Association between clinical, radiological, and haematological profile of children with pneumonia

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Abstract

Background: Patients with pneumonia present with varying symptoms, X-ray features and changes in the blood parameters.

Objectives: To find out the association between clinical, radiological, and haematological profile of children with pneumonia.

Methods: An analytical cross-sectional study was conducted in 130 children aged two to 60 months admitted to the paediatric ward of Manipal Teaching Hospital, who were chosen by convenience sampling technique from December 2019 to November 2020, and clinical, radiological and haematological parameters compared. The observed data were analysed using SPSS 20.

Results: . Of the 130 children studied, 80 (61.5%) were male and 50 (38.5%) were female. History of prior admission for respiratory illness was seen in 75 (57.7%) patients Bronchopneumonia was seen in 72 (55.4%) patients and lobar pneumonia in 37 (28.5%) patients. Cough 122 (93.8%), Noisy breathing 86 (66.15%), Fever 70 (53.84%) and Fast breathing 67 (51.54%) were the most common presenting complaints. Patients with lobar pneumonia were more likely to present with fever than those with Bronchopneumonia (p-value 0.015). Those with history of prior admission were more likely to present with wheeze (p-value 0.035) and crepitations (p-value 0.024) than those admitted for the first time. Also, those presenting with crepitations as lung finding, were found to present with significantly lower total White blood cells (WBC) counts (p-value 0.012).

Conclusion: There seems to be a significant association between fever as presenting complaint and lobar pneumonia. Also, those with history of prior admission are more likely to have lung signs (wheeze/crepitations) at presentation.

Key words: Child; Cough; Pneumonia

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INTRODUCTION

Pneumonia is one of the leading causes of morbidity and mortality in children two months to five years of age.[1] It accounts for highest mortality by a single disease among <5 years age.[2] According to the annual report published by the Department of Health Services for 2074/75, incidence of acute respiratory infection (ARI) was found to be 592 cases per 1000 children. Of these cases the incidence of pneumonia was 87 per 1000 children. The total deaths due to ARI at Health facility was 127 with a case fatality rate of 0.05 per 1000 cases at health facility.[3] The most common clinical features of pneumonia are running nose and cough of several days, fever, tachypnoea, chest retractions, cyanosis, lethargy and poor feeding. Auscultation of the chest may reveal crackles and wheezes.[4]

There is greater prevalence of severe pneumonia in children <1 years of age and in those who are malnourished which increases the risk of death.[5,6] There

are two categories of pneumonia; "pneumonia" with fast breathing and/or chest indrawing, and "severe pneumonia", with any general danger sign.[7] This study will help elaborate understanding of the clinical, radiological and haematological findings associated with pneumonia and ensure adequate management of these children.

METHODOLOGY

An analytical cross-sectional study was conducted in paediatric ward of Manipal Teaching Hospital (MTH) from December 2019 to November 2020. Approval for the study was taken from the Ethics and Research Committee of MTH (Ref. MEMG/IRC/294/GA). A total of 130 cases were included in the study. The sample size was calculated using Cochran's formula: $n = Z\alpha^2 \times (PQ) / d^2$. Here, n = required sample size; Z= 1.96 (for 95% level of confidence); P= 0.087 (Incidence of Pneumonia according to Annual report DoHS 2074/75 is 87 per 1000 population)[3]; Q = 1-P = 0.913; d = 0.05 (Precision = 5%). Thus, $n = 1.96*1.96*0.087*0.913/(0.05)^2 = 122$. So, the required sample size was 122 cases.

This number was rounded off to the nearest upper tens for convenience. First 130 cases to meet the inclusion criteria were included in the study by convenience sampling technique.

Children between 2-60 months of age admitted in paediatric ward with pneumonia as defined by World Health Organisation (cough and/or difficult breathing, with or without fever and presence of any one of: a) chest retractions/indrawing or b) age-specific tachypnoea with or without lung signs) were included in the study with due written consent from either parent.

