictors of TB infection in children, who had contact with a patient within the household, with a model contribution of 64 %.

The most effective in preventing tuberculosis is the BCG vaccine [9]. Vaccination of infants helps prevent the development and progression of severe forms of tuberculosis, such as disseminated or miliary tuberculosis, and tuberculous meningitis. Vaccination also reduces the risk of complications and mortality from tuberculosis. In particular, M. Hatherill and F. Cobelens [10] in their meta-analysis indicate that infant vaccination against all forms of tuberculosis in children under 5 years of age was 37 % effective, and against pulmonary diseases was 42 % effective in children under 3 years of age.

Song W. M. et al. [11] in their study found a potential relationship between MDR-TB incidence rates in children and the level of national economy, which requires more targeted attention to childhood TB cases in low-income countries, including Ukraine, to improve MDR-TB detection and reduce mortality.

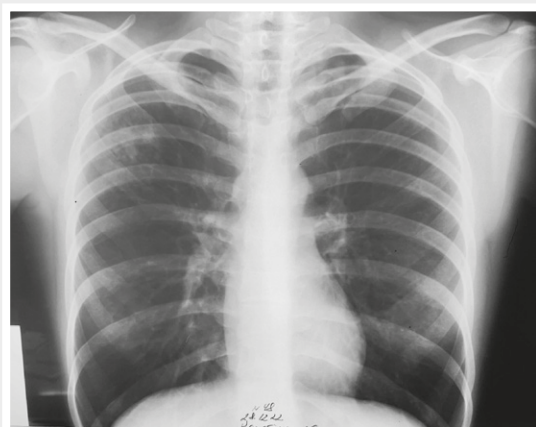
In summary, after analysing epidemiological indicators and current data from foreign studies, it can be noted that the problem of childhood TB infection and disease among young children, who have had contact with a patient within the household, is relevant. According to numerous studies, household contact tracing is a highly effective intervention for detecting infection or TB among children at risk. This was the basis for writing this article, which may be interesting to doctors of various specialties in diagnosis.

## Aim

To demonstrate the features of detection and diagnosis of latent tuberculosis infection and pulmonary tuberculosis in children from household contacts on the example of own clinical observation.

## Materials and methods

A clinical case of own observation of pulmonary tuberculosis and latent tuberculosis infection in children



**Fig. 1.** X-ray TCO + tomography scan of the right lung lobe at hospitalization in the department of the PNE “ZRCDCPP” ZRC.

from household contacts who were treated in the paediatric department of the clinical base of the Phthysiatry and Pulmonology Department of Zaporizhzhia State Medical and Pharmaceutical University on Public Non-Profit Enterprise of the “Zaporizhzhia Regional Clinical and Diagnostic Center of Phthysiatry and Pulmonology” of Zaporizhzhia Regional Council (PNE “ZRCDCPP” ZRC).

## Results

**Girl V.**, 7 months old. Anamnesis: the child was not vaccinated against tuberculosis at birth due to the lack of BCG vaccine. After the vaccine became available, the family doctor suggested routine vaccination of the child at the place of residence. Previously, the child was tested for a tuberculin skin test (TST) with 2 TU, as the child was 6 months old at the time.

The Mantoux test was positive and measured 8 mm. After that, the child was referred to a paediatric phthysiologist for an outpatient consultation. There, the girl was carried out a chest X-ray: there was no visible pathology in the lung parenchyma, the roots were structural, and the sinuses were free. The doctor recommended additional examination of the mother and a second consultation.

On an outpatient, the woman was proposed to take a X-ray of the thoracic cavity organs (TCO) and a tomography scan of the right lung lobe, where changes were detected (*Fig. 1*). Conclusion (28.12.2022): in the upper lobe of the right lung, numerous focal shadows of medium intensity with indistinct contours tend to fuse with the formation of single foci with signs of destruction up to 1 cm. All other lung areas on both sides were normal. Conclusion: The X-ray shows infiltrative tuberculosis of the upper lobe of the right lung in the phase of infiltration and destruction.

