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STUDYING THE ETIOLOGY OF COMMUNITY-ACQUIRED PNEUMONIA IN CHILDREN TREATED IN THE HOSPITAL

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ИЗУЧЕНИЕ ЭТИОЛОГИЧЕСКИ ЗНАЧИМЫХ МИКРООРГАНИЗМОВ У ДЕТЕЙ С ВНЕБОЛЬНИЧНОЙ ПНЕВМОНИЕЙ, ПРОХОДЯЩИХ ЛЕЧЕНИЕ В СТАЦИОНАРЕ

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The study determined the etiological structure and sensitivity to antibacterial agents of pathogens of uncomplicated and complicated forms of pneumonia in children treated in a multidisciplinary hospital. According to the study, that timely bacteriological diagnosis in the treatment of pneumonia in childhood with an adequate selection of effective antibacterial agents helps reduce hospitalizations and the development of complicated forms of pneumonia.

Keywords: community-acquired pneumonia, pathogens, children

В исследовании определена этиологическая структура и чувствительность к антибактериальным средствам возбудителей неосложненных и осложненных форм пневмонии у детей, проходивших лечение в многопрофильном стационаре. Полученные в исследовании данные свидетельствуют, что своевременная бактериологическая диагностика при лечении пневмоний в детском возрасте с адекватным выбором эффективных антибактериальных средств способствует уменьшению количества госпитализаций и развития осложненных форм пневмонии.

Ключевые слова: внебольничная пневмония, возбудители, дети

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CAP – community acquired pneumonia
ELISA – enzyme-linked immunosorbent assay
MRSA – methicillin-resistant staphylococcus aureus
NP – necrotizing pneumonia
PCR – polymerase chain reaction

Community-acquired pneumonia (CAP) in children is caused by several microorganisms, among which the leading role is played by Streptococcus pneumoniae (S. pneumoniae). In children older than five years, S. pneumoniae is determined in 35–40 % of cases, and the role of atypical bacteria increases – Mycoplasma pneumoniae (M. pneumoniae) (18–60 %) and Chlamydophila peumoniae (C. peumoniae) (1–30 %), especially in adolescence. Less often, Haemophilus influenza is determined. Relatively rare pneumonia pathogens in children older than five years include Bordetella pertussis, Legionella pneumophila, Moraxella catarrhalis, Klebsiella pneumoniae and Streptococcus pyogenes [1, 2].

Necrotizing Pneumonia (NP) in childhood has slightly different patterns. The main pathogens are pneumococcus (59 %), Staphylococcus aureus (23 %), and methicillin-resistant Staphylococcus aureus (MRSA) (8 %) [2, 3].

Viral-bacterial coinfections (23–35 %) are common in children, especially young children, due to the higher severity of pneumonia, the presence of parapneumonic effusions, the need for hospitalization in intensive care and artificial ventilation. Respiratory syncytial virus and influenza A virus are associated with increased colonization of the nasopharynx S. pneumoniae, S. aureus, including MRSA, and increased risk of secondary bacterial pneumonia [4, 5].

The study aimed to study the etiological structure and antibiotic sensitivity of pathogens involved in deve-

loping uncomplicated and complicated forms of CAP in children.

Material and Methods. Under the supervision, there were 165 children aged from 2 to 18 years who were admitted to the hospital with the diagnosis of «Out-of-hospital pneumonia». All patients were hospitalized after ineffective treatment at home or in a district hospital. Of these, 114 (69.1 %) were diagnosed with uncomplicated pneumonia and 51 (30.9 %) with EIT. The treatment was carried out in the infectious disease department and the purulent surgery department of the Stavropol Regional Children's Clinical Hospital. Microbiological research was carried out in the bacteriological laboratory of LLC «Center of Clinical Pharmacology and Pharmacotherapy» Stavropol, which was carried out following the clinical recommendations «Determination of sensitivity of microorganisms to antimicrobial drugs».

Blood, sputum and pleural exudate served as the material for isolating etiologically significant pathogens and determining their sensitivity to antibacterial drugs. All children also underwent serological diagnosis of respiratory mycoplasmosis and respiratory chlamydia by ELISA with the determination of antibodies of the IgM and IgG classes. In addition, 55 children underwent a comprehensive diagnosis for respiratory viruses in swabs from the nose and throat using multiplex PCR (influenza, parainfluenza, adenoviruses, respiratory syncytial viruses, rhinoviruses, metapneumoviruses, bocaviruses in swabs from the nose and oropharynx).

Statistical analysis of the obtained measurement results was conducted using Statistica 10.0 (StatSoftInc., USA). The Student's t-test and Shapiro-Wilk test were used. The differences between the groups were considered valid at $p<0.05$.

Results and Discussion. When conducting a bacteriological study in 88 (53.3 % of the total number of examined patients – 165) cases, etiologically significant microorganisms were isolated. Including in blood cultures for microflora – 9 (5.5 %), in the study of sputum – 49 (29.7 %), in the study of pleural exudate – 30 (18.2 %).

