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Clinico-microbiological study of severe pneumonia in below five years age of children

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Abstract
Background: Pneumonia is the leading cause of childhood morbidity and mortality under five-year-old children globally. 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.
Materials and Methods: This prospective and cross sectional study was conducted at Department of Pediatrics and Department of Microbiology, N.C. Medical College and Hospital, Israna, Panipat, India, over a period of one year from May 2018 to April 2019. Total 150 children below 5 years of age were included in the study.
Results: Total 150 cases examined in the study out of which 46% children belonged to 0-1 year of age, 32.67% 1-2 years and 21.33% children from 2-5 years. Males were 66% and females 34%. 147 (98%) children had fever history, 150 (100%) children had cough, tachypnea and chest in drawing which were the most common symptom observed in the study, followed by inability to take food or refusal was observed in 61 (40.67%) children, hepato splenomegaly was observed in 33 (22%). Severity of the disease was recorded according to WHO classification, severe pneumonia was observed in 94 (62.67%) and very severe pneumonia was observed in 56 (37.33%) Blood cultures were positive in 22.67% children (22.67%) and nasopharyngeal aspirates were positive in 36.67% children. The most common organism isolated from blood and nasopharyngeal culture was *Staphylococcus aureus* (10.67%) followed by *Streptococcus pneumoniae* (4.67%).
Conclusions: *Streptococcus pneumoniae* and *Staphylococcus aureus* predominate in blood culture and nasopharyngeal aspirates respectively. Our study highlights the use of blood culture and nasopharyngeal aspirates culture to confirm the bacterial pathogens of pneumonia.

Keywords: Pneumonia, cough, fever, blood culture

Introduction
Pneumonia is the leading cause of childhood morbidity and mortality globally. 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 [1]. A recent systematic review estimated 0.22 pneumonia episodes per child year in developing countries alone, with nearly one in eight cases progressing to severe disease [2]. Yet another systematic review estimated nearly 12 million hospitalizations in 2010 due to severe pneumonia and 3 million due to very severe disease [3]. Pneumonia is also estimated to be responsible for almost 1 million deaths among children under 5 years old [4], with maximum burden in Africa and South Asia [3]. India has a high burden of childhood pneumonia and the disease accounts for about a quarter of the under-five mortality in the country [5]. 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 [6-9]. 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 [10]. In the year 2015, it was reported that there were 5.9 million deaths of children under 5 years of age globally, of which 1.2 million (20%) occurred in India alone. Currently, India has an under 5 mortality rate of 48 per 1000 live births. Community acquired pneumonia (CAP) contributes to about one sixth of this mortality [11]. of cell wall of GAS contains several antigenic proteins, the most is M-protein and hence it can be divided on the basis of their M-protein into 80 distinct types [9].Virulence and likelihood of antibody response are dependent on the presence and amount l of the M-protein. M-protein inhabits

the phagocytosis of GAS by polymorph neutrophils [10] Approximately, 150 million episodes of childhood pneumonia are reported every year from the world, out of which 95% are from Developing countries. India alone bears the brunt of 25% disease burden [12]. Pneumonia accounts for 18% of annual deaths in under five-year-old children worldwide, 20% in developing countries compared to only 4.3% in developed countries [13]. Child Health Epidemiology Reference Group (CHERG) WHO methods and data sources for child's causes of death in 2015, also shows that pneumonia is one of the leading causes of death in post neonatal (1-59 months) children [14]. In addition, socioeconomic and environmental factors like overcrowding, air pollution, passive smoking, practice of bottle feeding etc., contribute to the significant rise in incidence of pneumonia during recent years [15]. Pneumonia is a leading cause of mortality in under five-year-old in developing countries. The known factors affecting mortality are malnutrition, inadequate vaccination, illiteracy and lack of exclusive breast feeding.

Materials and Methods

Study design: Prospective and cross sectional study.

