Original Article

Correlation Study of AIOS (Acute Illness Observation Scale) Score with Radiological Findings and Pulse Oximetry in Community-Acquired Pneumonia (Cap) Among Children Aged 2 To 59 Months

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Abstract

Background: Community-acquired pneumonia (CAP) is one of the primary causes of mortality in infants and young children. Acute Illness Observation Score (AIOS) - act as the best and accurate indicator for the same. Hence in this study, AIOS was used to relate X-ray abnormalities and pulse oximeter finding for early assessment in children with ARI. **Subjects and Methods:** This was a descriptive epidemiological study conducted for a period of 24 months. Children aged from 2 months to 59 months who had symptoms and signs suggestive of pneumonia were involved in the study. Pulse oximetry reading on admission was noted. AIOS scoring is done on each subject. Chest X-ray was taken and interpreted. **Results:** The majority of patients fall in the age group of 2- 12 months (57.2%). CXR showed abnormal radiological changes in 54.0%, among them endpoint consolidation, was seen in 40.20% and infiltrates seen in 59.7%. 67 patients had spo2 > 92% at admission, among them 44 (65.67 %) had normal & 23 (34.32 %) had abnormal chest X-ray. 57.3 % (43/75) children with AIOS of ≤10 had normal x-ray & 42.66% (32/75) had abnormal x-ray. AIOS with Spo2 reading showed a good correlation (p<0.05) indicating that high AIOS scores are associated with low SpO2 scores. **Conclusion:** This study shows that with the help of AIOS scoring, fair association with an initial pulse oximeter reading and X-ray abnormalities can be done which can be utilized as an early combining tool for risk assessment and management.

Keywords: AIOS scores, CAP, SPO2, X-ray abnormalities

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Introduction

Worldwide, respiratory diseases are a significant cause of morbidity in the pediatric age group. It is one of the most usual reasons with which parents bring their children to pediatric OPD as well as an emergency unit.[1] The burden of ARI is significantly more in developing countries when compared to industrialized countries due to various reasons. In developing countries, the incidence of ARIs in children aged less than 5 years is about 0.29 episodes per child-year accounting for up to 151 million new episodes per year.[2] Whereas in developed countries about 5 million new cases occur each year which is approximately 0.05 episodes per child year.[2] 12-20 of every 1000 children born per year succumb to death before 5 years of life. This shows that pneumonia accounts for about 21%

of all deaths in these children.[3] Hence it is important to formulate criteria for the effective and optimal management of Pneumonia in less developed countries. AIOS is a three-point scale with a total score ranging from 6-30. It has 6 ordinal components. If the AIOS score is 10 or less than 10, the incidence of significant bacterial infection is less than 2-3%, whereas the incidence rises to 26% for scores between 11-15 and 92% for scores equal to 16 or more.[4] Hence this score was used in the study to validate the correlation with radiological abnormalities and pulse oximetry reading in children with ARI.

Subjects and Methods

The aims and objectives of this study are to correlate AIOS score with radiological findings and pulse oximetry in community-acquired pneumonia. This descriptive epidemiological study was conducted in a tertiary care DM Wayanad Medical college and hospital in Kerala for a period of 24 months from September 2017- September 2019. Children in the age group of 2 to 59 months who presented with symptoms suspicious of pneumonia were included in the study. Clinical features included are a fever with less than 3 days of duration, cough or difficult breathing, tachypnoea, stridor, grunting, chest retractions, lethargy, convulsions, inability to drink. Children who presented with symptoms and signs suggestive of pneumonia and satisfying the inclusion criteria were involved in the study. IMNCI classification which assesses the severity of illness was used to identify patients needing outpatient or inpatient management. AIOS scoring is done on each subject on day 1, day 2, day 5 by two persons simultaneously in a reasonably quiet state. Spo2 reading of all patients was recorded. At the time of initial assessment, vital signs and respiratory variables were recorded. Cultures of blood and urine, Chest X-ray PA view and complete blood count were done within 24 hrs of admission. A radiologist who was blinded about the study was sought for reporting of Chest X-ray. A total of 124 children were enrolled in the study. Cases excluded from the study were those presented with more than 2 weeks duration of illness, upper respiratory infections like acute pharyngitis with less severe respiratory symptoms and those with predominant wheeze as the chief complaint. Results were analyzed for the extent to which chest X-ray and pulse oximetry readings correlate to the AIOS score thereby indicating the severity of pneumonia.

Statistical analysis & Statistical methods

Descriptive statistical analysis was carried out in the present study. Data entry was done in a Microsoft Excel sheet. Statistical significance was found using the chi-square test.

Results

After the exclusion of 28 children who had associated cardiac problems and positive for gastro-oesophageal reflux, 124 children were enrolled in the study. The demographic profile of the study group showed that the majority of them fall in the age group of 2- 12 months (n = 71, 57.2%) followed by 12-36 months (n= 48, 38.7%). Among this group majority were males (n=80, 64.5%).