This case was presented to the Central Medical Commission (CMC), where a diagnosis of newly detected tuberculosis (NDTB) of the upper lobe of the right lung (infiltrative) Destr+ MBT- M- MG- K- Hist 0 Cog 1 (2023) was established and treatment according to the scheme of sensitive tuberculosis was prescribed. The mother began treatment in an outpatient setting.

It should be noted that in April 2022, two children were registered with a paediatric phthysiologist due to a “virage” in a tuberculin test. At that time, they received an X-ray TCO, no changes were detected, observation and repeated consultation in 6 months were recommended. The mother received a digital X-ray TCO after giving birth, 3 months later, in the maternity hospital, and changes weren’t detected. According to the mother, no one else lives in the house except her and her children, and no one in the neighbourhood has TB.

Given the mother’s diagnosis, it was recommended to examine her four children living with her in addition to the youngest child. Taking into account household contact, all four children received TST with 2 TU and X-ray TCO. All children were normal according to the results of the X-ray TCO, but there was an increase in tuberculin sensitivity. Due to the increase in the Mantoux test results, it was decided to examine them in more detail in the children’s department of the PNE “ZRCDCPP” ZRC.

Upon admission to the paediatric department, the girl V., 8 months old, was in a satisfactory condition. From the anamnesis: BCG – not vaccinated. The result of tuberculin diagnostics: 20.12.2022 – 8 mm. The child was born with a weight of 2780 g and it was the 5<sup>th</sup> pregnancy, uncomplicated, urgent labour. The allergic anamnesis was uncomplicated. She was not registered with a phthysiologist and did not receive chemoprophylaxis. The skin was pale, clean. Peripheral lymph nodes were not enlarged. There was hard breathing over the lungs, no wheezing. The heart was rhythmic, the tones were muted. The abdomen was mild, painless on palpation. The lower border of the liver was near the costal arch. The tapping symptom was negative on both sides. Urination and stool were not disturbed.

Blood tests for HIV were negative.

The results of the general blood analysis (GBA): hemoglobin (HGB) – 124 g/l, erythrocytes (RBC) –  $4.04 \times 10^{12}/l$ , Platelets (PLT) –  $210 \times 10^9/l$ , leukocytes (WBC) –  $11.9 \times 10^9/l$ , eosinophils (EOS) – 5 %, banded neutrophils (b/n) – 1 %, segmented neutrophils (s/n) – 22 %, lymphocytes (LYM) – 69 %, monocytes (MONO) – 6 %, erythrocyte sedimentation rate (ESR) – 9 mm/h.

Biochemical blood analysis: bilirubin total – hemol, thymol test – 1.14 U, alanine aminotransferase (ALT) – 0.45, aspartate aminotransferase (AST) – 0.67, total protein (TP) – 65.4 g/l, glucose – 4.63 mmol/l, creatinine – 48.3  $\mu$ mol/l.

General urine analysis (GUA): colour – light yellow, transparency – moderate, specific gravity – 1012, reaction – neutral, protein, glucose, ketone bodies – absent.

The results of bacteriological and molecular genetic (MG) studies of gastric lavage (GL) were negative.

Results of CT scan of the chest: several infiltrates of 6.3 mm, 8.0 mm and 9.5 mm in size were detected in the S6 projection of the right lung. There is an increase in lymph nodes in the right root, forming a conglomerate at the level of the intermediate and lower lobe bronchus with sizes of 15.5  $\times$  11.2 mm, 17.0  $\times$  13.0 mm; in the mediastinum below the bifurcation and medial to the lower lobe bronchus with sizes of 16.5  $\times$  13.0 mm. Paratracheally on the right, a chain of enlarged lymph nodes was detected, forming a conglomerate with total dimensions of 26  $\times$  16 mm. All the enlarged lymph nodes have peripheral calcified shell-like rims. Conclusion: There were CT signs of primary tuberculosis complex (PTC) of the right lung in the form of few infiltrates of the lower lobe of the lung, conglomerates of enlarged with partial calcification lymph nodes of the right root and mediastinum on the right (Fig. 2).

Ultrasound examination of the abdominal cavity: ultrasound signs of moderate hepatomegaly.