Those children with congenital heart diseases, major congenital abnormalities, syndromic associations, Human Immunodeficiency syndrome Virus (HIV) or immunodeficiency disorders, steroids, tuberculosis, aspiration pneumonia and those who failed to give consent where excluded from study. Those requiring Paediatric Intensive Care Unit (PICU) care were also excluded from study. After detailed history and clinical examination, complete blood count (CBC) and chest X-ray was done.

The presenting symptoms like cough, fever, chest retractions and age-specific tachypnoea were observed. Lung signs were wheeze and crepitation. Chest x-ray was categorised as normal, bronchopneumonia or lobar pneumonia. Haematological parameters like total leukocyte counts, haemoglobin and platelet counts were studied. The observed data were analysed using SPSS 20 using Chi-square test.

RESULTS

Of the 130 children studied, 80 (61.5%) were male and the rest female (Table 1). The mean age of the patients was 15 ±2.63 months. Of the total patients studied, 75 (57.7%) had history of prior admission for respiratory illness and 55 (42.3%) were admitted for first time. Exclusive breastfeeding for initial six months was seen in 106 (81.5%) children, while 24 (18.5%) had mixed feeding. Bronchopneumonia was seen in 72 (55.5%) children, lobar pneumonia in 37 (28.5%) and rest 21 (16%) of the children had normal X-ray. None of the children in the study population developed complications like effusion, emphysema, or pneumothorax.

The mean WBC count was 15,552 (± 2,200) cells/mm^3, haemoglobin was 10 (± 3.1) gm/dl and platelet count was 3,69,110 (± 58,420) cells/mm^3.

On study of relationship between clinical features and radiological appearance, we categorised the data into independent variables and analysed the data using Chi-square test. Fever was seen in 47% of those cases who presented with lobar pneumonia and only 15.15% of those with bronchopneumonia with a p-value of 0.015. So, those patients with lobar pneumonia were more likely to have fever as presenting complaint. In a similar comparison, cough was not significantly associated with either bronchopneumonia or lobar pneumonia.

Of the lung signs, crepitation was observed in 50% of patients with history of prior admission for respiratory illness and in only 19% in those admitted for first time with a p-value of 0.024. So, those patients who have been previously admitted for respiratory illness are more likely to present with crepitation. Observation of crepitations did not significantly differ in either sex or any radiological pattern.

Wheeze was present in 74% of males and 45% of females with a p-value of 0.035. Also, wheeze was found in 83% of patients previously admitted and only 33% with first admission (p-value 0.001). So, males and those with prior admission for respiratory illness were more likely to present with wheezing. Wheeze was not associated with any radiological pattern.

Rest of the observations was not statistically significant.

Table 1: Socio-demographic characteristics of children with pneumonia

Variable	Frequency (Percent)
Sex	
Male	80 (61.5)
Female	50 (38.5)
Prior admission	
Yes	75 (57.6)
No	55 (42.4)
Exculsive breastfeeding	
Yes	106 (81.5)
No	24 (18.5)
Complete immunisation	
Yes	127 (97.7)
No	3 (2.3)

Table 2: Clinical symptoms of children

Variable	Frequency (Percent)
Cough	
Yes	122 (93.85)
No	8 (6.15)
Noisy breathing	
Yes	86 (66.15)
No	44 (33.85)
Fast breathing	
Yes	67 (51.51)
No	63 (48.46)
Chest indrawing	
Yes	50 (38.46)
No	80 (61.54)
Bluish coloration	
Yes	44 (33.85)
No	86 (66.15)
Running nose	
Yes	41 (31.54)
No	89 (68.46)
Sore throat	
Yes	20 (15.38)
No	110 (84.62)
Diarrhoea	
Yes	11 (8.46)
No	119 (91.54)
Poor feeding	
Yes	8 (6.15)
No	122 (93.85)
Excessive crying	
Yes	7 (5.38)
No	123 (94.62)
Vomiting	
Yes	6 (4.62)
No	124 (95.38)

