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Research Article

Features of Community-acquired Pneumonia in Children with Children's Cerebral Paralysis

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Abstract

Purpose: To investigate the features of the clinical course and treatment tactics for community-acquired pneumonia (CAP) in children with cerebral palsy (CP).

Materials and Methods: The analysis of clinical, radiological, laboratory parameters and treatment tactics was carried out in two groups: 56 children with CAP on the background of cerebral palsy and 100 children with CAP without neurological pathology at the age from 0 to 14 years.

Results: Children with cerebral palsy were more likely to have recurrent pneumonia. In cerebral palsy, CAP was more often bilateral, proceeded with prolonged manifestations of bronchitis and bronchial obstruction, problems with sputum discharge, more pronounced respiratory failure, which more often required intensive therapy, including artificial ventilation of the lungs, repeated courses of antibiotic therapy, and longer hospitalization. A significant role of *Streptococcus pneumoniae* in CAP in children with cerebral palsy has been established.

Conclusion: The revealed features determine the need to actively use in the treatment of children with cerebral palsy with community-acquired pneumonia (CAP), medication and non-medication methods of sanitation of the bronchial tree and bronchodilators. The tendency to develop community-acquired pneumonia (CAP) and its more severe course confirms the relevance of compulsory pneumococcal vaccination of children with cerebral palsy.

Keywords: Community-acquired Pneumonia; Cerebral Palsy; Children

Relevance

The last decades have been characterized by an increase in the prevalence of perinatal pathology of the central nervous system. In its structure, a special place is occupied by infantile cerebral palsy (cerebral palsy) - disorders of motor function and posture caused by a static defect or damage to an immature brain [1]. The prevalence of this pathology in countries with a sufficiently developed perinatal disease ranges from 0.76 to 5.8 per 1000 live newborns. According to statistical reporting in Kazakhstan, the number of children with cerebral palsy shows from 3.5 to 6.4 per 1000 children under 5 years old with an upward trend. A characteristic feature of brain lesions in children is their pathogenetic relationship with various comorbid pathologies, including bronchopulmonary diseases.

The tendency to develop acute diseases of the lower respiratory tract, primarily pneumonia, is determined by a number of factors that are associated with cerebral palsy. Children with cerebral palsy have hypoventilation, weakening of the cough reflex, dysphagia, frequent aspiration, secondary immunodeficiency states, severe protein-energy deficiency, antibiotic resistance of pathogenic microorganisms [1-3]. This category of patients has a special predisposition to pneumonia with an atypical, protracted course, significant respiratory disorders [4]. We have previously proved the role of diaphragm dysfunction in the pathogenesis of respiratory disorders in children with cerebral palsy [5].

Acute respiratory failure in patients with cerebral palsy associated with a respiratory infection is the most common cause of unplanned hospitalization, sometimes with an unfavorable outcome for life [2].

In the structure of deaths with respiratory diseases, patients with neuromuscular disorders account for 15%, which is significantly more than the proportion of these patients in the structure of the child population as a whole [6]. This indicates a significant negative "contribution" of these diseases to the development of death when the immediate cause of fatality is precisely respiratory pathology. Therefore, knowledge of the features of acute bronchopulmonary diseases in children with infantile cerebral palsy (CP), both in terms of clinical features of the course and treatment of these patients, is relevant to improve the quality of medical care for these patients.

Purpose of the Study

To study the features of the clinical course and treatment tactics in community-acquired pneumonia in children with cerebral palsy.

Materials and Methods

A prospective cohort continuous (solid) comparative study included 56 children with community-acquired pneumonia associated with cerebral palsy (group 1 - main) and 100 children with community-acquired pneumonia without cerebral palsy (group 2 - comparison group) aged 0 to 14 years treatment in the city children's clinical hospital No. 2 in Astana in 2013-2017. Group 1 included patients with different forms of cerebral palsy: spastic diplegia - in 35 (62.5%), hyperkinetic - in 7 (12.5%), hemiparetic form - in 5 (8.9%), double hemiplegia - 5 (8.9%), atonic-astatic - in 4 (7.2%) patients. Severe forms of cerebral palsy were predominant (in 40 patients - 71.4%): double hemiplegia with spastic tetraparesis and severe muscle hypertension; atonic-astatic with low muscle tone and damage to the cortical-subcortical connections; hyperkinetic with hyperkinesis (athetosis, choreoathetosis, torsion dystonia). The diagnosis of pneumonia was based on clinical, radiological and laboratory data in accordance with the criteria presented in the updated version of the Working Classification of Bronchopulmonary Diseases in Children [7] and the Clinical Guidelines of the Pediatric Respiratory Society [8].