The main bacterial pathogens were S. pneumoniae (62.5 %) and S. aureus (11.4 %). The role of gram-negative agents (22.7 %) represented by K. pneumoniae (8.0 %), E. coli (5.7 %) and Pseudomonas aeruginosa (2.3 %) turned out to be significant, which indicates a significant proportion of nosocomial infection and demonstrates the irrationality of the use of antibiotic therapy at the outpatient stage of medical care and treatment in district hospitals.

In uncomplicated pneumonia, S. pneumoniae was most often isolated (82.1 %). However, K. pneumoniae was found in 7.7 % of cases.

In patients treated in the Department of Purulent Surgery with NP, S. pneumoniae was also more often isolated (43.4 %). It is important to note that S. aureus was also quite often isolated (30.0 %). Gram-negative microflora was found less frequently (9.8 %).

Determination of the sensitivity of the isolated microflora to antibacterial agents revealed an increase in S. pneumonia resistance to penicillin: 24 % of isolated pneumococci demonstrated resistance in in vitro studies. Taking into account the mechanisms of formation of resistance of pneumococci to β-lactams, one can expect insufficient effectiveness of penicillins, cephalosporins and carbapenems. At the same time, there is a high sensitivity to vancomycin, lenezolid (100 %), rifampicin (87 %). Resistance to macrolides was 24 %, to clindamycin – 17 %, which allows in pediatric practice to consider the possibility of using these drugs when β-lactams are ineffective.

S. aureus was identified as MRSA in 23 % of patients with NP. Staphylococci retained a fairly high sensitivity to clindamycin (88 %), tigecycline (100 %), vancomycin (100 %) and linezolid (100 %).

Serological markers of atypical microflora, along with the isolation of pneumococci, were found in 48 (29.1 %) cases in children with pneumonia, including M. pneumoniae in 34 (20.6 %) children, C. pneumoniae in 14 (8, 5 %) children. This indicates that, along with pneumococci, atypical microorganisms may also be involved in the development of severe CAP in children. Accordingly, this fact should be taken into account when diagnosing and constructing antibiotic therapy.

Virological studies carried out in 55 patients suggested that SARS was likely In the analysis of ODRS pathogens in the nose and throat smears by PCR, respiratory-syncytial virus was detected in 20 (36.4 %), rhinovirus in 10 (18.2 %), parainfluenza in 8 (14.6 %), influenza in 7 (12.8 %), metapneumovirus in 10.9 % (10 %), parainfluenza 3 % (3 %).

Conclusions. Thus, the respiratory-syncytial virus can be considered a cause-significant viral agent before the development of MP in children. In a quarter of the cases, pneumonia occurs mixed with the presence of atypical mycoplasma or chlamydia microflora. Pneumococcus is the leading bacterial causative agent of uncomplicated pneumonia. At the same time, S. pneumonia resistance to penicillin and other β-lactams is increasing. In this regard, attention should be paid to the importance of the etiological diagnosis of non-hospital pneumonia, including identifying atypical agents. In children with complicated pneumonia, pneumococcus and Staphylococcus aureus occupy the leading positions; less often, the literal flora is revealed. The choice of antibacterial agents in all cases, especially for complicated forms of pneumonia, should be based on antibiotic resistance data. It is also obvious that timely bacteriological diagnosis in the treatment in the clinic and, accordingly, the choice of effective antibacterial agents can reduce the likelihood of hospitalization and the development of complicated forms of pneumonia.

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EXPERIMENTAL STUDY OF THE BIOCIDAL EFFECT OF NANOSILVER

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ЭКСПЕРИМЕНТАЛЬНОЕ ИССЛЕДОВАНИЕ БИОЦИДНОГО ДЕЙСТВИЯ НАНОСЕРЕБРА

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The study demonstrated the effectiveness of nanosilver (linear particle size 10–20 nm) in the form of a patented composition. This form showed high bactericidal and fungicidal activity against gram-positive, gram-negative bacteria and candida in minimal concentrations.

Keywords: silver nanoparticles, bacteria, fungi

В исследовании продемонстрирована эффективность наносеребра (линейный размер частиц 10–20 нм) в виде запатентованной композиции, которое показало высокую бактерицидную и фунгицидную активность против грамположительных, грамотрицательных бактерий и кандид в минимальных концентрациях.

Ключевые слова: наночастицы серебра, бактерии, грибы

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ATCC – American Type Culture Collection
ISO – International Organization for Standardization
MIC – minimum inhibitory concentration

The development of nanotechnology has given impetus to the development of new areas of healthcare, biotechnology, and additive technologies. Among other things, highly effective silver nanoparticles have been obtained that are more active in the 1–100 nm range than other biocides for some antibiotic-resistant strains of microorganisms with good wound-healing properties [1, 2]. Experimental data and clinical observations with the possibility of modification of application conditions allow assuming a reduction of quantitative load of silver nanoparticles, with the case of removal of the po-