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Analysis of Pathogen Distribution and Drug Resistance in 1,066 Cases of Community-Acquired Pneumonia in Children

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Abstract: *This study aimed to investigate the etiological profile of community-acquired pneumonia (CAP) in children and to provide evidence for the rational use of antimicrobial agents in clinical practice. A retrospective analysis was performed on 1,066 pediatric patients diagnosed with CAP between November 2024 and February 2025, examining clinical data including age, seasonal distribution, pathogen spectrum, and sputum culture findings. The results demonstrated distinct age and seasonal patterns in pathogen distribution: Mycoplasma pneumoniae was frequently detected across all age groups, with higher prevalence among school-aged children; respiratory syncytial virus was more common in infants and toddlers; and influenza virus infections peaked in winter and spring. Sputum cultures further revealed varying drug resistance profiles among bacterial isolates. In conclusion, the etiology of pediatric CAP is diverse and influenced by age and seasonal factors, underscoring the importance of etiology-guided antimicrobial therapy to optimize treatment outcomes.*

Keywords: *Children; Community-Acquired Pneumonia; Pathogens; Drug Resistance*

1. Introduction

Community acquired pneumonia (CAP) refers to an infectious inflammation of the lung parenchyma (including alveolar walls, also known as pulmonary interstitium) that occurs outside of a hospital, including pneumonia caused by pathogens with a clear latent period that develops within an average latent period after admission. CAP is one of the common infectious diseases in clinic. The incidence rate and mortality rate of pneumonia in children are very high, and it is the primary cause of common diseases and hospitalization in infancy [1]. There are numerous pathogenic microorganisms that can cause CAP, including bacteria, viruses, atypical pathogens, etc. The widespread use of immunosuppressants, hormones, and antibiotics has led to changes in the types, distribution, and resistance of pathogens[1]. To ensure the effectiveness of CAP treatment, we analyzed the pathogen distribution and drug resistance of 1066 pediatric CAP patients who received treatment, aiming to understand the pathogen spectrum of community-acquired pneumonia in children in the local area provide reference for clinical treatment and rational drug use based on the situation of point and drug resistance.

2. Data and methods

2.1 Data selection

CAP patients who were treated and hospitalized at Dezhou Municipal Hospital from November 7, 2024 to February 2025 were selected as the research subjects. Inclusion criteria: 1) Complies with the diagnostic criteria for childhood community-acquired pneumonia (CAP) established by the Diagnosis and Treatment Standards for Children (2019) [2]; 2) Age ≤ 18 years old, gender not limited. Exclusion criteria: 1) Patients with hospital acquired pneumonia, infectious diseases, asthma and other respiratory system diseases; 2) Children with other congenital or chronic underlying diseases; 3) Use immunosuppressants or children with immunodeficiency diseases.

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2.2 Method

2.2.1 Clinical specimen collection

1) Collect clinical specimens as soon as possible after confirming that the patient meets the definition of the case in this study (preferably before taking treatment measures). 2) Collect sputum or bronchial wash samples. Phlegm: Morning sputum is best. Cough deeply and forcefully, spit directly into a sterile collection container, and immediately send for testing. For children who do not cooperate, the pediatric sputum collection method can be used. While using a curved tongue depressor to press the tongue down and backwards, gently insert the swab into the throat. When the child coughs due to tongue stimulation, lung or tracheal secretions can be sprayed out, and the secretions adhered to the swab can be placed in a sterile collection container.

2.2.2 Bacterial identification

Within half an hour, the specimens were inoculated onto blood and chocolate plates and cultured in a 5% CO2 incubator at 35 ℃ for 24 hours to analyze the bacterial growth status. Using the VITEK 2-compact 3.0 fully automated microbial identification system (BioMerieux, France) for sputum pathogen detection; The criteria for determining sputum culture results are based on the "National Clinical Laboratory Operating Procedures".