Anamnestic and clinical indicators of the disease, chest x-ray data and laboratory studies were subjected to comparative analysis. Fibrobronchoscopy was performed in 37 children of the 1st group (66.1%) and 46 children in the comparison group (46.0%). In all these cases, a bacteriological study and PCR diagnostics for respiratory viruses of the washing water of the bronchial tree were carried out.

Mathematical processing of the material when comparing the average trends in the compared samples was carried out by the Mann-Whitney method, comparing the specific gravity (frequency) of a feature in two independent samples - by the Fisher angular transformation method [9]. At the same time, the average statistical characteristics of the samples were presented as the median (Me) and interquartile range (Q1 - Q3), the structure of the samples - in percent. Differences were considered statistically significant at $p < 0.05$.

Results and its Discussion

The distribution of patients by gender in both groups was characterized by the predominance of males (in group 1, boys 58.9%, girls - 41.1%; in group 2 - 62.0% and 38.0%, respectively) in the absence of statistically significant intergroup differences ($p > 0.05$). The average age of patients in the first group was 5 (2-9), in the second - 4 (1-10) years, which had no statistically significant differences ($p > 0.05$).

The age structure of patients without cerebral palsy reflects the more frequent incidence of pneumonia in young children [8]. At the same time, in the group of children with cerebral palsy, the proportion of patients over 3 years of age turned out to be statistically significantly higher than in the comparison group (Table 1), which can be associated with a tendency to develop acute bronchopulmonary pathology in children with organic lesions of the central nervous system. all age groups.

Comparison groups	Age Возраст					
	Up to 1 year		From 1 to 3 years		Over 3 years	
	abs.	%	abs.	%	abs.	%
1st group	8	14,2	17	30,4	31	55,4
2nd group	17	17,0	49	49,0	34	34,0
p	> 0,05		< 0,05		< 0,01	

Table 1

Note. In tables 1 - 4: 1st group - children with pneumonia and cerebral palsy; Group 2 - children with pneumonia without organic lesions of the central nervous system.

The average age of the mother at childbirth in the first group was 27 (22-32), in the second - 28 (21-33) years ($p > 0.05$). The mother's age over 35 years in the first group was recorded in 19.6% of cases, in the second group - in 17.0% ($p > 0.05$). Mother's tobacco smoking was registered in the first group in 12.5%, in the second - in 12.0% of cases ($p > 0.05$).

Acute and chronic extragenital diseases during pregnancy were statistically significantly more frequent in the first group than in the second (44.6% and 28.0%, respectively; $p < 0.05$), as well as taking medications (28.6% and 11.0%, respectively; $p < 0.05$). The same pattern was observed in the frequency of occurrence of pregnancy pathology (early and late gestosis): in the first group in 89.3% of cases, in the second - in 21.0% ($p < 0.01$). Complicated course of the intrapartum period or pathology of the neonatal period was also significantly more common in children with cerebral palsy than in the comparison group (48.2% and 23.0%, respectively; $p < 0.01$). The established patterns can be associated with the direct influence of these factors on the formation of perinatal pathology of the central nervous system [1].

The proportion of vaccinated children in accordance with the National Calendar of the Republic of Kazakhstan in the first group was statistically significantly less than in children without cerebral palsy (67.8% and 89.0%, respectively; $p < 0.01$), which was associated with a higher frequency medical leads in children with perinatal pathology. Children with cerebral palsy were more likely to have anemia (62.5% versus 40.0% in the second group, $p < 0.01$), while atopy and food allergies did not have statistically significant differences in frequency (12.5% in the first group and 15.0% - in the second; $p > 0.05$).

