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Paediatrics Section

Clinico-Aetiological Study of Severe and Very Severe Pneumonia in Two Months to Five Years Children in a Tertiary Health Care Centre in Odisha, India

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ABSTRACT

Introduction: Pneumonia is a major cause of mortality under five-year-old children. In spite of recent advances in management, there is paucity of data on clinical, aetiological profile of severe and very severe pneumonia among under five-year-old children in developing countries.

Aim: To determine the clinico-aetiological factors of severe and very severe pneumonia and its outcome in children aged two -months to five-years in a tertiary health care centre in Odisha, India.

Materials and Methods: This was a prospective observational study. All the patients between two-months to five-years age admitted to SCB Medical College, Cuttack, Odisha, India, were screened for features of severe and very severe pneumonia based on WHO diagnostic criteria, over a one year period. Out of 10300 patients admitted to our hospital during the study period; 141 cases were included in the study. Their clinical parameters were recorded and were followed up till discharge or death. Continous variables were analyzed using Student t-test or Mann-Whitney U test whereas categorical data were analyzed using Pearson Chi square test or Fischer Exact test.

Results: Out of 141 patients included in the study, cough, tachypnea and chest retractions were present in 100% cases while fever in 97.1% (137) cases. In 17% (24) cases, bacterial pathogen was isolated. Most common organism being *Staphylococcus aureus* 8.51% (12) followed by *Streptococcus pneumonie* 6.4% (9). Higher mortality 11.34% (16) was found among patients presenting after three days of illness (p=0.048). About 17% (24) patients developed complications. Common complications were sepsis 5.6% (8), CCF 4.2% (6) and empyema 4.2% (6). Higher mortality 22 (15.6%) was observed in very severe pneumonia group (p=0.003).

Conclusion: The incidence of severe and very severe pneumonia was higher in infancy. Rainy and winter season were associated with higher incidence of disease. Bottle feeding practice and smoking were significantly associated with more severe disease. Death rate was high among patients admitted to hospital after three days of onset of illness, so early referral is indicated for better outcome.

Keywords: Chest retraction, Cough, Fever, Tachypnea

INTRODUCTION

Among the common childhood illness, pneumonia is a substantial cause of morbidity and mortality in children throughout the world, rivalling diarrhoea as a cause of death in developing countries [1]. 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 [2]. 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 [3]. Child Health Epidemiology Reference Group (CHERG) WHO methods and data sources for childs' causes of death in 2015, also shows that pneumonia is one of the leading causes of death in post neonatal (1-59 months) children [4]. 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 [5]. 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.

Delay in seeking tertiary care facility is another contributing factor for increased mortality in severe pneumonia.

The aim of the study was to determine clinico-aetiological factors of severe and very severe pneumonia and it's outcome in children aged two-months to five-years.

MATERIALS AND METHODS

This was a prospective observational study conducted over a period of one year from Septmber 2013 to August 2014 in a SCB Medical College, Cuttack, Odisha, India. 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 prior to the study.

Inclusion criteria involved patients between two-months to five-year of age having features of severe and very severe pneumonia. The diagnosis of severe and very severe pneumonia was based on WHO criteria [6]. 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 five-years of age.

Exclusion criteria: Children below two-months of age and more than five-years, with underlying heart disease or pulmonary tuberculosis presenting as pneumonia, were excluded.

After admission of a child; detailed history was taken from the

parents regarding the onset, duration and progress of symptoms. Education and socio-economic status, population and overcrowding in the family, parental smoking etc., were noted as per the case record proforma specially designed for the study. A thorough clinical examination including respiratory as well as other systems were done. Anthropometric measurements like height, weight, chest, head and mid arm circumference were recorded in each case; which were then compared with the available norms of 50th percentile of National Centre for Health and Statistics (NCHS) standards. The weight-for-age criteria was taken for the diagnosis of different grades of malnutrition, as per the nutrition subcommittee of Indian Academy of Paediatrics in the year 1972. Socioeconomic class was identified using Modified Kuppuswamy Scale.

Haemoglobin, Erythrocyte Sedimentation Rate (ESR), Total Leucocyte Count (TLC), peripheral smear for differential leucocytes count and blood picture were done in each patient. Chest X-ray was done to examine the site, type and associated complications. Blood gas analysis was done in anticipation of assisted ventilation. Pulse oximetry was done to detect the degree of hypoxia. CT scan of thorax was done if obstruction or tumour was suspected. Bronchoscopy was done when there was evidence of an obstructing tumour or foreign body.

