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Bacteriological And Clinical Profile of Community Acquired Pneumonia in Children with Associated Co-Morbidities in A Tertiary Care Centre in Western Maharashtra

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Abstract

Background:
In the Indian context, pneumonia contributes significantly to the pediatric disease burden, with a considerable number of cases occurring in the under-5 age group, the disease accounts for about a quarter of the under-five mortality in the country. Despite the substantial burden of pneumonia among children in Western Maharashtra, there exists a paucity of local data specifically focusing on the bacteriological and clinical profile of community-acquired pneumonia in children with associated co-morbidities. By undertaking this study, we aim to address this critical gap in knowledge.

Methods: This was a prospective, observational, study, conducted over the duration of 1 year. Enrolment of children aged 1 month to 5 years, fulfilling the WHO IMNCI case definition of CAP designed for children <5 years was carried out. After that, pneumonia severity was categorized based on the WHO classification. A blood sample was drawn by venipuncture. One to three ml blood was processed for bacterial culture using BACTEC/ALERT media and isolates were identified to species level. A nasopharyngeal aspirate (NPA) specimen was obtained from all children and subjected to bacterial cultures. All the data was tabulated in Microsoft Excel and Statistical analysis was done using SPSS program (version20).

Results: A total of 96/139 children (69.1%) were diagnosed with severe pneumonia and 43/139 children (30.9%) with very severe disease. Acute malnutrition was observed in 78/139 children (56.1%). The most common organism isolated on blood culture was Streptococcus pneumonia (5.03%) followed by Staphylococcus aureus (3.6%) and Hemophilus influenza (2.2%). The most common organism isolated on nasopharyngeal aspirate culture was Streptococcus pneumonia (9.35%), followed by Streptococcus aureus, Hemophilus influenza, Klebsiella and Pseudomonas.

Conclusions: The study's conclusions have substantial significance for future research projects, public health policies, and clinical practice. We seek to guide targeted treatments that aim to avoid pneumonia, improve diagnostic accuracy, rationalize the use of antibiotics, and improve patient care overall by producing strong evidence that is appropriate for the local context.

Keywords: Blood culture, Community acquired pneumonia, nasopharyngeal aspirate

Introduction

Pneumonia is the leading cause of childhood morbidity and mortality globally.[1] It is estimated that there were over 120 million episodes of pneumonia among children younger than five years during 2010-11 of which over 10% were severe episodes.[2]

In the Indian context, pneumonia contributes significantly to the pediatric disease burden, with a considerable number of cases occurring in the under-5 age group, the disease accounts for about a quarter of the under-five mortality in the country.[3] Factors such as overcrowded living conditions, air pollution, inadequate nutrition, and suboptimal healthcare infrastructure contribute to the high prevalence of pneumonia, particularly in regions like Western Maharashtra, where socio-economic disparities and environmental challenges intersect.[4-6] The burden of CAP is further compounded when co-morbidities exist; presenting a complex clinical scenario that demands meticulous management and targeted interventions.[7]

Recognizing this burden, the World Health Organization (WHO) developed and disseminated a simple case definition for identification and treatment of pneumonia, which could be used by field-workers in resource poor settings. It relies on the physiological principle that parenchymal lung disease results in compensatory tachypnea; therefore, any tachypnea indirectly indicates parenchymal disease including pneumonia. This case definition is highly sensitive, and does not require chest radiography.[8,9]

The bacteriological profile of community-acquired pneumonia is different in different countries and changing with time within the same country, probably due to frequent use of antibiotics, changes in environmental pollution, sanitation, increased awareness of the disease and vaccination coverage.[10] In the context of Western Maharashtra, where both urban and rural populations intermingle amidst various environmental challenges, understanding the bacteriological and clinical nuances of CAP in children with co-morbidities becomes imperative.

Despite the substantial burden of pneumonia among children in Western Maharashtra, there exists a paucity of local data specifically focusing on the bacteriological and clinical profile of community-acquired pneumonia in children with associated co-morbidities. This knowledge gap hampers the formulation of contextually relevant interventions and impedes progress towards achieving optimal health outcomes for affected children.

By undertaking this study, we aim to address this critical gap in knowledge by systematically investigating the bacteriological and clinical characteristics of pneumonia in children with co-morbidities within our tertiary care center.

The findings of this research hold the potential to inform evidence-based clinical practices, guide antimicrobial stewardship initiatives, and foster collaborative efforts towards combating pediatric pneumonia and ultimately improving patient outcomes in Western Maharashtra and beyond.