Electrocardiography (ECG) data: Sinus tachycardia – 109 per minute. The voltage is preserved. The electrical axis of the heart is deviated to the right: SI – S II – SIII. Incomplete blockade of the right block of bundle of His. QRS – 377 msec.

Consultation with an ophthalmologist: no pathology was detected.

According to the data obtained, the child was diagnosed: NDTB PTC of the right lung Destr- MBT- M- MG- K 0 Resist- Hist 0 Cog 1 (2023). Treatment with the use of the following drugs was prescribed: isoniazid (H), rifampicin (R), pyrazinamide (Z), ethambutol (E). This is a regimen for the treatment of sensitive tuberculosis, which consists of four drugs (HRZE) for 2 months, and then two drugs (HR) for 4 months – 2 HRZE4HR.

**Boy V.**, 2 years old. No complaints at the time of the examination. Anamnesis: BCG – 3 mm scar. Dynamics of tuberculin tests: 10.08.2022 – negative, 09.01.2023 – 13 mm. The child was born with a weight of 2860 g and it was the 4<sup>th</sup> pregnancy, uncomplicated, urgent labour. The allergic anamnesis was not complicated. He was not registered with a phthisiologist and did not receive chemoprophylaxis. Objectively: general condition is satisfactory. The skin was pale, clean. Peripheral lymph nodes were enlarged in the anterior neck group by the type of micropolyadenopathy. There was rough breathing over the lungs, no wheezing. The heart was rhythmic, the tones were muted. The abdomen was mild, painless on palpation. The lower border of the liver was near the costal arch. The tapping symptom was negative on both sides. Urination and stool were not disturbed.



**Fig. 2.** CT scan of the chest in the paediatric department of the PNE "ZRCDCPP" ZRC.

The following data was obtained upon admission to the PNE "ZRCDCPP" ZRC.

Blood tests for HIV were negative.

GBA: HGB – 130 g/l, RBC –  $4.06 \times 10^{12}$ /l, WBC –  $9.1 \times 10^9$ /l, PLT –  $210 \times 10^9$ /l, EOS – 5 %, b/n – 2 %, s/n – 58 %, LYM – 30 %, MONO – 5 %, ESR – 3 mm/h.

Biochemical analysis of blood: bilirubin total – 12.8  $\mu$ mol/l, thymol test – 1.29 U, ALT – 0.18, AST – 0.31, TP – 63.1 g/l, creatinine – 44.5  $\mu$ mol/l, glucose – 4.75 mmol/l.

GUA: colour – light yellow, transparency – moderate, specific gravity – 1010, reaction – neutral, protein, glucose, ketone bodies – absent.

The results of bacteriological and MG, culture studies of GL were negative.

Results of CT scan of TCO: In the parenchyma of the right lung, there were few infiltrates in the subpleural area, size of which is 5.5  $\times$  4.5 mm in S1/2, 11.6 mm in S2, and 21.5  $\times$  12.0 mm in S8. In the right root, a non-enlarged lymph node measuring 8.6  $\times$  5.6 mm with a calcification area in the structure was detected. Conclusion: There was CT signs of primary tuberculosis complex of the right lung in the form of few lung infiltrates, partially not enlarged lymph nodes of the right root (Fig. 3).

Ultrasound examination of the abdominal cavity: ultrasound signs of moderate hepatomegaly.

ECG data: Sinus tachycardia – 109 per minute. The voltage is preserved. The electrical axis of the heart is not deviated. Incomplete blockade of the right block of bundle of His. QRS – 376 msec.

Consultation with an ophthalmologist: no pathology was detected.

After receiving the data, the child was diagnosed: NDTB PTC of the right lung Destr- MBT- M- MG- C- Resist- Hist 0 Cog 1 (2023). Treatment was prescribed according to the sensitive tuberculosis regimen: 2HRZE4HR.

**Girl V.**, 5 years old. No complaints at the time of the examination. Anamnesis: BCG – 4 mm scar. Tuberculin diagnostician's data: 2019–2020 – negative, 28.03.2022

– 11 mm, 09.01.2023 – 14 mm. The child was born with a weight of 3100 g and it was the 2nd pregnancy, uneventful, urgent labour. The allergic anamnesis was not complicated. She was registered with a phthisiopediatrian from 04.2022 in category 5.4, X-ray TCO – without pathology, did not receive chemoprophylaxis. It was recommended to be examined after one year.

