Original Research Article

Study of risk factors for severe pneumonia among children between 2 months to 5 years of age

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ABSTRACT

Background: Acute respiratory illness is responsible for 19% of all deaths in children in below five years of age and 8.2% of all disability as measured by DALY. Recent studies have added other risk factors to the list including large family size, poor socioeconomic status, family history of bronchitis, advanced birth order, crowding, young age, air pollution, and the use of non-allopathic treatment in early stages of illness. Also, indoor air pollution is one of the major risk factors for acute lower respiratory tract infection in children in developing countries. The objectives of this study were to identify and compare the risk factors associated with severe and very severe pneumonia.

Methods: A prospective observational study. Children between 2 months to 5 years with clinical features of severe pneumonia were included in the study. Socioeconomic history like the type of house, family size, sanitary facilities and fuel-based cooking was recorded. Detailed history about immunization, feeding practice and degree of malnutrition was recorded. Chi Square test was used to determine significant differences between two groups.

Results: Total 150 patients could be included in the study. Immunization status shows that 74% were completely immunized, 9% were unimmunized and 17% were partially immunized. Most of the children were breast fed 95.33% and only 4.67% were bottle fed. 30% of the cases were grade 3 and 4 PEM and anemic. The socioeconomic status showed 84% were belonged to grade 3,4 and 5 and 16% belonged to grade 1 and 2. 96.67% were living in ill ventilated kutcha house with poor sanitation facilities and nearly 94% were living in house with fuel other than LPG.

Conclusions: Factors like previous history of similar illness, inappropriate immunization for age, anemia, PEM grade 3 and 4, poor housing condition, and indoor air pollution were significantly associated with severity of pneumonia. While severity of illness, PEM grade 3 and 4 and associated illness were the important risk factors for mortality.

Keywords: Indoor air pollution, Mortality under 5 years, Severe and very severe pneumonia in children, Risk factors

INTRODUCTION

Acute respiratory illness is responsible for 19% of all deaths in children in below five years of age and 8.2% of all disability as measured by Disability Adjusted Life Years (DALY). It is estimated that South East Asian countries like India, Bangladesh, Indonesia and Nepal together account for 40% of global ARI mortality and 90% of ARI deaths are due to pneumonia, which is bacterial origin. The incidence of pneumonia in developed countries may be as 3-4%, but in developing countries ranges from 20-30%. In India, the standard case management of ARI and prevention of deaths due to pneumonia is now an integral part of Reproductive and Child Health programme (RCH).[1-3] Many studies have been done in past to know the magnitude, etiology, risk factors and outcome of pneumonia in young children. Review of the epidemiology of ALRTI done by Behrmen

S et al, in developing countries identified low birth weight, malnutrition, vitamin A deficiency, lack of breastfeeding and passive smoking as risk factors for ALRTI.[4] Recent studies have added other risk factors to the list including large family size, poor socioeconomic status, family history of bronchitis, advanced birth order, crowding, young age, air pollution, and the use of non-allopathic treatment in early stages of illness.[5] More recent reviews suggest that indoor air pollution is one of the major risk factor for acute lower respiratory tract infection in children in developing countries.[6] The objectives of this study were to identify and compare the risk factors associated with severe and very severe pneumonia. Secondary objective was to know the choice of antibiotics for severe pneumonia.