Sample design: Total 150 children of 0 to 5 years of age were included in this study. Each child underwent a detailed history and clinical examination. After that, pneumonia severity (severe and very severe pneumonia) was categorized based on the WHO classification [16]. A patient was considered to have severe pneumonia when chest in-drawing was present along with fast breathing. Very severe pneumonia was considered when patient presented with any one of the following signs i.e., cyanosis, severe chest in drawing, feeding difficulty, along with fast breathing. Fast breathing was considered to be present when the respiratory rate was ≥ 50 breaths per minute for infants of 2 to 12 months of age and ≥ 40 breaths per minute for children between 12 months to 5 years of age.

Place of study: Department of Pediatrics and Department of Microbiology, N.C. Medical College and Hospital, Israna, Panipat, Haryana, India

Period of study: One year from May 2018 to April 2019.

Inclusion criteria

1. Children were included age group of 0 to 5 years.
2. Cases were included as per WHO criteria for pneumonia, severe pneumonia or very severe pneumonia.
3. All cases of community-acquired pneumonia were included.

Exclusion criteria

1. Children were age more than 5 years were excluded.
2. Children with underlying heart disease or pulmonary tuberculosis presenting as pneumonia, were excluded.
3. All cases of hospital-acquired pneumonia were excluded.

Ethical clearance: Informed consent was obtained from the parents prior to inclusion of subjects (infants) into the study. Ethical committee approval was obtained from the Institutional Ethical Committee of N.C. Medical College and Hospital prior to the study.

A 1 to 3 ml blood sample was drawn by venipuncture and transferred into blood culture bottle (Brain Heart Infusion broth, Hi Media Labs, Mumbai, India) for bacterial culture. The bottles were incubated at 37°C for seven days, subculture were done onto blood agar, Mac Conkey's agar and chocolate agar. A nasopharyngeal aspirate specimen was obtained from all children using a sterile, disposable suction catheter and subjected to bacterial cultures, sample were processed according to standard microbiological procedures. The samples were inoculating with loop onto blood agar, Mac Conkey's agar and chocolate agar, and then the inoculated plates were incubated for 24 hours at 37 °C [17]. The isolates from blood samples and nasopharyngeal aspirates were identified by using standard biochemical tests [18].

Results

Age wise distribution among the 150 cases examined in the study 69 children belonged to 0-1 year of age constituted 46%, 49 children belonged to 1-2 years of age constituting 32.67% and 32 were belonged to 2-5 years of age constituting 21.33%. [Table 1] Sex wise distributions in the total of 150 children 99 were male and 51 were female constituting 66% and 34% respectively. [Table 2] Among 150 children 147 (98%) had fever history, 150 (100%) children had cough, tachypnea and chest in drawing which were the most common symptom observed in the study, followed by inability to take food or refusal was observed in 61 (40.67%) children, hepato splenomegaly was observed in 33 (22%). Severity of the disease was recorded according to WHO classification, severe pneumonia was observed in 94 (62.67%) and very severe pneumonia was observed in 56 (37.33%) [Table 3]Blood cultures were positive in 34/150 patients (22.67%) and nasopharyngeal aspirates were positive in 55/150 patients (36.67%). The most common pathogen isolated from blood culture was *Staphylococcus aureus* (10.67%) followed by *Streptococcus pneumoniae* (4.67%) and *Pseudomonas aeruginosa* (3.33%), *Klebsiella pneumoniae* (2.67%), *Acinetobacter species* and *Citrobacter koseri* (0.67%) each. The most common pathogen isolated from nasopharyngeal aspirate culture was *Streptococcus pneumoniae* (17.33%), followed by *Staphylococcus aureus* (9.33%), *Hemophilus influenza* (4%), *Klebsiella pneumoniae* (3.33%) and *Pseudomonas aeruginosa* (2.67%). [Table 4]

Table 1: Shows age wise distribution of patients (n=150).

Age group	Number	Percentages
0-1 year	69	46%
1-2 years	49	32.67%
2-5 years	32	21.33%
Total	150	100%

Table 2: Sex wise distribution of patients (n=150).

