Original Article

Radiological Evaluation of WHO-Defined Pneumonia and Severe Pneumonia

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Abstract

In developing countries like Bangladesh, Pneumonia remains a significant cause of morbidity and mortality. In about 50% of cases, no organism can be identified. Therefore, pneumonia diagnosis is usually based on radiographic findings, even in developed countries. World Health Organization (WHO) defines pneumonia based on the clinical conclusions obtained by chest inspection and respiratory rate of the under-five year children. It was a cross-sectional descriptive type of study conducted in the department of pediatrics in collaboration with the Department of Radiology & Imaging, Rajshahi Medical College, for two years. Chest x-rays with interpretation showed out of 100 patients, 14% were normal, and 31%, 30%, and 25% were suggestive of bacterial Pneumonia, bronchiolitis, and viral Pneumonia, respectively. The chest radiograph is the single most important tool for the diagnosis, exclusion, management, planning of further diagnostic procedures, and follow-up of pneumonia patients. So diagnosis and management of pneumonia are impossible without the use of a chest x-ray evaluation.

Keywords: World Health Organization, Pneumonia, Radiology, Bronchiolitis, Morbidity.

Introduction

Lower respiratory tract infection (LRTI) is a very common illness in children. Acute LRTI is the major cause of morbidity in resource-rich countries and the major cause of mortality in resource-poor countries.[1] The most important causes of lower respiratory tract infection (LRTI) in children are pneumonia and bronchiolitis.[2] Acute respiratory infection contributes to significant morbidity and mortality in children worldwide.[3,4] Each year, more than 10 million children under five years die throughout the world.[5]

The epidemiology of pneumonia is poorly understood because of its inherent difficulty in diagnosis and establishing a specific etiology.[6] Viruses are responsible for 65% of pneumonia in childhood and more than 90% in children less than two years of age,[7] 30% of cases of viral infection have co-existent bacterial infection,[8] Bacteria account for 5% to 10% of childhood pneumonia. In developing countries like Bangladesh, facilities for etiological diagnosis still need to be improved.[9] In developing countries, pneumonia is diagnosed using some clinical parameters, usually based on fever, cough, fast breathing, and chest indrawing.[10]

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The WHO criteria for diagnosis of pneumonia includes- a history of cough and or difficulty breathing of fewer than three weeks duration with

a.   Increased respiratory rate-
     -Rate ≥60/min < 2 month of age
     -Rate ≥50/min 2-12 months of age
     -Rate ≥40/min 12-59 months of age

b. Lower chest indrawing- Severe Pneumonia

c. Cyanosis or inability to feed or drink- Very severe pneumonia.[10]

This is a sensitive definition maximizing the number of children identified and treated empirically, but it is non-specific. This definition includes Pneumonia, bronchiolitis, and Pneumonia with complications or other causes of respiratory distress.[11] Because the clinical features of pneumonia are non-specific, by X-ray, we can confirm the diagnosis of pneumonia and exclude other diseases with similar presentation.[12] X-ray remains the principal and sometimes the only sensitive method for diagnosing pneumonia.[13] So, a chest x-ray is the most effective tool for diagnosing pneumonia; it is cost-effective and available everywhere, even in remote areas.

By conventional chest radiographs, we can confirm the diagnosis of pneumonia and exclude other diseases with a similar presentation, like bronchiolitis or viral pneumonia. The X-ray also helps to identify the etiology,[7,14] types of pneumonia, complication, and even guideline for therapeutic intervention.

Objectives

To evaluate the radiological findings of WHO-defined Pneumonia and severe Pneumonia under five years of age.

Materials and Methods

It was a cross-sectional type of descriptive study done in the department of pediatrics in collaboration with the department of radiology and imaging from January 2009 to December 2010. Purposive sampling was done. WHO defined pneumonia and severe patients selected with or without fever, age under five years, cough <3 weeks and fast breathing with or without chest indrawing. Patients with recurrent wheezing, congenital heart disease presence of any general danger sign (vomits everything, not able to drink or B/F, convulsion, lethargy, or unconsciousness). Informed written consent was taken from the parents or person attending the children. A thorough and careful history was taken from the mother or person attending to the children. A proper clinical examination was done for the diagnosis of Pneumonia and severe Pneumonia. A specified questionnaire form was filled up. Chest x-rays and radiological evaluations were done. The nutritional status of the patients was assessed and divided into two groups well or mild and moderate or severe malnutrition. Data were analyzed with the help of the SPSS software program and expressed as a mean p-value < 0.05 was considered significant. Ethical clearance from the ethical review board (ERB) of Rajshahi medical college was taken before the study.

