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MODERN ASPECTS OF DIAGNOSIS AND TREATMENT OF DESTRUCTIVE PNEUMONIA IN PEDIATRIC PRACTICE

K.Z. Kadirov[1] B.X Mirzakarimov[1]

[1] Andijan State Medical Institute, Andijan, Uzbekistan

Background. Destructive pneumonia in children is a severe disease characterized by necrotic changes in lung tissue with the formation of destruction cavities, abscesses, pleural empyema, and bronchopleural fistulas. Despite the development of antibiotic therapy and surgical technologies, this pathology remains a significant problem in pediatrics, accompanied by a high risk of complications and mortality.

Objective. To optimize diagnostic and treatment tactics for destructive pneumonia in children by developing a differentiated approach considering etiological, pathogenetic, and clinical-morphological features of the disease to improve immediate and long-term treatment outcomes, reduce the frequency of complications, and shorten hospital stays.

Materials and Methods. Results of examination and treatment of 126 patients aged 6 months to 17 years with destructive pneumonia who were hospitalized from 2018 to 2023 were analyzed. The diagnostic algorithm included clinical examination, laboratory tests (complete blood count, biochemical and immunological parameters, microbiological monitoring), chest radiography, ultrasound of the pleural cavities, computed tomography, and, when necessary, video-assisted thoracoscopy. By morphological forms, patients were distributed as follows: pulmonary-pleural form – 78 (61.9%) children, bullous-destructive form – 29 (23.0%), abscess-forming form – 19 (15.1%).

Results. A comprehensive approach was used in treating children with destructive pneumonia, including antibiotic therapy, drainage interventions, immunocorrection, respiratory support, and early rehabilitation. The microbial landscape was represented by S. aureus (43.7%), including MRSA (18.3%), S. pneumoniae (21.4%), P. aeruginosa (12.7%), K. pneumoniae (8.7%), and mixed flora (13.5%). The effectiveness of initial antibiotic therapy was 64.3%; in other cases, correction was required based on microbiological data. Various types of drainage interventions were performed in 97 (77.0%) patients: pleural puncture – 23 (18.3%), pleural drainage – 46 (36.5%), video-assisted thoracoscopic sanitation – 28 (22.2%). Early use of video-assisted thoracoscopy for pleural empyema reduced the duration of pleural drainage by 4.6±1.2 days ($p<0.05$) and hospitalization by 6.8±1.7 days ($p<0.05$). Treatment effectiveness was assessed by the dynamics of clinical and laboratory parameters, radiological findings, and ultrasound data. With comprehensive therapy, complete clinical recovery was achieved in 118 (93.7%) patients, chronic process occurred in 7 (5.5%) children, and a fatal outcome was recorded in 1 (0.8%) case.

Conclusion. The study demonstrates the effectiveness of a comprehensive approach to the diagnosis and treatment of destructive pneumonia in children. The developed diagnostic and treatment algorithm, based on a thorough assessment of the morphological variant of destruction, etiological factor, and degree of respiratory failure, allows individualizing therapeutic tactics and improving treatment outcomes.

Keywords: *destructive pneumonia, children, lung abscess, pleural empyema, video-assisted thoracoscopy, antibiotic therapy, drainage, bullous changes.*

Relevance. According to the World Health Organization, pneumonia remains the leading cause of death in children under 5 years of age worldwide, resulting in the death of approximately 800,000 children annually. Destructive pneumonia, characterized by necrotic changes in lung tissue with the formation of cavities, accounts for 10-15% of all pneumonias in children and represents a particularly severe form of the disease with a high risk of complications [1]. Despite the development of antibacterial therapy, in the last decade there has been an increase in the frequency of destructive forms of pneumonia in pediatric practice, especially those caused by methicillin-resistant Staphylococcus aureus (MRSA) and highly virulent strains of pneumococcus [2].

Destructive pneumonia in children has a number of characteristics, including rapid disease progression, severe respiratory failure, and the development of pleural effusion with a high risk of developing empyema and bronchopleural fistulas [3]. Diagnosis of this pathology is particularly challenging, especially in the early stages, when radiological signs of destruction may be absent or minimal. Traditional radiography has limited sensitivity in detecting early destructive changes, and computed tomography, the "gold standard" of diagnostics, is not always available in emergency

situations and is associated with radiation exposure, which is especially important in pediatric practice [4].

