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 symptoms observed in the study, followed by inability to take food or refusal was observed in 61 (40.67%) children, hepatosplenomegaly 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 [1]. 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 antigens. 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 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 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 below 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 pneumoniaic 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.

References

1. Walker CL, Rudan I, Liu L, Nair H, Theodoratou E, Bhutta ZA et al. Global burden of childhood pneumonia and diarrhoea. Lancet. 2013; 381:1405-16.
2. Rudan I, Brien KL, Nair H, Liu L, Theodoratou E, Qazi S et al. Epidemiology and etiology of childhood pneumonia in 2010: estimates of incidence, severe morbidity, mortality, underlying risk factors and causative pathogens for 192 countries. J Glob Health. 2013; 3:10-401.
3. Nair H, Simoes EAF, Rudan I, Gessner BD, Baumgartner AE, Zhang JSF. Global and regional burden of hospital admissions for severe acute lower respiratory infections in young children in 2010: a systematic analysis. Lancet. 2013; 381:1380-90.
4. Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE et al. Global, regional, and national causes of child mortality in 2000-13, with projections to inform post 2015 priorities: an updated systematic analysis. Lancet.
5. Mathew JL, Patwari AK, Gupta P, Shah D, Gera T, Gogia S et al. Acute respiratory infection and pneumonia in India: A systematic review of literature for advocacy and action: UNICEF–PHFI series on newborn and child health, India. Indian Pediatric. 2011; 48:191-218.

6. World Health Organization. Technical bases for the WHO recommendations on the management of pneumonia in children at first level health facilities. Geneva, Switzerland, 1991.

7. World Health Organization (WHO), Department of child and adolescent health and development. (CAH). Integrated management of childhood illness (IMCI) Technical seminar acute respiratory infections. Available at http://www.who.int/maternal_child_adolescent/documents/pdfs/cah_01_10_ts_ari.pdf. Accessed on 10 June 2015.

8. World Health Organization, Handbook IMCI. Integrated management of childhood illness. Geneva, Switzerland: World Health Organization, 2005. Available at http://apps.who.int/iris/bitstream/10665/42939/1/9241546441.pdf. Accessed on 12 January 2015.

9. Scott JA, Wonodi C, Mosi JC, Deloria KM, Deluca AN, Karron RA et al. The definition of pneumonia, the assessment of severity, and clinical standardization in the pneumonia etiology research for child health study. Clin Infect Dis. 2012; 54(2):109-16.

10. Shekhawat YS, Sharma P, Singh A, Payal V. Bacteriological and clinical profile of community acquired pneumonia in hospitalized children with associated co-morbidity in a tertiary care center of Western Rajasthan, India. Int. J Contemp Pediatr 2016; 3:1380-4.

11. Yadav KK, Awasthi S. The current status of community-acquired pneumonia management and prevention in children under 5 years of age in India: a review. There Adv. Infectious Dis. 2016; 3(3-4):83-97.

12. Rohit Agrawal C, Pneumonia A, Parthasarathy. IAP Text book of Pediatrics. 5th ed. Jaypee Brothers Medical Publishers (P) Ltd. 2013; 8(6):470-74.

13. Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG et al. Global, regional, and national causes of child mortality in: a systematic analysis. The Lancet. 2008-2010; 375(9730):1969-87.

14. Global Health Observatory (GHO) data. Available at http://www.who.int/gho/child_health/mortality/causes/en/.

15. Rudan I, Boschi-Pinto C, Biloglav Z, Mulholland K, Campbell H. Epidemiology and aetiology of childhood pneumonia. Bull World Health Organ. 2008; 86(5):408-416.

16. McMurray DN, Loomis SA, Casazza LJ, Rey H, Miranda R. Development of impaired cell-mediated immunity in mild and moderate malnutrition. Am J Clin Nutr. 1981; 34(1):68-77.

17. Collee JG, Marr W. Culture of bacteria. In: Collee JG, Fraser AG, Marmion BP, Simmons A, editors. Mackie & McCartney Practical Medical Microbiology. 14th ed. Edinburgh, UK: Churchill Livingstone, 2006, 113-30.

18. Winn W, Allen S, Janda W, Koneman E, Woods G. Koneman’s color atlas and textbook of diagnostic microbiology. Baltimore: Lippincott Williams & Wilkins, 2006.

19. Prajapathi B, Talsania N, Lala MK, Somalia KN. A study of risk of acute respiratory tract infection (ARI) of under-five age group in urban and rural communities of Ahmedabad district, Gujarat. Health line. 2012; 3(1):16-20.

20. Kabra SK, Lodha R, Broor S, Chaudhary R, Ghosh M and Maitreyi RS. Etiology of acute lower respiratory tract infection. Indian J Pediatr. 2003; 70:33-6.

21. Pala fox M, Guiscard H, Reyes H, Munoz O, Martinez H. Diagnostic value of tachypnoea in pneumonia defined radio logically. Arch Dis Child. 2000; 82:41-5.

22. Taylor JA, Beccaro DM, Done S, Winters W. Establishing clinically relevant standards for tachypnea in febrile children younger than 2 years. Arch Pediatr Adolesc Med. 1995; 149:283-7.

23. Kumar A, Sethi GR, Mantan M, Aggarwal SK, Garg A. Empyema thoracis in children: a short term outcome study. Indian Pediatr. 2013; 50:879-82.

24. Goyal V, Kumar A, Gupta M, Sandhu HP, Dhir S. Empyema thoracis in children: still a challenge in developing countries. Afr J Paediatr Surg. 2014; 11:206-10.

25. Hamer DH, Darmstadt GL, Carlin JB, Zaidi AK, Antwi YK, Saha SK, et al. Etiology of bacteremia in young infants in six countries. Pediatr Infect Dis J. 2015; 34:1-8.

26. Agarwal G, Awasthi S, Kabra SK, Kaul A, Singh S, Walter SD, ISCAP Study Group. Three day versus five day treatment with amoxicillin for non-severe pneumonia in young children: a multi-center randomized controlled trial. British Med J. 2004; 328:791.

27. Jain A, Kumar P, Awasthi S. High nasopharyngeal carriage of drug resistant Streptococcus pneumoniae and Hemophilus influenzae in North Indian school children. Trop Med Int Health. 2005; 10:234-9.