Results

Regarding the frequency distribution of patients by WHO-defined pneumonia, it was found that most of them 90(90%) had severe pneumonia, and 10 (10%) patients had Pneumonia

Table 1:

WHO classification	Frequency	
	N	**Percentage**
Pneumonia	10	10
Severe Pneumonia	90	90
Total	100	100

Regarding the frequency distribution of patients by sex, it was found that the majority of the patients, 68 (68%), were male and 32 (32%) were female. The results indicate that a higher proportion of males (68%) suffered from pneumonia than females (32%)

Table 2:

Sex of the patients	Frequency	
	N	**Percentage**
Male	68	68
Female	32	32
Total	100	100

Regarding the frequency distribution of patients by symptoms, it was found that all of the patients in the pneumonia group presented with cough and difficulty breathing, and absent or low-grade fever, and most 7 (70%) patients presented with a runny nose, about the severe pneumonia group, all patients presented with cough and difficulty breathing. Forty-three (47.80%) patients reported runny noses, and the majority, 48 (53.3%), had no or low-grade fever, and the rest (42 (46.70%) patients presented with high-grade fever (Table-3).

Table 3: Frequency distribution of patients by symptoms

Symptoms	Pneumonia (n=10) N(%)	Severe Pneumonia (n=90) N(%)
Cough	10(100%)	90(100%)
Runny nose:		
-Present	7(70%)	43(47.80%)
-Absent	3(30%)	47(52.20%)
Fever		
-Absent or low grade<102^0F	10(100%)	48(53.30%)
-High grade >102^0F	0(00%)	42(46.70%)
Difficult breathing		
[-Moaning		
-Fast breathing	10(100%)	90(100%)
-Added sound(bronchial,crepitation,rhonchi)]		

Table 3 shows the increased severity of cough, fever, and respiratory distress in severe pneumonia than in pneumonia.

Table 4: Frequency distribution of patients with x-ray findings and WHO-defined Pneumonia and severe Pneumonia.

X-ray findings	WHO defined pneumonia		
	Pneumonia **n=10** **N(%)**	**Severe pneumonia** **n=90** **N(%)**	**Total N(%)**
Normal[51]	8(57.10)	6(42.90)	14(14.00)
Suggestive bronchiolitis	1(3.30)	29(96.70)	30(30.00)
Suggestive bacterial pneumonia	0(00.00)	31(100.00)	31(31.00)
Suggestive viral pneumonia	1(4.00)	24(96.00)	25(25.00)
Total	10(10.00)	90(90.00)	100(100.00)

Table 4 showed X-ray findings normal in 14 patients; out of them, the majority of 8(57.10%) were in the pneumonia group, and the rest, 6(42.90%), were in the severe pneumonia group. X-ray findings suggestive of bacterial pneumonia. All patients were in the severe pneumonia group. Among the x-ray suggestive bronchiolitis group, most of the patients, 29(96.70%), were severe pneumonia, and only 1(3.30%) patient was in the pneumonia group. X-ray findings suggestive of viral pneumonia were 25 patients, of which 24(96.00%) were severe pneumonia, and only 1(4.00%) patient was in the pneumonia group. This result indicated an association between X-ray interpretation and the WHO-defined pneumonia group, which was statistically significant.

Figure-1: Radiological finding of bronchopneumonia patients (n=31).
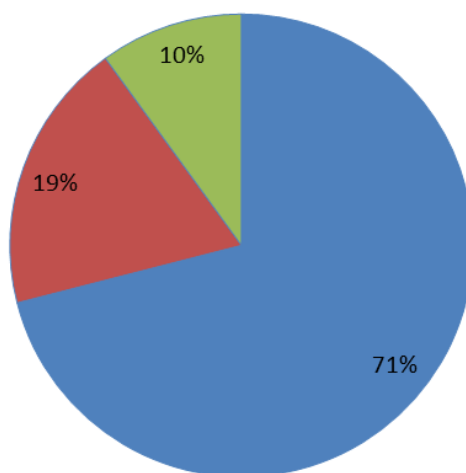
The study showed that out of 100 patients, 31 had X-rays suggestive of bacterial pneumonia. Among them majority, 22(70.97%) patients' x-ray findings showed patchy bilateral opacity; 6(19.35%) patients showed segmental consolidation, and the rest 3(9.68%) showed lobar consolidation (Figure-1).

Table 5: Frequency distribution of patients with fever and x-ray findings.

X-ray findings	Fever of the patients		
	Absent or low grade	High grade	Total
	N(%)	N(%)	N(%)
Normal	13(92.9%)	1(7.1%)	14(14%)
Suggestive of bronchiolitis	24(80%)	6(20%)	30(30%)
Suggestive of bacterial pneumonia	3(9.7%)	28(90.3%)	31(31%)
Suggestive of viral pneumonia	18(72%)	7(28%)	25(25%)
Total	58(58%)	42(42%)	100(100%)

$* (x^2 = 44.67, df = 3, p<0.001)$

Table 6: Frequency distribution of patients with blood count and WHO-defined pneumonia

Complete blood count	WHO group		
	Pneumonia	Severe Pneumonia	Total
	N(%)	N(%)	N(%)
Normal	10(100%)	69(76.70%)	79(79%)
Neutrophilic leukocytosis	00(00%)	21(23.3%)	21(21%)
Total	10(10%)	90(90%)	100(100%)

$* (x^2 = 2.954, df = 1, p>0.05)$

Table 7: Radiological finding of bronchiolitis patients (n=30)

Radiological feature	Frequency	
	N	%
Increase translucency of lung fields	27	93.33
Increase interstitial markings	25	83.33
Hyperinflation of lungs	20	80.00
Streaky density	15	50.00

- Increased percentage due to multiple findings in the same film.