Previously transferred pneumonia was registered more often in children of the first group (33.9% and 14.0%, respectively; $p < 0.01$). This case of pneumonia was the second in 21.4% of children with cerebral palsy and in 10.0% - without cerebral palsy ($p < 0.05$), the third case was 12.5% and 4.00% ($p < 0.05$), respectively. At the same time, pneumonia transferred in the first year of life was registered in 23.2% of cases in the first group and in 12.0% in the second ($p < 0.05$). The established pattern reflects the tendency to develop pneumonia in children with cerebral palsy, which is consistent with the literature data [2-5].

When analyzing the nature of the course of community-acquired pneumonia in the compared groups, there was no increase in temperature upon admission to the hospital in the first group in 8.90% and in 13.0% in the second, subfebrile temperature - in 41.1% and 45.0%, febrile - in 50.0% and 42.0%, respectively, without statistically significant differences between the compared groups ($p > 0.05$). Intoxication syndrome in the form of lethargy, weakness, irritability was noted in children with cerebral palsy in 89.3% of cases, without cerebral palsy - in 76.0% ($p > 0.05$).

Cough was a constant symptom in all children of both groups. However, paroxysmal obsessive cough was more often recorded in patients with cerebral palsy (76.8% and 57.0%, respectively; $p < 0.01$), as well as distant wheezing (96.4% and 34%, respectively; $p < 0, 01$). Difficulty in excreting sputum with a wet cough, which required the appointment of medication (mucolytics and mucokinetics) and physical (vibration massage) methods of liquefying and stimulating sputum discharge, was also more typical for patients of the first group (67.8% and 29.0%, respectively; $p < 0.01$). This can be associated with a weakening of the cough reflex in patients with cerebral palsy [2,3].

The frequency of occurrence of various types of local physical symptoms did not have statistically significant differences in the compared groups (group 1 - 87.5%; group 2 - and 88.0%; $p > 0.05$), however, in the group of patients with Cerebral palsy was more often recorded a local weakening of breathing over the lesion (group 1 - 67.5%; group 2 - and 40.0%; $p < 0.01$). Wheezing was more often recorded in children with cerebral palsy than in the comparison group (96.4% and 69.0%, respectively; $p < 0.01$).

Moreover, persistent wet wheezing lasting more than 7 days from the moment of their registration was also more often noted in the first group of patients (60.7% and 40.0%, respectively; $p < 0.05$).

As you know, broncho-obstructive syndrome is not typical for pneumonia [13]. However, in the first group, it was registered statistically significantly more often (23.2% and 8.0%, respectively; $p < 0.01$). It can be assumed that pneumonia develops more frequently in children with acute obstructive bronchitis in the presence of cerebral palsy.

The data in table 2 indicate a longer cough and wet wheezing in the group of children with cerebral palsy, which can be associated with a tendency characteristic of children with this pathology to make it difficult to evacuate sputum due to the complex of the above reasons and, consequently, a longer course of the inflammatory process in the form of perifocal or diffuse bronchitis [2-5]. Children with cerebral palsy were statistically significantly more likely to have a secondary "wave" of fever, which may reflect a tendency to reinfection in a hospital setting, which is more characteristic of patients with organic lesions of the central nervous system.

Indicators	1st Group n = 56	2nd Group n = 100	p
Specific gravity in % of patients with prolonged fever (more than 5 days from admission)	8,9	4,00	> 0,05
Specific gravity in% of patients with repeated “wave” of fever	12,5	4,00	< 0,05
Duration in days of cough: Me (Q1-Q3)	9(5-10)	6(4-8)	< 0,05
Duration in days of local symptomatology: Me (Q1-Q3)	6(5-8)	5(4-7)	> 0,05
Duration in days of wheezing: Me (Q1-Q3)	8(4-10)	6(3-9)	< 0,05

Table 2: Duration of the main clinical symptoms of pneumonia in children of the compared groups.

The X-ray characteristics of pneumonia presented in table 3 indicate the prevalence of bilateral lung lesions in the group with cerebral palsy. There were no statistically significant differences in the structure of pneumonia forms in the compared groups ($p > 0.05$).