METHODS

A prospective study conducted by department of pediatrics, Government Medical College and new civil hospital, Surat, Gujarat, India. Institutional Human Research Ethics committee permission was taken before starting the study. Children between 2 months to 5 years with clinical features of severe pneumonia as per WHO guideline were included in the study. Children with congenital anomalies of heart and lungs, anatomical defects like cleft lip and claft palate, immunocompromised states and infants less than 2 months of age were excluded from the study. Patients fulfilling the inclusion and exclusion criteria were included in the study only after taking inform written consent from legal guardian of the patients. A detailed history of presenting symptoms like fever, cough, rapid breathing, refusal of feeds, wheezing etc., were noted. A detailed examination of each child including anthropomentry was carried out. Emphasis was laid on assessing general condition of child, respiratory rate, presence of fever and other signs of cyanosis, and pallor. Detailed systemic examination of respiratory, cardiovascular, and central nervous system were done. Any associated illness like septicemia, meningitis, and congestive cardiac failure if any was noted. Socioeconomic history like the type of house (pucca or kutcha), family size (overcrowding), sanitary facilities and fuel-based cooking (LPG or non-LPG) were recorded. Socioeconomic status was classified according to modified Prasad's classification. Detailed history about Immunization and feeding practice were taken. Degree of malnutrition was recorded according to IAP classification. Patients were classified into severe pneumonia and very severe pneumonia according to WHO ARI criteria. Risk factors for severe and very severe pneumonia were studied for analytical purpose. Investigations like hemoglobin, total WBC count, differential WBC count, ESR, chest X-ray and blood culture were done in all patients. Investigations were repeated according to need during treatment to see the prognosis and treatment effectiveness. All patients were received antibiotics. Antibiotics received were First line: ampicillin with gentamycin, Second line: amoxicillin with clavulenic acid with amikacin and others: cloxacillin, ceftriaxone/cefotaxime. Majority of patients (except with complications) received first line antibiotics. Those who failed to respond to first line within 48 hours, received second line antibiotics. Cloxacillin was given in case of empyema/massive consolidation. All children were evaluated during the hospital stay and response to treatment was noted. Statistical analysis was done using Microsoft Excel. Chi Square test was used to determine significant differences between two groups. Odds ratio was determined whenever required. Significance for the statistical tests was predetermined at a probability value of 0.05 or less. (p <0.05).

RESULTS

Total 150 patients could be included in the study during study period of one and half years.

Table 1: Socio-demographic data of all cases.

| Age groups (months)	No. (%)
2-6	57 (38)
7-12	23 (15)
13-60	70 (47)
Total	150
Gender	
Male	89 (59)
Female	61 (41)
Immunization status of all cases	
Immunized	111 (74)
Partially immunized	26 (17.33)
Unimmunized	13 (8.67)
Feeding practice	
Breast fed	143 (95.33)
Bottled fed	7 (4.67)
Protein energy malnutrition	
Normal	06 (04)
Grade 1	18 (12)
Grade 2	81 (54)
Grade 3	39 (26)
Grade 4	06 (04)
Socioeconomic status (modified Prasad's classification)	
1. Grade 1	18 (12)
2. Grade 2	06 (04)
3. Grade 3	39 (26)
4. Grade 4	81 (54)
5. Grade 5	06 (04)
Types of house	
1. Pucca	05 (3.33)
2. Kutcha	145 (96.67)
Sanitary facilities	
1. Good (toilet available)	04 (2.6%)
2. Poor (open air defecation)	146 (97.33)
Fuel for cooking	
1. LPG	09 (06)
2. Non LPG	141 (94)
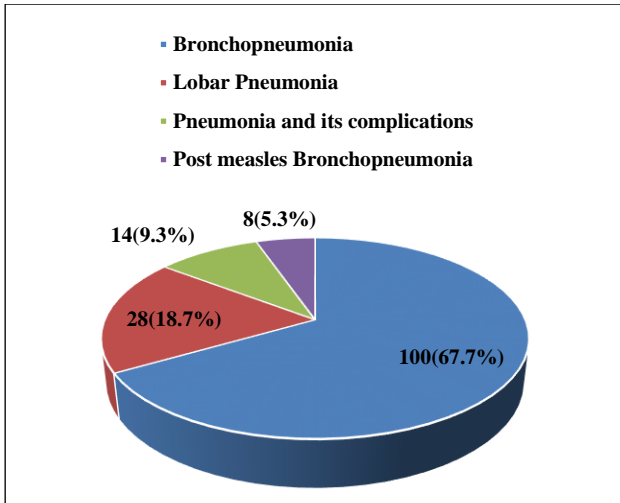
Figure 1: Clinical diagnosis of all cases.

