

Children with Pneumonia Caused by *Streptococcus pneumoniae* Resistance Analysis and Clinical Features

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Abstract

Objective: To analyze the causes of childhood pneumonia *Streptococcus pneumoniae* resistance and clinical characteristics, and provide a basis for better and timely clinical therapy, and medication to reduce blindness. **Methods:** MIC method in our hospital 114 under 2020 pediatric pneumococcal respiratory infection in children with lower respiratory tract specimens were isolated antimicrobial susceptibility testing, and analyzed retrospectively. **Results:** 84 male children, 30 female children, the largest of which 9 years old, the youngest two months, infants less than 1 year old, 90 people; suffering from bronchial pneumonia, 90 cases, 21 cases of pneumonia, wheezing, 3 cases of bronchitis, the average length of stay for about a week; improved in 79 cases, 33 cases were cured, 2 cases transferred to higher level hospitals. All children with throat congestion, swollen tonsils, lung breath sounds rough, smell and moist rales. 114 penicillin-resistant *Streptococcus pneumoniae* was 64.9%, erythromycin 97.4%, clindamycin 86.8%, tetracycline 87.7%, trimethoprim-sulfamethoxazole 82.5%, amoxicillin 21.9%, cefotaxime 49.1%, chloramphenicol 10.5%, was not found to levofloxacin and vancomycin. **Conclusion:** Penicillin, erythromycin, and clindamycin are not as pneumococcal pneumonia in children experience preferred medication in children less than one year old child could easily cause lung chain *Streptococcus pneumoniae*. Therefore, the antimicrobial resistance of *Streptococcus pneumoniae* analysis provides a reference for experienced clinicians to adjust medication.

Keywords

Streptococcus pneumoniae, Childhood Pneumonia, Drug Resistance

1. Introduction

Streptococcus pneumoniae is one of the most common pathogens causing acquired respiratory tract infections in children. It is not only the pathogen of lobar pneumonia and bronchopneumonia, but also can cause otitis media, mastoiditis, sinusitis, meningitis and bacteremia. Its invasiveness is mainly capsule. The virulence is weakened or lost if the capsule is lost. Hemolysin and neuraminidase are also the main pathogenic factors [1]. In recent years, with the extensive clinical application of broad-spectrum antibiotics, the drug resistance of clinical isolates of *Streptococcus pneumoniae* is becoming more and more serious, and there are great differences between different regions [2]. Strains can produce drug resistance through selective pressure mutation of antibiotics and horizontal gene migration [3]. In order to reduce medication blindness and guide clinical rational drug use, the drug resistance and clinical characteristics of 114 strains of *Streptococcus pneumoniae* isolated from lower respiratory tract specimens in pediatrics of Liuyang Hospital of traditional Chinese medicine in 2020 were retrospectively analyzed.

2. Materials and Methods

2.1. Clinical Material

In 2020, 114 strains of *Streptococcus pneumoniae* were isolated from the sputum of children with lower respiratory tract infection in Liuyang hospital. The ethics approval number was YAH011.

2.2. Sputum Collection

Apply lubricating oil to the top of the sputum suction tube. The child lies on his back. Insert the sputum suction tube into the throat through the pharyngeal cavity or respiratory tract, and connect with the negative pressure sputum suction device to absorb sputum. Sputum was screened under a microscope. If the white blood cells of the specimens were larger than 25/LP, epithelial cells were less than 10/LP or 10 - 25/LP, the culture medium would be further inoculated.

2.3. Bacterial Isolation

The inoculated medium was placed in the incubator at 35°C and incubated in 5% CO₂ for 18 - 24 h. then, the slime colonies with gray, flat, moist, grass-green hemolytic ring, central depression and umbilical fossa or oil drop like colonies were picked out. Apply it on the blood plate with 5 μ After incubated at 35°C and 5% CO₂ for 18 - 24 h, the positive colonies were defined as the diameter of inhibition zone ≥ 14 mm.