Methods:

This was a prospective, observational, study, conducted over the duration of 1 year at a tertiary care medical college hospital in Western Maharashtra to identify the clinico-etiological profile of children with diagnosis of community acquired pneumonia (CAP) admitted in the hospital.

Simple convenience non-probability sampling technique was used for data collection.

Enrolment of children aged 1 month to 5 years, fulfilling the WHO IMNCI case definition of CAP designed for children <5 years was carried out.

All children received standard treatment including antibiotics, other medications as required and supportive care as per institution guideline. Each child underwent a detailed history and clinical examination.

Tachypnea was defined as respiratory rate >60/min for infants <2 months; >50/min for infants 2-12 months; >40/min for children >12–60 months; and >30/min for children >60 months.

Children with duration of illness >7 days; those with previous hospitalization within the preceding 30 days, evidence of immunodeficiency were excluded.

After that, pneumonia severity was categorized based on the WHO classification. In addition, all children underwent chest radiography. The chest radiographic of all children were reviewed by a senior pediatrician and radiologist and classified as alveolar, interstitial, and bronchopneumonia. The co-morbid conditions associated and immunization statuses were also noted.

A blood sample was drawn by venipuncture for routine investigations (hemogram, blood biochemistry). One to three ml blood was processed for bacterial culture using BACTEC/ALERT media. The bottles were incubated at 37°C for seven days and isolates were identified to species level by

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conventional biochemical and serological tests. A nasopharyngeal aspirate (NPA) specimen was obtained from all children using a sterile, disposable suction catheter and subjected to bacterial cultures.

All the data was tabulated in Microsoft Excel and Statistical analysis was done using SPSS program (version20). Categorical data are expressed as frequency and percentage. Continuous data (if any) are expressed with mean and standard deviation. Chi-square test was used to compare two categorical data. A P-value of <0.05 was considered statistically significant.

An informed consent was taken from patient's attendant before enrolling the patient in the study.

The study protocol was approved by the Ethical committee of Dr. Vithalrao Vikhe Patil Foundation's Medical College and Hospital, Ahmednagar and ethical clearance was obtained before starting the study.

Sample size was calculated using the formula N=z2 pq/d2 where, p=prevalence, q=p-1, N=sample size, z=1.96 at 95% confidence interval (CI), d=maximum tolerable error. Estimated sample size was 139.

Results:

In a period of 12 months, a total of 139 children were enrolled.

Their baseline characteristics were noted and workups were done.

Blood cultures and nasopharyngeal aspirates were sent for etiological diagnosis.

Table 1: Baseline characteristic of children enrolled in the study.

	Number (n)	**Percentage**
Gender		
Male	74	53.2
Female	65	46.8
Age Group		
<12 months	33	23.7
12-59 months	75	54
>= 60 months	31	22.3
Severity		
Severe pneumonia	96	69.1
Very severe pneumonia	43	30.9
Co-morbidity		
Malnutrition	78	56.1
Asthma	38	27.3
Others	23	16.6
Immunization status		
Immunized	90	64.7
Partially immunized	45	32.4
Not immunized	4	2.9

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There were 74 (53.2%) males and 65 (46.8%) females. Majority of patients were in the age group of 12-59 months (75) (54%) followed by age group of <12 month (33) (23.7%) and >60 months (31) (22.3%). A total of 96/139 children (69.1%) were diagnosed with severe pneumonia and 43/139 children (30.9%) with very severe disease. Acute malnutrition defined as weight for age z score less than 3, was observed in 78/139 children (56.1%). It was most common co-morbid condition identified in the admitted children. There were 90/139 children (64.7%) who were completely immunized and 49/139 children (35.3%) were partially immunized as per national immunization schedule. Almost all children presented with cough, fever and rapid breathing.

Table 2: Presenting symptoms, clinical examination findings and chest radiograph at enrolment into the study.

	Number (n)	**Percentage**
Symptoms		
Cough	128	92.1
Fever	121	87.1
Rapid breathing	115	82.8
Refusal to feed	15	10.8
Signs		
Chest retractions	130	93.5
Crackles	124	89.2
Wheezes	116	83.5
Abnormal breath sounds	121	87.1
Clinical diagnosis of cases		
Bronchopneumonia	105	75.5
Lobar pneumonia	28	20.1
Pneumonia with complication (ARDS, Empyema, effusion, pneumothorax)	6	4.3

The common symptoms in the decreasing order of frequencies were cough (921%), fever (87.1%) and rapid breathing (82.8%).

The other atypical symptoms were refusal to feed, convulsions, abdominal pain, chest pain and vomiting.

