Year: 2014; Volume: 1; Issue: 1
Article ID: MD14 12; Pages: 1-8

BioMed Research

The Open Access Publisher

www.bmrjournals.com

BMR Medicine

Research Article

Hypoxia in Acute Respiratory Infection

[1]Vinod Uplaonkar, [2]Shipla Uplaonkar, [1]Mujumdar V G and [3]Venkatesh M Patil

[1]Departments of Pediatrics and [2]Pathology, Khaja Bhande Nawaz Institute of Medical Sciences, Gulbarga, Karnataka, India
[3]Department of Pharmacology, Navodaya Medical College, Raichur, Karnataka, India

Correspondence should be addressed to Vinod Uplaonkar.

Received 2 July 2014; Accepted 5 July 2014; Published 7 July 2014

Abstract

Respiratory disease continues to be an important cause of hospitalization in infancy and preschool children. It occupies the second place in hospital admission disorders. Hypoxemia is the most serious manifestation of severe respiratory illness in children and strong risk factors for mortality. The case fatality rate is inversely proportional to the oxygen saturation of arterial blood. Most clinical rely on clinical signs to identify hypoxemia. Reliance on single clinical signs may not be optimal. Current World Health Organization guidelines recommend the use of oxygen in children with Acute Lower Respiratory Infection (ALRI) based on availability and clinical signs such as cyanosis or inability to feed. But cyanosis being late sign and its assessment in dark skinned is difficult.

Key words: Respiratory, Hypoxia, Infection

Introduction

Acute lower respiratory infection (ALRI) are leading cause of mortality and morbidity among children in developing countries, causing about 1/3rd of all deaths in childhood.[1] Acute respiratory infections in children < 5 years old are the leading cause of childhood mortality in the world. Most of deaths are caused by pneumonia and bronchilits. WHO estimated that the annual number of ARI – related deaths in this age group (excluding those caused by measles and pertussis and neonatal deaths) was 3.9 millon deaths accounting for about 40% of all childhood deaths in South East Asian region.[2] Hypoxemia is the most serious manifestation of severe respiratory illness in children and a strong risk factor for mortality. The case fatality rate is inversely related to oxygen saturation of arterial blood.[3] Traditionally in tertiary care settings, concentration in plasma (PO_2) has been gold standard to assess hypoxemia. But his method requires a blood sampling and laboratory facilities.[4] In most developing countries situations, where facilities to measure plasma concentration are not available, most clinician rely on clinical signs to identify hypoxemia. Reliance on single clinical signs may not be optimal, as some clinical signs like lower chest in drawing or fast breathing may be sensitive but not very specific for identification of the hypoxemia. Whereas, other signs like cyanosis,

unable to drink, grunting or lethargy, etc., may be very specific, but not very sensitive.[4]

Objectives:

- To study on hypoxia in acute respiratory infection using pulse oximetry.

Methodology

The current study on Hypoxia in Acute respiratory illness using pulse oximetry was under taken at Basveshwar Teaching and General Hospital and Sangmeshwar Teaching and General Hospital, attached to M.R Medical College, Gulbarga.

The study was conducted over period of one year from October 2005 to March 2007, overall 120 hospitalized children with age group from 2 months - 60 months were included in the present study. Children who were admitted with symptoms of fever, cough, breathing difficulty were included and they were classified as pneumonic according **WHO** criteria and non pneumonic.

Study design; Cross sectional study

Inclusion Criteria: A history was obtained from the informant about the presence and duration of various symptoms: cough, fever, difficulty in breathing, wheeze and vomiting. History of repeated respiratory symptoms, foreign body, aspiration and past history of bronchial asthma were also recorded in the proforma.

Exclusion Criteria: Children with congenital heart disease, severe anemia, peripheral circulatory failure, children needing ventilator support were excluded from the study. The child was examined and the following signs were recorded: appearance, weight, height, pulse rate, respiratory rate, (counted for 60 seconds when child is quiet and at rest) Cyanosis, chest in drawing, grunting, nasal flaring, pallor, air entry, abnormal breath sounds crepitations or rhonchi on auscultation.

A portable oximeter ohmeda 3800 was used to measure the oxygen saturation with an appropriately sized sensor on the finger or the great toe. The reading was taken in a blinded manner by another author, while the child was breathing in a room air. Hypoxemia was defined as oxygen saturation less than 90%. The statistical analysis was performed with software package.

