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Diagnosis of Pneumonia in Children with Severe Acute Malnutrition, Validation of WHO Recommended Criteria and Pulse-Oximetry

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ABSTRACT
Aim: *To find incidence of clinical pneumonia viz a viz radiologically confirmed pneumonia in children with severe acute malnutrition.*
Materials and Methods: *It was a hospital based prospective analytical study carried out over a period of 12 months from January 2013 to December 2013. 184children with SAM admitted to paediatrics ward were evaluated for pneumonia as per WHO criteria. Besides the routine investigations, each patient was subjected to X-ray chest, pulse-oximetry and Montoux test and the results were correlated.*
Results: *Out of 184 patients with SAM, 52 (28.26%) had features of clinical pneumonia but 7 (3.8%) out of them had a normal X-ray chest. Similarly, 15 (8.15%) cases had definite radiological features of pneumonia however, they did not fit into the clinical diagnostic criteria. Moreover, 6 of these 15 cases (40%) had hypoxia (Spo2< 90% at room air) on pulse-oximetry at the time of admission.*
Conclusion: *WHO recommended clinical criteria; if used alone is inadequate for diagnosis of pneumonia in children with SAM as occult pneumonia was seen in about 25% cases. Traditionally used X-ray chest should be made a basic cornerstone for diagnosis of pneumonia. Moreover, on pulse-oximetry, 40% of occult pneumonia cases showed hypoxia; thereby making it a useful adjunct in diagnosing pneumonia cases.*
Keywords: *Pneumonia, SAM, Occult pneumonia, Pulse-oximetry, Chest X-ray.*

INTRODUCTION

Pneumonia is currently the leading cause of childhood death in developing countries, including India [(1)], constituting 19 % of the total 10.6 million deaths among children aged less than five years, that occur globally each year, and nearly all of these deaths occur in developing countries [(2)]. Malnutrition is a common co-morbidity in such communities [(3)] and is a major risk factor for deaths due to pneumonia [(4)]; the risk increases with increasing severity of malnutrition [(5)] and also when treatment is delayed [(6)]. Early and efficient management can reduce case-fatality rates from pneumonia [(7)]. In resource-poor settings, health professionals often rely heavily on clinical assessment alone in diagnosing

pneumonia; however, clinical signs may be protean in severely-malnourished children [5,8]. WHO recommended clinical signs are often not found in malnourished children, hence the diagnosis is likely to be missed [9,10]. Occult pneumonia is defined as "Radiographic pneumonia in a patient without signs of pneumonia" it may occur in severely-malnourished children.

Although X-ray chest does not give a reliable answer to aetiology, but it does diagnose pneumonia with certainty and hence can be taken as gold standard [11,12,13]. There are very few studies conducted in last 10 years on clinical and laboratory features of pneumonia in malnourished children [14].

This prospective observational analytical study was thus under taken to find the incidence of clinical, radiological and occult pneumonia in children admitted with severe acute malnutrition and to evaluate various parameters used to diagnose these cases with respect to their predictive capability.

MATERIALS AND METHODS

Inclusion criteria-

All malnourished children age between 2-59 months admitted to paediatrics ward of JNMCH, AMU over a period of 12 months from January 2013 to December 2013.

Exclusion criteria-

Known or clinically recognizable causes of difficulty in breathing were excluded like

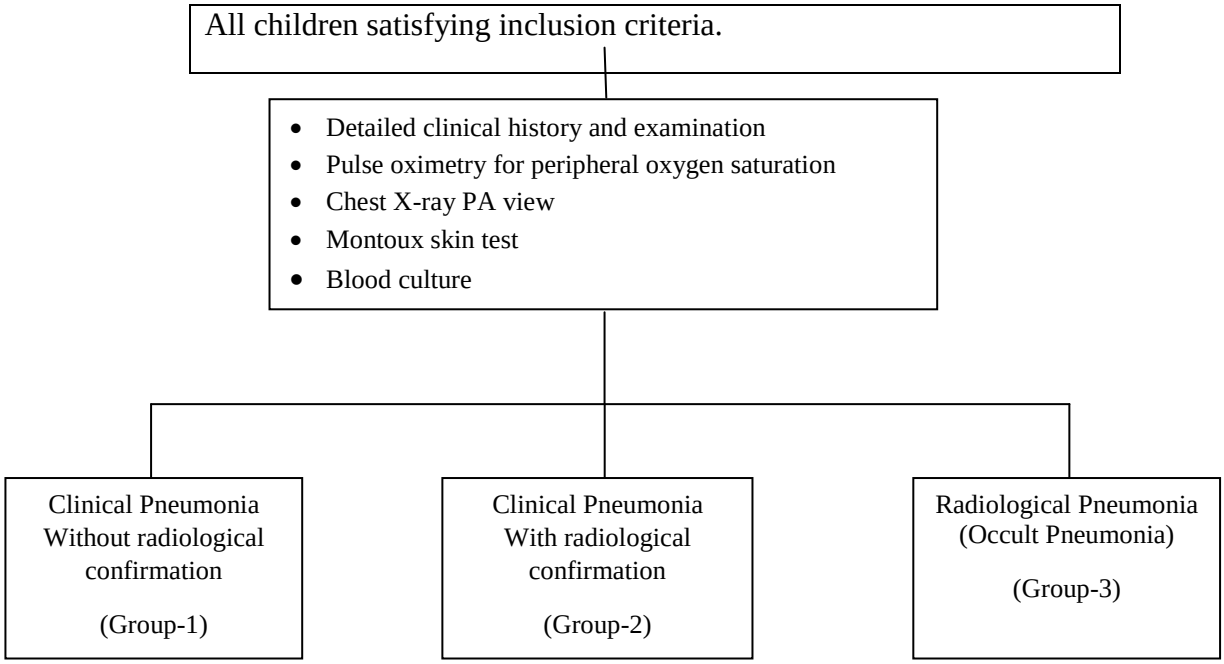
- Bronchial asthma that responds to trial of nebulisation.
- Suspected surgical pathology.
- Foreign body inhalation
- Poisoning
- Dehydration
- Acidosis

A detailed history and examination was done and the subjects were categorised as having clinical pneumonia based on the established WHO criteria [16].