2.2.3 Detection of viruses and atypical pathogens

The throat swab real-time fluorescence quantitative PCR (Polymerase Chain Reaction, PCR) method was used for respiratory virus pathogen detection, including respiratory syncytial virus, adenovirus, rhinovirus, influenza A virus, influenza B virus, Mycoplasma pneumoniae, etc. Positive results indicate the presence of corresponding viruses and Mycoplasma pneumoniae infections. The atypical pathogen in this article mainly refers to Mycoplasma pneumoniae.

2.3 Statistical processing

Using SPSS 24.0 software, count data is expressed as percentages (%).

3. Results

3.1 Pathogen detection in CAP patients

Table 1 2024.11-2025.2 Pathogen Types and Detection Status of CAP Children in Dezhou City

Pathogen types		Number of strains	Positive rate (%)
	sputum culture	116	116/708 16.4
germ	SA	38	5.4
	Klebsiella pneumoniae	11	1.6
	E.coli	18	2.5
	baumanii	8	1.1
	Pseudomonas aeruginosa	6	0.8
	Streptococcus pneumoniae	5	0.7
	Other gram-negative bacteria	30	4.2
virus	influenza A virus	88	12.9
	influenza B virus	4	0.6
	syncytial virus	64	9.4
	adenovirus	57	8.4
	rhinovirus	25	3.7
Atypical pathogens	Eaton's agent	532	532/985 54.0
	Pneumococcal mycoplasma resistance	179	179/324 55.2
mixed infection	Mycoplasma + bacteria	46	7.1
	Mycoplasma + virus	66	10.9
	Bacteria + Virus	23	4.9

Out of 1066 cases, 739 (69.3%) were pathogen positive. A total of 886 pathogens were detected, including 116 bacteria (13.1%), mainly including Staphylococcus aureus, Klebsiella pneumoniae, Escherichia coli, Acinetobacter baumannii, Pseudomonas aeruginosa, etc. 238 strains (26.7%) of viruses

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were detected, mainly including respiratory syncytial virus, influenza A virus, adenovirus, etc. 532 cases (60.0%) of atypical pathogens were mainly detected as Mycoplasma pneumoniae. The main Gram positive bacteria have high resistance to erythromycin; The main Gram negative bacteria have high resistance to ceftriaxone and ampicillin, and high sensitivity to piperacillin tazobactam and meropenem. (See Table 1.)

3.2 Drug resistance of major pathogens

Analyze the drug resistance of major gram-negative pathogens (Klebsiella pneumoniae, Escherichia coli, Acinetobacter baumannii, Pseudomonas aeruginosa) and major gram-positive bacteria (Staphylococcus aureus, Streptococcus pneumoniae). Staphylococcus aureus has a high resistance rate to gentamicin, erythromycin, and benzylpenicillin, with rates of 45%, 69.6%, and 44%, respectively. It is also highly sensitive to fusidic acid, vancomycin, and linezolid. The resistance rate to piperacillin sodium and tazobactam is relatively low. The resistance rates of Klebsiella pneumoniae to cefotaxime, ceftriaxone, and azuron are relatively high, at 33%, 44%, and 44%, respectively; Highly sensitive to piperacillin tazobactam, amoxicillin clavulanate potassium, levofloxacin, and meropenem; The resistance rate to cefepime and gentamicin is relatively low. The resistance rates of Escherichia coli to ceftriaxone and gentamicin are relatively high, reaching 36.4% and 38.5%, respectively; High sensitivity to piperacillin sodium, tazobactam, and meropenem; The resistance rate to amoxicillin, clavulanate potassium, cefepime, azuron, and levofloxacin is relatively low. Acinetobacter baumannii has a high resistance rate to ceftriaxone, reaching 50%, and is highly sensitive to piperacillin sodium tazobactam, amoxicillin clavulanate potassium, cefepime, gentamicin, azuron, levofloxacin, and meropenem. (See Tables 2 and 3.)