Blood culture was collected from a vein under strict aseptic measures using povidone-iodine, rectified spirit for skin sterilization. About 5 ml of blood was collected into 50 ml of glucose broth (the ratio being 1:10) bottle, which was observed for growth of organisms after 24 hours and 72 hours.

Aetiological diagnosis was established on the basis of isolating the organism from the culture and sensitivity reports. Clinical monitoring and recording of data were done daily until discharge or death. All the data were serially tabulated and critically analyzed.

STATISTICAL ANALYSIS

Data analysis was done using the Microsoft excel, SPSS for Windows version 23.0. Values for continuous data were expressed as mean ± SD (if normally distributed) and median (range) (if not normally distributed). Categorical variables were reported as proportions. Continuous variables with normal distribution were compared using Student t test while those not normally distributed were analyzed using Mann-Whitney U test. Categorical data were analyzed using Pearson Chi square test or Fischer Exact test.

RESULTS

Out of 10300 patients admitted to our hospital during the study period 141 patients were included in the study based on the inclusion and exclusion criteria.

[Table/Fig-1] shows the demographic profile of the studied population. The median age was five months (range 2-60 months). Most of the patients were male 86 (61%). More number of cases were admitted during the months of January, February and August. One hundred nineteen (84%) patients were in the age group of 2-12 month. Only 36 (25%) patients were born with a birth weight ≤ 2500 gm. Most of the patients 127 (90%) included in the study had grade IV malnutrition. About 137 (97%) patients were completely immunized according to their age. Eighty five (60%) patients were exclusively breastfed. Eighty one (58%) patients were from middle socio-economic status. Ninety six (68%) patients did not have any history of exposure to smoke.

[Table/Fig-2] shows severe and very severe pneumonia were present in 84 (60%) and 57 (40%) of patients respectively. Seventeen percent of patient had blood culture positive and *Staphylococcus aureus* was the most common organism isolated. Twenty four (17%) patients developed some form of complication during hospital stay. Thirty one (22%) patients died while undergoing treatment.

[Table/Fig-3] shows that both the groups (severe pneumonia and very severe pneumonia) were comparable to each other in respect to age, sex, nutritional status, immunization status, Socio Economic Status (SES), feeding practice and exposure to smoke.

[Table/Fig-4] shows mortality was higher in the very severe pneumonia group and the difference was statistically significant (p=0.003). Mortality was higher among the patients who were admitted to hospital beyond 72 hours of onset of illness (p=0.048).

DISCUSSION

In our study, most cases of severe pneumonia and very severe pneumonia, i.e., 119 (84%) were reported in the age group of 2 months-12 months. In the age group of 12 months to 60 months, 22 (16%) of cases were present. Debnath D et al., [7] in their study found occurrence of severe pneumonia /very severe illness in 38.2% cases in the age group 2 months-12 months and 29.9% in the age group 12 months to 60 months. Banstola A et al., [8] also found occurrence of pneumonia more in the age group below one year as compared to age group one year-five year. Major occurrence of severe pneumonia cases in less than one year age group could be attributed to low immunity, smaller and narrower airways and frequent exposure to infection, poor nutritional status as well as more susceptibility of infants to viral and general infections [9-11] .

Male to female ratio in our study was 1.56:1. Similar observations were noticed by Debnath D et al., [7] in a study in Pune, India and found male to female ratio to be 1.4:1. Study by Banstola A et al.,