2.4. Identification and Drug Sensitivity

The positive strains in optochin disk test were identified as *Streptococcus pneumoniae* by rapid ID32STREP identification card read by French merier ATB semi-automatic identification analyzer, and the quality control strain was *Strep-*

Streptococcus pneumoniae ATCC49619. Then read the cotton test results by ATB STRE5 drug sensitive card of French BioMerieux company.

2.5. Statistical Treatment

Statistical comparison was performed by one-way ANOVA preceded by LSD test. The level of significance for all analyses was set at $p < 0.05$ SPSS 16.0 (Inc., USA) statistical package for Windows was used for data analysis.

3. Results

3.1. Clinical Data

Among the 114 cases, 84 were male and 30 were female. Among them, the oldest was 9 years old and the youngest was 2 months old. 90 (78.5%) were under 1 year old. There were 90 (78.95%) cases with bronchopneumonia, 21 (18.42%) with asthmatic pneumonia and 3 (2.63%) with bronchitis. After a week of hospitalization, 79 cases were improved, 33 cases were cured, and 2 cases were transferred to the superior hospital. All children showed cough, pharyngeal congestion, tonsillar enlargement, bilateral lung breathing sounds thick, audible and moist rales and other symptoms, through imaging examination confirmed pulmonary infection. The number of *Streptococcus pneumoniae* isolated in winter was higher than that in other seasons.

3.2. Antimicrobial Resistance of *Streptococcus pneumoniae*

The drug sensitivity test results of *Streptococcus pneumoniae* to antibiotics are shown in **Table 1**. A total of 114 strains of *Streptococcus pneumoniae* were

Table 1. Susceptibility of 114 strains children of *Streptococcus pneumoniae* to antibiotics (Unit: %).

antibiotic	children			adult		
	Drug resistance rate	Intermediary rate	Sensitivity rate	Drug resistance rate	Intermediary rate	Sensitivity rate
Penicillin	64.9	25.4	9.6	35.3	19.1	45.6
Amoxicillin	21.9	16.7	61.4	16.2	7.4	76.5
Cefotaxime	49.1	25.4	25.4	27.9	13.2	58.8
Levofloxacin	0.0	1.8	98.2	3.0	0.0	97.0
Compound Sulfamethoxazole	82.5	6.1	11.4	67.6	7.4	25.0
Clindamycin	86.8	0.0	13.2	73.5	0.0	26.5
Erythromycin	97.4	0.0	2.6	89.7	0.0	10.3
Vancomycin	0.0	0.0	100.0	0.0	0.0	100.0
Chloramphenicol	10.5	0.0	89.5	10.3	0.0	89.7
Tetracycline	87.7	0.0	12.3	85.3	0.0	14.7

Table 2. According to the results of penicillin susceptibility of *Streptococcus pneumoniae* category 114 (Unit: %).

Antibiotic	PRSP (74 strains)			PISP (29 strains)			PSSP (11 strains)		
	Drug Resistance rate	Intermediary rate	Sensitivity rate	Drug Resistance rate	Intermediary rate	Sensitivity rate	Drug Resistance rate	Intermediary rate	Sensitivity rate
Penicillin	100.0	0.0	0.0	0.0	100	0.0	0.0	0.0	100.0
Amoxicillin	33.8	25.7	40.5	0.0	0.0	100.0	0.0	0.0	100.0
Cefotaxime	73.0	25.7	1.4	6.9	34.5	58.6	0.0	0.0	100.0
Levofloxacin	0.0	2.7	97.3	0.0	0.0	100	0.0	0.0	100.0
Compound Sulfamethoxazole	93.2	4.1	2.7	65.5	3.4	31.0	54.5	27.3	18.2
Clindamycin	91.9	0.0	8.1	75.9	0.0	24.1	81.8	0.0	18.2
Erythromycin	98.6	0.0	1.4	93.1	0.0	6.9	100.0	0.0	0.0
Vancomycin	0.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	100.0
Chloramphenicol	9.5	0.0	90.5	10.3	0.0	89.7	18.2	0.0	81.8
Tetracycline	91.9	0.0	8.1	79.3	0.0	20.7	81.8	0.0	18.2