Anthropometric analysis of the subjects including the following measurements was done and patients were classified into SAM as per WHO criteria [15].

- **Weight:** It was measured using a digital weighing scale having an accuracy of 0.05 kilograms in children.
- **Height/length:** It was measured by infantometer in children less than 2 years and by a portable stadiometer, with the subject standing bare footed against a standard vertical sliding scale in children greater than 2 years.
- **MUAC:** It was measured by using measuring tape with least count of 0.1 cm; at a point midway between acromian process and olecranon process. MUAC of less than 11.5 cm will be considered malnourished.
- Haemogram, Montoux test and Pulse Oximetry was done in all children right at the time of examination. A baseline blood culture and chest roentgenogram were also done in each patients at the time of admission. Postero- anterior view were taken and all the skiagrams were read independently by both the radiologist and paediatrician to minimise inter-observer error.
- Those with following radiological findings were classified as having pneumonia [12, 13].
  - Dense opacity,
  - Fluffy chest infiltrates
  - Consolidation of a portion or whole of a lobe or of the entire lung.

All the patients were started empirically on antibiotics (Ampicillin and Gentamycin) and the medication were further changed if the patients deteriorated after 48 hours or didn't improve after 72 hours [17]. This study was approved by the institutional Ethical Committee and an informed/ implied consent was taken from all the study subjects as per required.



RESULTS

The mean age of 184 children was 12.02 months. They were 116 boys (63%) and 68 girls (37%). Baseline characteristics of the patients and the controls were shown in Table 1.

Out of 184 patients, there were 67 (36.4 %) cases of pneumonia. The number of patients having Clinical pneumonia with and without radiological confirmation were 45 (67%) and 7 (10.4%) respectively (Table 2). However, 15 children (12.8%) who did not have any respiratory symptoms on presentation were also found to have radiological features of pneumonia (Occult pneumonia). 6 (40%) of these 15 showed an added feature of hypoxia (Spo2< 90% at room air) on pulse oximetry.

Table 1. Baseline characteristics of patients

Item	Malnourished children (Data are presented mean ± SD)
• Age (months) • Sex (M/F) • Weight (kg) • Height (cm) • MUAC (cm) • Haemoglobin (g/dl)	12.02±9.04 116/63 5.38±1.86 65.79±8.58 10.33±1.36 10.14±1.91

Table 2 (Number of patients in three different groups)

Clinical Pneumonia Without radiological confirmation (Group-1)	Clinical Pneumonia With radiological confirmation (Group-2)	Radiological pneumonia (Occult pneumonia) (Group-3)	TOTAL PNEUMONIA CASES
7	45	15	67

Table 3: Clinical versus Radiologically defined Pneumonia (contingency table)

		Radiological pneumonia		Total	
		Yes	No		
Signs symptoms of Pneumonia	Yes	45 (86.5%)	7 (13.4%)	52	Sensitivity-75% Specificity-94.3% PPV-86.5% NPV-88.6%
	No	15 (11.3%)	117 (88.6%)	132	
Total		60 (32.6%)	124 (67.3%)	184	

DISCUSSION

As per the WHO defined clinical criteria, 52 (28.26%) cases of pneumonia were picked up but 15 cases of occult pneumonia have been missed. Thus, clinical criteria used alone had positive predictive value of 86.53% and negative predictive value of 88.6%. Similar incidence of occult pneumonia was found in previous studies [18, 19].

Out of 7 cases of clinical pneumonia without radiological confirmation, 3 presented with Bronchiolitis, 2 with severe anaemia with acidosis and 2 patients had high grade fever. Thus, as a predictor of pneumonia, X-ray chest had a sensitivity of 75% and specificity of 94.35%.

3 out of 15 (8.15%) cases of occult pneumonia were diagnosed as tubercular pneumonia on the basis of history of contact and Montoux test and chest x-ray showed non-resolving pneumonia.

Out of 15 confirmed cases of occult pneumonia 12 (80%) children showed hypoxia (spo2 <95% at room air) and6 (40%) of them showed Spo2< 90% at room air thereby; making pulse-oximetry as a significant predictor of pneumonia in our setting. Also, as pulse-oximetry is more objective and cheaper than radiography, its role as a clinical and investigative tool merits further exploration.

These results suggest that WHO recommended clinical signs for the diagnosis of pneumonia in severely malnourished children are not sensitive enough when used solely as predictors of pneumonia. Clinical signs of pneumonia may be absent in severely-malnourished children due to sub-optimal inflammatory responses, reduced power of the respiratory muscles, and depletion of potassium and magnesium. Severe malnutrition also contributes to immune deficiency and reduced host-defence. Reduced clinical signs of pneumonia in severely malnourished children have previously been reported; however, we could not find any report of radiological pneumonia in absence of all the clinical signs in such populations.

We thus conclude that occult pneumonia in severely malnourished infants and young children is a reality and not a myth. Therefore, a vigilant work up of such cases including a constellation of clinical assessment, radiological findings as well as use of pulse-oximetry is must by the physicians to search for any possibility of occult pneumonia in order to start early and appropriate management thereby, reducing morbidity and mortality.

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