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Original Research Article

A Retrospective Observational Assessment of the Oxygen Saturation Monitoring in Diagnosis of Childhood Pneumonia in Children

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Abstract

Objective: To study the role of clinical features (including that of current WHO criteria), and oxygen saturation (SpO2) in the diagnosis of childhood pneumonia.

Methods: A retrospective observational study was conducted in IGIMS, Patna, Bihar, India. Children, 2 to 59 months of age, suffering from acute respiratory infection (ARI).

Results: The prevalence of radiological pneumonia in the present study was 44%. Consolidation was found in 44 cases, Alveolar infiltration was found in 35 cases, Peribronchial thickening was found in 45 cases, Interstitial thickening was found in 24 cases and Atelectasis was found in 33 cases.

Conclusion: Current WHO criteria based on fast respiratory rate and/or chest indrawing have poor sensitivity and specificity for diagnosing pneumonia. Adding 92% SpO2 to chest indrawing or WHO criteria enhances the chance of pneumonia diagnosis and is crucial in managing a kid with pneumonia.

Introduction

Pneumonia is the most common cause of death in children under the age of five [1, 2]. Over 80% of children with community-acquired pneumonia (CAP) have a cough and fever. Other symptoms, like trouble breathing, feeling sick, throwing up, and not eating well, happen less often [3]. One of the hardest parts of diagnosing CAP in children is getting it right.

Based on evidence from the early 1980s, WHO (World Health Organization) made an algorithm for treating acute respiratory infections (ARI) in children, like CAP, in the same way [4]. The WHO algorithm's clinical criteria for diagnosing pneumonia included a child's fast breathing, cough, and/or trouble breathing. The sensitivity of the WHO algorithm was found to be between 59 and 81%, and there have been worries about its specificity, which has led to antibiotics being given to people who don't need them. [3, 5-11].

In 2014, the WHO algorithm for pneumonia was changed. Severe and very severe pneumonia were combined into one category, and pneumonia was defined as

rapid breathing and/or lower chest indrawing (LCI) [12]. But this updated algorithm kept the same signs and symptoms that were used in the older version to classify how bad a child's pneumonia was. A recent systematic review found that the lack of a cough was a significant negative predictor, while a SpO2 of less than 95% or increased work of breathing (nasal flaring, grunting, or lower chest indrawing) were significant diagnostic predictors of pneumonia.

There is as yet no study from the Indian setting, assessing the diagnostic accuracy of clinical signs and symptoms (including WHO criteria) of pneumonia, with or without SpO2 measurement

Materials and Methods

This retrospective observational, multicentric study was conducted in IGIMS Patna in five sites in India over a 1 year period. Children aged 2-59months with ARI (any cough and/or breathing difficulty for<2 weeks) were enrolled. Those with chronic respiratory diseases (asthma, cystic fibrosis, broncho-pulmonary dysplasia, airway anomalies), congenital heart disease, gastro-oesophageal reflux/ recurrent aspirations, immunosuppression, radiologically confirmed pneumonia in last 2 months, residing outside the study city, and who were critically ill (impending respiratory failure, cyanosis at room air, shock), were excluded.

Details regarding clinical features, nutritional and immunization status, treatment history, demographic information, and examination findings were obtained from the hospital records.

Spo2 records were also obtained. A chest X-ray (CXR) was obtained in all children clinically assessed to have acute lower respiratory tract infection (ALRI/pneumonia) as per the WHO criteria. CXR was also obtained in every fifth child assessed as no pneumonia (URI).

Statistical analysis: For analysis, the data were entered into Microsoft excel sheet and analyzed using Stata v.14 (StataCorp LLC) statistical software. Categorical data were analyzed by Chi-square test. For studying the association between WHO pneumonia classification and CXR findings, risk ratio (RR) with 95% confidence interval (95% CI) was calculated. Sensitivity, specificity, likelihood ratio (LR), and post-test probability were calculated. A P value <0.05 was taken as significant. Results

Table 1: Baseline Demographic and Clinical Characteristics of Enrolled Children

Age (month) (mean±SD)	20±9.41
Weight for age z-score	-0.53
Height/Length for age z-score	-0.65
Weight for height z-score	-0.35
Mid upper arm circumference z-score	-1.09

The prevalence of radiological pneumonia in the present study was 44%,

Table 2: Association between WHO Pneumonia classification and Chest X-Ray Findings

	No pneumonia	Pneumonia	RR (95% CL)
Consolidation	56	44	1.55 (1.3-1.9)
Alveolar infiltration	65	35	2.06 (1.36-2.85)
Peribronchial thickening	55	45	1.95 (1.57-2.15)
Interstitial thickening	76	24	1.13 (0.43-2.06)
Atelectasis	67	33	1.34 (0.97-2.92)

Consolidation was found in 44 case, Alveolar infiltration was found in 35 cases, Peribronchial thickening was found in 45 cases, Interstitial thickening was found in 24 cases and Atelectasis was found in 33 cases.