PSSP: penicillin susceptible *S. pneumoniae*; PISP: penicillin intermediate *S. pneumoniae*; PRSP: penicillin resistant *S. pneumoniae*.

erythromycin 97.4%, tetracycline 87.7%, clindamycin 86.8%, compound sulfamethoxazole 82.5%, penicillin 64.9%, cefotaxime 49.1%, amoxicillin 21.9%, chloramphenicol 10.5%. No resistance to levofloxacin and vancomycin was found. Compared with 68 cases of adult isolated *Streptococcus pneumoniae* in our hospital, the drug resistance rate of children to *Streptococcus pneumoniae* was higher than that of adults, and the detection rate was also higher than that of adults.

According to the resistance, mediation and sensitivity of *Streptococcus pneumoniae* strains to penicillin, *Streptococcus pneumoniae* strains were divided into 74 strains in PRSP group, 29 strains in PISP group and 11 strains in PSSP 1 group three (Table 2). The drug resistance rate of PRSP group was significantly higher than that of PISP and PSSP groups.

4. Discussion

The positive rate of *Streptococcus pneumoniae* was higher in children and adults with young relatives or nursery children, smoking habits, asthma or acute respiratory infection [4]. This study showed that 79% of the children were diagnosed with bronchopneumonia, which was consistent with *Streptococcus pneumoniae* as the main pathogen of bronchopneumonia. The isolation rate of *Streptococcus*

pneumoniae in children with respiratory tract infection ranged from 5.1% to 40.5% [5] [6] due to WHO estimates, in 2008, 8.8 million children under the age of 5 died worldwide, of which 476,000 died from *Streptococcus pneumoniae* infection. In developing countries, the mortality rates of *Streptococcus pneumoniae* sepsis and meningitis were 20% and 50% respectively.

With the wide spread of drug-resistant strains in the world, the rate of antibiotic resistance is increasing. The emergence of multidrug-resistant *Streptococcus pneumoniae* brings severe challenges to clinical treatment [7]. This study showed that the resistance rate of *Streptococcus pneumoniae* to penicillin reached 64.7%, higher than 25.12% [8], and lower than 96.4% [9]. Five high molecular weight PBPs (pbps1a, 1b, 2x, 2a, 2b) and one low molecular weight protein [10] were found in *Streptococcus pneumoniae*. The affinity of penicillin to pbp2B of *Streptococcus pneumoniae* was stronger than that of the fourth generation cephalosporins.

The resistance rate of *Streptococcus pneumoniae* pneumonia to erythromycin, clindamycin and tetracycline was 97.4%, 86.8% and 85.3%, respectively, which were lower than those reported [8] [9] [10] [11]. According to these data, macrolide antibiotics can no longer be used as the first choice of experiential medication for children with community-acquired pneumonia.

The resistance rate of *Streptococcus pneumoniae* to antibiotics commonly used in children is high, and the situation is not optimistic [12] [13]. While antibiotics have cured and saved many patients' lives, there has been a gradual increase in bacterial resistance and the emergence of multi-drug-resistant strains due to the irrational use of antibiotics. In recent years, a rapid diagnostic reagent for *Streptococcus pneumoniae* antigen has been developed, which mainly detects *Streptococcus pneumoniae* antigen in urine, cerebrospinal fluid or pleural effusion [14] [15].

5. Conclusion

To sum up, in the face of the complex drug resistance of *Streptococcus pneumoniae*, there is a long way to go for the continuous monitoring of drug resistance, the control of the spread of multi-drug-resistant strains and the rational use of antibiotics.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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