As seen in Table 1 nearly 50% (80 cases) below one year of age and 50 cases were from one year to five years of age and Sex wise distribution shows that nearly 60% of cases were male with male:female ratio was 1.45. Immunization status shows that 74 % were completely immunized, 9% were unimmunized and 17% were partially immunized. Most of the children were breast fed i.e. 143 (95.33%) and only 7 (4.67%) were bottle fed. 30% of the cases were grade 3 and 4 PEM and anemic. The socioeconomic status according to Modified Prasad's classification showed 84% were belonged to grade 3, 4

and 5 and 16% belonged to grade 1 and 2. Majority cases (145 (96.67%)) were living in ill ventilated kutcha house with poor sanitation facilities and nearly 94% (141 cases) were living in house with fuel other than LPG.

As per seen in Figure 1, 66.7% (100 cases) patients were diagnosed as bronchopneumonia, and 18.7% (28 cases) diagnosed as lobar pneumonia. Other diagnoses were pneumonia with complications (9.3% (14 cases)) and post measles bronchopneumonia (5.3% (8 cases)).

About 9 (6.3%) patients were died out of total 150 cases. Among them 55.5% (5 cases) were died within 24 hours of presentation to hospital. Septicemia with shock was seen in 4 cases and meningitis in 3 cases. And all cases were belonged to severe pneumonia as per WHO ARI program. Anemia was present in 6 and grade 3and 4 malnutrition in 7 cases.

As seen in Table 2, among various risk factors studied severity of pneumonia, malnutrition (grade 3 and 4), and associated illness (septicemia, meningitis) were significantly associated with mortality.

Risk factors for very severe pneumonia were studied in present study (Table 3). It was found that incomplete immunization, past history of similar illness, malnutrition grade 3 and 4, kutcha house, and cooking fuel other than LPG were significant risk factors for very sever pneumonia.

Table 2: Risk factors for mortality among all cases.

Factors		Not survived (09)	Survived (141)	P	Odds ratio	Significance
Age	<1 yr	06	72	P >0.05 Chi sq=0.86	1.03	NS
	<1 yr	03	69			
Gender	Male	03	86	P >0.05 Chi sq=0.13	1.15	NS
	Female	06	75			
Severity	Severe pneumonia	03	122	P <0.01 Chi sq=9.81	6.42	Highly significant
	Very Severe pneumonia	06	19			
Associated illness	Absent	04	111	P <0.05 Chi sq=4.65	3.7	Significant
	Present	05	30			
Nutrition	Normal, Grade 1 and 2	02	103	P <0.05 Chi sq=7.29	2.71	Significant
	Grade 3 and 4	07	38			
Anemia	Present	06	61	P >0.171 Chi sq=1.875	46	NS
	Absent	03	80			

In present study, antimicrobials were given in all cases. Among them 143 (95.33%) cases received first line antimicrobials of choice and 24 (16%) received second line of drugs and 20 (13.33%) changed from first line to second line antibiotics. In 91 (60.67%) cases oral

antibiotics were continued at the time of discharge. As seen in Table 4, majority of cases received antibiotics for 10-14 days. And mean duration of antibiotics was 14.08±2.2 days.

Table 3: Risk factors among severe and very severe pneumonia.

Factor		Severe pneumonia (125)	Very severe pneumonia (25)	X^2	P	Significance
Age	<1 yr	67	13	0.005	0.942	NS
	>1 yr	58	12			
Gender	Male	78	11	2.173	0.140	NS
	Female	47	14			
Past history	Yes	05	04	5.391	0.021	S
	No	120	21			
Family history of ARI	Yes	12	06	2.461	0.117	NS
	No	113	19			
Immunization	Complete	97	14	5.052	0.025	S
	Incomplete	28	11			
Anemia	Yes	23	57	4.552	0.033	S
	No	10	60			
Feeding	Breast fed	122	21	5.874	0.015	S
	Bottle fed	03	04			
Malnutrition	N and G 1and 2	95	10	10.33	0.001	HS
	G 3 and 4	30	15			
Type of house	Pucca	02	03	4.138	0.042	S
	Kutcha	123	22			
Fuel for cooking	LPG	05	04	5.319	0.021	S
	Non-LPG	120	21			
Sanitization	Poor	124	25	0.00	1.00	NS
	Good	01	00			
Socioeconomic status (MPC)	Grade 1, 2, 3	90	19	0.00	1.00	NS
	Grade 4, 5, 6	34	07			

Table 4: Duration of antimicrobial agents use.

