Community-Acquired Pneumonia in Children: Clinical, Laboratory and Etiological Features

Komiljon Zakirdjanovich Kadirov, Yuriy Daliyevich Azizov, Marifat Shakirovna Ganieva, Obidjon Zakirdjanovich Kadirov

Department of Pediatric Surgery,

Andijan State Medical Institute, Uzbekistan.

Topicality of the problem .Respiratory diseases occupy a leading position in the structure of childhood morbidity and mortality. Every year, about 155 million cases of pneumonia in children are registered in the world , and it kills about 1.8 million children under the age of five, which is 20% of all child deaths. Acute pneumonia due to their frequent spread in children remains one of the urgent health problems. In Uzbekistan, acute respiratory diseases and pneumonia account for 50-60% of all morbidity in children. Mortality from acute pneumonia in children of 1 year of age continues to be quite high. According to WHO (1995), its share in the structure of mortality in developed countries is 3-4%, and in developing countries - 10-20% per year. Pneumonia plays a leading role among them.

The above is a logical outcome of the most frequent respiratory tract involvement in children, as well as the severity of the prognosis of many late diagnosed and untreated pneumonias [1,2]. Among the main reasons for the increase in the frequency of pneumonia, there is a high level of diagnostic errors and untimely diagnosis. In recent years, the proportion of pneumonia has increased, the clinical picture of which does not correspond to radiological data, and the frequency of asymptomatic forms of the disease is growing [1,3].

It should be noted that there are certain difficulties in the etiological diagnosis of pneumonia, associated both with the expansion and modification of the spectrum of pathogens, and the insufficient equipment of children's medical institutions. If relatively recently the cause of community-acquired pneumonia was mainly Streptococcuspneumoniae, then at present the etiological profile of the disease has expanded significantly, and in addition to bacteria, it can also be represented by atypical pathogens in the form of Mycoplasmapneumoniae, Chlamydophilapneumoniae , fungi, and also quite often viruses (influenza, parainfluenza, metapneumoviruses , etc.). The role of the latter is especially great in children under 5 years of age [3]. All these reasons in a certain way explain the belated correction of treatment, leading to a worsening of the patient's condition, the emergence of a need for the appointment of additional drugs, which ultimately affects the prognosis of the disease .

Therefore, despite a fairly in-depth study of the problem of childhood pneumonia, there is a need to understand the modern clinical features of pneumonia, to study the characteristics of various pathogens, including pneumotropic viruses, in this disease.

The pathogenesis of pneumonia in children is determined by the characteristics of the factors of both epidemic and immunodeficiency . The main causes of pneumonia in children are rather weak immunity and underdevelopment of the respiratory system compared to adults. In addition, the narrowness of the respiratory passages in children causes stagnation of mucus into them and makes it difficult to remove it. The main manifestation of primary and secondary immunodeficiency in children is an abnormal susceptibility to infection, in which other manifestations of immune deficiency may be small or absent.

In most cases, pneumonia develops in children against the background of immunodeficiency with the addition of bacterial flora. Among bacteria, the most common causative agents of pneumonia in children are streptococcus pneumoniae, staphylococci, Haemophilusinfluenzae. In secondary or acquired immunodeficienciesin children, B-humoral and T-cell immunity suffers. There may also be violations in the system of non-specific protection factors. In other cases, defects can combine and lead to immunodeficiency. With IDS in children, infections are chronic or relapse, and sometimes they progress. Infections in these cases differ in that they affect many organs and tissues, especially the respiratory organs. It should be noted that children are more susceptible simultaneously to many pathogens in the primary form of IDS.

The aim of research: toidentify modern clinical, laboratory and etiological features of the course of pneumonia in children with immunodeficiency.

