

## RELATION BETWEEN PULSE OXIMETRY AND CLINICAL SCORE IN INFANTS WITH ACUTE BRONCHIOLITIS

**Background:** Bronchiolitis is inflammation of the bronchioles, the smallest air passages of the lungs. It is the most common severe viral lower respiratory tract infection of infancy. Clinical diagnosis remains the most important tool for diagnosis. Clinical diagnosis would be supplemented by pulse oximetry but pulse oximetry may not be always available.

**Aims & Objective:** To study Relation between SPO<sub>2</sub> (oxygen saturation) and clinical score in children with acute bronchiolitis patients less than 12 months of age.

**Materials and Methods:** This was the cross sectional observational study done in paediatric department of Jhalawar medical college, Jhalawar. One hundred and forty two infants were evaluated by the single paediatrician. Modified Tal's clinical score and SPO<sub>2</sub> of the patient were recorded. Bonferroni analysis was used using Graph pad 5 prism software for statistical analysis.

**Results:** The mean ( $\pm$  SD) SpO<sub>2</sub> value was  $98.2 \pm 1.3\%$  for children with clinical scores of 2–5 ( $n = 32$ );  $95.2 \pm 0.9\%$  for those with scores of 6–7 ( $n = 84$ ), and  $92.3 \pm 0.87\%$  for children with scores of 8–10 ( $n = 26$ ), ( $P < 0.001$  by Bonferroni's multiple comparison, when all two-way comparisons were done for each pair of results). The clinical score showed a good correlation with SpO<sub>2</sub> [ $r = -0.734$  ( $P < 0.0001$ )].

**Conclusion:** We conclude that Modified Tal's clinical score can be used as a primary tool to confirm severity of hypoxemia in infants with acute bronchiolitis even if pulse oximetry is not available.

**Key Words:** Pulse Oximetry; SPO<sub>2</sub>; Modified Tal's Clinical Score

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**Received Date:** 03.09.2013

**Accepted Date:** 11.10.2013

**DOI:** 10.5455/njppp.2014.4.111020131

### INTRODUCTION

Bronchiolitis is a disorder most commonly caused in infant by viral lower respiratory tract infection. It is most common lower respiratory infection in this age group and is characterized by acute inflammation, edema and necrosis of epithelial cells lining the airway, increase mucus production and bronchospasm. Most cases occur particularly during the winter epidemics and due to infection with the respiratory syncytial virus. Common Symptoms are cough, Wheezing, shortness of breath.<sup>[1]</sup>

American academy of paediatrics had stressed on the importance history and physical examination as an important tool for diagnosis of the acute bronchiolitis.<sup>1</sup> Modified Tal's clinical score is important tool for assessing the severity of the disease.<sup>[2]</sup> The usefulness of clinical scores for the evaluation of the severity of acute wheezing episodes in infants has been shown in several studies.<sup>[2,3]</sup> However, there are conflicting data in the literature.<sup>[4,5]</sup>

Thus there is the need of the objective method for assessment. Hypoxemia is the primary early feature of acute bronchiolitis. Pulse oximetry is a simple noninvasive method, and it gives fast and fairly accurate assessment of arterial oxygen saturation.<sup>[6]</sup> In this study,

we had made an attempt to study relation between SPO<sub>2</sub> (oxygen saturation) and clinical score in children with acute bronchiolitis patients less than 12 months of age. In India, especially in this part, we do not have instrument like pulse oximeter at all level of health services because of the economical reason. Also more than 70 percent population of India stays in rural area where again pulse oximetry may not be possible. By this study, we had made an attempt to find whether clinical diagnosis would suffice for the diagnosis acute bronchiolitis with hypoxia. If there is a good correlation then this clinical score can be useful to predict the severity of hypoxia without pulse oximetry and required treatment can be initiated earliest.

