

Получена: 12 сентября 2021 / Принята: 29 января 2022 / Опубликовано online: 28 февраля 2022

DOI 10.34689/SH.2021.24.1.024

УДК 616-053.2

X-RAY DIAGNOSIS OF ACUTE DESTRUCTIVE PNEUMONIA IN A 1.5-YEAR-OLD CHILD. CASE REPORT.

Madina R. Madiyeva¹, <https://orcid.org/0000-0001-6431-9713>

Dina M. Smagulova¹, <https://orcid.org/0000-0002-4616-8496>

Aigerim A. Baibolova¹, <https://orcid.org/0000-0002-8306-6843>

¹ NCJSC «Semey Medical University», Department of Radiology,
Semey city, Republic of Kazakhstan.

Abstract

This article presents a case of acute destructive pneumonia, diagnosed on the basis of radiological data (X-Ray), which is still the "gold standard" for lung diseases. X-ray method plays an important role both in the diagnosis and treatment of pneumonia complications in children. The severity of pneumonia is associated with anemia, which often accompanies acute and chronic diseases. We present the role of computed tomography in the diagnosis of complications and the spread of the pathological process. We also describe specific features, clinical signs and changes in the course of disease.

Keywords: acute destructive pneumonia, pleural empyema, acute respiratory failure, anemia.

Резюме

РЕНТГЕНОЛОГИЧЕСКАЯ ДИАГНОСТИКА ОСТРОЙ ДЕСТРУКТИВНОЙ ПНЕВМОНИИ У РЕБЕНКА 1,5 ГОДА. КЛИНИЧЕСКИЙ СЛУЧАЙ.

Мадина Р. Мадиева¹, <https://orcid.org/0000-0001-6431-9713>

Дина М. Смагулова¹, <https://orcid.org/0000-0002-4616-8496>

Айгерим А. Байболова¹, <https://orcid.org/0000-0002-8306-6843>

¹ НАО «Медицинский университет Семей», Кафедра радиологии,
г. Семей, Республика Казахстан.

В данной статье представлен клинический случай острой деструктивной пневмонии, диагностика которого основывается на рентгенологическом методе, до сих пор являющимся «золотым стандартом» при заболеваниях легких. Рентгенологический метод играет важную роль как в диагностике, так и в лечении осложнений пневмонии у детей. Тяжесть течения пневмоний ассоциируется с анемией, которая часто сопровождает острые и хронические заболевания. Показана роль компьютерной томографии для диагностики осложнений и объема патологического процесса. Отмечены особенности течения, клиники и динамики развития заболевания.

Ключевые слова: острая деструктивная пневмония, эмпиема плевры, острая дыхательная недостаточность, анемия.

Түйіндеме

1,5 ЖАСТАҒЫ БАЛАНЫҢ ЖЕДЕЛ ДЕСТРУКТИВТІ ПНЕВМОНИЯНЫҢ РЕНТГЕНОЛОГИЯЛЫҚ ДИАГНОСТИКАСЫ. КЛИНИКАЛЫҚ ЖАҒДАЙ.

Мадина Р. Мадиева¹, <https://orcid.org/0000-0001-6431-9713>

Дина М. Смағұлова¹, <https://orcid.org/0000-0002-4616-8496>

Айгерим А. Байболова¹, <https://orcid.org/0000-0002-8306-6843>

¹ КеАҚ "Семей медицина университеті", Радиология кафедрасы,
Семей қ., Қазақстан Республикасы.

Бұл мақалада өкпе ауруларының әліде «алтын стандарты» болып табылатын диагностикасы рентгендік әдіске негізделген жедел деструктивті пневмонияның клиникалық жағдайы келтірілген. Балалардағы пневмонияның асқынуын диагностикалауда, емдеуде де рентгендік әдіс маңызды рөл атқарады. Пневмония ағымының ауырлығы анемиямен байланысты, ол жиі жедел және созылмалы ауларымен бірге жүреді. Асқынуларды диагностикалауда және патологиялық процестін көлемін анықтау үшін компьютерлік томографияның рөлі көрсетілген. Ауру ағымының ерекшеліктері, клиникасы және даму динамикалары атап өтіледі.

Түйінді сөздер: жедел деструктивті пневмония, плевралық эмпиема, жедел тыныс жетіспеушілігі, анемия.