Materials and methods.124 children with community-acquired pneumonia aged 1 to 18 years were under our supervision who received treatment in the pulmonology department of the regional children's multidisciplinary medical center in the city of Andijan. Among the examined children there were 101 boys (52.4%) and 59 girls (47.6%). The patients were divided according to the morphological forms of pneumonia - two groups (sick children with focal pneumonia and segmental pneumonia) and into 4 groups by age - young children (1-3 years), preschool (4-6 years), primary school (7-10 years old) and senior school age (11-18 years old). All patients underwent the necessary complex examination, including: a general clinical blood test, urinalysis, a biochemical blood test with the determination of the level of C-reactive protein (CRP), chest x-ray, microscopic and bacteriological examination of sputum for flora and sensitivity to antibiotics. Detection of respiratory viruses in 40 patients was carried out by polymerase chain reaction (PCR).

The obtained data were processed using the STATISTICA 6.1 software product. Comparison of quantitative indicators in the study groups was performed using Student's t-test. Differences in mean values, correlation coefficients were recognized as statistically significant at a significance level of $p<0.05$.

Results of the study and their discussion. Among the examined children with pneumonia, patients with focal pneumonia prevailed - 113 children (68.07%), children with segmental pneumonia - 53 (31.93%), of which 15 (48.4%) - with polysegmental pneumonia. Most of the hospitalized patients were young children - 67 (51.6%), as well as preschoolers - 44 (35.5%) (Table 1). The mean age of the patients was 5.05± 3.93 years.

Table 1.

Distribution of children by age groups with focal and segmental pneumonia

Age group	**Total**		**Focal pneumonia _**		**Segmental pneumonia**	
	n	**%**	**n**	**%**	**n**	**%**
1-2 years	67	40.36	49	43.36	18	33.96
3-6 years old	54	32.53	38	33.63	16	30.19
7-10 years old	22	13.25	10	8.85	12	22.64
11-15 years old	23	13.86	16	14.16	7	13.21
Total	166	100	113	68.07	53	31.93

Children were admitted to the hospital on average 8.0±4.7 days from the onset of the disease in case of focal pneumonia and 7.7±4.6 days in case of segmental pneumonia. Right-sided lung lesions were most often noted - in 95 cases (57.23%), left-sided lesions were almost 2 times less common - 51 cases (30.72%), bilateral - in 20 children (12.05%). A similar situation was observed in both groups. At the same time, right-sided inflammation developed more often in the 5th (39.29%) and 4th segments of the lungs (16.67%), and left-sided - in the 5th (26.23%), 10th (22.95%) %) and 9th (18.03%) ($p=0.01$). Pneumonia with a moderate course prevailed - 155 cases (93.37%). While severe pneumonia was noted only in 11 children (6.63%), and most of them were segmental - 81.8% ($p<0.001$). Among hospitalized patients, respiratory failure of the 2nd degree was more common - in 81.93% (136), 1st degree - in 17.47% (29). There were no signs of it in 1 case (0.6%).

Mixed dyspnea was more often observed in children with segmental pneumonia: 86.79% (46) versus 70.8% (80) ($p<0.05$). With focal pneumonia, the absence of dyspnea on admission was noted more often by 3.5 times - 20.35% (23) versus 5.66% (3), $p<0.05$. Severe toxicosis was in 121 children (72.89%), moderate in 43 - 25.9%, absent in 2 children - 1.2%. Subfebrile body temperature before admission was registered in 19 people (11.45%), febrile in 99 (59.64%). The rise in body temperature to febrile numbers for 3 days or more was noted only in 74 children (44.58%), and significantly more often with segmental pneumonia - in 60.38% (32), while with focal pneumonia - in 37.17 % (42) ($p<0.01$). Children with segmental pneumonia had fever in the hospital more often than with focal pneumonia: febrile temperature within 1 day was noted in 30.19% (16) and 19.47% (22), within 2-3 days in 11.32% (6) and 6.19% (7), 1.89%(1) and 1.77%(2) of children, respectively ($p<0.05$). At admission, half of the patients complained of an unproductive cough - 84 (50.6%), productive in 65 (39.16%), dry in 17 (10.24%). No significant differences were found between the groups. Complaints of abdominal pain and chest pain were more common in segmental pneumonia - 3.01% (5) and 1.8% (3) ($p<0.05$ and $p<0.01$, respectively). Lethargy, weakness and decreased appetite were noted in the majority of children - 83.13% (138) and 80.72% (134), respectively.