Age in months [median (range)]	5(2-60)				
Age group N(%)	2-12month–119(84%) >12month-22 (16%)				
Sex N (%)	Male 86(61%) Female 55(39%)				
Seasonal distribution	Month	Severe pneumonia	Very severe pneumonia	Total	%
	September	3	5	8	6%
	October	3	5	8	6%
	November	7	2	9	6%
	December	7	5	12	9%
	January	10	5	15	11%
	February	10	6	16	11%
	March	5	6	11	8%
	April	6	5	11	8%
	May	5	3	8	6%
	June	7	5	12	8%
	July	9	3	12	8%
	August	12	7	19	13%
Birth weight	Birth wt. ≤ 2500 gm – 36 (25%) Birth wt. ≥ 2500 gm - 105 (75%)				
Nutritional status N (%)	Normal-7 (4.9%) Grade I-1(0.7%) Grade II-3(2%) Grade III-3(2%) Grade IV-127(90%)				
Feeding practice N (%)	Exclusively breastfed 85 (60.28%) Not exclusively breastfed • Cup or spoon 21 (14.89%) • Bottle feeding 35 (24.82%)				
Socio economic status N (%)	Upper(I) 9 (6.38%) Upper middle(II) 39(27.65%) Lower middle(III) 42 (29.78%) Upper lower(IV) 51 (36.17%) Lower (V) 0 (0%)				
Immunisation status N (%)	Complete for age 137 (97.16%) Incomplete for age 4 (2.84%)				

[Table/Fig-1]: Demographic data.

Characteristics	N (%)
Exposure to smoke N (%)	Exposed • Wood smoke 31 (21.98%) • Passive smoking 14 (9.92%) Not exposed 96 (68.08%)
Clinical presentation N (%)	Fever 137(97.16%) Cough 141(100%) Tachypnea 141(100%) Chest in drawing 141(100%) Severe respiratory distress 57(40.42%) Central cyanosis 1(0.7%) Inability to take food/Refusal 57(40.42%) Hepatosplenomegaly 49(34.7%)
Severity of disease N (%)	Severe pneumonia 84 (60%) Very severe pneumonia 57 (40%)
Bacteriology N (%)	*Staphylococcus aureus* 12 (8.51%) *Streptococcus pneumoniae* 9 (6.38%) *Haemophilus influenza* 3 (2.1%) No growth 117 (82.97%)
Complications	No complication 117(83%) Complication 24 (17%) • Pleural effusion 4 (2.8%) • Empyema 6 (4.2%) • Septicaemia 8(5.6%) • Pericarditis/CCF 6 (4.2%)
Presentation to hospital after onset of illness	Within 72 hours 90 (63.83%) After 72 hours 51 (36.17%)
Hospital stay mean ± SD	Survivor 10.75 ± 6.7 Non survivors 3.94 ± 4.32
Hospital stay according to severity of disease	Severe pneumonia 9.92days Very severe pneumonia 8.26days
Outcome	Discharge 110 (78%) Death 31 (22%)

[Table/Fig-2]: Clinico-aetiological data.

Characteristics		Severity of disease		p-value
		Severe pneumo-nia n=84 (%)	Very severe pneumonia n=57 (%)	
Sex	Male	55 (39%)	31 (22%)	0.185
	Female	29 (21%)	26 (18%)	
Age	2 months-12 months	73 (52%)	46 (32%)	0.32
	>12 months	11 (8%)	11 (8%)	
Nutritional status	Normal	3(2%)	4(3%)	0.36
	Grade I	0(0%)	1(0.7%)	
	Grade II	3(2%)	0(0%)	
	Grade III	2(1.4%)	1(0.7%)	
	Grade IV	76(54%)	51(36%)	
Immunisation status	Immunized	81 (57.5%)	56 (39.7%)	0.903
	Not immunised	3 (2.1%)	1 (0.7%)	
Socio-economic Status	Upper(I)	7(5%)	2(1%)	0.614
	Upper middle(II)	23(16.3%)	16(11.34%)	
	Lower middle(III)	26(18.4%)	16(11.34%)	
	Upper lower(IV)	28(19.8%)	23(16.3%)	
	Lower (V)	0	0	
Feeding practice	*EBF	56 (40%)	29 (20%)	0.06
	Non *EBF	28 (20%)	28 (20%)	
Exposure to smoke	Exposed	25 (18%)	20 (14%)	0.79
	Not exposed	59 (42%)	37 (26%)	

[Table/Fig-3]: Base line characteristics vs severity of disease.
*EBF-Exclusive breast feeding

[8] in Nepal found male to female ratio to be 1.5:1. Divyarani D C et al., [12] in a similar study in Karnataka, India, observed 62.6% were males and 37.4% were females (ratio 1.67:1). More number of male cases were admitted for treatment of pneumonia in the age group of under five. This might be due to preferential treatment given to male child in family. Another possibility is that boys are more exposed to the outer environment though under five male and female children