Sex	Number	Percentages
Male	99	66%
Female	51	34%
Total	150	100%

Table 3: Shows symptoms of patients. (n=150)

Symptoms	No.	%
Fever	147	98%
Cough	150	100%
Tachypnea	150	100%
Chest in drawing	150	100%
Inability to take food/Refusal	61	40.67%
Severe respiratory distress	57	38%
Hepato splenomegaly	33	22%
Severity of disease as per WHO classification		
Severe pneumonia	94	62.67%
Very severe pneumonia	56	37.33%

Table 4: Shows bacterial isolates from blood samples and nasopharyngeal aspirates.

Bacterial isolates	Blood N=150 (%)	Nasopharyngeal aspirates n=150 (%)
Staphylococcus aureus	16 (10.67%)	14 (9.33%)
Streptococcus pneumoniae	7 (4.67%)	26 (17.33%)
Pseudomonas aeruginosa	5 (3.33%)	4 (2.67%)
Hemophilus influenzae	0 (0%)	6 (4%)
Klebsiella pneumoniae	4 (2.67%)	5 (3.33%)
Acinetobacter species	1 (0.67%)	0 (0%)
Citrobacter koseri	1 (0.67%)	0 (0%)
Total	34 (22.67%)	55 (36.67%)

Discussion

Pneumonia continues to pose threat to health of children in developed and developing countries despite improvement in socioeconomic status, immunization and early diagnosis and treatment. Age is an important predictor of morbidity and mortality in pediatric pneumonias. The maximum number of cases of pneumonia (46%) belongs to the age group 0 to 1 year. This is in accordance with other studies in India, the most vulnerable age group for pneumonia [10, 19]. In our study males were (66%) and females (34%). A similar study was conducted by Shekhawat YS *et al*. [10]. 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 [20]. Tachypnea has been considered to be a sensitive and specific indicator for the presence of pneumonia. Also the traditional, method of making a clinical diagnosis of pneumonia has been by the recognition of auscultatory signs, in particular crepitations, in a child with cough. In this study, tachypnoea, cough and chest in drawing (100%) each were the important findings for making a clinical diagnosis of pneumonia. severe respiratory distress (38%) and hepato splenomegaly (22%) were the other associated signs. These findings are in consonance with other studies which showed that tachypnoea and chest in drawing were highly specific signs for detecting pneumonia [21, 22]. In our study, blood culture was positive in 34 cases (22.67%). Bacterial pathogen isolated from blood culture varies from 5-10% in other studies [20]. *Staphylococcus aureus* was the major pathogen isolated from blood culture, followed by *Streptococcus pneumoniae*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*. A study suggests that *Staphylococcus aureus* is frequently responsible for community acquired infections in India, although it has not previously been documented as the most frequent cause of bacteremia in childhood pneumonia [10]. In contrast, it is the most frequently recovered pathogen in par pneumonic effusions/empyema complicating pneumonia and also commonly isolated in blood cultures from infants with bacteremia [23-24].

In this study, we could identify etiological agent by the conventional culture studies of nasopharyngeal aspirate in 36.67% cases. The common organisms isolated were *Streptococcus pneumoniae* followed by *Staphylococcus aureus*, *Hemophilus influenza, Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. Our results are similar to some previous studies from India [20, 25-27].

Conclusion

The overall rate of identification of bacterial etiology of pneumonia was low. However the incidence of severe and very severe pneumonia was higher in infancy. *Streptococcus pneumoniae* and *Staphylococcus aureus* predominate in blood culture and nasopharyngeal aspirates respectively. Our study highlights the use of blood culture and nasopharyngeal aspirates culture to confirm the bacterial pathogens of pneumonia. It is concluded that *Staphylococcus aureus* and *Streptococcus pneumoniae* are the common pathogens isolated from children less than 5 years of age which may associated with community acquired pneumonia.

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