The severity of community-acquired pneumonia in children with cerebral palsy was more often than in the comparison group aggravated by gastroesophageal reflux with microaspiration, vomiting (21.4% and 4.00%, respectively; $p < 0.01$), dysphagia (37.5% and 0, 00%, respectively). Convulsive syndrome was statistically significantly more frequent in the first group (8.9% and 3.00%, respectively; $p < 0.05$). This reflects a greater tendency to convulsive reactions in children with organic lesions of the central nervous system under the influence of toxic-hypoxic factors [1]. Protein-energy deficiency, aggravating the course of the disease, was revealed only among children with cerebral palsy - in 26.8% of cases.

In children with cerebral palsy, pneumonia often proceeded with more pronounced respiratory failure (DN). Patients without DN in the first group were 8.90%, in the second - 33.0% ($p < 0.05$), with DN-1 44.7%, and 44.0%, respectively ($p > 0.01$), with DN-2 - 32.1% and 20.0%, respectively ($p < 0.05$), with DN-3 - 14.3% and 3.0%, respectively ($p < 0.05$). Pulse oximetry was performed upon admission to the hospital for 53 children of the first group and 88 children of the second group. At the same time, lower oxygen saturation indices were recorded in children with cerebral palsy: 89 (86-95)% and 94 (90-97)%, respectively ($p < 0.05$).

All patients with a severe course of community-acquired pneumonia underwent the stage of treatment in the intensive care unit (ICU), where patients with cerebral palsy were hospitalized more often - 32.1% of patients in the first group and 12.0% in the second group ($p < 0.01$). Moreover, all 18 children with cerebral palsy who were in the ICU required intensive therapy in this department for more than 3 days, while in the comparison group 9 out of 12 (75.0%) patients needed this duration ($p < 0.01$). Artificial ventilation (ALV) was required in 14.3% of children with cerebral palsy and 5.00% of patients without organic lesions of the central nervous system ($p < 0.05$). The indications for transfer to mechanical ventilation were DN-3, difficult to stop convulsive syndrome (true and febrile convulsions) and hypoxic cerebral edema. In ICU patients with cerebral palsy, more pronounced and more persistent changes in blood gas composition and acid-base state were recorded: hypoxemia and hypercapnia, gas acidosis.

Pleural complications occurred in the first group in 10.7%, in the second - in 10.0% of patients ($p > 0.05$). Synpneumonic pleu-

Comparison groups	Localization						Form of pneumonia							
	Bilateral		Right-sided		Left-sided		Focal		Segmental, polysegmental		Drain		Lobe	
	abs	%	abs	%	abs	%	abs	%	abs	%	abs	%	abs	%
1st group (n = 56)	0	1,5	1	9,6	5	8,9	43	6,8	0	7,8	3	5,4	0	0,0
2nd group (n = 100)	48	8,0	38	8,0	4	4,0	73	73,0	19	19,0	6	6,0	2	2,0
P	< 0,01		< 0,01		> 0,05		> 0,05		> 0,05		> 0,05		> 0,05	

Table 3: X-ray characteristics of pneumonia in the compared groups.

risy in children with pneumonia and cerebral palsy was diagnosed in 3.56% of cases, metapneumonic - in 7.14%. The corresponding figures in children of the second group were 3.00% and 7.00%, which did not have statistically significant differences with the first group ($p > 0.05$).

It should be noted that the disease with pneumonia aggravated the course of cerebral palsy and led to an exacerbation of neurological symptoms.

Pneumonia was the most difficult in the atonic-astatic form of cerebral palsy. The severity of neurological symptoms was characterized by the severity of the labyrinthine-tonic reflex, a sharp increase in hyperkinesis, and an exacerbation of convulsive syndrome.

In children of both groups, upon admission, in the absolute majority of cases, neutrophilic leukocytosis was recorded (group 1 - 85.7%, group 2 - 91.0%, $p > 0.05$), a shift to the left to young forms was noted in 21, 4% in children of the 1st group and 25.0% in the second ($p > 0.05$), toxic granularity of neutrophils - in 14.3% and 15.0%, respectively ($p > 0.05$).