Neither cough nor wheeze had a significant LR for ruling in or ruling out the diagnosis of pneumonia. The parameters like breathing difficulty, fast breathing, chest indrawing, existing WHO criteria for pneumonia, SpO2 <92%, existing WHO criteria + SpO2 <92%, existing WHO criteria and/or SpO2<92%, chest indrawing + SpO2 <92%, existing WHO criteria present and SpO2 <92% applied serially had a significant positive LR as well as negative LR (except fever, which had a significant negative LR only). Positive LRamong confirmed pneumonia cases ranged from 1.5 (for breathing difficulty) to 2.7 times (for chest indrawing +SpO2 <92%) in confirmed pneumonia cases compared to those without. Negative LR ranged from 0.85 (for chestindrawing + SpO2 <92%) to 0.64 (for fever, and existing WHO criteria and/or SpO2 <92%, both) in those with pneumonia compared to those without

Discussion

Overall, the analysis shows that the current WHO criteria for pneumonia have a moderate level of sensitivity (56.5%) and specificity (66.2%), which is in line with what a previous meta-analysis found. [8].

The prevalence of radiological pneumonia in the present study was 44%,similar to previous studies [13]. Primary endpoint pneumonia is usually defined as presence of consolidation or pleural effusion with or without other infiltrates (e.g., interstitial infiltrates/thickening, atelectasis, peri-bronchial thickening, and alveolar infiltrates not sufficient to refer as a consolidation) [8]. Other infiltrates are commonly seen in viral or atypical pneumonia. In the present study, only consolidation and alveolar infiltrates were found to be significantly associated with WHO pneumonia, which probably means that majority had bacterial pneumonia [13],which is consistent with the finding of a relatively high proportion of severe pneumonia cases, in the present study(37%) [14].

It has been shown that an LR+ of 2.0 and an LR of 0.5 change the post-test chance of disease by a lot. In this study, neither a cough nor a wheeze that can be heard (7.3% of the children) is a strong indicator of pneumonia or not. This is an interesting point to make, since coughing has always been the most common sign of pneumonia. A recent systematic review [3] found that none of the symptoms, such as cough, audible wheeze, poor feeding, trouble breathing, or illness lasting more than 3 days, had a significant likelihood of diagnosing pneumonia. However, the absence of cough had a significant negative LR (LR 0.47; 95 percent CI 0.24 to 0.70) for ruling out the diagnosis of pneumonia. Also, a high work of breathing (nasal flaring, grunting, or lower chest indrawing) and a SpO2 of less than 95% (LR+2.1) were strong signs of pneumonia. Studies using other cut-off SpO2 values (i.e., 96%, 92%, and 90%) had lower LR+, whereas, SpO2 >96% had a LR– of 0.47 [3,15].The poor diagnostic performance of auscultatory findings(e.g., presence of wheeze or crackles) could be because these are subjective parameters. The present study shows that the probability of having pneumonia improved to 66% among those tested positive for WHO criteria with a SpO2 of <92%,and to 69% among those with chest in-drawing and a SpO2of <92%. None of the parameters in the present study were found to have negative LR of ≤0.5, thus making them inappropriate for ruling out the pneumonia diagnosis. Our findings are different from previously published studies[3,8], probably because of variation in the age of included.

The problem with this study is that we couldn't do a subgroup analysis of things like age, length of symptoms at presentation, and severity, which in a previously published study were shown to change how well a diagnosis was made. [16,17].

Conclusion

To conclude, Current WHO criteria based on fast respiratory rate and/or chest indrawing have poor sensitivity and specificity for diagnosing pneumonia. Adding 92% SpO2 to chest indrawing or WHO criteria enhances the chance of pneumonia diagnosis and is crucial in managing a kid with pneumonia.

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