Bibliographic citation:

Madiyeva M.R., Smagulova D.M., Baibolova A.A. X-ray diagnosis of acute destructive pneumonia in a 1.5-year-old child. Case report // *Nauka i Zdravookhranenie* [Science & Healthcare]. 2022, (Vol.24) 1, pp. 215-219. doi 10.34689/SH.2022.24.1.024

Мадиева М.Р., Смагулова Д.М., Байболова А.А. Рентгенологическая диагностика острой деструктивной пневмонии у ребенка 1,5 года. Клинический случай // *Наука и Здравоохранение*. 2022. 1(Т.24). С. 215-219. doi 10.34689/SH.2022.24.1.024

Мадиева М.Р., Смагулова Д.М., Байболова А.А. 1,5 жастағы баланың жедел деструктивті пневмонияның рентгенологиялық диагностикасы. Клиникалық жағдай // *Ғылым және Денсаулық сақтау*. 2022. 1 (Т.24). Б. 215-219. doi 10.34689/SH.2022.24.1.024

Introduction. Acute destructive pneumonia is one of the most serious diseases in children. The incidence of the destructive forms among all cases of community-acquired pneumonia is up to 10% [9]. It is characterized by a destructive change in the lung tissue and can be caused by various strains of microorganisms. This type of pneumonia and lung abscess are caused by *Streptococcus pneumoniae* and *Staphylococcus aureus* serotypes. Predisposing factors include congenital lung abnormalities, bronchiectasis, neurological disorders, and immunodeficiency [1].

According to official statistics, respiratory diseases are the most common conditions among children and adolescents in Kazakhstan [4]. The worldwide prevalence also remains at a fairly high level [10]. Low treatment effect with disseminated lung destruction leads to the complications, such as pleural effusion or empyema, pneumothorax, lung abscess, bronchopleural fistula [1,8]. Acute pleural empyema is a localized or diffuse inflammation of the visceral and parietal pleura with the accumulation of pus in the pleural cavity, signs of purulent intoxication and often respiratory failure. The severity of the acute pleural empyema in young children makes this disease one of the most serious in pediatrics and pediatric surgery. Diagnosis and treatment of patients with purulent parenchymal and pleural complications of pneumonia remains a challenge, despite state-of-art diagnostic methods (CT, X-ray, ultrasound). In addition, long-term antibiotic treatment with surgical drainage and decortication are necessary [3].

The radiological method plays an important role both in the diagnosis and treatment of complications of pneumonia in children [5]. Plain chest X-Ray (CXR) represents the "gold standard" of imaging in lung diseases, including community-acquired pneumonia [6]. On the other hand, computed tomography (CT) is not the first line method in children with suspected uncomplicated community-acquired pneumonia. CT is used mostly in case of suspected complications or in complex cases for differential diagnosis with another pathological condition. Ultrasonography (US) and magnetic resonance imaging (MRI) also play a role in complicated pneumonias, although to a lesser extent. However, there are limitations for routine use of CT, MRI, and US [6].

Laboratory method is also of particular importance. Thus, in a number of publications the authors noted the association of community-acquired pneumonia with anemia, which is obviously associated with the severity of pneumonia in both children and adults [7]. Anemia, being an individual clinical and hematological syndrome, accompanies a number of acute and chronic diseases, including pneumonia.

In this article, we review the effect of imaging on the primary diagnosis, treatment, and outcomes of pneumonia in young children. We mainly discuss the use of chest x-ray for clinical and investigational purposes, and also provide a briefly discussion of the computed tomography (CT).

Aim: describe the role of the radiological methods in the diagnosis of the acute destructive pneumonia in a 1.5-year-old child.

Methods. A retrospective analysis of the medical history, radiological and laboratory data of a 1.5-year-old girl admitted to the Semey Medical University Hospital with acute severe community-acquired bilateral pneumonia. Complications: left-sided pneumothorax, right-sided sacculated pleurisy. Grade I-II respiratory failure. Grade 3 mixed anemia. Complications: neutrophilic leukemoid reaction.

Historical data: the child was transferred from another clinic, where she underwent inpatient treatment since September 4, 2021 to September 8, 2021 with a diagnosis of bilateral pneumonia complicated by the left-sided non-tension pneumothorax, right-sided pleurisy without effusion (Fig. 1).



Figure 1. Chest X-Ray on admission. Bilateral pneumonia. Left-sided pneumothorax. Right-sided pleuritis.

According to the mother, the child is ill 4 days, the onset was acute with fever, catarrhal signs. The child from the 5th pregnancy. Term delivery at the gestational age of 39 weeks. Birth weight 3050, height 52 cm. She does not receive any dispensary follow-up care. Vaccinations

according to the schedule. History of allergies is not burdened. On September 6, 2021 the child underwent thoracocentesis with Bulau drainage. Due to the severe condition with respiratory distress against the background of intoxication signs she was transferred to the Emergency department of the Semey Medical University Hospital.