### MATERIALS AND METHODS

This was the cross sectional observational study done on paediatric department of Jhalawar Medical College, Jhalawar. The study was approved by the local Ethics Committee, and consent of each parent was obtained. We evaluated One hundred and forty two infants (Mean  $\pm$  SD: 181.36 days  $\pm$  91.22 days).

**Inclusion Criteria:** Children with acute wheezing episodes without any co morbidity (age range, 1–12 months).

**Exclusion Criteria:** (1) Children with a clinical and/or radiological diagnosis of pneumonia; (2) Pulmonary or cardiac congenital malformations; (3) Chronic pulmonary disease; (4) Malnutrition; (5) A history of prematurity; (6) Infants with clinical scores of 11–12 must be referred immediately for hospitalization and, therefore, were not included in the present study.<sup>[1,2,8]</sup>

All patients were evaluated clinically by the single paediatrician. The patients were accompanied by their mothers at all times. After a period of adjustment for at least 5 min, and with the child quiet, not crying, without fever, and breathing room air only, Paediatrician evaluated the severity of the acute wheezing episodes using a Modified Tal’s clinical score see table 1. Respiratory frequency was determined by observation of the thoracic movement over a full minute. The degree of accessory muscle use was based on the degree of intercostals or sub costal retraction. Simultaneously, and without knowing the result of the clinical score, we measured SPO<sub>2</sub> with a pulse oximeter (BPL) using a paediatric probe placed on the big toe, with infant quiet, awake, and in natural light. The maximum SPO<sub>2</sub> was recorded after a period of at least three satisfactory sweeps of the pulse wave were recorded (corroborating that the cardiac frequency of the oximeter coincided with the simultaneously taken heart rate by auscultation). For this study, we defined hypoxemia as a Sp<sub>a</sub>O<sub>2</sub> value  $\leq 91\%$ .

The data were analyzed with the Graph pad 5 prism software. Student’s t-test was used to test the significance of r or the difference between two means. Bonferroni analysis was used for evaluations of multiple comparisons and multiple regressions. Statistical significance was considered when  $P < 0.05$ .

**Table-1: Modified TAL’s clinical score<sup>[1]</sup>**

Score	Respiratory Rate (per mm)		Wheezing	Cyanosis	Accessory Muscle Use
	< 6 mths	≥ 6 mths			
0	40	30	None <sup>[2]</sup>	None	None
1	41 – 55	31 – 45	End expiration With stethoscope	Perioral with crying	+
2	56 – 70	46 – 60	Inspiration and expiration With stethoscope	Perioral at rest	++
3	> 70	> 60	Audible without Stethoscope	Generalized at rest	+++

## RESULTS

One hundred and forty two infants (Mean  $\pm$  SD: 181.36 days  $\pm$  91.22 days) were evaluated in this study. Mean SPO<sub>2</sub> and mean Modified Tal’s clinical score for the entire population was (n=142) was  $96.3 \pm 3.11$  and  $4.66 \pm 1.98$

respectively.

Average SPO<sub>2</sub> by clinical score and age group is shown in table 2. Total patients with the clinical score 2-5 were 32 and their mean SPO<sub>2</sub> was  $98.1 \pm 1.3$ . Total patients with the clinical score 6-7 were 84 and their mean SPO<sub>2</sub> was  $95.2 \pm 0.9$ . Total patients with the clinical score 8-10 were 26 and their mean SPO<sub>2</sub> was  $92.3 \pm 0.87$ . When all two-way comparisons were done for each set of pairs in each age-group and the total group, SpO<sub>2</sub> for all pairs was significantly different ( $P < 0.001$  corrected for Bonferroni’s multiple comparisons).

