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Analysis of Sensitivity and Resistance of Pneumococcus, Staphylococcus Aureus, Hemolytic Streptococcus to Antibiotics in Children Diagnosed with Pneumonia

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Mirzakhanov Said Madridovich1*, Khanakhmedova Aisha Timurovna1, Azizova Kamilla Shamilevna1, Abakarova Amina Gadzhievna1, Kuhmazova Zarina Mameyevna1, Kurbanov Ahmed Huseynovich1, Abdurakhmanova Nazila Raidinovna1, Gamzatova Karina Ruslanovna1

1Federal State Budgetary Educational Institution of Higher Education "Dagestan State Medical University" of the Ministry of Health of the Russian Federation
mirzahanovsaid@mail.ru

Keywords

sputum sowing, antibiotics, antibiotic sensitivity, antibiotic resistance.

Abstract

In our work, the issues of sensitivity and resistance of the main bacterial pathogens of pneumonia in children in Russia to the main groups of antibiotics were investigated. The study involved 164 patients. The material of the study was the morning sputum of patients obtained before the appointment of antibacterial therapy. The method of investigation is the analysis of sputum for microflora and sensitivity to antibiotics. Examination of sputum for microflora and sensitivity to antibiotics is an important part of the appointment of effective therapy, which is aimed at the etiology of the disease. But the study of sputum culture for microflora and sensitivity to antibiotics lasts more than 4 days, because of this, at the initial stage of treatment, antibiotics are prescribed based on current data on the sensitivity of the main pathogens of pneumonia to antibacterial drugs, therefore, monitoring of antibiotic resistance and sensitivity is necessary for timely and effective initiation of antibacterial therapy.

1. Introduction

Sputum examination for microflora and sensitivity to antibiotics is an important laboratory research method that makes it possible to choose an effective and correct treatment in situations where there is resistance of pathogenic microorganisms to many antibiotics. This method of laboratory research allows to detect the presence of pathogenic microorganisms in the studied material, to detect conditionally pathogenic microorganisms at a high titer and to establish the sensitivity of pathogens to specific groups of antibiotics [1].

The data of published statistics increasingly indicate a steady increase in the number of antibiotic-resistant infections. This is one of the main problems of the direction of antibacterial treatment aimed at the etiological component. Recently, the detection of polyresistant strains of pneumococcus has become of great importance. Pneumococcus is mainly sensitive to penicillin antibiotics and amoxiclav. Circulation of strains with reduced sensitivity to antibiotics was registered in preschool and school institutions. About a third of the strains resistant to penicillin antibiotics have reduced sensitivity to sumamed, 4-8% - to cephalosporins of the 3rd generation, up to half of the strains - to amoxiclav. It is assumed that the mechanism of penicillin resistance of pneumococcus is associated with the modification of penicillin - binding proteins. It is known that pneumococcus has 6 high-molecular penicillin -binding proteins, changing 3 of them reduces the sensitivity of Streptococcus pneumoniae to penicillins. Modifications of penicillin-binding proteins occur due to genetic changes in the pneumococcal chromosome. Antibiotic resistance and polyresistance of pneumococcus are one of the main problems in the treatment of community-acquired pneumonia caused by Streptococcus pneumoniae. In this regard , the need to monitor antibiotic sensitivity becomes of great importance for choosing an adequate antibacterial drug [2].

Official statistics of recent years indicate an increase in the number of respiratory diseases. The structure of morbidity is dominated by acute and chronic

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inflammatory diseases, among which the most common pathology is community-acquired pneumonia. In Russia, according to the chief epidemiologists of the Ministry of Health In Russia, 2 million 724 thousand cases of community-acquired pneumonia were registered in 2020 . This problem is especially relevant these days. During the COVID-19 pandemic the number of cases of community-acquired viral pneumonia with the possible subsequent addition of a bacterial component, which requires the use of antibacterial drugs, has increased. Treatment of community-acquired bacterial pneumonia etiology is carried out with antibiotics, taking into account the data of the study of the etiological factor of the disease [3].