Complaints on admission to the Semey Medical University Hospital: cough, shortness of breath, weakness, fever. The condition is severe due to the respiratory failure, intoxication. Fully conscious. Subfebrile body temperature, 37.6°C. Skin and visible mucous membranes are clean, pale, warm, with no signs of cyanosis. Mixed-type shortness of breath. Accessory muscles participate in the act of respiration. Breathing rate 40 per minute. On auscultation: reduced harsh breathing sounds on both sides with moist rales on the right. Heart tones are clear. Heart rate 144 bpm. Bulau drainage function is not impaired.

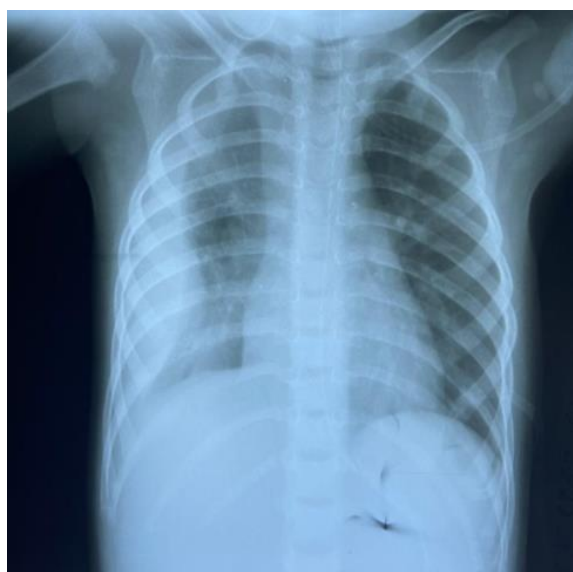


Figure 2. Plain chest X-Ray (September 8, 2021).
Right-sided multisegmental pneumonia.
Right-sided pleuritis (sacculation).



Figure 4. Plain chest X-Ray (September 13, 2021).
Right-sided multisegmental pneumonia with incomplete resolution. Right-sided sacculated pleurisy.

Taking into account the epidemiological situation, PCR tests for COVID were carried out on September 5, 2021 and September 10, 2021 with negative results. Clinical blood test data: neutrophilic leukocytosis with a left formula shift, toxic granularity of white blood cells, increased ESR, anemia (table 1).

Chest X-ray was carried out on September 8, 2021 and September 9, 2021 (Fig. 2, 3).

Based on the radiological data, thoracoscopy was performed on September 9, 2021 under general anesthesia with drainage and sanitation of the right pleural cavity. The postoperative course was uncomplicated.

Pleural exudate test data: neutrophils - 89%; lymphocytes - 11%; white blood cells - 15 per HPF; red blood cells - 30 per HPF; protein - 4.95 g/l; the exudate has hemorrhagic nature.



Figure 3. Lateral chest X-Ray (September 9, 2021).
Right-sided multisegmental pneumonia.
Right-sided pleuritis (sacculation). Pleural empyema?

Considering the severity of the condition, chest X-Ray were carried out on September 13, 2021 and September 16, 2021. Results showed positive changes (Fig. 4, 5).

Although pleural effusion has been diagnosed on radiographs, ultrasound is the method of choice to assess the amount of fluid. Chest ultrasound showed signs of free fluid: 129 ml and 190 ml in the right and left pleural cavities, respectively.

To determine the volume, type of the destructive lesion, its extent and localization in the lung tissue in order to increase the informative value of the X-ray diagnostics of the inflammatory process in the lungs of the child, chest CT with intravenous bolus contrast enhancement was carried out on September 21, 2021.

On the 10th day after the onset, antibiotic sensitivity tests were conducted with the biomaterial from the pharynx, wounds, eyes, ears, urine - no signs flora growth were noted. The control chest X-Ray was carried out on September 30, 2021. Results showed positive changes: right-sided multisegmental pneumonia in the resolution stage. Right lower lobe cavity is sanitized. Pleural adhesions in the right lung. Clinical blood test data of October 4, 2021 - normalization of parameters (table 1).