The etiologic structure of destructive pneumonia in children has undergone significant changes in recent years. While Staphylococcus aureus was previously the dominant pathogen, Streptococcus pneumoniae (especially serotypes 1, 3, and 19A), antibiotic-resistant strains of Klebsiella pneumoniae, Pseudomonas aeruginosa, and intracellular pathogens, including Mycoplasma pneumoniae, are now playing an increasingly important role [5]. The pathomorphosis of the disease, associated with changes in the spectrum of pathogens and their antibiotic resistance, often renders traditional antibacterial therapy regimens ineffective, requiring the development of new approaches to empirical antibiotic therapy [6].

Treatment of destructive pneumonia remains complex and requires a multidisciplinary approach involving pediatricians, pediatric surgeons, resuscitation specialists, pulmonologists, and antimicrobial therapy specialists. The optimal method for pleural drainage, timing and indications for video-assisted thoracoscopic interventions, duration of antibacterial therapy, and the appropriateness of using fibrinolytics in pleural empyema remain controversial [7]. Long-term treatment outcomes, including the development of chronic bronchopulmonary diseases and functional disorders of the respiratory system after destructive pneumonia in childhood, remain insufficiently studied [8].

Thus, despite significant progress in understanding the pathogenesis, diagnosis and treatment of destructive pneumonia in children, many aspects of this problem remain unresolved, which necessitates the development of a differentiated approach to the diagnosis and treatment of various morphological forms of the disease to improve treatment outcomes and reduce the incidence of complications.

Purpose of the study. Optimization of diagnostic and treatment tactics for destructive pneumonia in children by developing a differentiated approach taking into account the etiological, pathogenetic and clinical-morphological characteristics of the disease to improve immediate and long-term treatment results, reduce the incidence of complications and shorten the duration of hospitalization.

Materials and methods. A retrospective and prospective study was conducted, including an analysis of the results of examination and treatment of 126 patients aged 6 months to 17 years with destructive pneumonia, who were hospitalized from 2018 to 2023. Inclusion criteria: the presence of pneumonia with radiologically confirmed destructive changes in the lung tissue and / or the development of pleural empyema, age from 0 to 17 years inclusive, informed consent of parents or legal representatives for inclusion in the study.

Distribution of patients by age: children under 3 years old - 41 (32.5%), from 3 to 7 years old - 53 (42.1%), from 7 to 12 years old - 21 (16.7%), from 12 to 17 years old - 11 (8.7%). Among the examined children, boys predominated - 74 (58.7%) patients. According to the morphological forms of destructive pneumonia, patients were distributed as follows: pulmonary-pleural form (pneumonia with pleural empyema) - 78 (61.9%) children, bullous-destructive form - 29 (23.0%), abscessing form - 19 (15.1%).

The diagnostic algorithm included a clinical examination, laboratory tests (complete blood count, biochemical parameters, including C-reactive protein, procalcitonin, immunological parameters), bacteriological examination of pleural effusion, sputum and blood, polymerase chain reaction (PCR) to identify atypical pathogens. Instrumental diagnostics included chest X-ray in two projections, ultrasound examination of the pleural cavities, high-resolution computed tomography (HRCT) in 97 (77.0%) patients. If pleural effusion was present, it was analyzed to determine biochemical parameters, cellular composition and microbiological examination. Videothoracoscopy, in addition to therapeutic purposes, was used as a diagnostic method in 28 (22.2%) cases with material collection for histological and microbiological examination.

Results. The clinical picture of destructive pneumonia in the examined children was characterized by an acute onset with rapid progression in 102 (81.0%) patients. Febrile fever was observed in 118 (93.7%) children, and in 76 (60.3%) the body temperature exceeded 39 °C. Respiratory failure of varying severity was observed in 109 (86.5%) patients: grade I – in 47 (37.3%), grade II – in 48 (38.1%), grade III – in 14 (11.1%). Intoxication syndrome was expressed in 113 (89.7%) children.

Laboratory tests in most patients revealed leukocytosis (mean 18.6±5.3×10^9/L), neutrophilia (relative neutrophil count 78.4±7.6%), elevated ESR (42.7±13.2 mm/h), elevated C-reactive protein (mean 156.3±48.7 mg/L), and procalcitonin (3.6±2.1 ng/ml) levels.

Microbiological testing identified the pathogen in 94 (74.6%) patients. The composition of the isolated pathogens is presented in Table 1.