Results

Table 1: Age wise incidence of the patients

Age group	Number of patients	%
2-5month	33	27.5%
6-11month	25	20.8%
12-23month	20	16.6%
24-35month	10	8.3%
36-60month	32	26.6%
Total	120	100%

Table 2: Sex incidence

Sex	Numbers	%
Males	86	71.6%
Females	34	28.33%
	120	

Males had slightly higher incidence when compared to females as the male children are given more care in the family .They are brought to hospital immediately for the treatment. So, this may be reason for increased incidence of LRTI in males.

Table 3: Prevalence of hypoxia in infants (2-11months, 12-60months) with respect to diagnosis

Diagnosis	No. of infants (2-11)		No. of childrens (12-60)	
	(n)	< 90%	(n)	< 90%
Pneumonia	09	06 (66.6%)	16	03 (18%)
Severe	24	22 (91.16%)	24	15 (62 %)
Very Severe	08	08 (100%)	06	06 (100%)
Broncholitis	12	11 (91.6%)	06	01 (16.6%)
Acute Asthma	00	00	09	08 (88.8%)*
LTB	00	00	02	01(50%)
Others	02	00	02	00

Various respiratory illness were listed with respect to their diagnosis depending on prevalence of hypoxia in various age group. The level of hypoxia is mainly assessed by pulse oximetry. Hypoxemia was significantly more frequent (85%, 55to 47) 2-11months. As compared to children12-60 months (50% ,65 to 33).Across the other disease category prevalence of hypoxemia is varying, but it was more frequent in children12-60mo with acute asthma.($p<0.05$)*

Table 4: Selected clinical predicators of hypoxemia with acute respiratory illness

Symptoms	Hypoxemic < 90%	Non Hypoxemic > 90%	sensitivity	specificity	Chi-square value	p-value
Fever	67	33	79.7%	8.3%	2.57	= 0.1
Cough	77	30	91.6%	16.6%	1.81	= 0.1
Breathlessness	76	25	90.4%	30.5%	8.36	<0.005
Wheeze	40	04	47.6%	88.8%	14.5	<0.001
Vomiting	18	03	21.4%	91.66%	14.5	<0.001

Table 5: Clinical signs

Signs	Hypoxemic < 90%	Non Hypoxemic > 90%	sensitivity	Specificity	Chi-square value	p-value
Crepitations	60	14	71.42%	61.11%	11.3	0.001
Rhonchi	38	08	45.2%	77.7%	5.65	<0.01
Nasal flare	70	15	83.33%	58.3%	21.2	<0.0001
Cyanosis	13	00	15.4%	100%	6.25	<0.01
Breath sounds	21	04	25%	88.8%	2.95	>0.5
Grunt	31	10	36.9%	72.22%	0.93	>0.3
Chest indrawing	72	14	85%	61%	24.9	<0.0001
Added sounds	05	01	5.9%	97.2%	0.53	>0.4
Respiratory rate 2-12m(>50) 13-60m(>40)	37 26	08 20	44.4% 30.9%	77.7% 44.4%	4.23 5.45	<0.03 <0.01

Table 4 and 5, shows the promoted symptoms and signs .Among symptoms, breathlessness ,wheeze and vomiting had significant association with hypoxemia.but they were specific but not sensitive for predicting hypoxemia.Among individual clinical signs, cyanosis (100%) had increased specificity but are less sensitive for predicting hypoxemia.The most sensitive indicators are crepitations, nasal flare and chest indrawing. While the best predictor was cyanosis. Cyanosis was found to effectively predict hypoxia but if used alone would failed to detect more than 60% of the children with hypoxia. Bronchial breath sounds, decreased air entry and grunt on auscultation were specific sign of lobar consolidation .However, their usefulness is limited by the low sensitivity .Using WHO cut off values for defining tachypnea: in age group 2-12months, 37 of children with hypoxemia compared with 08 without tachypnea, p value in the 13-60 month old 26 of hypoxic children compared with 20without hypoxemia

Discussion

It is found that hypoxemia was common in ALRI, to predict hypoxemia for early intervention. Pulse oximetry was used to the know the level of hypoxemia in the following study. At what level of SpO2 should oxygen be supplemented to patients with ARI is of major concern. Studies on predictors of hypoxemia in patients living at sea level are scarce.

In present study, hospitalized childrens with respiratory symptoms with definite clinical signs were included .It was found that hypoxemia was common in patients with ALRI more show in infants then in childrens. Early recoginitation of hypoxemia and its prevalence is studied. A systemic review of studies on the prevalence and predictors of hypoxemia in developing countries is discussed.