Table 2 Resistance analysis of Gram positive bacteria in CAP children in Dezhou City to commonly used antibiotics from November 2024 to May 2025

antibacterials	Klebsiella pneumoniae (11 strains)		Escherichia coli (18 strains)		Acinetobacter baumannii (8 strains)	
	bacterial strain	Drug resistance rate (%)	bacterial strain	Drug resistance rate (%)	bacterial strain	Drug resistance rate (%)
Piperacillin tazobactam	0	0	0	0	0	0
Amoxicillin clavulanate potassium	0	0	2	20	-	-
nebcin	0	0	1	9.1	0	0
ceftazidime	2	33	0	0	0	0
cefatriaxone	4	44	4	36.4	1	50
Cefoperazone and sulbactam	0	0	0	0	0	0
cefepime	2	22	1	10	0	0
gentamicin	2	22	5	38.5	0	0
aztreonam	4	44	1	9.1	0	0
Levofloxacin	0	0	3	27.3	0	0
Meropenem	0	0	0	0	0	0

Table 3 2024.1-2025.2 Analysis of resistance of gram-negative bacteria in CAP children in Dezhou City to commonly used antibiotics

antibacterials	Staphylococcus aureus (38 strains)		Streptococcus pneumoniae (5 strains)	
	bacterial strain	Drug resistance rate (%)	bacterial strain	Drug resistance rate (%)
Piperacillin tazobactam	1	16.7	0	0
ceftazidime	0	0	-	-
cefatriaxone	0	0	0	0
Cefoperazone and sulbactam	0	0	-	-
gentamicin	1	4.5	-	-
fusidic	0	0	-	-
erythromycin	16	69.6	2	100
Levofloxacin	3	11.5	0	0
oxacillin	11	44	-	-
vancomycin	0	0	0	0
linezolid	0	0	0	0

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4. Discussion

For a long time, scholars at home and abroad have conducted extensive research on the pathogen distribution of community-acquired pneumonia, especially the distribution of bacteria. In the past, bacteria were thought to be the main pathogen of community-acquired pneumonia in children. However, in recent years, epidemiological investigation literature reports have shown that the infection rate of Streptococcus pneumoniae has decreased, while the infection rate of atypical pathogens is constantly increasing. Mycoplasma pneumoniae is the main pathogen of community-acquired pneumonia in children and adolescents, and its infection rate has been increasing year by year in pediatrics. Pneumonia caused by Mycoplasma pneumoniae accounts for 20% to 40% of childhood pneumonia[3]. In this study, the infection rate of Mycoplasma pneumoniae reached 60%, with a relatively high infection rate and a significantly higher drug resistance rate than developed countries such as Europe and America [4-5], and lower than the 92.7% resistance rate of MP to macrolide antibiotics reported by Jiang et al. in hospitalized children in Beijing [6]. Mycoplasma pneumoniae infection and drug resistance in children have obvious regional characteristics, which are correlated with the local economic development level, distribution of medical resources, and residents' health awareness. The clinical symptoms of pneumonia caused by Mycoplasma pneumoniae infection are diverse, similar to pneumonia caused by other pathogens, which increases the difficulty of clinical diagnosis. Therefore, pathogen diagnosis is particularly important for clinical treatment.

In recent years, with the improvement of detection methods, particularly the application of rapid respiratory test kits, there has been increasing attention to viral causes of CAP. In this study, viral infections accounted for 26.7%, which is lower than the 33.0% reported by Chen Jinni [7] in children with CAP. Respiratory syncytial virus (RSV) was identified as the leading viral pathogen in pediatric CAP, consistent with her findings. RSV-induced pneumonia often has an acute onset and rapid progression. Studies have reported that many hospitalized children with RSV-associated pneumonia require transfer to the intensive care unit or mechanical ventilation [8,9]. This highlights the importance of remaining vigilant in clinical practice for the risk of RSV pneumonia progressing to severe disease, closely monitoring patients, and ensuring early intervention and treatment.

The detection rate of bacteria in this study was lower than that of Mycoplasma pneumoniae and viruses, which is inconsistent with the view that bacterial infection is the main cause of pneumonia in children in developing countries[10]. The highest detection rate among detected bacteria is Staphylococcus aureus, followed by Escherichia coli and Klebsiella pneumoniae, which is inconsistent with Lin Jianmin's research on the bacterial etiology of CAP in children in the southern Fujian region [11]. Therefore, when treating bacterial CAP patients in clinical practice, consideration should be given to the coverage of common local pathogens, and empirical drug selection should be targeted. Bacterial resistance is a serious public health issue, limited by the limitations and specificity of antimicrobial drug selection in children. The issue of drug resistance should be highly valued, and the indications for drug selection should be strictly controlled to delay microbial resistance[12]. By analyzing the pathogen composition and drug resistance of the main pathogens in pediatric CAP patients in Texas, reference can be provided for clinical prevention and treatment of pediatric CAP.