During an objective examination, such an important sign of pneumonia as the presence of local symptoms was not observed in everyone. So, dullness of lung sound over the area of inflammation was more often noted in segmental pneumonia than in focal pneumonia (84.91% vs. 70.8%, respectively), as well as the presence of crepitus and small bubbling rales (79.25% vs. 62.83% , respectively) ($p<0.05$). There were no significant differences between the groups in terms of local weakening of breathing. Significant differences in local symptoms in different age groups were observed only with lung percussion. Local dullness was more often noted in the group of younger schoolchildren (7-10 years old) - in 90.91% (20), a little less often in the group of preschoolers (3-7 years old) and older schoolchildren (11-15 years old) - 81.48% (44) and 73.91% (17), respectively, and least often in the group of young children (1-2 years) - 65.67% (44) ($p<0.05$). Clinically, upon admission to the hospital, complete local symptoms (in the form of dullness of lung sound during percussion over the area of inflammation, weakening of breathing and moist fine bubbling rales and/or crepitus) were recorded only in half of the patients - 51.8% (86). The full range of local symptoms was more often detected in segmental pneumonia - 66.04% (35) compared to 45.13% (51) in focal pneumonia ($p<0.05$). Their complete absence, on the contrary, was more often observed in focal pneumonia - 5.31% (6) versus 1.89% (1) ($p<0.05$). Local symptoms with focal pneumonia stopped faster than with segmental (by 7.2 ± 1.8 and 8.3 ± 2.8 days, respectively, $p<0.01$).Broncho -obstructive syndrome was registered in 24 children with pneumonia (14.46%),

more often in young children - 22.39% (15), in preschool children - in 16.67% (9), $p<0.05$. Atelectasis as a complication of pneumonia was recorded in 2 children (1.2%), lung tissue destruction in the area of inflammation in 1 (0.6%), synpneumonic pleurisy in 1 (0.6%). There were no significant differences in the development of complications between the groups.

Table 2.

Changes in the clinical analysis of blood upon admission to the hospital

Index		**Pneumonia**			
		Focal		**Segmental**	
		n	**%**	**n**	**%**
Leukocytes	norm (4 - 9 x 10^9 / l)	**74**	**67,27**	**37**	**69,81**
	moderate leukocytosis (10.0 - 15.0 x 10^9 /l)	**25**	**22,73**	**9**	**16,98**
	pronounced leukocytosis (15.1 - 20.0 x 10^9 / l)	**7**	**6,36**	**5**	**9,43**
	pronounced leukocytosis (>20.0 x 10^9 / l)	**2**	**1,82**	**2**	**3,77**
	leukopenia (<4.0 x 10^9 / l)	**2**	**1,82**	**0**	**0**
Changes in the leukocyte formula	shift left	**8**	**7,41**	**8**	**16**
	neutrophilia	**39**	**36,11**	**26**	**50,98**
	lymphocytosis	**13**	**12,04**	**5**	**9,8**
Erythrocytes sedimentation rate	Norm (≤ 10 mm/h)	**70**	**64,64**	**24**	**45,28**
	Moderate acceleration (11-15 mm/hour)	**10**	**9,09**	**6**	**11,32**
	Marked acceleration (16-20 mm/h)	**5**	**4,55**	**5**	**9,43**
	Sharply pronounced acceleration (>20 mm/h)	**25**	**22,73**	**18**	**33,96**
C-reactive protein	Negative	**67**	**77,01**	**25**	**60,98**
	Slight increase (6 mg/ml)	**11**	**12,64**	**7**	**17,07**

	Moderate increase (12 mg/ml)	**8**	**9,2**	**6**	**14,63**
	Pronounced increase (≥24 mg/ml)	**1**	**1,15**	**3**	**7,32**

The average level of leukocytes at admission in the group of focal pneumonia was 9.04±3.9 x10 ^{9} /l, segmental - 10.4±8.2 x10 ^{9} /l.

In the group of segmental pneumonias, the ESR value was higher than in focal pneumonias - 19.11±17.36 mm/h versus 12.67±13.1 mm/h, respectively (p<0.001).