Fever and cough were seen in almost all the children, whereas the history of Tachypnoea was seen in 98% of cases. Regarding danger symptoms, majority had lethargy (n= 31, 25%) while convulsion (n= 5, 4%) and grunt (n=7, 5.6%) was least common. 48.38% of cases had a respiratory rate between

Table 1: Depicting Age and Sex Distribution among the Study Group:

		n	%
Age	2-12 months	71	57.2
	12-36 months	48	38.7
	>36 months	5	4.0
Sex	Male	80	64.5
	Female	44	35.5

51- 60 (48.38%) which was the most common sign in the study group. Mild to moderate retraction was seen in 53.65% of cases and severe retraction in 32.6% of cases. Grunting and cyanosis were seen in 6.4% and 2.4% cases respectively.

Table 2: Depicting Respiratory Morbidity Distribution

Signs		Total	%
Respiratory	40 -50	39	31.77
	51 -60	60	48.38
	>60	15	12.09
Intercostal recession		56	45.16
Sub coastal recession	Mild-moderate	66	53.20
	severe	41	33.00
Grunt		8	6.4
Cyanosis		3	2.4
Lethargy		32	25.8
Convulsion		5	4
inability to drink		19	15.30
Abnormal Capillary refill time (>2 sec)		15	12.09
Decreased breath sounds		6	4.8
Bronchial breathing		7	5.6
Crepitations		113	91.12
Wheeze		32	25.80
Vocal	Decreased	3	2.4
	increased	3	2.4

Pulse oximeters recording were taken in all children on days 1, 2 and 5. 5.6% (7/124) of cases had central cyanosis with Spo2 below 85%. Spo2 recording of >92 was seen in 54.0% (67/124) and the remaining being in between. The average pulse oximeter value on day 1 in the study sample was 92.9(SD-5.10).

In this study, 45.96% (57/124) had normal CXR findings and the remaining 54% (67/124) had significant abnormalities. Endpoint consolidation was seen in 40.2% of cases while
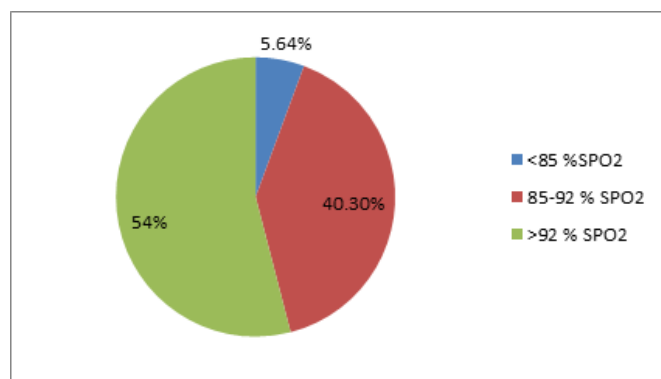
Figure 1: Depicting Spo2 Reading in the Study Population:

59.7% had non-end point infiltrates which were the common X-ray abnormalities.

Spo2 reading of < 92% at admission, predicted abnormal chest x- ray was seen in 44 out of 57 patients (77.19%) & normal in 12 out of 57 patients (21%). 67 patients had spo2 > 92 at admission, among them 44 (65.67 %) had normal & 23 (34.32 %) had abnormal chest X-ray.

AIOS score more than 10 at the time of primary evaluation was seen in 40% of children with community-acquired pneumonia which was abnormal. The mean score for AIOS is 12.32 (SD-6.12). It highlights the magnitude of illness of children involved in this study.

$\chi 2 = 7.68$ **P=0.16**

In our study, on comparing AIOS score with their radiologic finding, it was found that 57.3 % (43/75) of children with AIOS of ≤10 had normal x-ray & 42.66% (32/75) had an abnormal x-ray. 47.6% (10/21) of children with AIOS of 11-15 had a normal x-ray. In AIOS score >16, 85.7% (24/28) children had abnormal x-ray and these results were statistically significant (P-value <0.05).

P-value <0.05

Relating children's AIOS score against their pulse ox meter recording on admission, severe hypoxemia associated with cyanosis (SpO2<85) was observed in 7 children of which 85.7% (6) scored a high value on AIOS (AIOS>16) whereas 82.0 % (55) of children scored normally on AIOS among the group of 67 with a spo2>92.