5. Conclusion

Bacterial resistance is a serious public health issue, limited by the limitations and specificity of antimicrobial drug selection in children. The issue of drug resistance should be highly valued, and the indications for drug selection should be strictly controlled to delay microbial resistance. This study provides a reference for clinical prevention and treatment of childhood CAP by analyzing the pathogen composition and drug resistance of major pathogens in pediatric CAP patients in Dezhou.

References

[1] Hongping Li, Hua Li. Investigation on Influencing Factors and Preventive Measures for Hospital-Acquired Pneumonia in Inpatients[J]. Maternal and Child Health Care of China, 2018, 33(15): 3511-3513.

[2] National Health Commission of the People's Republic of China, National Administration of Traditional Chinese Medicine. Diagnosis and Treatment Guidelines for Community-Acquired Pneumonia in Children (2019 Edition) [J]. Chinese Journal of Clinical Infectious Diseases, 2019, 12(1): 6-13.

ISSN 2706-6819 Vol.7, Issue 4: 113-117, DOI: 10.25236/IJFM.2025.070414

[3] Xiaoyan Fu, Deli Xin, Xuanguang Qin. Research Progress in the Epidemiology, Clinical Characteristics, Pathogenesis, and Treatment of Mycoplasma pneumoniae Infection in Children[J]. Shandong Medical Journal, 2015, 55(4): 96-99.

[4] Loconsole D, De Robertis AL, Sallustio A, et al. Update on theepidemiology of macrolide-resistant mycoplasma pneumoniae in Europe: a systematic review[J]. Infect Dis Rep, 2021, 13(3):811-820. DOI: 10.3390/idr13030073.

[5] Waites KB, Ratliff A, Crabb DM, et al. Macrolide-resistant mycoplasma pneumoniae in the United States as determined from a national surveillance program[J]. J Clin Microbiol,2019, 57(11):16-19. DOI:10.1128/JCM.00968-19.

[6] Jiang TT, Sun L, Wang TY, et al. The clinical significance of macrolide resistance in pediatric mycoplasma pneumoniae infection during COVID-19 pandemic[J]. Front Cell Infect Microbiol,2023, 13:1181402. DOI:10.3389/fcimb.2023. 1181402.

[7] Jinni Chen. Analysis of pathogenic characteristics of 600 cases of community-acquired pneumonia in children [J]. Chinese Journal of Pathogenic Microbiology, 2016, 11 (12): 1126-1130.

[8] Chunmei Yu,Xiqiang Yang, Feng Xu, et al. Analysis of respiratory virus pathogens in infants and young children with severe pneumonia in Chongqing [J]. Chinese Journal of Pediatrics, 2010, 48 (2): 143-147.

[9] Jie Lin, Lin Dong, Haiyan Li, et al. Clinical characteristics and analysis of antibiotic use in severe respiratory syncytial virus pneumonia [J]. Journal of Clinical Pediatrics, 2011, 29 (5): 454-458.

[10] Mathew JL, Singhi S, Ray P, et al. Etiology of community acquired pneumonia among children in India: proapective, cohort study[J]. J Glob Health, 2015, 5(2): 50418.

[11] Jianmin Lin, Ling Chen, Qingrong Lian, et al. Analysis of the pathogenic characteristics of 5869 children with community-acquired pneumonia in the southern Fujian region [J]. Chinese Journal of Microbiology, 2018, 30 (10): 1160-1163.

[12] Jinqiang Deng, Investigation of pathogenic bacteria in community-acquired pneumonia in children and study on rational use strategies of antibiotics [J]. Modern Drug Application in China, 2018, 12 (7): 151-153.