Fibrobronchoscopy was performed in 37 children of the first group and 46 children in the second group (66.1% and 46.0%, respectively, $p < 0.01$). Bilateral endobronchitis in the structure of all patients with cerebral palsy who underwent this study was documented in 70.3%, right-sided - in 18.9%, left-sided - in 10.8% of cases. In the second group, these figures were, respectively, 65.2%, 21.7% and 13.0% without statistically significant differences from the first group ($p > 0.05$). Moreover, in children with cerebral palsy, the structure of endobronchitis was represented by a catarrhal form in 24.3% of cases, mucopurulent - in 75.7% of cases. In the second group, these figures were 67.4% and 32.6%, respectively. Thus, in pneumonia with cerebral palsy, the purulent component of inflammation of the mucous membrane of the bronchial tree was statistically more frequent ($p < 0.01$).

The results of bacteriological research and PCR diagnostics of the washing water of the bronchial tree are presented in table 4, from which it follows that *Streptococcus pneumoniae* occupies an important place in the structure of etiologically significant bacterial pathogens of pneumonia in children with cerebral palsy, moreover, with a higher frequency than in the comparison group ($p < 0.05$). Other bacterial pathogens (*Streptococcus pyogenes, Streptococcus viridans, Haemophilus influenza, Haemophilus influenza, Acinetobacter, Enterobacter*) were found much more rarely and with approximately the same frequency in the compared groups ($p > 0.05$). DNA of rhinovirus and respiratory syncytial virus was statistically significantly more often detected in bronchial washings of children with pneumonia without cerebral palsy ($p < 0.05$). As you know, pneumonia is often preceded by a viral respiratory infection, which contributes to the violation of the local immunity of the bronchial mucosa, mucociliary clearance and, consequently, the easier spread of bacterial infection to the terminal bronchioles and alveoli [8]. Patients with cerebral palsy initially have unfavorable factors characteristic of this pathology that contribute to the pri-

mary bacterial contamination of the lower respiratory tract with the development of bacterial inflammation even without a previous viral respiratory infection: microaspiration, hypoventilation of the lungs, diaphragm dysfunction, weakness of the respiratory muscles, general hypokinesia [2-5].

Pathogens	1st group (n = 37)		2nd group (n = 46)		p
	Abs.	%	abs	%	
Pathogen detected	25	67,6	39	84,8	< 0,05
Including					
Rhinovirus	2	8,0	8	20,5	< 0,05
Respiratory syncytial virus	3	12,0	7	17,9	> 0,05
Adenovirus	2	8,0	0	0,0	–
Streptococcus pneumonia	13	52,0	11	28,2	< 0,05
Streptococcus pyogenes	0	0,0	3	7,7	–
Streptococcus viridans	0	0,0	1	2,6	–
Haemophilus influenzae	1	4,0	3	7,7	> 0,05
Acinetobacter	2	8,0	5	12,8	> 0,05
Enterobacter	2	8,0	2	5,1	> 0,05

Table 4: Characteristics of the causative agents of community -acquired pneumonia in children of the compared groups according to the study of the lavage water of the bronchial tree (abs./%).

Antibiotics were administered to all children with pneumonia in both groups. At the same time, the need for a second course of antibiotic therapy occurred statistically significantly more often in the group of patients with cerebral palsy: in 23.2% of cases versus 11.0% in the comparison group ($p < 0.05$). Mucolytics and/or mucokinetics were prescribed to children with pneumonia in both groups. However, patients of the first group statistically significantly more often than the comparison group used a combination of these drugs (ambroxol in age-related doses by mouth and/or inhalation using a compressor nebulizer): in 37.5% and 9.0% of cases, respectively, ($p < 0.01$). For patients with cerebral palsy, vibration massage was more often used to improve the drainage of the bronchial tree: in 82.1% of cases in the first group and in 25.0% in the second ($p < 0.01$). Due to the more frequent diagnosis of broncho-obstructive syndrome in pneumonia, children of the first group were statistically significantly more likely to receive bronchodilators (salbutamol or fenoterol + ipratropium bromide in age-specific doses) using a compressor nebulizer: in 23.2% of cases with pneumonia with cerebral palsy and 8.0% patients of the second group ($p < 0.01$).

In general, the duration of hospital stay in patients with pneumonia and cerebral palsy was statistically significantly longer than in patients with pneumonia without organic lesions of the central nervous system: 9 (7 - 10) and 6 (5 - 7) bed-days, respectively ($p < 0,05$).