When she was admitted to the PNE “ZRCDCPP” ZRC, the following data were obtained. Objectively: general condition was satisfactory. The skin was pale, clean. The peripheral lymph nodes were enlarged in the anterior neck group by the type of micropolyadenopathy. There was rough breathing over the lungs, no wheezing. The heart was rhythmic, the tones were muted. The abdomen was mild, painless on palpation. The lower border of the liver was near the costal arch. The tapping symptom was negative on both sides. Urination and stool were not disturbed.

Blood tests for HIV were negative.

GBA: HGB – 126 g/l, RBC –  $3.93 \times 10^{12}/l$ , WBC –  $8.8 \times 10^9/l$ , PLT –  $188 \times 10^9/l$ , EOS – 8 %, b/n – 1 %, s/n – 46 %, LYM – 38 %, MONO – 7 %, ESR – 2 mm/h.

Biochemical analysis of blood: bilirubin total –  $13.6 \mu\text{mol}/l$ , thymol test – 0.83 U, ALT – 0.26, AST – 13.6, TP – 67.6 g/l, creatinine –  $56.2 \mu\text{mol}/l$ , glucose – 4.81 mmol/l.

GUA: colour – light yellow, transparency – moderate, specific gravity – 1020, reaction – neutral, protein, glucose, ketone bodies – absent.

The results of bacteriological and MG, culture studies of GL were negative.

Results of CT scan of TCO: At the S4/5 border, a single solid lesion measuring 2.2 mm was found almost subpleural. Several calcifications of 3 mm and 2.1 mm were detected in the right root. Conclusion: There was CT signs of a single dense of the middle lobe lesion, single calcifications of the right lung root. No infiltrative, extensive pathology of the lungs and mediastinum was detected (*Fig. 4*).

Ultrasound examination of the abdominal cavity: ultrasound signs of significant hepatomegaly.

ECG data: Sinus rhythm – 86 per minute. The voltage is preserved. The electrical axis of the heart is not deviated. QRS – 376 msec.

Consultation with an ophthalmologist: no pathology was detected.

After receiving the data, the child was diagnosed: NDTB PTC of the right lung Destr- MBT- M- MG- C- Resist- Hist 0 Cog 1 (2023). Treatment was prescribed according to the sensitive tuberculosis regimen.

**Boy T.**, 3 years old. No complaints at the time of examination. Anamnesis: BCG – 5 mm scar. Tuberculin diagnostician's data: 2020 – negative, 2021 – 3 mm (doubtful), 20.08.2022 – 10 mm, 09.01.2023 – 16 mm. The child was born with a weight of 3360 g and it was the 3<sup>rd</sup> pregnancy, delivery without complications, urgent labour. The allergic anamnesis was not complicated. He was not registered with a phthisiologist, did not receive chemoprophylaxis.

Objectively: general condition was satisfactory. The skin was pink, clean. Peripheral lymph nodes were not enlarged.

There was vesicular breathing over the lungs, no wheezing. The heart was rhythmic, the tones were muted. The abdomen was mild, painless on palpation. The lower border of the liver was near the costal arch. The tapping symptom was negative on both sides. Urination and stool were not disturbed.

The following data was obtained upon admission to the PNE “ZRCDCPP” ZRC.

Blood tests for HIV were negative.

GBA: HGB – 131 g/l, RBC –  $4.18 \times 10^{12}/l$ , WBC –  $6.1 \times 10^9/l$ , PLT –  $195 \times 10^9/l$ , EOS – 2 %, b/n – 1 %, s/n – 49 %, LYM – 45 %, MONO – 3 %, ESR – 2 mm/hour.

Biochemical analysis of blood: bilirubin total –  $22.2 \mu\text{mol}/l$ , thymol test – 3.01 U, ALT – 0.41, AST – 0.22, TP – 66.5 g/l, creatinine –  $73.1 \mu\text{mol}/l$ , glucose – 4.77 mmol/l.