The common signs were crackles, chest retractions, wheezes and abnormal breath sounds.

A large proportion of these children had clinical diagnosis of bronchopneumonia (75.5%) followed by Lobar pneumonia and pneumonia with complications.

Blood cultures were positive in 21/139 patients (15.1%) and nasopharyngeal aspirates were positive in 37/139 patients (26.6%).

The most common organism isolated on blood culture was Streptococcus pneumonia (5.03%) followed by Staphylococcus aureus (3.6%) and Hemophilus influenza (2.2%).

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The most common organism isolated on nasopharyngeal aspirate culture was Streptococcus pneumonia (9.35%), followed by Streptococcus aureus, Hemophilus influenza, Klebsiella and Pseudomonas.

Table 3: Bacterial culture in clinical specimen.

Organism	**Blood n=139**	**Nasopharyngeal aspirates n=139**
Staphylococcus aureus	5	8
Streptococcus pneumonia	7	13
Pseudomonas aeruginosa	2	3
Hemophilus influenza	3	5
Staphylococcus albus	1	2
Klebsiella spp	2	3
Enterococci	1	2
Citrobacter	0	1
Total	**21**	**37**

In this study, 38.3% cases require ICU admission and 61.7% cases were admitted to general ward. The number of patients expired were 14 out of 139. The case fatality rate was 10.1%.

Discussion:

Pediatric pneumonia presents a multifaceted challenge, characterized by diverse bacteriological and clinical profiles that influence its management. Understanding the spectrum of pathogens involved, clinical manifestations, and associated comorbidities or risk factors such as prematurity, malnutrition, or immune compromise is crucial for effective treatment and prevention strategies in children.

This study has comparable admissions of male as well as female children with a slightly higher preponderance of males (53.2%). A study done in Bangladesh[11] has also mentioned that male children were predominant in their study and has attributed the same to genetic causes or higher reporting for male children by the mothers due to gender bias, which potentially causes mothers to notice symptoms due to a higher attention to male children particularly for seeking health care much earlier than female children. Another possibility of male children to be in the high risk of infection could be the testosterone suppressing the immune response.[12]

Age is an important predictor of morbidity and mortality in pediatric pneumonias. The maximum number of cases of CAP (54%) belongs to the age group 12 month-59 months. This is in accordance with other studies in India, the most vulnerable age group for pneumonia was 12 month – 59 months.[13]

In the present study, 64.7% cases were completely immunized while 35.3% cases were either partially immunized or unimmunized.

The risk of acquiring pneumonia in unvaccinated children was found to be higher than vaccinated children. This result was similar with studies conducted in Brazil.[14] This outcome was likewise supported by Jackson et al.'s systematic review. [15] The reason behind this association might be due to low or weak immunity. So, children who were unvaccinated will have weak immunity and increased probability of acquiring infections including pneumonia.[16]

Malnutrition was associated with 56.1% of cases and asthma with 27.3% of cases. Malnutrition was most common co-morbidity associated with CAP. This was in concordance with other studies that shows malnutrition, congenital anomalies, and asthma to be the significant risk factors associated with pneumonia.[17] Malnutrition in children results in an immunocompromised state and subsequent increase in

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infectious morbidity and mortality due to impairments in multiple aspects of the immune system including cell mediated and complement responses, inefficient chemotaxis, reduced mature T cells, compromised phagocytic activity, among others. The results of our study highlight the importance of stunting in children being treated for severe pneumonia.[18]

The WHO protocol puts forward two signs as the "entry criteria" or basis for examining a child bellow five years of age for possible pneumonia: cough or difficult breathing. The incidences of these symptoms in present study are almost 90% comparable to other studies in India.[19]

Tachypnoea has been a sensitive and specific indicator for the presence of pneumonia. In this study, cough (92.1%), fever (87.1%) tachypnea (82.8%) and chest retractions (93.5%) were the important findings for making a clinical diagnosis of pneumonia. Crepitations (72.31%), wheeze (14.61%) and abnormal breath sounds (15.38%) were the other associated signs. These findings are in consonance with other studies which showed that tachypnoea and chest retractions were highly specific signs for detecting pneumonia.[20]

In this study, bronchopneumonia was the most common diagnosis made at admission (75.5%) followed by lobar pneumonia (16.4%) and pneumonia with complications were seen in 8.1%. Complications of pneumonia include empyema, pleural effusion, pneumothorax, and ARDS. These findings were similar to other studies conducted earlier. [21]