Duration (days)	1st line	2nd line
7	33	14
10	68	12
14	36	10
>14	13	6

DISCUSSION

Childhood clinical pneumonia is caused by a combination of exposure to risk factors related to the host, the environment and infection. In present study risk factors amongst severe and very severe pneumonia like appropriate immunization for age, presence of anemia, previous history of similar illness, Protein Energy Malnutrition (PEM) grade 3 and 4, poor housing conditions and indoor environmental pollutions (use of cooking fuel other than LPG like kerosene and wood) were studied.

As seen in Table 2, above risk factors showed significant role in occurrence of very severe pneumonia. Broor S et al, have reported that lake of breast feeding, severe malnutrition, cooking fuel other than LPG and history of ALRTI in family were significant contributors of severe ALRTI in children under 5 years of age.[7] In a case control study by Hassan MK et al, it was found that age less than 6 months, smoking at home, anemia, lake of breast feeding and malnutrition were significant risk factors for severe pneumonia.[8] Shah N et al, also found that young age, immunizations, malnutrition, previous history of severe ARI emerged as significant risk factors for severe pneumonia.[9]

In present study, case fatality rate was 6.3% (9 cases) with 55.5% (5 cases) of the fatal cases occurred within 24 hours. Other studies like Sehgal V et al, Reddaiah VP et al, and Mishra S et al, showed case fatality rate of 10.45%, 12.8% and 7.7%.[10-12] The case fatality ratio in present study is lower than these all studies. Underlying congenital heart diseases (CHD) is a significant risk factor for pneumonia mortality. As in this study pneumonia with CHD is being excluded, this might be the probable reason for low case fatality rate in present study. Significant predictor for mortality was determined by comparing dead subjects with survived children. It was found that severity of pneumonia (very severe) malnutrition grade 3 and 4 and associated illness (septicemia, meningitis) were significantly associated with mortality. Sehgal V et al, in their study have

reported that age less than 1 year associated with congenital heart disease, very severe pneumonia and malnutrition were very significant predictors of mortality.[10]

Management of pneumonia included supportive case and antibiotics. Because of definitive information about causative pathogens is not available all the time, treatment is most often empirical. In present study all patients received antibiotics. Majority (95.33%) responds to first line antibiotics (ampicillin and gentamycin). 16% didn't respond to first line, and hence received second line antibiotics. 8% of cases received cloxacillin in addition to first line antibiotics.[12] Duke T et at, have established that combination of crystalline penicillin with gentamycin would be better as first line treatment in children with severe pneumonia in less developed countries.[13] WHO has recommended that crystalline penicillin is one of the standard antimicrobial agent for the treatment of severe pneumonia. Mishra S et al, in their study reported that 91% of patients of pneumonia with chest in drawing responded to crystalline penicillin.[12]

By this study, it is found that among the risk factors studied, previous history of similar illness, inappropriate immunization for age, anemia, PEM grade 3 and 4, poor housing condition, and indoor air pollution were significantly associated with severity of pneumonia. Household indoor air pollution occurs through solid fuel use required reduction and switching to other fuels, improving combustion and ventilation, and possibly other measures, would make an important contribution to prevention of pneumonia morbidity and mortality in ALRTI among children. While severity of illness, PEM grade 3 and 4 and associated illness were the important risk factors for mortality. Ampicillin and Gentamicin are still the antibiotics of choice in pneumonia and so, indiscriminate uses of higher antibiotics are not justifiable in view of emergence of resistant organism.

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