GUA: colour – yellow, transparency – moderate, specific gravity – 1017, reaction – neutral, protein, glucose, ketone bodies – absent.

The results of bacteriological and MG, culture studies of GL were negative.

Conclusion of CT scan: CT signs of focal, infiltrative, volumetric pathology of the lungs and mediastinum weren't detected.

Ultrasound examination of the abdominal cavity: ultrasound signs of hepatomegaly.

ECG data: Sinus tachycardia – 120 per minute. The voltage is preserved. The electrical axis of the heart is deviated – SI – SII – SIII. QRS – 397 msec.

Consultation with an ophthalmologist: no pathology was detected.

After receiving the data, the child was diagnosed: LTBI. A course of prophylactic HR treatment was prescribed for 3 months after the diagnosis was made.

**Boy D.**, 7 years old. No complaints at the time of examination. Anamnesis: BCG – 4 mm scar. Dynamics of tuberculin tests: 2016–2019 – negative, 2020 – 4 mm, 2021 – negative, 28.03.2022 – 11 mm, 09.01.2023 – 13 mm. The boy was born with a weight of 3080 and it was the 1st pregnancy, uneventful, urgent labour. The allergic anamnesis was not complicated. He was registered with a phthisiopediatrian from 04.2022 in category 5.4, did not receive a course of chemoprophylaxis. An examination after one year was recommended.

Upon admission to the PNE “ZRCDCPP” ZRC, the following data were obtained. Objectively: the general condition is satisfactory. The skin was pale, clean. The peripheral lymph nodes were enlarged in the anterior neck group by the type of micropolyadenopathy. There was rough breathing over the lungs, no wheezing. The heart was rhythmic, the tones were muted. The abdomen was mild, painless on palpation. The lower border of the liver was near the costal arch. The tapping symptom was negative on both sides. Urination and stool were not disturbed.

Blood tests for HIV were negative.

GBA: HGB – 127 g/l, RBC –  $3.96 \times 10^{12}/l$ , WBC –  $5.0 \times 10^9/l$ , PLT –  $188 \times 10^9/l$ , EOS – 8 %, b/n – 2 %, s/n – 55 %, LYM – 38 %, MONO – 7 %, ESR – 2 mm/h.

Biochemical analysis of blood: bilirubin total –  $16.9 \mu\text{mol}/l$ , thymol test – 2.5 U, ALT – 0.66, AST – 0.45, TP – 69.0 g/l, creatinine –  $100.4 \mu\text{mol}/l$ , glucose – 4.5 mmol/l.

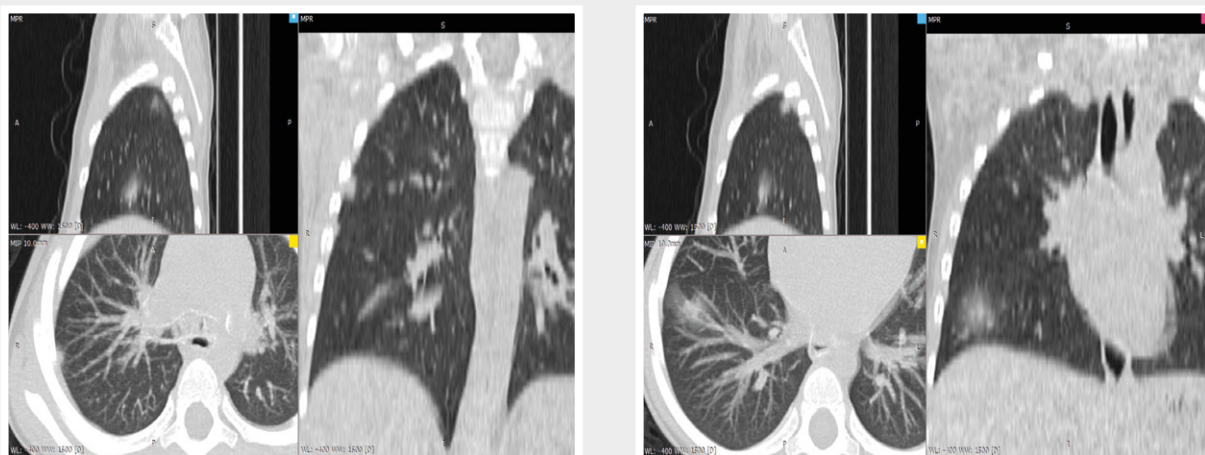


Fig. 3. CT scan of the chest in the paediatric department of the PNE "ZRCD CPP" ZRC.