Characteristics		Outcome		p-value
		Discharge n=110 (%)	Death n=31 (%)	
Sex	Male	69 (48.9%)	17 (12.05%)	0.43
	Female	41(29.07%)	14(9.9%)	
Age	2 months-12 months	92 (65.24%)	27 (19.15%)	0.64
	>12 months	18 (12.76%)	4 (2.8%)	
Nutritional status	< Grade IV	12 (8.5%)	2 (1.4%)	0.46
	Grade IV	98 (69.5%)	29 (20.56%)	
Immunisation status	Immunized	108 (76.59%)	29 (20.56%)	0.17
	Not immunised	2 (1.4%)	2 (1.4%)	
Socio-economic Status	Upper(I)	7 (4.96%)	2 (1.4%)	0.69
	Upper middle(II)	33 (23.4%)	6 (4.25%)	
	Lower middle(III)	31 (21.98%)	11 (7.8%)	
	Upper lower(IV)	39 (27.65%)	12 (8.51%)	
	Lower (V)	0	0	
Feeding practice	*EBF	67 (47.51%)	18 (12.76%)	0.77
	Non *EBF	43 (30.49%)	13(9.21%)	
Exposure to smoke	Exposed	33 (23.4%)	12 (8.51%)	0.36
	Not exposed	77 (54.6%)	19 (13.47%)	
Severity of disease	Severe pneumonia	75 (53.19%)	9 (6.38%)	0.0003
	Very severe pneumonia	35 (24.82%)	22 (15.6%)	
Bacteriology	Culture +ve	21 (14.89%)	3(2.1%)	0.22
	Culture –ve	89 (63.12%)	28 (19.85%)	
Days of hospitalization after onset of illness	Within 72 hours of onset of illness	75 (53.19%)	15 (10.63%)	0.048
	After 72 hours of onset of illness	35 (24.82%)	16 (11.34%)	

[Table/Fig-4]: Baseline characteristics vs outcome.
*EBF-Exclusive breast feeding

are usually equally exposed. The lower incidence in girls might be due to some inherent immunity in terms of extra 'X' chromosome present with their genotype as per article of Libert C et al., [13].

In the current study, increased number of cases was seen in January, February and August i.e., in winter and rainy season respectively. Banstola A et al., [8] also observed increased number of cases in winter and rainy season. Rudan I et al., [5] also reported peak occurrence of pneumonia in the rainy season in tropical climates. There was similar trend in our study as per seasonal distribution. Monthly distribution of cases in our study was different and it could be due to difference in geographical location and delay in reaching of monsoon.

In our study, 36 (25%) of cases were Low Birth Weight (LBW) at birth, 105 (75%) cases were having normal weight at the time of birth. Divyarani DC et al., [12] in a similar study in Karnataka, India, reported 84% of cases were LBW at birth in their study. This disparity was because of our study population which is two months to 60 months whereas in the study of Divyarani DC et al., the age group was birth to 60 months [12].

In the present study, 7 (4.9%) of cases were having normal nutritional status whereas 134 (95%) were malnourished and 127 (90%) cases had Grade IV malnutrition. Debnath D et al., [7] in a similar study

in Pune, India found no malnutrition in 9.5%, mild malnutrition in 28.9% and moderate /severe to very severe malnutrition in 44.7% of their studied cases.

Various community based study also marked malnutrition as a major contributor of pneumonia. A Delhi based study observed that severe malnutrition was a significant contributor of acute respiratory infection in children under-five years [14] and a study from Kolkata showed that malnutrition was significantly associated with occurrence of Acute Respiratory Infection (ARI) among under-five children [15]. Malnutrition causes defective cell mediated immune response thus predisposes to infection [5,16].

In our study, 137(97.16%) cases were immunized as per National Immunisation Schedule (NIS) completed for age, and only 4(2.84%) were unimmunized. Debnath D et al., [7] in found 23.8% cases were immunized complete for age as per NIS and in 51.2% cases immunization was incomplete as per age. This difference might be due to better immunization (as per NIS) coverage in our study area as well as increased awareness among parents. Immunization has a major role in preventing pneumonia as it is one of the common complication of both pertussis and measles.

