

Clinical predictors of Hypoxemia in Acute respiratory tract infections in children aged 6 to 60 months

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ABSTRACT

Objectives: To determine the Clinical Predictors of Hypoxemia in Acute respiratory tract infections (ARI) in children aged 6 to 60 months and to study the incidence of ARI with Hypoxemia.

Materials & Methods: A Prospective observational study carried on 138 children between the age of 6 to 60 months presenting with a complaint of cough or difficulty in breathing were assessed between September 2016-February 2017. Hypoxemia is defined as arterial saturation of oxygen less than 90% (SPO₂<90%) recorded by portable pulse oximeter.

Results: Out of 138 children, Prevalence of hypoxemia in children with ARI was 28.26% (39/138). Clinical predictors significantly associated with hypoxemia are Tachypnea in 28.20% (11/39), chest indrawing in 20.51% (8/39), and difficult breathing in 7.69% (3/39). On assessment, none of the children with URI had hypoxemia but the incidence increases with the increasing severity of ARI.

Conclusion: The increasing frequency of hypoxemia in children with more severe illness and the clinical predictors identified in the study validate the WHO classification of ARI based on severity. Simple clinical signs can still be used to identify hypoxemia, classify ARI and administer oxygen.

Keywords: ARI, Hypoxemia, Clinical predictors, Pulse oximeter

INTRODUCTION

Respiratory tract infections are one of the leading causes of childhood morbidity and mortality. According to WHO approximately 2.5 million deaths from acute respiratory tract infections (ARI) occur throughout the world every year. Among them pneumonia is the most leading cause of childhood death killing 2 million children annually^[1]. India a developing country has an infant mortality rate of 37/1000 live births and an under 5 mortality rate of 48/1000 live births^[2]. ARI are classified as upper respiratory tract infections (URI) and lower respiratory tract infections (LRI). Except during the neonatal period, ARI

are the most common causes of both illness and mortality in children under five.

WHO average three to six episodes of acute respiratory tract infections annually regardless of where they live or what their economic situation^[3].

With the introduction of pulse oximeter, a sufficiently accurate and non invasive tool for the measuring arterial oxygen saturation, assessment of hypoxemia in acute respiratory tract infection has become possible. Hypoxemia is defined as the arterial oxygen saturation of less than 90% (SPO₂<90%) in the present study. Clinical signs that best predict hypoxemia in acute respiratory tract infections have been evaluated in earlier studies in other developing countries. Clinical features like irritability, excessive cry, refusal to feed, tachypnea, grunting and Chest indrawing have been identified as the best clinical predictors of hypoxemia

MATERIALS & METHODS

A prospective observational study was carried out from September 2016 to February 2017 in Prathima Institute of Medical Sciences, Nagnur, Karimnagar. 138 children's between the age of 6 to 60 months, who presented to out-patient or emergency department with a complaint of cough or difficulty in breathing, were assessed. Children with Heart disease, neurological problem, congenital defects and bleeding manifestations are excluded.

Detailed history was taken from the mother about the presence and duration of various respiratory symptoms like Fever, Cough, Rhinitis, Excessive cry, refusal to feed, Irritability, Difficult breathing, Noisy breathing, Loss of appetite, Altered sensorium, Grunting and Lethargy. Complete physical examination of the child was done and the following signs were recorded like appearance, weight, heart rate, respiratory rate (counted for 1 minute), Tachypnea, Chest indrawing, Nasal flaring, Grunting, Decreased breath sounds, Crackles, Rhonchi, Tachycardia, Altered sensorium, Lethargy. During the physical examination, arterial saturation (SPo₂) was recorded using a portable, battery powered pulse oximeter (model no: MD300C26 manufactured by Beijing

choice electronics tech.co.ltd) with the sensor device placed over the right hand finger (index or middle) or the big toe. A reading that was stable for at least 1-2 minutes was noted down and again confirmed with multiparameter (Philips sure sign VM6, made by Philips medical systems U.S.A). Hypoxemia is defined as an arterial oxygen saturation of <90% recorded by pulse oximeter. An arterial oxygen saturation of 90% generally correspond to an arterial oxygen tension of 60-70 mm of Hg, this relation however is effected by factors such as temperature ,ph and age.The statistical analysis was performed with "SPSS (Statistical Process for Social Sciences) Software" VERSION-19.