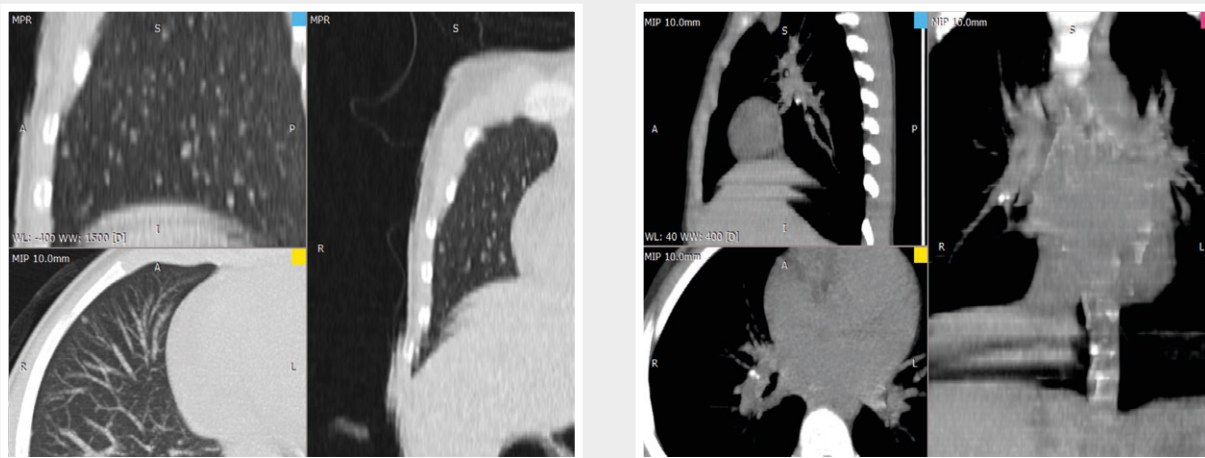


Fig. 4. CT scan of the chest in the paediatric department of the PNE "ZRCD CPP" ZRC.

GUA: colour – yellow, transparency – moderate, specific gravity – 1024, reaction – neutral, protein, glucose, ketone bodies – absent.

The results of bacteriological and MG, culture studies of GL were negative.

Conclusion of CT scan: CT signs of focal, infiltrative, volumetric pathology of the lungs and mediastinum weren't detected.

Ultrasound examination of the abdominal cavity: ultrasound signs of significant hepatomegaly.

ECG data: Sinus rhythm – 84 per minute. The voltage is preserved. The electrical axis of the heart is deviated – SI – SII – SIII. QRS – 409 msec.

Consultation with an ophthalmologist: no pathology was detected.

Based on the data obtained, the child was diagnosed with LTBI. A course of preventive treatment was prescribed after the diagnosis was established.

After starting treatment, the results of the culture test were received. In the youngest girl, in the analysis of the GL, the culture test revealed MG+ Rif+, fTMS Resist+ (HR), and thus the diagnosis was changed to MDR-TB of the right lung

PTC Destr- MDR+ M- MG+ (from culture) Rif+ fTMS Res (HR) Hist 0 Cog 1 (2023). The Public Health Centre (PHC) consultation recommended the prescribe of a delamanid regimen for 9–12 months – linezolid (Lzd) levofloxacin (Lfx) cycloserine (Cs) delamanid (Dlm) – for vital indications. MDR-TB was not detected in other children, so the diagnosis of children with lung changes was changed to risk MDR-TB (RMDR-TB) and the treatment regimen was adjusted at the modified short-term treatment regimens No. 3.

The children with LTBI also changed their preventive treatment regimen to Lfx for 6 months. The mother also started receiving treatment, according to the diagnosis of RMDR-TB.