In our study, 85 (60.28%) cases were exclusively breast fed, 21 (14.89%) cases were on spoon feeding and 35 (24.82%) cases were on bottle feeding. Divyarani DC et al., [12] in a similar study in Karnataka, India, found 94.6% cases were on exclusive breast feeding. This low figure of exclusive breast feeding in our studied cases could be due to poor awareness of benefits of exclusive breast feeding among mothers.

Majority of cases belonged to upper lower (IV), lower middle (III) class i. e., 51 (36.17%) and 42 (29.78%) respectively in our study and 39 (27.65%) cases were from upper middle (II) class. Kumar AMK et al., [17] in their study from Karnataka observed 76.5% of occurrence of pneumonia in lower social status (class III-V). Thorn LK et al., [18] also reported inverse relationship between cases of pneumonia and SES class.

In the current study, 31 (21.98%) cases were exposed to firewood cooking and 14 (9.92%) were exposed to passive smoking, but in 96 (68.08%) of studied cases there was no exposure to smoking. Literature says parental smoking has direct impact on childhood clinical pneumonia in the community in developing country [5].

In our study, cough, tachypnea, and chest in-drawing were present in 141 (100%) of studied cases, fever in 137 (97.16%), severe respiratory distress in 57 (40.42%) and central cyanosis in 1(0.7%) , inability to take food or refusal to food in 57 (40.42%) cases. Yaguo Ide LE et al., [19] reported cough in 75.9%, fever in 70.7%, fast breathing in 53%, respiratory distress in 83.6% of pneumonia cases. Ahmad Al Najjar S et al., [20] reported fever in 87.4%, tachypnea in 73.5%, cough in 98% and retraction in 80% cases of pneumonia which is almost tallying with our reports.

In the present study, blood culture was positive in 24(17.02%) of cases out of which *Staphylococcus aureus* was 12 (8.51%) cases, *Streptococcus pneumoniae* in 9 (6.38%) cases and *Haemophilus influenzae* in 3(2.1%) cases. Mudhusudhan K et al., [21] in their study from Telengana, India, observed blood culture positive in 23.63% cases with predominance of *Staphylococcus aureus*. Banstola A et al., [8] in their descriptive study found *Streptococcus pneumoniae* in 15.8% cases, *Haemophilus influenzae* type b (Hib) in 9.2%, Respiratory Syncytical Virus (RSV) in 12.6%, Influenzae A in 7.5%, Parainfluenzae type 3 in 4.0% and Influenzae B in 3.5%. Viral isolation method could not be adopted because of lack of PCR facility as well as inaffordability of most of the parents.

In the present study, 90 (63.83%) cases reported to the hospital within first 72 hours, while 51 (36.17%) cases reported to hospital after 72 hours of onset of illness. Mortality observed among patients admitted before and after 72 hours of illness was 15 (10.63%) and 16 (11.34%) respectively.

Average hospital stay among survivors was 10.75±6.7 days where as among the non survivors it was 3.94±4.32 days. Kumar AMK et al., [17] in their study from Karnataka observed that duration of hospital stay was more in very severe pneumonia group. The duration of hospital stay was less in very severe pneumonia group in our study, because more number of deaths occurred early due to more serious nature of illness.

Complications in our study were septicaemia 8 (5.6%), CCF 6 (4.2%), empyema 6 (4.2%) and pleural effusion 4 (2.8%). Kumar AMK et al., [17] in their study from Karnataka observed similar trends in complications.

Overall mortality in our study was 31 (21.98%). Mortality seen in severe pneumonia was 9 (6.38%) and in very severe pneumonia was 22 (15.6%). Kumar AMK et al., [17] in their study observed mortality of 3%. The higher mortality rate observed in our study could be due to more number of very severe pneumonia cases in contrast to their study population. More seriousness of the illness as well as delay in reaching in tertiary center could be another attributing factor.

LIMITATION

This was a hospital based study and does not represent the true incidence of pneumonia and its different forms and aetiologies of the entire population. Viral pathogens were not routinely identified in this study as the diagnosis and treatment was based on WHO case management protocol and non-availability of PCR facility for viral isolation in our centre.

CONCLUSION

The incidence of severe and very severe pneumonia was high in infancy. More number of patients died who arrived at hospital after 72 hours of onset of illness and most death were recorded in children who had very severe pneumonia. Hence, early referral is of paramount importance as it will not only halt the progression of severity of disease but death as well. A detailed prospective study is needed to further confirm the findings.

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