Prevalence of hypoxemia in children with ALRI in developing countries				
Place, year, author	Altitude	Population group	Level of hypoxemia with pulse oximetry	Prevalence of hypoxemia%
Fajara,Gambia;1999. Usen et al.[3]	Sea level	1072 in patients	<90%	8%
Banjul,Gambia;1997 Weber et al.[5]	Sea level	83 opd patients	<90%	12.6%
Lima, peru;1995 Madico et al[6]	Sea level	290 ED pts	<90%	25%(non – pneumonic)70% pneumonic
Nepal, Kathmandu; 1999 Sudha et al.[7]	1336m above sea level	150 OPD &ED pts	<90%	38.7%
Peruvian andes;1989 Reuland et al.[8]	3750m above sea level	423ED	82-90%	36%(non-pneumonic) 83%(pneumonic)
Four cities of Egypt;1993 Gadomski et al.[9]	Sea level	679OPD	<90%	15%
Present study	454 m above Sea level	120ED	<90%	70%

The prevalence of hypoxemia in developing countries in various studies. There were variations between the reports in the study population ,the setting and the altitude. In total of seven papers including the present study included 2-60 months of age as study group Three reports assessed ARI on OPD basis. Four papers as inpatient/ emergency ward. The altitudes also changed from sea level to 3750m; consequently the level of hypoxemia also changed from 82%-90%. All studies measured SP02 using pulse oximetry. The reported prevalence of hypoxemia ranged from 8%-83%.Several factors may contribute to the variations in the prevalence of hypoxemia in these reports .prevalence is low in OPD (median 8%) highest in ED and Hospitalized (47%).So frequency of desaturaion is 5 times more in ED and Hospitalized. These differences reflects the severity of ARI, which seems more in severe pneumonia and less in URTI. Two additional sources of variations include could be altitude of the settings. At high altitude physiologically on or near steep portion of oxyhemoglobin saturation .Consequently these childrens are risk for decreased SP02 and increased oxygen needs.

Name of worker	Observed high incidence of LRTI age group	Incidence
Nascimento et al.[10]	2-11 months 12-60 months	16.1% 8.5%
Present study	2-12 months 12-60 months	85.45% 52.54%

Hypoxemia incidence observed in various age group shows that infants have high prevalence of hypoxemia when compared to childrens.

Sex incidence

Name of worker and place of work	Male/ Female ratio
Peter D. Phelan[11]	1.5:2
Anthony Olinsky and Colin F Robert Son (Blackwekk scientific publications)[12]	2:1
Present study	2.5:1

This table shows comparative study of sex incidence, in present study the ratio of male to female is 2.5:1 compared to Anthony Olinsky, where ratio is 2:1. This clearly correlates that boys have high prevalence compared to girls.

The above table shows the data regarding distribution of these children with respect to diagnostic category of ARI and prevalence of hypoxemia in various categories of ARI. The prevalence was highest in patients with very severe pneumonia better compared with the study, (100%present study,73%singhi et al), followed by a broncholitis (88.8%) in present study and sever pneumonia (26%) in study compared.

Pneumonia and LTB are with low prevalence of hypoxia in both the studies. Acute asthma is more frequent in children, 12-60 months in present study (88%) compared with acute asthma (6.5%) in singhi et al.[6]

In the present study ,we have evaluated various clinical signs and symptoms for their ability to identify hypoxemia in children with ARI clinical symptoms included are fever (79% and 69%) and cough(91% and 73%) sensitivity ,but are statistically insignificant.wheezing and vomiting are considered to be highly specific, but taken alone will not fulfill the criteria for assessment of hypoxemia.

Signs	**Weber et al[3]**		**Lodha et al[13]**		**Present study**		**Singhi et al[6]**	
	Sens	**Spec**	**Sens**	**Spec**	**Sens**	**Spec**	**Sens**	**Spec**
Creptations	93%	61%	67%	68%	71%	61%	75%	75%
Grunt	15%	93%	14%	96.2%	36.9%	72.2%		
Cyanosis	39%	100%	14.6%	96.2%	15%	100%	3%	100%
Nasal flare	71%	54.6%	28.5%	81.4%	83.33%	58%	64%	82%
Inter costal indrawing	49%	60%	35%	86%	85%	61%	90%	74%
rhonchi	43%	72%	60.7%	82.7%	45%	77%	51%	70%
2-12mo(>50) 13-60(>40)	81%	47%	89%	23.5%	80.9%	22%	65%	80%

The review presented the sensitivity and specificity of clinical signs associated with hypoxemia as discussed by various studies .These includes crepitations, cyanosis, nasal flare, grunting, Tachypnea, rhonci and intercostal indrawing. The reported value of these signs as indicators of the need oxygen therapy is presented subsequently. Cyanosis in majority of studies including the present study appears to be highly specific than other signs ,but clinical recognition is difficult in severe anemia and dark pigmented .In addition it has poor sensitivity, it detects only proportion of hypoxic that varies widely from 9-80%.