X2=85.4 P=0.001

Discussion

In underdeveloped and developing countries, Childhood pneumonia is one of the most common infective illnesses. It holds a pivotal role as it is one of the preventable causes of mortality in children. In comparison to the traditional history taking and physical examination which has poor sensitivity, our study showed that history and examination when combined with AIOS scoring have a higher sensitivity and correlation for serious illness. Among 124 children enrolled in this study, 45.9% (n=57) of patients had hypoxemia. This was similar to the study done by Salah et al, [5] (42.7%) and Basnet S et al, [6] (38.7%). In our study, the majority of them fall in the age group of 2- 12 months (n = 71, 57.2%). Studies were done by Reddaiah VP et al, [7] (63.2%) and Sehgal V et al, [8] (52.2%) also had a similar observation. Tachypnoea and chest retractions were found to be a distinct features in detecting pneumonia in a study conducted by Palafox M et al. [9] In our study also these both signs were predominant among the majority. Crepitation (91.12%), abnormal breath sounds (5.6%), wheeze (25.80%), lethargy (25.80%), CRT >2sec (12.09%), cyanosis (2.4%) & grunt (6.4%) were other associated signs in our study. In our study, CXR showed abnormal radiological changes in 54.0%, among them endpoint consolidation was seen in 40.20% and infiltrates seen in 59.7%. Spo2 reading of < 92% at admission, predicted abnormal chest x-ray was seen in 44 out of 57 patients (77.19%) & normal in 12 out of 57 patients (21%). 67 patients had spo2 > 92 at admission, among them 44 (65.67 %) had normal & 23 (34.32 %) had abnormal chest X-ray, this was in comparison with the study conducted by Cevey-Macherel M et al. [10]

AIOS score more than 10 at the time of primary evaluation was seen in 40% of children with community-acquired pneumonia which was abnormal. The mean score for AIOS is 12.32 (SD-6.12). It highlights the magnitude of illness of children involved in this study. This AIOS scoring system was studied. Bhavneet Barathi et al, [11] for assessing its usefulness in managing severe childhood pneumonia5 in 2-59 months. In predicting abnormal chest X-ray, Sensitivity of AIOS score > 11 was 77%, Specificity was 48%. 57.3 % (43/75) children with AIOS of ≤10 had normal x-ray & 42.66% (32/75) had abnormal x-ray. 47.6% (10/21) of children with AIOS of 11-15 had a normal x-ray. In AIOS score >16, 85.7% (24/28) children had abnormal x-ray. In a study done by Murali BH et al, [12] similar observations were noted with 77.5% of x-rays being normal when the AIOS score was <10 in cases of community-acquired pneumonia. As AIOS scoring has a good correlation with X-ray abnormalities it can be utilized to decide on x-ray evaluation and hence minimizing exposure to hazardous radiations in a child with pneumonia. AIOS scoring has a good association with initial pulse oximeter reading and decision regarding supplementation of oxygen. In this study, we found a good correlation between AIOS with Chest X-Ray (p<0.05). AIOS with Spo2 reading showed a good correlation (p<0.05) indicating that high AIOS scores are associated with low SpO2 scores thereby denoting more

Table 3: Depicting Radiologic Findings in the Study Population:

investigation		n	%
CXR	abnormal	67	54
	normal	57	45.9
finding	Endpoint consolidation	27	40.2
	infiltrates	40	59.7

Table 4: Depicting the Correlation between X-Ray Findings and Pulse Oximetry:

CHEST X-	SPO2 ON ADMISSION(n=124)						p-value
	≥92(67)		85-91(50)		<85(7)		
	NO.	%	NO.	%	NO.	%	
NORMAL	44	65.6	11	22	2	28.5	<0.05
ABNORMAL	23	34.3	39	78.0	5	71.42	

Table 5: Depicting AIOS Score Distribution in the Study Population:

Age	AIOS on day 1					
	≤10		11-15		≥16	
	n	%	n	%	n	%
2-12 months	39	54.9	14	19	18	26.8
12- 36 m0nths	32	68.4	7	14.7	8	16.8
>36 months	4	63.6	0	0	2	36.4

Table 6: Depicting the co rrelation between AIOS scores with chest X-ray:

Chest X-ray	AIOS score on day 1					
	≤10		11-15		≥16	
	n	%	n	%	n	%
abnormal	32	47.7	11	16.4	24	35.8
normal	43	75.4	10	17.5	4	7.01

Table 7: Depicting the Correlation between AIOS Scores with Spo2 Reading:

SpO2 reading	AIOS score on day1					
	≤10		11-15		≥16	
	n	%	n	%	N	%
<85	1	14.2	0	0	6	85.7
85-92	19	38.0	13	26.0	18	36.0
>92	55	82.0	8	11.9	4	5.97

severe respiratory illness. Lazzerini M et al,[13] in a systemic review and meta-analysis showed that in underdeveloped and developing countries hypoxemia is the key determinant in mortality in ARI in children. Therefore the significance of routine use of Pulse oximetry and accessibility to oxygen in reducing death rate is to be understood. Similarly, Zhang L et al,[14] have also expressed that in developing countries there should be facilities for easy and quick access to pulse oximetry.

Conclusion

To conclude the AIOS score has good sensitivity in the pneumonia group but with a poor specificity. But in both the severe pneumonia group and in the very severe pneumonia group, it has good specificity and poor sensitivity in diagnosing pneumonia when compared with IMNCI. So IMNCI is still the superior sensitive tool in the classification of pneumonia. This

study shows that the AIOS scoring has a fair association with initial pulse oximeter reading and decision regarding supplementation of oxygen. So it can be used as a tool to decide on providing oxygen to patients in resource-limited areas. AIOS scoring also has a good correlation with X-ray abnormalities so can be utilized to decide on x-ray evaluation and hence prevents preventing the unnecessary display of child presenting with ARI to radiations.

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