With the identification of the pathogen and the presence of an antibioticogram, the etiological treatment of pneumonia does not have significant difficulties. Since the study of sputum culture for microflora and sensitivity to antibiotics can last from 5 to 14 days, antibiotics when a patient is admitted to the hospital are prescribed based on the doctor's previous experience, usually based on data on the most likely spectrum of possible pathogens of infection in this patient. The epidemiological situation, clinic and symptoms of the disease, knowledge of the resistance of modern pathogens to the main antibacterial drugs are also taken into account. Therefore, monitoring of antibiotic resistance and antibiotic sensitivity of infectious agents is so important for the timely and effective initiation of antibacterial therapy. Incorrect selection of antibacterial drugs lengthens the period of morbidity, causing a decrease in economic efficiency, and sometimes increases the mortality rate [4].

Pneumonia is an inflammation of the lung tissue, usually of infectious origin, occurring with damage to the respiratory parts of the lungs, intraalveolar exudation, infiltration of lung tissue by inflammatory cells and the presence of clinicorentgenological signs of inflammation unrelated to other causes [5]. In Russia , the most common etiological pathogens of community-acquired pneumonia are pneumococcus (20-60%), mycoplasma respiratory infection, chlamydia respiratory infection, legionella pneumonia (totaling 8-30%), other types streptococci (pyogenic streptococcus, hemolytic streptococcus) (about 20%). Less often Haemophilus influenza, Klebsiella pnemoniae, Pseudomonas auriginoza, Staphylococcus aureus, Escherichia coli, Branchamella catarrhalis – in 3-10% of cases, respectively, for each pathogen, Candida (about 5%). Currently, there is a proportion of community-acquired pneumonia caused by coronavirus infection, and community-acquired pneumonia can also often be caused by respiratory infections, such as influenza A, B virus, adenovirus, respiratory syncytial virus, parainfluenza [6-8].

Objective: to investigate the sensitivity and resistance of Streptococcus pneumoniae, Staphylococcus aureus, Streptococcus haemolyticus to antibiotics. To achieve this goal, the following tasks were set: to determine the presence of Streptococcus pneumoniae, Staphylococcus aureus, Streptococcus haemolyticus pathogens in the studied material. To study the sensitivity of Streptococcus pneumoniae, Staphylococcus aureus, Streptococcus haemolyticus to antibiotics: AMOXICLAV, AMIKACIN, SUMAMED, CEFAZOLIN, CEFOTAXIME, CEFTAZIDIME, CEFTRIAXONE, CEFUROXIME. To study and analyze the results obtained using statistical research methods and summarize the work done.

2. Methodology

The study was conducted in the period from August 2021 to October 2022, during this period, 164 case histories of patients admitted to the pulmonological department of the Republican Children's Pulmonological Center of Makhachkala were analyzed. A study was conducted in 164 patients to identify the causative agent of pneumonia and its sensitivity to antibiotics. Patients who received antibiotics before admission to the hospital were not included in the study. In 126 patients, the condition is of moderate severity and in 38 - severe. Among the analyzed patients, the female sex was 87 (53%) people, the average age was 9.6±0.32 years, the male sex was 77 (47%), the average age was 9.7± 0.3 years. The laboratory material of the study was the morning sputum of patients obtained before the appointment of antibacterial therapy. Recognition of microorganisms was carried out by quantitative sputum culture on Petri dishes with 5% blood agar, Endo, ZHSA, Saburo media. The sensitivity of microorganisms to antibiotics was determined by the discodiffusion method using standard discs. During the sputum examination for microflora and antibiotic sensitivity, discs were used for the following antibiotics: groups

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of penicillins (AMOXICLAV), cephalosporins of the I-II-III generation (CEFAZOLIN, CEFUROXIME, CEFTRIAXONE, CEFOTAXIME, CEFTAZIDIM), aminoglycosides (AMIKACIN) and macrolides (SUMAMED).

Statistical analysis of the data obtained was carried out using the MS Office Excel program, with the calculation of extensive indicators. The value P<0.05 was taken as the level of statistical significance of the differences.

3. Result:

These data indicate that the most effective antibiotics in relation to pneumococcus are AMOXICLAV (99.6 ± 0.4%), CEFTRIAXONE (97.1±1.9%), CEFOTAXIME (92.9±3%), CEFUROXIME (90.1±3.5%), CEFAZOLIN (83.5±4.3%), SUMAMED (84.5±4.3%) AND CEFTAZIDIME (85,9±,4,1%), AMIKACIN (73.2±5.2%).