The correlation coefficient between total clinical score and SpO<sub>2</sub> for all the total patients was  $r = -0.734$  ( $P < 0.0001$ ). The linear regression model between SpO<sub>2</sub> and clinical score is also shown in Graph1. The correlation of each component of the clinical score and SpO<sub>2</sub> was also significant. (Table 3)

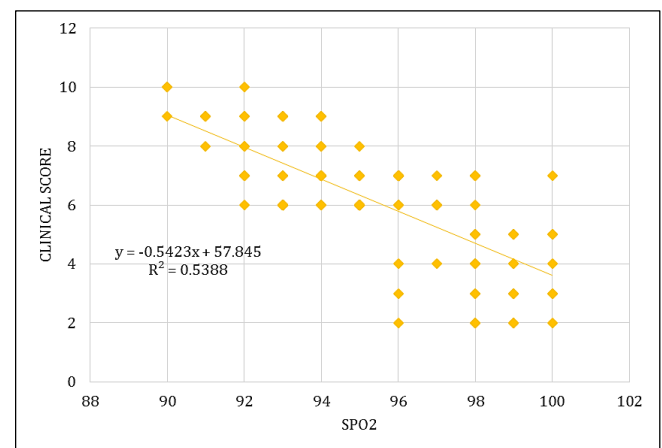
**Table-2: Average SPO<sub>2</sub> by clinical score and age group**

Clinical Score	SPO <sub>2</sub>							
	Total		< 3 month		3-5 month		> 6 month	
	Mean $\pm$ SD	N	Mean $\pm$ SD	N	Mean $\pm$ SD	N	Mean $\pm$ SD	N
2-5	98.1 $\pm$ 1.3	32	98.2 $\pm$ 1.2	14	98.7 $\pm$ 0.78	4	98.1 $\pm$ 1.1	14
6-7	95.2 $\pm$ 0.9	84	95.1 $\pm$ 0.8	19	95.1 $\pm$ 0.8	32	95.2 $\pm$ 0.81	33
8-10	92.3 $\pm$ 0.87	26	93.1 $\pm$ 0.9	2	92.1 $\pm$ 1.3	8	93.1 $\pm$ 0.77	16

**Table-3: Correlation between component of the clinical score Vs. SPO<sub>2</sub>**

Clinical Score Component	r*
Cyanosis	-0.30
Respiratory Rate	-0.33
Wheezing	-0.40
Accessory muscle use	-0.48

\* $P < 0.05$  for all component



**Figure-1: Correlation between SPO<sub>2</sub> and clinical score**

## DISCUSSION

Clinical examination is an important tool for diagnosis of the acute bronchiolitis.<sup>[1]</sup> Various clinical score had been described in the literature like Tal’s score, modified Tal’s

score, Kristjansson Respiratory Score and Wang Respiratory Score.<sup>[2,9]</sup> In the present study, modified Tal's score was used as the usefulness of clinical scores for the evaluation of the severity of acute wheezing episodes in infants has been shown in several studies.<sup>[2,3,9]</sup> McCallum GB et al had concluded that Modified-Tal scoring systems for bronchiolitis is repeatable and can reliably be used in research and clinical practice.<sup>[10]</sup> The SPO<sub>2</sub> determined by pulse oximeter is the single best objective predictor of severity in infants with acute bronchiolitis<sup>[10]</sup> and was chosen as the gold standard in this study. The severity of acute bronchiolitis is closely related to the degree of hypoxaemia and hyperpnoea arising from an abnormal distribution of ventilation relative to perfusion. In this study, significant correlation was seen between modified Tal's score and SPO<sub>2</sub>.