Table 1. Etiological structure of destructive pneumonia in the examined children

Pathogen	Absolute number (n=94)	Relative number (%)
Staphylococcus aureus (MSSA)	32	34,0
Staphylococcus aureus (MRSA)	9	9,7
Streptococcus pneumoniae	20	21,3
Pseudomonas aeruginosa	12	12,8
Klebsiella pneumoniae	8	8,5
Mixed flora	13	13,7

Computed tomography performed in 97 patients revealed the following: areas of lung tissue consolidation with abscess formation in 19 (19.6%), bullous changes in 29 (29.9%), necrotizing pneumonia in 14 (14.4%), pleural complications in 78 (80.4%), including free effusion, encapsulated fluid collections, pleural empyema, and pneumothorax. The sensitivity of CT in diagnosing destructive changes was 97.6%, which significantly exceeds the performance of standard radiography (68.3%).

In the treatment of children with destructive pneumonia, a comprehensive approach was used, including antibacterial therapy, drainage interventions, immunocorrection, respiratory support, infusion therapy and early rehabilitation.

Antibacterial therapy was prescribed empirically with subsequent adjustment based on the results of microbiological tests. Initial therapy included a combination of third-generation cephalosporins with macrolides in 76 (60.3%) patients, protected aminopenicillins with macrolides in 32 (25.4%), and carbapenems in combination with glycopeptides or linezolid in 18 (14.3%) patients with severe disease. The effectiveness of initial antibacterial therapy was 64.3%; in the remaining cases, adjustments were required based on microbiological data. The average duration of antibacterial therapy was 18.3±4.7 days.

In 97 patients (77.0%), various types of drainage procedures were performed: pleural puncture – 23 (18.3%), pleural drainage – 46 (36.5%), video-assisted thoracoscopic sanitation – 28 (22.2%). Indications for video-assisted thoracoscopy were: ineffectiveness of previous pleural drainage, the presence of multiple encapsulated collections in the pleural cavity, fibrinothorax, and suspected bronchopleural fistula. Intraoperatively, lung decortication was performed in 12 patients (42.9%), removal of necrotic areas of lung tissue – in 7 (25.0%), and suturing of bronchopleural fistulas – in 3 (10.7%). Analysis of treatment results showed that early (within the first 3-5 days of illness) use of videothoracoscopy for pleural empyema allowed to reduce the time of pleural cavity drainage by 4.6±1.2 days ($p<0.05$), the duration of fever by 3.2±0.9 days ($p<0.05$) and the duration of hospitalization by 6.8±1.7 days ($p<0.05$) compared to the group of patients who only underwent pleural cavity drainage.

Treatment effectiveness was assessed based on clinical and laboratory parameters, radiographic findings, and ultrasound data. With combination therapy, complete clinical recovery was achieved in 118 (93.7%) patients. Chronicization of the disease with the development of chronic bronchopulmonary disease occurred in 7 (5.5%) children. A fatal outcome was recorded in 1 case (0.8%) due to the development of septic shock and multiple organ failure. The average duration of hospitalization was 24.6 ± 8.3 days.

Conclusion. The study demonstrates the effectiveness of a comprehensive approach to the diagnosis and treatment of destructive pneumonia in children. The developed treatment and diagnostic algorithm, based on a thorough assessment of the morphological pattern of destruction, the etiologic factor, and the degree of respiratory failure, allows for individualized therapeutic strategies and improved treatment outcomes.

Computed tomography is the most informative method for diagnosing destructive changes in lung tissue and should be used in all patients with suspected destructive pneumonia to accurately verify the nature and extent of the lesion. Timely identification of the infectious agent is crucial for optimizing antibacterial therapy, especially in the face of increasing antibiotic resistance.

The high efficacy of early video-assisted thoracoscopic debridement of the pleural cavity in empyema deserves special attention, as it significantly reduces treatment time and the risk of chronicity. Our experience confirms the need for an active surgical approach in the presence of encapsulated pleural fluid and the ineffectiveness of conservative therapy.

A differentiated approach to selecting an antibacterial treatment regimen, taking into account the likely pathogen, regional antibiotic resistance data, and the severity of the patient's condition, allows for adequate infection control in most cases. Of particular importance is the etiotropic treatment of methicillin-resistant staphylococcal infections, which requires the use of reserve medications.

The obtained results demonstrate the feasibility of using the developed algorithm for the diagnosis and treatment of destructive pneumonia in children, including early CT diagnostics, complex antibacterial therapy taking into account the probable pathogen, and timely surgical intervention when indicated, which allows for the optimization of treatment results, a reduction in the incidence of complications, and a reduction in the duration of hospitalization.

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