RESULTS

In the study conducted , a total of 138 children were examined, out-patient were 38.41 %(53) and children admitted in hospital were 61.59 %(85). Male children were 59.42 %(82) and 40.58 %(56) were female children between 6 to 60 months age.[Table 1]

TABLE I Comparing male and female in different age group

AGE MONTHS	MALES	FEMALES	TOTAL	PERCENTAGE (%)
6 -- 12	24	18	42	30.43
13 – 24	16	14	30	21.74
25 – 36	12	10	22	15.94
37 - 48	18	08	26	18.84
49 - 60	12	06	18	13.0
TOTAL	82(59.42%)	56(40.58%)	138	100%

A proportion test (chi square) was applied to compare the association between hypoxemia and clinical signs of acute respiratory tract infections. "Fisher's exact test" was applied wherever applicable, statistics were obtained from open epidemiological calculator and The statistical analysis was performed with "SPSS".

The distribution of children according to age and sex . Age range was 6 to 60 months. with the male, female ratio of 1.5:1. There were a significantly higher number of infants with respiratory infections 30.43 %(42),as the age increases the incidence decreases because of the resistance developed towards the repeated infections and small airways in infants.

Howard et al^[4] conducted similar type of work and found the incidence of ARI to be highest in children under 2 years of age and males predominance is more with ARI than females. On assessment, children with cough and cold had

SPO2 of >90% but the children with very severe pneumonia had SPO2 of <90%. Prevalence of hypoxemia in children with ARI was 28.26 %(39/138). The present study explains highest incidence of ARI seen in the month of Sep 2016 may be due to the change in the season from rainy to winter.[Table 2]

TABLE II HYPOXEMIA IN ACUTE RESPIRATORY TRACT INFECTION

OXYGEN SATURATION (SPO2)	NO OF CASES	PERCENTAGE(%)
< 90%SPO2 (HYPOXEMIC)	39	28.26
>=90%SPO2 (NON-HYPOXEMIC)	99	71.74
TOTAL	138	100

Presenting feature of the present study had fever in 69.56%(96) children, cough in 73.19%(99), common cold in 30.43%(42), difficult breathing in 39.85%(55), irritability in 19.56%(27), excessive cry in 22.46%(31) and in refusal to feed/drink in 16.67% (23).Among symptoms **Breathing difficulty** (3/55)(P < 0.001 χ^2 = 23.46) **Irritability** (1/27) (P < 0.001 χ^2 = 9.9) **Excessive cry** (2/31) (P < 0.002 χ^2 = 9.38) **Refusal to feed** (2/23) (P < 0.002 χ^2 = 9.38) had significant association with hypoxemia in the present study . Onyango^[5] in his study stated that history of difficult breathing was associated with hypoxemia.Usen and Weber^[6] also reported in their studies that the severely reduced feeding in infants was associated with hypoxemia.

In the present study the different physical signs are noted, **Tachypnea (11/95)** (P < 0.001 χ^2 = 41.85) . Tachypnea was defined by using cut off values based on age according to WHO guidelines. **Chest indrawing (8/73)** (P < 0.001 χ^2 = 22.8) Chest indrawing in the children's between the ages of 6-60 months is one of the best clinical predictor of hypoxemia in the present study. Weber^[6] and Kabra^[7] in their study reported that chest in drawing is the best predictor of hypoxemia in children's under 5 years, **Tachycardia (3/55)** (P < 0.001 χ^2 = 23.46), **Nasal flaring (2/23)** (P < 0.002 χ^2 = 5.21) and **Crackles (2/23)** (P < 0.002 χ^2 = 5.21) Laman et al^[8] reported that children with nasal flaring and crackles were significantly associated with hypoxemia. **Rhonchi (1/27)** (P < 0.001 χ^2 = 9.9). **Decreased breath sound (2/31)** (P < 0.002 χ^2 = 9.38) **Grunting (2/32)** (P < 0.002 χ^2 = 9.42) Onyango and weber in their study reported that children with grunting was associated with hypoxemia.