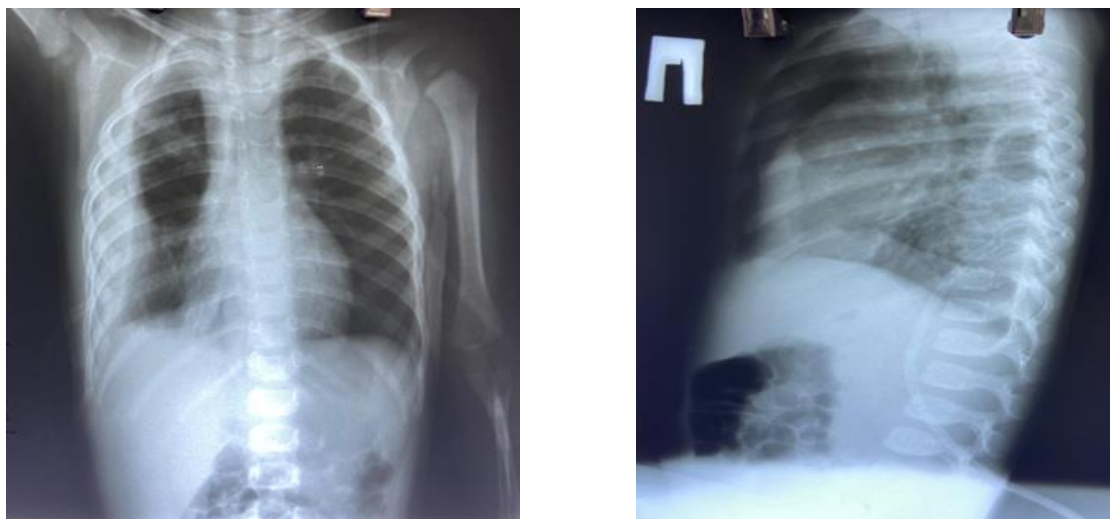


Figure 5. Chest X-ray in two planes (September 16, 2021).
Right-sided multisegmental pneumonia with incomplete resolution. Right-sided sacculated pleurisy.



Figure 6. Chest computed tomography (September 21, 2021).
Multisegmental pneumonia of the S1, S2, S6 segments of the right lung with partially drained abscess in the S6 of the right lower lobe, right-sided paracostal suppurative exudative pleuritis, pleural empyema with compression atelectasis in the basal segments of the right lower lobe, compensatory emphysema of the right middle lobe.

Table 1.

Hematological indicators in the course of inpatient treatment.

No.:	Indicator	September 8, 2021	September 13, 2021	September 16, 2021	September 21, 2021	October 4, 2021
1	White blood cells (WBC)*10 ⁹ /l	33.98	35.6	22.53	11.84	8.37
2	platelets (PLT)*10 ⁹ /l	106	637	720	810	350
3	Red blood cells (RBC) *10 ¹² /l	2.28	2.47	4.01	4.29	3.77
4	hemoglobin (HGB) g/l	68	86	123	126	122
5	hematocrit (HCT) %	20.5	24.7	35.8	41.1	36.2
6	color index	0.89	1.0	0.92	0.88	0.97
7	ESR, mm/h	75	60	40	48	16
8	Lymphocytes, %	6	12	22	16	-
9	Monocytes, %	7	8	6	4	-
10	band neutrophils, %	5	4	5	2	-
11	Segmented neutrophils, %	82	74	67	78	-

Discussion

Acute complicated destructive pneumonia is a severe purulent-septic disease of childhood. The relevance of investigation of the clinical signs of this disease is due to the high prevalence of purulent processes in the lungs and pleura in children of different ages.

Radiological method is widely used in the diagnosis of pneumonia in children and remains the "gold standard". However, the efficacy of the method depends on the clinical course of pneumonia, the experience of the pediatrician, radiologist, and the epidemiology of the disease within the population. X-Ray diagnostics is the most widely used

approach, but its value is limited in mild forms of disease, as well as for prediction of clinical outcomes, and for differential diagnostics between viral and bacterial infections. Other methods such as CT and MRI are more informative, but their value in an uncomplicated disease is questionable. Limitation of the CT is related to the irradiation dose. At the same time, early X-ray and laboratory diagnosis of bacterial destruction of the lungs in children helps to reduce the rate of complications and mortality.

The presented clinical case, describes the development of complications in the form of pleural empyema, compression atelectasis, bronchopulmonary lymphadenopathy (diagnosed based on the CT data) against the background of adequate antibiotic therapy. Pneumonia had a severe and prolonged course, complicated by pleural empyema, as well as hematological disorders with the development of anemia.