## Discussion

The presented clinical case demonstrates the following. The mother was diagnosed with tuberculosis after the first positive Mantoux test of an unvaccinated child. After the mother was examined, she diagnosed of pulmonary TB, without bacterial excretion. According to her, she lived alone in the house with her children, and no one else in the household had

TB. She also reported that two other children were registered in pediatric phthisiatrician according to the category 5.4. A. After the diagnosis of the mother, it was decided to examine all the children of the family in more detail. All children had positive TST results, and no changes in the lungs were detected by the results of the X-ray TCO. Due to the age of the children, namely 8 months, 2 years, 3 years, 5 years and 7 years, and the lack of vaccination in the youngest child, it was decided to perform CT scan for all children. According to the results of this examination, three children were diagnosed with pulmonary TB in the form of PTC, and two were infected. The most widespread process in the lungs was observed in the youngest child, who was not vaccinated with BCG. After receiving the results of a sputum culture test, it was established that the youngest child had MDR-TB. Thus, initially, the investigation of contacts around the index patient, who was the mother, was effective and timely, but during the examination, it was found that she wasn't the source of infection. It was not possible to identify the original IP.

This clinical case confirms and supplements the data of national scientists in the area of paediatric tuberculosis, O. I. Belogortseva et al. [12], who noted that in 61.7 % of children, the index case could not be detected. The majority of children with confirmed TB contact were in contact with patients with sensitive TB, and others had confirmed TB contact with a patient with MDR-TB, 62.5 % and 37.5 %, respectively.

In this situation, it is also informative to use a TST from the 2 TU, which was positive in all children, which complements the data of L. Sun et al. [13], who noted that the

proportion of positive IGRA and TST results was higher in household contacts than outside the household.

This case also complements the data from foreign studies, which indicate that children who have been in contact with a TB patient within the household are at the highest risk of infection or disease, and that the priority screening group is unvaccinated children and children under 5 years of age. It is important to work not only with the index patient, but also with all other contacts, who have been in contact with this household.

## Conclusions

1. Household contacts are the most important risk factor for TB in children with IP due to their close proximity.
2. Unvaccinated children and children up to the age of five years, who are in contact with TB patients in the household should be the focus of priority screening to prevent transmission of TB infection and progression of TB disease.
3. In case of established household contact in children, especially from risk groups, there is a need for a more detailed examination using CT of the chest, not only for TB prevention, but also for earlier and more timely detection of pulmonary TB, avoiding possible complications.
4. Rapid diagnosis of TB cases in adults is an effective way to prevent these cases in children. The work shouldn't only be done with the IPs, but also be broader in scope among those related to the household.

**Prospects for further research:** continue to study the features of detecting children with TB from the source of tuberculosis infection.

### Information about authors:

Myronchuk Yu. V., PhD, Assistant of the Department of Phthisiology and Pulmonology, Zaporizhzhia State Medical and Pharmaceutical University, Ukraine. ORCID ID: 0000-0002-4608-2991

Pushnova O. O., MD, Pediatric Phthisiatrician, PNE "Zaporizhzhia Regional Clinical and Diagnostic Center of Phthisiatry and Pulmonology" ZRC, Ukraine. ORCID ID: 0009-0004-4302-961X

Chernyshova L. I., MD, Head of the Pediatric Department of the PNE "Zaporizhzhia Regional Clinical and Diagnostic Center of Phthisiatry and Pulmonology" ZRC, Ukraine. ORCID ID: 0009-0003-3955-2064

Dvizov O. V., MD, Radiologist, PNE "Zaporizhzhia Regional Clinical and Diagnostic Center of Phthisiatry and Pulmonology" ZRC, Ukraine. ORCID ID: 0009-0001-3264-3313

### Відомості про авторів:

Мирончук Ю. В., д-р філософії, асистент каф. фтизіатрії і пульмонології, Запорізький державний медико-фармацевтичний університет, Україна.

Пушнова О. О., лікар-фтизіатр дитячий, КНП «Запорізький регіональний фтизіопульмонологічний клінічний лікувально-діагностичний центр» ЗОР, Україна.