After the complex treatment, control blood tests compared with blood tests at admission showed a significant decrease in the level of leukocytes from 9.49±5.7 x 10 ^{9} /l to 7.65±2.1 x 10 ^{9} /l (p<0.001) , and ESR from 15.05±14.9 mm/h to 6.14±5.2 mm/h (p<0.001).

In the study of tracheobronchial aspirate by PCR, pneumococcal DNA was isolated in 30 (75%) of 40 children, only pneumococcus was isolated in 24 (60%) of them, and metapneumovirus RNA was isolated in 6 (15%) of pneumococcal DNA in combination with viruses (2), respiratory syncytial virus RNA (2), adenovirus DNA (2). In 4 (10%), the pathogen was not isolated, in 6 (15%) - only adenovirus DNA (Fig. 1). RNA of rhinovirus and parainfluenza viruses types 1,2,3,4 were not found in the study group.

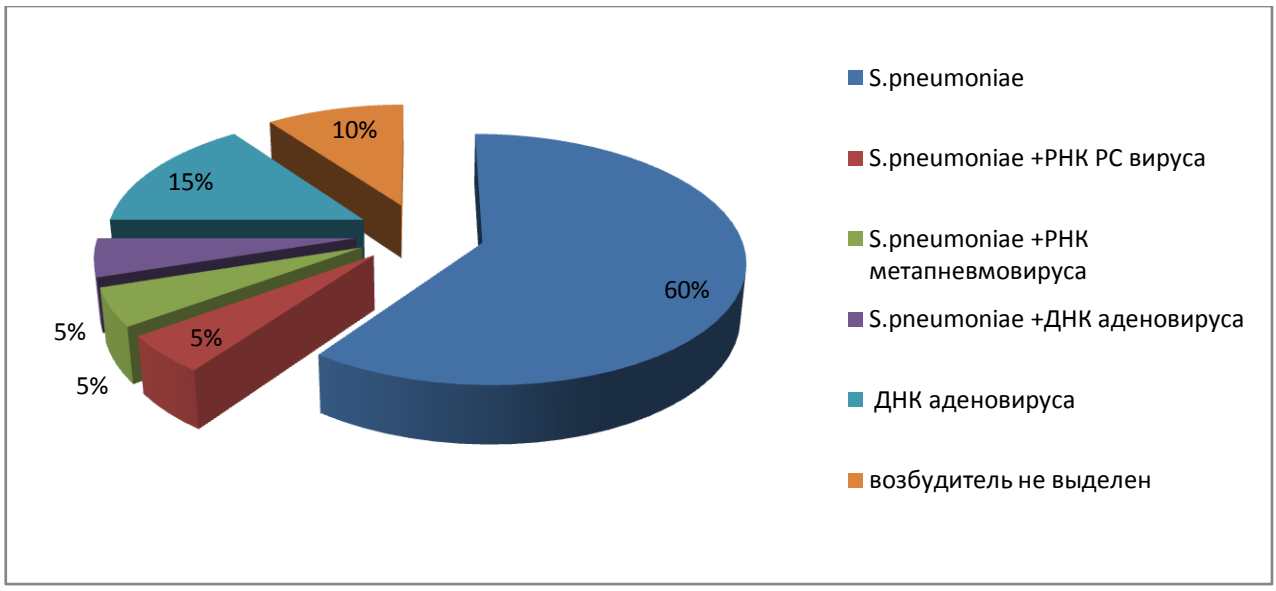

Figure 1. Microorganisms isolated by PCR intracheobronchial aspirate in patients with pneumonia

All examined patients with pneumonia also underwent bacteriological examination of sputum. Among 30 patients with isolated pneumococcal DNA, in half - 16 (53.3%) bacteriological examination of sputum gave a negative result, in 6 of them (20%) - only Candidaalbicans was isolated , in 4 (13.3%) – Streptococcusviridans , in 2 (6.7%) – Pseudomonasaeruginosa , another 2 (6.7%) – Proteusmirabilis and Proteusvulgaris in a non-diagnostic titer. In 10 patients in whom pneumococcus was not isolated by PCR, no growth of bacterial flora was detected during sputum culture.