There is a number of publications describing a correlation between community-acquired pneumonia and anemia [9, 10, 11]. It was found that anemia was commonly diagnosed even in patients without comorbidities or with mild pneumonia (55% of adults). Moderate and severe anemia (< 10 g/dL) was associated with an increase in 90-day mortality even after successful hospital discharge [7]. In their publications on necrotizing pneumonia in children, the authors also noted anemia, leukocytosis, hypoalbuminemia, and hematological changes, which correlated with changes on CT in 48% of cases [8,2]. In our study, the child had anemia from the moment of hospitalization (hemoglobin level 68 g/l), when bilateral pneumonia with pleural effusion was diagnosed based on the CXR data. In the course of treatment of pneumonia, a gradual normalization of radiological and hematological parameters was noted, the hemoglobin level have increased to 123 g/l on the 8th day of disease. Anemia in the child have developed with the onset of the underlying disease, since the blood tests data in the outpatient medical record before the disease show normal hemoglobin level and red blood cell count (red blood cells - $3.62 \times 10^{12}/l$, hemoglobin - 118 g/l). Anemia, leukocytosis and thrombocytosis in the acute phase indicate the immunological protective function of the bone marrow against the infection, i.e. changes with a trend towards leuko- and thrombopoiesis to the detriment of the maturation of erythroblasts leading to anemia (Table 1). At the end of the inpatient treatment, the child is discharged with clinical improvement and residual inflammatory signs on radiographs, as well as normalization of hematological parameters.

Conclusion. The radiological method for the diagnosis of pneumonia is still relevant. Chest CT is superior to the X-Ray, and the risks of irradiation should be weighed against

the benefits for the pediatrician for timely and accurate diagnosis. CT is indicated for diagnosing complications of pneumonia when treatment is ineffective, and when standard chest x-ray and ultrasound of the pleural cavities are "questionable". Pneumonia-associated anemia has an "inflammatory" cause, as evidenced by the normalization of hemoglobin and red blood cell count after recovery.

References:

1. Bradley J.S., Byington C.L., Shah S.S. et al. Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America // *Clin Infect Dis*. 2011. 53(7):e25–76.
2. de Benedictis F.M., Kerem E., Anne B., Chang A.B. et al. Complicated pneumonia in children // *Lancet*. 2020. 396(10253):786–798. doi: 10.1016/S0140-6736(20)31550-6.
3. Islam S., Calkins C.M., Goldin A.B. The diagnosis and management of empyema in children: a comprehensive review from the APSA outcomes and clinical trial committee // *J. Pediatr. Surg.* 2012. 47:2101–10. doi: 10.1016/j.jpedsurg.2012.07.047
4. Kulmanova N.K., Donobaeva B.K., Moldakulova G.M. Health of adolescents and youth as a public value of Kazakhstan. (Analytical report on the family state in Kazakhstan). Almaty, 2009. p. 48.
5. Kurian J., Levin T.L., Han B.K. et al. Comparison of ultrasound and CT in the evaluation of pneumonia complicated by parapneumonic effusion in children // *Am J Roentgenol*. 2009. 193:1648–1654. DOI:10.2214/AJR.09.2791.
6. O'Grady K.A., Torzillo P.J., Kieran Frawley K., Chang A.B. The radiological diagnosis of pneumonia in children // *Pneumonia*. 2014. 5(Suppl 1):38–51. doi:10.15172/pneu.2014.5/482.
7. Reade M.C., Weissfeld L., Angus D.C. et al. The prevalence of anemia and its correlation with 90-day mortality in hospitalized community-acquired pneumonia. *BMC Pulm. Med*. 2010; 10:15. doi: 10.1186/1471-2466-10-15.
8. Sawicki G.S., Lu F.L., Valim C., et al. Necrotising pneumonia is an increasingly detected complication of pneumonia in children // *European Respiratory Journal*. 2008. 31:1285–1291. DOI:10.1183/09031936.00099807
9. Spencer D.A., Thomas M.F. Necrotising pneumonia in children // *Paediatr Respir Rev*. 2014. 15(3):240–5. doi: 10.1016/j.prrv.2013.10.001.
10. Walker C.L., Rudan I., Liu L., Nair H., Theodoratou E., Bhutta Z.A., et al. Global burden of childhood pneumonia and diarrhoea // *Lancet*. 2013. 381(9875):1405–16.

Corresponding Author:

Madiyeva Madina – PhD, MD, ass. Professor, Head of the Department of Radiology, NCJSC «Semey Medical University», Semey city, Republic of Kazakhstan.

Mailing Address: 071412, Republic of Kazakhstan, Semey city, Karmenova st. 61-3.

E-mail: m.madiyeva@mail.ru; madina.madiyeva@nao-mus.kz

Phone: 87085244745