Table 3: Radiological presentation

Radiological presentation	Frequency (Percent)
Normal X-ray	21 (16)
Lobar pneumonia	37 (28.5)
Bronchopneumonia	72 (55.5)

Table 4: Hematological features

Variable	Value
WBC count	15,552 (±2,200) cells/mm^3
Haemoglobin	10 (±3.1) gm/dl
Platelet count	3,69,110 (±58,420) cells/mm^3

Table 5: Association between various clinical and radiological features

	Characteristics	Prevalence	p-value
Fever	Bronchopneumonia	11	0.015*
	Lobar pneumonia	17	
Cough	Bronchopneumonia	43	0.192
	Lobar pneumonia	15	
Crepitation	Male	34	0.389
	Female	15	
Crepitation	Past admission	38	0.024*
	No past admission	11	
Crepitation	Bronchopneumonia	48	0.433
	Lobar pneumonia	20	
Wheeze	Male	59	0.035*
	Female	23	
Wheeze	Past admission	62	0.001*
	No past admission	18	
Wheeze	Bronchopneumonia	48	0.433
	Lobar pneumonia	20	
Chest Retractions	Bronchopneumonia	31	0.806
	Lobar pneumonia	15	
Age specific Tachypnea	Bronchopneumonia	37	0.782
	Lobar pneumonia	21	

On study of the changes in haematological parameters with various clinical and radiological features, there was not much significance.

The mean TLC in those presenting with crepitations was 13.81 and those without crepitations was 18.48 with a p-value of 0.012. So those with crepitations were more likely to have lower TLC. This might be due to greater occurrence of viral pneumonia in children.

Rest of the study of association between clinical and radiological patterns with haematological features were not statistically significant.

Table 6: Relationship between haematological parameters and clinical/radiological features

Parameter	Value (mean)	p-value
Chest retractions	**TLC** Yes 14.98×10³ cells/mm³ No 15.96×10³ cells/mm³	0.193
	Haemoglobin Yes 9.93 gm/dl No 10.04 gm/dl	0.195
	Platelets Yes 353.9×10³ cells/mm³ No 379.77×10³ cells/mm³	0.318
Age specific tachypnea	**TLC** Yes 15.7×10³ cells/mm³ No 15.38×10³ cells/mm³	0.857
	Hemoglobin Yes 10.09 gm/dl No 9.88 gm/dl	0.543
	Platelets Yes 394.81×10³ cells/mm³ No 340.2×10³ cells/mm³	0.123
Crepitations	**TLC** Yes 13.81×10³ cells/mm³ No 18.48×10³ cells/mm³	0.012*
	Hemoglobin Yes 10.1 gm/dl No 9.81 gm/dl	0.425
	Platelets Yes 352.4×10³ cells/mm³ No 397.26×10³ cells/mm³	0.233
Wheeze	**TLC** Yes 15.66×10³ cells/mm³ No 15.37×10³ cells/mm³	0.879
	Hemoglobin Yes 10.04 gm/dl No 9.91 gm/dl	0.719
	Platelets Yes 373.03×10³ cells/mm³ No 362.52×10³ cells/mm³	0.781
Radiology	**TLC** Lobar Pneumonia 15.535×10³ cells/mm³ Bronchopneumonia 15.66×10³ cells/mm³	0.872
	Hemoglobin Lobar Pneumonia 10.41 gm/dl Bronchopneumonia 9.76 gm/dl	0.069
	Platelets Lobar Pneumonia 371×10³ cells/mm³ Bronchopneumonia 368×10³ cells/mm³	0.939

DISCUSSION

Cough, noisy breathing, fever and refusal to feed are the most common presenting complaints in children with pneumonia. These features may be present in various combinations with additional complaints in children.