Чернишова Л. І., зав. дитячого відділення, КНП «Запорізький регіональний фтизіопульмонологічний клінічний лікувально-діагностичний центр» ЗОР, Україна.

Двізов О. В., лікар-рентгенолог, КНП «Запорізький регіональний фтизіопульмонологічний клінічний лікувально-діагностичний центр» ЗОР, Україна.

### References

- [1] World Health Organization (WHO). Global tuberculosis report 2022. 2022 [cited 2023 May 12]. Available from: <https://www.who.int/publications/i/item/9789240061729>.
- [2] World Health Organization (WHO). WHO consolidated guidelines on tuberculosis: module 1: prevention: tuberculosis preventive treatment [Internet]. 2020 [cited 2023 May 12]. Available from: <https://www.who.int/publications/i/item/who-consolidated-guidelines-on-tuberculosis-module-1-prevention-tuberculosis-preventive-treatment>.
- [3] World Health Organization (WHO). Latent tuberculosis infection: updated and consolidated guidelines for programmatic management [Internet]. 2018 [cited 2023 May 12]. Available from: <https://apps.who.int/iris/handle/10665/260233>.
- [4] Bilohortseva OI, Shekhter II, Dotsenko YI. [Analysis of MBT resistance types in children with newly diagnosed tuberculosis with existing and unidentified tub. contacts]. Infusion & chemotherapy. 2022;(4.1):17-17. Ukrainian. doi: 10.32902/2663-0338-2022-4.1-08.
- [5] Martinez L, Cords O, Horsburgh CR, Andrews JR; Pediatric TB Contact Studies Consortium. The risk of tuberculosis in children after close exposure: a systematic review and individual-participant meta-analysis. Lancet. 2020;395(10228):973-84. doi: 10.1016/S0140-6736(20)30166-5.

- [6] Jenkins HE, Yuen CM. The burden of multidrug-resistant tuberculosis in children. *Int J Tuberc Lung Dis*. 2018;22(5):3-6. doi: 10.5588/ijtld.17.0357.
- [7] Martinez L, Shen Y, Mupere E, Kizza A, Hill PC, Whalen CC. Transmission of Mycobacterium Tuberculosis in Households and the Community: A Systematic Review and Meta-Analysis. *Am J Epidemiol*. 2017;185(12):1327-339. doi: 10.1093/aje/kwx025.
- [8] Haerana BT, Prihartono NA, Riono P, Djuwita R, Syarif S, Hadi EN, et al. Prevalence of tuberculosis infection and its relationship to stunting in children (under five years) household contact with new tuberculosis cases. *Indian J Tuberc*. 2021;68(3):350-5. doi: 10.1016/j.ijtb.2020.10.011.
- [9] Kobayashi S, Yoshiyama T, Uchimura K, Hamaguchi Y, Kato S. Epidemiology of childhood tuberculosis after ceasing universal Bacillus Calmette-Guérin vaccination. *Sci Rep*. 2021;11(1):15902. doi: 10.1038/s41598-021-95294-y.
- [10] Hatherill M, Cobelens F. Infant BCG vaccination is beneficial, but not sufficient. *Lancet Glob Health*. 2022;10(9):e1220-1. doi: 10.1016/S2214-109X(22)00325-4.
- [11] Song WM, Li YF, Liu YX, Liu Y, Yu CB, Liu JY, et al. Drug-Resistant Tuberculosis Among Children: A Systematic Review and Meta-Analysis. *Front Public Health*. 2021;9:721817. doi: 10.3389/fpubh.2021.721817.
- [12] Bilohortseva OI, Shekhter Ie, Sukhanova LA, Sivachenko Ole. [Features of contacts in children with tuberculosis]. *Infusion & chemotherapy*. 2022;(4.1):17-8. Ukrainian. doi: 10.32902/2663-0338-2022-4.1-09.
- [13] Sun L, Qi X, Guo Y, Qi H, Li J, Wu X, et al. Tuberculosis infection screening in children with close contact: a hospital-based study. *BMC Infect Dis*. 2021;21(1):815. doi: 10.1186/s12879-021-06480-2.