In the present study all the patients with very severe pneumonia are more hypoxemic than severe pneumonia, and than with pneumonia are hypoxemic. Lozano^[9] also reported that the frequency of hypoxemia is determined by the severity

of infections. While out-patient children and those with clinical Diagnosis of URI are at low risk of hypoxemia and than those with pneumonia.[Table 3]

TABLE II HYPOXEMIA IN ACUTE RESPIRATORY TRACT INFECTION

CLINICAL PREDICTORS	HYPOXEMIA (n=CHILDREN)	PERCENT-AGE(%)	(CHI SQUIRE χ^2)
TACHYPNOEA (95)			
6-12 MONTHS (\geq 50/MIN) (57) 07	11 (P<0.001)	28.20	41.85
13-60 MONTHS (\geq 40/MIN) (38)04			
CHEST INDRAWING (73)	08 (P<0.001)	20.51	22.8
DIFFICULT BREATHING (55)	03 (P<0.001)	7.69	23.46
INABILITY TO FEED/ DRINK (23)	02 (P<0.002)	5.12	9.38
IRRITABILITY (27)	01 (P<0.001)	2.56	9.9
EXCESSIVE CRY (31)	02 (P<0.001)	5.12	9.38
CRACKLES (23)	02 (P<0.002)	5.12	5.21
TACHYCARDIA (55)	03 (P<0.001)	7.69	23.46
NASAL FLARING (23)	02 (P<0.002)	5.12	5.21
DECREASE BREATH SOUND (31)	02 (P<0.001)	5.12	9.38
GRUNTING (32)	02 (P<0.001)	5.12	9.42
RHONCHI (27)	01 (P<0.001)	2.56	9.9
TOTAL	39	100%	

DISCUSSION

In the present study the prevalence of hypoxemia (SPO₂ of < 90%) in children 6-60 months old with ARI was 28.26%(39).Studies reporting prevalence of hypoxemia measured by pulse oximetry show wide variations and are not comparable because the cut-off values used to define hypoxemia, study population and setting in which they were conducted differ. Total of 138 children were examined, in that outpatient children were 38.41% (53/138) and children with Hypoxemia were 28.26% (39/138) ,Non hypoxemia were 71.74% (99/138).

Children with only cough and cold are not hypoxemic .Outpatient children had a low risk of hypoxemia, while hospitalized children are at higher risk .Of the 138 enrolled children in this study there were a significantly more infants

and they were also noted to have more frequency of hypoxemia. Infants are vulnerable to acute respiratory infections because, they have less mature immune systems,narrow glottis,anteriorly placed tongue,bifurcation of trachea and omega shaped epiglottis,unable to clear secretion.Age below 12 months has been seen as a predictor of mortality in children with pneumonia.

Symptoms such as difficulty breathing and refusal to feed/drink were associated with hypoxemia in the present study. The signs significantly associated with hypoxemia in the present study were lethargy, nasal flaring, tachycardia, grunting, chest indrawing, decreased breath sounds and tachypnea. In other studies^[6] also shows some symptoms and signs were associated with hypoxemia . Tachypnea in the present study was defined as per WHO guidelines. Respiratory rate of \geq 50/min was found to be associated with hypoxemia in the present study. An elevated respiratory rate in a sick child with pneumonia could result from the metabolic acidosis , dehydration , decreased peripheral perfusion. In the age group of 13-60 months, a respiratory rate of \geq 40/ min to predict hypoxemia. Chest indrawing was the best clinical predictor of hypoxemia in this study.This study shows a higher frequency of hypoxemia in children with increasing severity of ARI. Clinical predictors significantly associated with hypoxemia are tachypnea,lethargy, grunting, nasal flaring, tachycardia, and complaint of inability to breastfeed/drink are those used for the recognition of very severe pneumonia in 6-60 month old children by WHO.

The study therefore validates WHO criteria for the recognition of children with severe and very severe pneumonia, age \leq 12 months as a risk factor for hypoxemia. This study and a review of other similar studies^{[5][6]} show that no single clinical sign can predict hypoxemia. Other studies have used combination models to improve the predictive value of clinical signs. While constructing models, addition of signs to predict the hypoxemia. In this study, a combination model using signs for the prediction of hypoxemia in settings with supply of oxygen was constructed.

CONCLUSION

The increasing frequency of hypoxemia in children with more severe illness and the clinical predictors identified in the study validate the WHO classification of pneumonia based on severity simple clinical signs can still be used to identify hypoxemia. Simple clinical signs can still be used to identify hypoxemia in children between the ages of 6 to 60 months with acute respiratory tract infection according to our findings. By using pulse oximeter we can predict hypoxemia early and by administering the oxygen we can decrease the incidence of

hypoxemia with the severity of ARI ,morbidity and mortality.We need further more studies to discuss the prevalence between the hypoxemia and acute respiratory tract infections.

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