Conclusion

The results of the study allow us to conclude about the tendency of children with cerebral palsy to develop pneumonia, as well as the presence of clinical features of community-acquired pneumonia in this neurological pathology, which are characterized by a more severe and prolonged course of the disease with more pronounced respiratory disorders, more frequent bilateral lung damage, more pronounced and long-term involvement in the inflammatory process of the bronchial tree with a more common broncho-obstructive syndrome, difficulty in sputum discharge, exacerbation of symptoms of a neurological disease. These patterns can be associated with a violation of the mechanics of respiration due to damage to the respiratory muscles and deformation of the chest, a tendency to microaspiration, insufficient effectiveness of cough in organic lesions of the central nervous system.

The tendency to a more severe course of pneumonia determines the need for more frequent hospitalization of children with cerebral palsy in the ICU, mechanical ventilation and longer hospitalization.

The established clinical features determine the need to more actively use in the treatment of such patients methods aimed at sanitizing the bronchial tree (combined use of mucolytics, mucokinetics and vibration massage of the chest, up to fibrobronchoscopy) and bronchodilators. In children with cerebral palsy, with the development of pneumonia, there is often a need to prescribe repeated courses of antibacterial treatment.

The etiological significance of *Streptococcus pneumoniae* in community-acquired pneumonia in children with cerebral palsy

confirms the relevance of mandatory primary prevention of pneumonia in children with this neurological disease using a pneumococcal vaccine.

Bibliography

1. Barbaeva SN and Kulishova TV. "Cerebral palsy. Germany: LAP LAMBERT". 190 (2015). [Barbaeva S.N., Kulishova T.V. Detskii tserebral'nyi paralich. Germaniya: LAP LAMBERT 190 (2015). (in Russian)].

2. Jeremy Hull., *et al*. "British Thoracic Society guideline for respiratory management of children with neuromuscular weakness". *Thorax* 1 (2012): 1-40.

3. "Bronchopulmonary complications of diseases of the neuromuscular system: clinical guidelines of the Spanish Society of Pulmonologists and Thoracic Surgeons". *Pulmonology* 6 (2013): 11-20. [Bronkholegochnye oslozhneniya zabolevanii nervno-myshechnoi sistemy: klinicheskie rekomendatsii Ispanskogo obshchestva pul'monologov i torakal'nykh khirurgov. Pul'monologiya. 6 (2013): 11-20. (in Russian)]

4. Millman AJ., *et al*. "Community-Acquired Pneumonia Hospitalization among Children with Neurologic Disorders". *Journal of Pediatrics* 173 (2016): 188-195.

5. Aishauova RR., *et al*. "Characteristics of the morphofunctional state of the diaphragm in children with infantile cerebral palsy". *Diary of the Kazan Medical School* 1 (2018): 35-39. [Aishauova R.R., Abdrakhmanova S.T., Meshcheryakov V.V. Kharakteristika morfofunktsional'nogo sostoyaniya diafragmy u detei pri detskom tserebral'nom paraliche. Dnevnik Kazanskoi meditsinskoi shkoly 1 (2018): 35-39. (in Russian)].

6. Jimenez Trujillo I., *et al*. "Decrease in the incidence and in hospital mortality of community-acquired pneumonia among children in Spain (2001-2014)". *Vaccine* 35.30 (2017): 3733-3740.

7. "Modern classification of clinical forms of bronchopulmonary diseases in children". *Pediatrics* 4 (2010): 7-15. [Sovremennaya klassifikatsiya klinicheskikh form bronkholegochnykh zabolevanii u detei. Pediatriya 4 (2010): 7-15. (in Russian)].

8. "Community-acquired pneumonia in children: clinical guidelines". Original layout (2015): 64. [Vnebol'nichnaya pnevmoniya u detei: klinicheskie rekomendatsii. M .: Original-maket (2015): 64. (in Russian)].

9. Rebrova O Yu. "Statistical analysis of medical data. Application of the STATISTICA application package". *Media Sphere* (2002): 312. [Rebrova O.Yu. Statisticheskii analiz meditsinskikh dannykh. Primenenie paketa prikladnykh programm STATISTICA. M .: Media Sfera (2002): 312 (in Russian)].

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