Chest indrawing and grunting are consider to be related to disease severity, in present study chest indrawing has high sensitivity when compared with lodha et al (35.7%) and weber et al (40%) has poor correlation. In study by Hall et al, found no relationship with Broncholits. Grunt is protective mechanism to hypoxia, it has high specificity in all the studies including the present one. Reparatory rate is studied as per WHO algorithm, in present study it has high sensitivity and better correlated with studies compared. There is lack of aggrement among observers for clinical signs of respiratory disorders. Rhonci and crepitations are auscultatory findings and it varies with different obserever.

WHO Classification of pneumonia						
	Present Study			Sudha basnet et al[7]		
	Very severe	Severe pneumonia	pneumonia	Very severe	Severe pneumonia	pneumonia
2-11mo	08(57%)	24(50%)	09(36%)	16(80%)	16(64%)	56(53%)
12-60mo	06(42%)	24(50%)	16(64%)	04(20%)	09(36%)	49(46.7%)

In the above table patients are categorized based on WHO algorithm, diseases are classified. In present study, 2-11 months) very severe pneumonia 57.1% were as in comparative study it is 80%. Severe pneumonia, 50% whereas in comparative study 64%, pneumonia 36%, whereas in comparative study 53.3%. In 12-60 months, very severe pneumonia 42.8% in compared study it is 20%, severe pneumonia 50% in compared study it is 36%, pneumonia 64% in compared study it is 46.7%.

Conclusion

- A review of literature on the incidence of various respiratory diseases is done.
- Detailed aspects of pulse oximetry, its limitations accuracy and prognosis is studied.
- During the one year period of study total number of cases investigated with LRTI is 120.
- Males to females ratio is 2.5:1 is observed.
- Prevalence of hypoxemia as assessed by pulse oximetry at presentation is 70%.

References

1. Garenne M, Ronsamans C, Campbell H. The magnitude of mortality countries. World health statistics Quarterly 1992; 45: 180-191
2. Park & Park. Text book of Social and Preventive Medicine. 2007; 17: 142
3. Usen S, Weber M, Mulholland K, et al. Clinical predictors of hypoxemia in Gambian children with acute lower respiratory tract infection: prospective cohort study. BMJ 1999; 318: 86-91.
4. American association for resp care AARC clinical practice Guideline; pulse oximetry. Respir care 1991; 361(12): 1406-1409.
5. Martin Weber ,Stanley usen,Ayo palmer ,Kim muiholland ;predictors of hypoxemia in hospital admission with acute lower respiratory tract infection in a developing nations. Arch . dis .in .childhood ;1997;76;310-314.
6. Madico G, Gilman RH, Jabra A, et al. The role of pulse oximetry. Its use as an indicator of severe of respiratory diseases in Peruvian children living at sea level. Arch Pediatr Adolesc Med 1995; 149: 1259-1263.
7. Sudha Basnet, Ramesh Kant Adhikari and Chitrakumar Gurung. Hypoxemia in children with pneumonia and its clinical predictors. IJP – Vol 73; Sept 2006: 777-781.
8. Reuland DS., Steinhoff CM., Gulman HR. Prevalence and prediction of hypoxemia in children with respiratory infections in the Peruvian Andes. Journal of Pediatrics; Vol. 119: 6: 900-905.
9. Gadomski AM, Aref GH, Hassanien F, et al. Caretaker recognition of respiratory signs in children: correlation with physical examination findings, X-ray diagnosis and pulse oximetry. Int J Epidemiol 1993; 22: 1166-1173.
10. Nascimento CM,Carvalho and Benguigni Y.Evaluation of the degree of tachypnea for hospitalizing children with pneumonia. Indian pediatrics, Vol 41, Feb17, 2004: 175-178.
11. Peter D Phelan, Anthony Olinsky, Colin F, Roberston. The epidemiology of acute respiratory infections. Textbook of pediatrics on “Respiratory illness in children”. Blackwell Sceintific Publications, 4th edition, 1994: 27-42.
12. Amy J Maneker et al. Contribution of routine pulse oximetry to evaluation and management

of patients with respiratory illness in a pediatric emergency department.

13. Rakesh Lodha, Prakash Singh Bhaduria, SK Kabra Can clinical symptoms and signs accurately predict Hypoxemia in children with Acute Lower respiratory tract infections? AIIMS.