In our study, Staphylococcus aureus has the greatest sensitivity to CEFTRIAXONE (96±2.8%); AMIKACIN (93.8±3.4%); CEFUROXIME (87.7±4.7%); SUMAMED (85.7±5%); CEFATOXIM (81.6±5.5%); CEFAZOLIN (79.5±5.8%); AMOXICLAV (82.6±5.3%); CEFTAZIDIME (60.2± 6.9%).

Streptococcus haemolyticus is most sensitive to CEFTRIAXONE (95.4±3.2%); AMIKACIN (92±3.9%); CEFUROXIME (86.1±5.2%); CEFOTAXIME (88.6±4.8%); AMOXICLAV (93.1±3.8%), CEFTAZIDIME (82.9±5.6%); CEFAZOLINE (81.8±5.8%); SUMAMED (73.8±6.6%).

Table 1: Sensitivity of Streptococcus pneumoniae, Staphylococcus aureus, Streptococcus haemolyticus to antibiotics: AMOXICLAV, AMIKACIN, SUMAMED, CEFAZOLIN, CEFOTAXIME, CEFTAZIDIME, CEFTRIAXONE, CEFUROXIME.

Antibiotics	Staphioloccus aureus	Streptococcus haemolyticus	Streptococcus pneumoniae
AMOXICLAV	82,6±5,3%	93,1±3,8%	99,6±0,4%
AMIKACIN	93,8± 3,4%	92±3,9%	73,2±5,2%
SUMAMED	85,7±5%;	73,8±6,6%	84,5±4,3%
CEFAZOLIN	79,5±5,8%;	81,8±5,8%	83,8±4,3%
CEFOTAXIME	81,6±5,5%;	88,6±4,8%	92,9±3%
CEFTAZIDIME	60,2±6,9%	82,9±5,6%	85,9±,4,1%
CEFTRIAXONE	96±2,8%;	95,4±3,2%	97,1±1,9%
CEFUROXIME	87,7±4,7%;	86,1±5,2%	90,1±3,5%

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4. Discussion

Based on this:

1. The greatest sensitivity of Streptococcus pneumoniae, Staphilococcus aureus, Streptococcus haemolyticus was shown to be resistant to CEFTRIAXONE, the presence of differences in efficacy between microorganisms was not detected.

2. AMICAZINE has a high efficacy against Staphylococcus aureus and hemolytic streptococcus, but is ineffective against Streptococcus pneumoniae.

3. Staphilococcus aureus, Streptococcus haemolyticus, Streptococcus pneumoniae highly sensitive to CEFUROXIME, no significant differences in the activity of the action were found.

4. These studies have shown that hemolytic streptococcus and pneumococcus are more sensitive to CEFOTAXIME than Staphylococcus aureus.

5. The study also shows that Staphylococcus aureus and pneumococcus are more sensitive to SUMAMED than to hemolytic streptococcus.

6. AMOXICLAV is more effective in use against pneumonia caused by Streptococcus pneumoniae and hemolytic streptococcus than against Staphylococcus aureus.

7. Obtained data on the effect on Streptococcus pneumoniae, Staphilococcus aureus and Streptococcus haemolyticus CEFAZOLIN indicates good efficacy against these pathogens.

8. The study showed the resistance of Staphylococcus aureus to the action of CEFTAZIDIME (60.2%), but hemolytic streptococcus and Streptococcus pneumoniae are sensitive to the action of CEFTAZIDIME (82.9% and 85.9%, respectively).