Similar study was done by Pavo'n D et al.<sup>[8]</sup>, where he found significant correlation between modified Tal's score and SPO<sub>2</sub> in the age group 0 to 2 years. Hal et al<sup>[11]</sup> and Chin HJ et al<sup>[9]</sup> had studied correlation of SPO<sub>2</sub> with the Kristjansson Respiratory Score and Wang Respiratory Score. They also found strong correlation. Parameters in Kristjansson Respiratory Score are respiratory rate, chest recession, breath sound, skin colour and general condition of the patient while parameters in Wang Respiratory Score are respiratory rate, wheezing, chest retraction and general condition of the patient<sup>[9,11]</sup>, thus there is overlap with some of the parameters with Modified Tal's Score, hence we had also compared these studies. McCallum GB et al had done the study 115 children with the median age of 5.4 months. He evaluated the Tal and Modified-Tal scoring systems for bronchiolitis. He concluded that they are repeatable and can reliably be used in research and clinical practice but its utility for prediction of O<sub>2</sub> requirement is limited.<sup>[10]</sup> Similar study was done in 71 paediatric patient (mean  $\pm$  SD, 10  $\pm$  2.6 years of age) and 110 children (2-15 years) to study the correlation between severity asthma and SPO<sub>2</sub>, where also the strong correlation was found. However contradictory result are shown by some authors.<sup>[12,13]</sup> Alario et al<sup>[14]</sup> showed a poor correlation between SPO<sub>2</sub> and acute wheezing episodes in 74 infants. (mean age, 16.1 months) Wang et al also could not find a significant correlation between SpO<sub>2</sub> and a clinical score in 58 infants hospitalized for pneumonia (mean age, 12.3 months) and bronchiolitis (mean age, 6.6 months).<sup>[4]</sup>

In our study, we also studied the correlation of each component of the clinical score and SPO<sub>2</sub> which was also the significant. Similar result was shown by Pavo'n D et

al<sup>[7]</sup> where correlation for cyanosis and respiratory rate was less as compared to wheezing and accessory muscle use as in us. Correlation with the cyanosis is less which was also shown by some authors.<sup>[7,8]</sup> this may be because skin colour is affected by many factors besides peripheral tissue perfusion and oxygenation. Cyanosis which only occurs in children with severe hypoxaemia may not be easily detectable in children with anaemia and dark pigmentation.<sup>[8]</sup>

Next in ascending order of correlation was respiratory frequency and wheezing<sup>[5,7,15]</sup> this may be because Respiratory frequency is more dependent on PaCO<sub>2</sub> than PaO<sub>2</sub>.<sup>[16]</sup> Children with acute bronchiolitis may be clinically well even when the inspiratory and expiratory airway resistance is high, because increased resistance is due to dynamic narrowing of the airways. Thus, the respiratory rate and breath sounds may not correlate well with SPO<sub>2</sub> and are not good indicators of disease severity.<sup>[17]</sup>

Correlation for accessory muscle use was of the highest order in the present study which is also comparable with the author.<sup>[7,8]</sup> It was postulated that chest recession reflects the effort to improve oxygenation in hypoxaemic children with lower respiratory infection and this may be the reason that the use of accessory muscles had been shown to correlate strongly with the severity of disease.<sup>[10]</sup> Mulholland et al<sup>[18]</sup> did not find a correlation between this sign and SPO<sub>2</sub>, perhaps due to more severe airway obstruction in their population.

Aim of the study was to find whether clinical diagnosis would suffice for the diagnosis acute bronchiolitis without SPO<sub>2</sub> measurement as measurement of SPO<sub>2</sub> may not be possible as instrument like pulse oximeter may not be available readily especially in rural population. We conclude that Modified Tal's clinical score can be used as a primary tool to diagnose severity of the patients even if pulse oximetry is not available. Doctors at primary health care level should be given training about this scoring method so that severity of the patient could be assessed and treatment is started.

#### **Limitation of the Study**

We should have assessed simultaneously various other clinical scoring method, so that best clinical score method would have identified. So in future we recommend such study whereby all these scoring methods are assessed.

## CONCLUSION

Modified Tal's clinical score can be used as a primary tool to confirm severity of hypoxemia in infants with acute bronchiolitis even if pulse oximetry is not available.

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**Cite this article as:** Shete AS, Nagori G, Nagori P, Hamid M. Relation between pulse oximetry and clinical score in infants with acute bronchiolitis. *Natl J Physiol Pharm Pharmacol* 2014; 4:124-127.

**Source of Support:** Nil

**Conflict of interest:** None declared