The failure of bacteriological examination of sputum can be explained by the fact that the majority of children (63.3%) received antibiotic therapy on an outpatient basis.

Respiratory syncytial virus RNA was found in 2 young children who were admitted to the hospital on days 4 and 5 from the onset of the disease with signs of acute rhinopharyngitis. One of them- with a clinic of bronchial obstructive syndrome. Human metapneumovirus RNA was isolated from two preschool children (3 and 3.5 years old) admitted on the 6th day from the onset of the disease with residual symptoms of acute pharyngitis. Adenovirus DNA was isolated from 8 children: in 2 of them in combination with pneumococcus - children of early age, 4 - from the group of preschoolers, 2 - of senior school age. Older students were admitted 6 and 7 days after the onset of the disease without obvious signs of acute upper respiratory tract infection, and younger children - on 3-4 days with signs of nasopharyngitis .

Pneumococcus was isolated by PCR mainly in young children - 46.7% (14), a little less often in preschoolers - 30% (9), and in younger and older schoolchildren much less often - 13.3% (4) and 10% (3) respectively (Table 3).

Table 3

Results of examination for S.pneumoniae by PCR method in children of different age groups

Age group	**The result of the PCR test**			
	Negative (20)		**Positive (45)**	
	n	%	N	%
1-2 years	1	5	17	37,8
3-6 years old	4	20	10	22,2
7-10 years old	8	40	12	26,7
11-15 years old	7	35	6	13,3

More often, pneumococcus was isolated in children with focal pneumonia - in 70% (21), and with segmental - in 30% (9).

Respiratory failure of the 2nd degree in children with pneumococcal etiology of pneumonia occurred somewhat more often than in the other group - 90% (27) and 80% (8), respectively (Table 4).

Table 4

Respiratory failure in children depending on the result of the examination for S.pneumoniae by PCR

Age group	**The result of the PCR test**			
	Negative (20)		**Positive (45)**	
	n	%	N	%
1 c temperature	3	6	7	15,6
2 degree	10	50	23	51,1

For children with pneumococcal pneumonia, unproductive cough was more common - in 60% (18), 2 times less often - productive - 33.3% (10), and almost 8 times less - dry cough - 6.7% (2) .

Lethargy, weakness, decreased appetite in patients with pneumococcal pneumonia were noted more often than in non-pneumococcal pneumonia - 80% (24) and 70% (7), respectively ($p< 0.05$).

When examined in the blood test, leukocytosis was noted in 30% (9) of cases (in the group without pneumococcus - in 20%), ESR acceleration - in 43.3% (13), changes in the leukoformula - in 36.7% (11) in in the form of shift to the left in 10% (3), neutrophilia in 30% (9), lymphocytosis in 6.7% (2). An increase in the level of C-reactive protein was more common in pneumococcal pneumonia - 41.4% (12) versus 33.3% (3).

The average length of stay of children with pneumonia in the hospital was 11.3±3.3 days. There were no significant differences in the duration of hospitalization between the groups.

Most of the children were discharged with recovery: with focal pneumonia in 97.35%, with segmental pneumonia in 83.02% of cases; 2.65% and 13.21%, respectively, were discharged for further outpatient aftercare with improvement in the form of decrease in lung tissue infiltration on the radiograph ($p<0.01$). The outcome of segmental pneumonia in 1 child was the formation of the

area of pneumosclerosis at the site of infiltration, in another - the formation of a thin-walled cavity due to destruction of the lung tissue.

Conclusions:

1. The most common clinical and morphological form of pneumonia in children at the present stage is focal right-sided pneumonia with a moderate course and localization in the middle lobe (4 and 5 lung segments).

2. Segmental pneumonia is more characterized by a severe course with a long-lasting febrile body temperature, severe local symptoms and severe laboratory changes.

3. In the majority of patients (75%), pneumonia is of pneumococcal etiology. At the same time, the study of sputum by PCR for pneumococcus is more informative than sowing on the flora.

4. An important role in the development of pneumonia is played by respiratory viruses, which were isolated in 30% of patients, and in half of them - in combination with pneumococcus.

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