In this study, blood culture was positive in 21 cases (15.1%). The yield of blood culture varies from 5-15% for bacterial pathogens in other studies.[19]

In the small number of positive blood cultures, *S. pneumoniae* predominated followed by *S. aureus* and *H. influenza.*

Because of low yield and long reporting time, traditional blood culture is not very useful as a diagnostic tool. Therefore, researchers have used nasopharyngeal aspirate (NPA) to assess possible etiology. However, the NPA reflects the organism present in nasopharynx and does not necessarily reflect the causative organism of CAP.[22]

In the present study, we could identify etiological agent by the conventional culture studies of NPA nasopharyngeal aspirate in 37 (26.6%) cases. The common organisms isolated were *S. pneumoniae* followed by *S. aureus* and *H. influenzae*. Present study results are consistent with some previous results from India. The rate of isolation in previous Indian studies for *S.pneumoniae* was 9% to 40% and for *H. influenzae* was 7.6% to 22.7%.[23,24] It has been debated that nasopharyngeal colonization may or may not translate into disease itself. Though this is true, studies have shown nasopharyngeal colonization to be a risk factor for development of pneumonia.[25]

Several studies showed that *S. pneumoniae* was most common organism (30–50%)[26,27] followed by *H. influenzae* type b in 8.8% [28] and *Staphylococcus aureus* 7–23% [29]

Other organisms had also been isolated like *Acinetobacter* in 20% [28] and *Klebsiella pneumoniae* in 3.3–20.5% [28]

Conclusion:

The study's conclusions have substantial significance for future research projects, public health policies, and clinical practice. We seek to guide targeted treatments that aim to avoid pneumonia, improve diagnostic accuracy, rationalize the use of antibiotics, and improve patient care overall by producing strong evidence that is appropriate for the local context.

This study underscores the public health importance of addressing CAP in children with co-morbidities. Preventive strategies such as vaccination against common pathogens (e.g., pneumococcal and Haemophilus influenzae type b vaccines) should be prioritized, especially for high-risk populations. Enhancing nutritional programs and ensuring early diagnosis and treatment of underlying conditions can significantly reduce the burden of CAP in these vulnerable groups.

Furthermore, this study opens the door for interdisciplinary cooperation and coordinated efforts to lessen the burden of paediatric pneumonia in Western Maharashtra and comparable contexts across the globe by promoting a greater understanding of the intricate interactions between pneumonia and co-morbidities.

Limitations:

While the study provides valuable insights, it has limitations. Our study was conducted for a short time

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period, had a limited sample size and was a single centre-hospital based study. Additionally, the study focused only on bacterial pathogens, potentially overlooking viral co-infections that are common in paediatric CAP. Future studies need to be conducted on a larger scale to substantiate our findings and should consider a multicentre approach and include comprehensive pathogen identification, including viral and atypical bacteria. The nature of convenience sampling also limits the generalization of these findings to the entire paediatric population of India. However, this study provides a good idea about the bacteriological and clinical profile of CAP in under-5-year children with associated co-morbidities.

Recommendations:

1. **Enhanced Surveillance and Early Detection:**
    - Establish robust surveillance systems for pneumonia, especially among children with co-morbidities.
    - Promote community-based initiatives for early symptom recognition and timely healthcare access.
2. **Strengthening Immunization Programs:**
    - Ensure universal access to pneumonia vaccines, prioritizing high-risk populations like children with co-morbidities.
3. **Optimal Management of Co-morbidities:**
    - Develop comprehensive management protocols addressing specific needs of co-morbid conditions predisposing children to pneumonia.
4. **Antimicrobial Stewardship and Rational Antibiotic Use:**
    - Promote judicious antibiotic use based on local epidemiology and antimicrobial resistance patterns.
    - Implement antimicrobial stewardship programs to optimize antibiotic selection and dosing.
5. **Nutritional Interventions and Supportive Care:**
    - Advocate for nutritional support and comprehensive care for children with malnutrition.
    - Provide supportive measures, including oxygen therapy and respiratory support, for severe pneumonia cases.
6. **Health Education and Empowerment:**
    - Conduct community-based health education programs on pneumonia prevention and symptom recognition.
    - Empower caregivers with knowledge and skills for preventive measures and timely healthcare seeking.
7. **Research and Innovation:**
    - Encourage further research on pneumonia-co-morbidity interactions and innovative preventive strategies.
    - Foster collaboration for translating research findings into evidence-based interventions.

Implementing these recommendations can significantly reduce the burden of pneumonia among children under 5, improving overall health outcomes and fostering community well-being.**References:**

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