In this study cough was the most common symptom seen in 122 (93.85%) children, followed by noisy breathing 86 (66.15%), fever 70 (53.85%) and fast breathing 67 (51.54%). Finding was similar to observations by many other researchers. A study done at Chidambaram, India found that rapid breathing and cough was seen in all cases while fever was seen in 99% cases and refusal to feed in 24% cases.[8] In similar study in Rajasthan, India the common symptoms in the decreasing order of frequencies were cough (97.7%), fever (92.3%) and rapid breathing (89.2%).[9] Cough, respiratory distress, rhinorrhoea and abdominal pain were the most common presenting complaints as according to a study conducted in Bolivar, Colombia.[10] Cough was the predominant symptom found in 98% patients, followed by fast breathing (95%) and fever (90%) in another study at Vadodara, India.[11]

Age of the child is an important predisposing factor of incidence and severity of pneumonia. The mean age in this study population was 15 months. Pneumonia (47.5%) and severe pneumonia (48.7%) were found to be significantly more in 24-60 months age and very severe pneumonia was found to be significantly more in the 2-6 months in one study in Tiruchirappalli, India.[12]

Multiple vaccines in the national immunisation schedule prevent against various respiratory illness. So, immunisation also provides protection from respiratory illness. In this study we found that 96.1% of the population had been completely immunised and 3.9% of the children were not completely immunised. Those with complete immunisation were 74% in the study done at Chidambaram and only 52.3% in the study in Rajasthan.[8,9]

Malnutrition, lack of immunisation, overcrowding, past history of measles infection, lower socioeconomic status as risk factors for pneumonia have also been supported by various studies including that by WHO in 2008.[13]

Tachypnoea, chest retractions, crepitations and wheeze are the most common signs of pneumonia. In this study it was found that tachypnoea was found in 52.9%, chest retractions in 49%, crepitations and wheeze in 62.7% of the study population. Tachypnoea and chest retractions

in all cases and crepitations in 82% of cases was seen in the study done in Chidambaram.[8] 69.1% of the patients presented tachypnoea and 66.4% of these had chest wall indrawing in study in Bolivar, Colombia.[10] Tachypnoea was the most common sign present in 93% of the patients followed by respiratory distress (83%), hypoxia (58%), fever (18%) and cyanosis (8%) in the study done at Vadodara, India.[11]

Pneumonia can have normal radiology, infiltrates, consolidation or complications. 35.3% of cases were lobar pneumonia and 64.7% bronchopneumonia in this study. It was comparable to similar studies mentioned earlier with bronchopneumonia in 60% and lobar pneumonia in 30% in one study 59.9% bronchopneumonia in other.[8,9] Slightly different findings were observed in Himachal Pradesh where 51.8% had lobar consolidation, 31.3% had interstitial abnormalities and 16.9% had normal chest radiograph.[14] Radiological findings have prognostic significance as well. Children who had interstitial pneumonia (2.7 times), lobar consolidation (6 times), leukocytosis (1.8 times) and neutrophilia (1.9 times) had higher odds of delayed response than children who had normal findings according to a study done in Islamabad.[15]

Despite efforts to be as comprehensive and inclusive, this study has its own limitations. The sample size is relatively small with age restriction of 2-60 months. So, it gives no information about other age groups. The study population includes only those patients who have been admitted to the ward, had we been able to include cases from PICU and OPD as well it could have been more informative. Complicated radiological findings were coincidentally not found in the study population. Culture and isolation of causative organisms could not be done. This would have further broadened the scope of this study.

CONCLUSION

It was observed that those children with radiological presentation of lobar pneumonia were more likely to present with fever as presenting complain than those with bronchopneumonia. This might be due to lobar pneumonia being a frequent presentation of bacterial pneumonia and bronchopneumonia being more viral in origin. Also, those children with prior history of admission for respiratory illness were more likely to present with lung signs than those being admitted for first time. The total WBC count was found to be significantly less in those children presenting with crepitation as a presenting lung sign. This can be due to predominance of viral pneumonia in children. Further studies are recommended before concluding these findings.

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