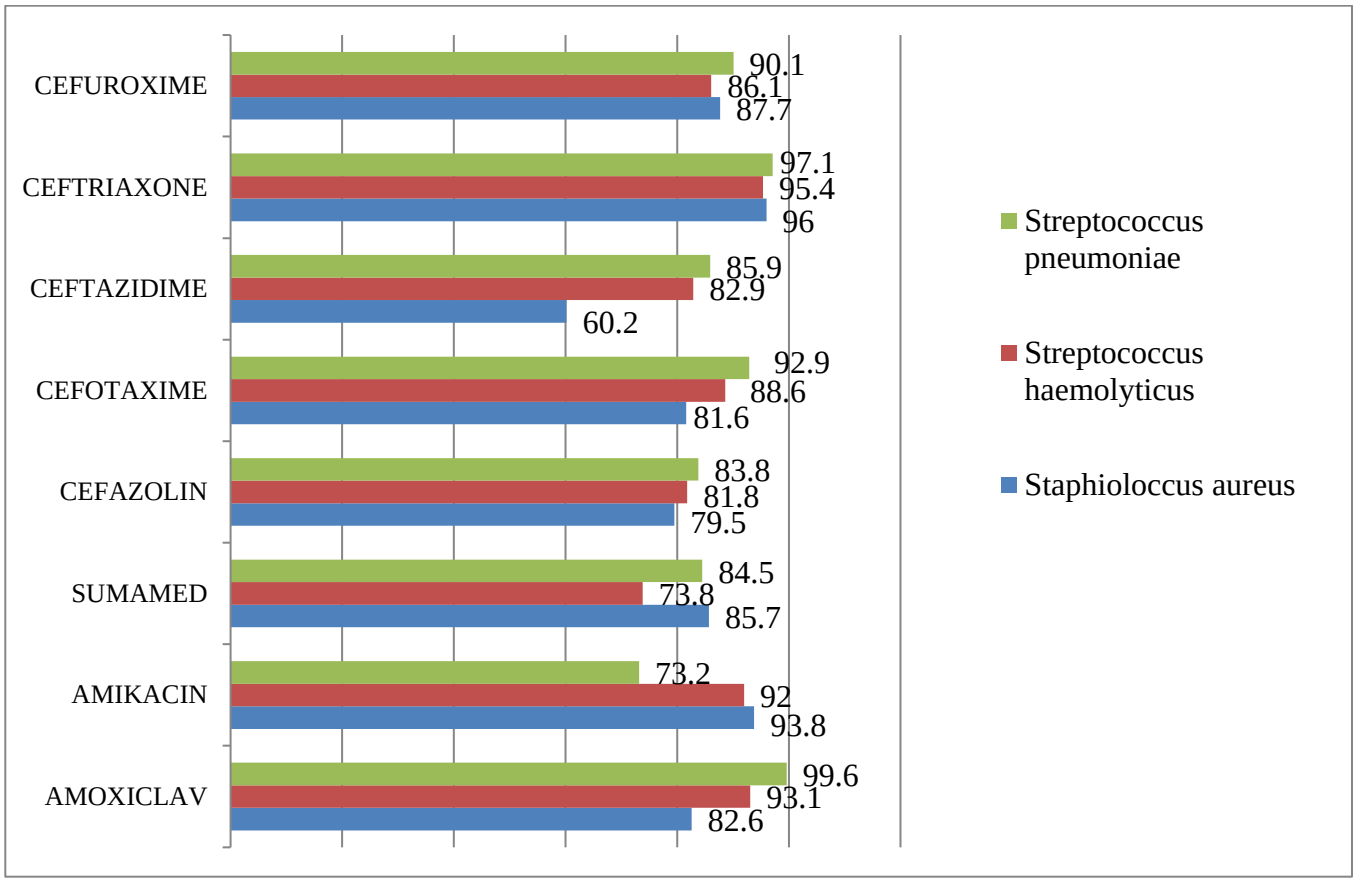

Figure 1. Comparative characteristics of the sensitivity of community-acquired pneumonia pathogens to antibiotics

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5. Conclusion:

Summarizing our study of sensitivity and resistance to antibacterial agents of Streptococcus pneumoniae, Staphiloccus aureus, Streptococcus haemolyticus, we can draw the following conclusions: recommend the use of AMOXICLAV as a starter drug, which is a highly effective remedy for children of any age with community-acquired pneumonia (presumably bacterial etiology) of a mild course against Streptococcus pneumonia (99.6 %), staphylococcus aureus(82.6%),Streptococcus haemolyticus(93.1%), Haemophilus influenza, as well as CEPHALOSPORIN PREPARATIONS OF THE 3RD GENERATION. This therapy covers almost the entire spectrum of potential pathogens covers almost the entire spectrum of potential pathogens.

The data obtained should be taken into account when empirically choosing the starting antibacterial therapy for nosocomial pneumonia. Regular microbiological monitoring is a prerequisite for optimizing the choice of antimicrobial drugs in pediatrics.

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