Out of 100 patients, radiological findings suggestive of bronchiolitis was 30. Typical features are illustrated in numbers and percentages.

Table 8: Radiological findings of viral pneumonia patients (n=25).

Radiological features	Frequency	
	N	**%**
Parahilar peribronchial infiltrate/bilateral interstitial infiltrates	25	100
Hypeinflation	20	80
Hilar adenopathy	5	20
Segmental atelectasis	3	12

- An increased percentage is due to multiple findings in the same film.

Out of 100 patients, radiological findings suggestive of viral pneumonia were 25. Results are shown in numbers and percentages. Most of the findings suggestive of viral pneumonia are perihilar peribronchial infiltrate/bilateral interstitial infiltrates (100%) and hyper expansion (80%) (Table 7).

Table 9: Frequency distribution of patients' nutritional status and x-ray findings.

X-ray findings	Nutritional status		
	Well or mild nutrition	Moderate or severe malnutrition	Total
	N(%)	N(%)	N(%)
Normal	13 (92.90)	1 (7.10)	14 (14.00)
Suggestive of bronchiolitis	29 (96.70)	1 (3.30)	30 (30.00)
Suggestive of Pneumonia	16 (51.60)	15 (48.40)	31(31.00)
Suggestive of viral Pneumonia	23 (92.00)	2 (8.00)	25 (25.00)
Total	80 (81.00)	19 (19.00)	100 (100.00)

$* (x^2 = 25.424, df = 3, p < 0.001)$

These findings between the nutritional status of the patients and x-ray findings were found to be statistically highly significant.

Discussion

Acute respiratory tract infection is responsible for high mortality and morbidity of children in developing countries like Bangladesh. It is responsible for 4 million deaths under five years of age each year. Pneumonia is caused by varieties of organisms, especially bacteria and viruses. By using all the modern investigation facilities, in about 20-60% of cases, no causative pathogen is identified.[1,8]

The present study was carried out in Rajshahi medical college hospital at the Department of Pediatrics and Department of Radiology and Imaging. A total number of 100 patients were included in this study. The patients were divided into two groups according to WHO criteria, Pneumonia and severe Pneumonia (Table no. 1). Most of the patients were in the severe pneumonia

group because pneumonia patients can be managed at OPD, according to WHO treatment protocol. Males were predominant, which is consistent with other studies, male to female ratio was 2:1[15](Table 2,3). The severity of the disease correlated well with the WHO pneumonia severity algorithm[16] (table 4). The present study showed that out of 100 patients, normal chest X-ray was 14%. X-ray suggestive of bronchiolitis was in 30% of cases, X-ray suggestive of bacterial pneumonia was in 31%, and radiological feature consistent with viral pneumonia was in 25% (Table 5). Most of the normal X-rays (80%) were in the pneumonia group, and all the (31%) radiologically confirmed bacterial pneumonia were in pneumonia.

Another important observation was found that those patients were radiologically diagnosed with bacterial pneumonia (31%). Most of them (90.30%) had a high-grade fever and neutrophilic leukocytosis. So high, grade fever and elevated WBC count are consistent with radiologically proven bacterial pneumonia without lower respiratory tract finding on examination[17] (Table-7,8).

Common radiological findings in bacterial pneumonia are patchy bilateral opacities, segmental consolidation, and lobar consolidation. A study done by Hossain[15] found that clinically common respiratory diseases were bronchopneumonia (26.8%), bronchiolitis (24%), and lobar pneumonia (11.2%). X-ray findings were also suggestive of bronchopneumonia, bronchiolitis, and lobar pneumonia, respectively (figure 1).

This study showed that out of 100 patients, radiological features consistent with bronchiolitis were 30%. Feature suggestive of bronchiolitis were increased translucency of lung fields in 93.33%, increased interstitial markings in 83.33%, hyperinflation of lungs in 80% of cases, and streaky densities in 50% (Table-8). A similar observation was found in a study in Bangladesh[17].

Out of 100 patients, radiological features consistent with viral pneumonia were 28%. Most of the patients were in the severe pneumonia group. This study found a common pattern of radiological findings was perihilar peribronchial infiltrate, hyperexpansion, hilar adenopathy, and segmental atelectasis. Neumas et al. 55 showed four common radiographic findings consistent with our results (Table 7).

The present study also showed the radiological diagnoses of the patients as bronchiolitis and viral pneumonia. In addition, most of the patient's nutritional status was good (Table 8).

Conclusion

There is no gold-standard test available to confirm pneumonia. Clinical symptoms are non-specific, especially in young children. Radiology can help in the diagnosis of pneumonia and exclude other diseases with similar presentation. Radiological as well as clinical assessment is necessary for the proper diagnosis of acute lower respiratory tract infection. So X-ray should be done in every suspected case of severe pneumonia, defined as high-grade fever, tachypnea, and chest indrawing.

Conflict of interest: None declared

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