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Role of Grading Of Chest Radiograph In Predicting Severity Of Pneumonia In Children Between 2 Months And 5 Years

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Abstract

Background: This study aims to find if the chest x-ray findings can be correlated with the clinical severity of pneumonia[1] and therefore be used as one of the parameters for grading severity of pneumonia.

Objective: To assess the role of grading of chest radiograph as one of the parameters in predicting the severity of pneumonia in children between 2 months and 5 years.

Method:

Study design: Cross-sectional analytic study

Study setting: Tertiary care hospital in kerala

Study period: May 2017 - October 2017

Study subjects: Pediatric patients aged 2 months to 5 years who were admitted to pediatric ward for respiratory illness. Children with pre-existing chronic medical ailments were excluded from the study. Recruited children were classified based on their symptoms and signs as per ARI control programme by WHO[2] (Table 1)

The chest radiographs taken in the Posteroanterior (PA) view with adequate exposure, well centred and no rotation[3] were evaluated for homogenous or heterogenous opacities in lung fields and graded.

The grading of chest radiograph was compared with clinical symptoms, duration of hospital stay, and severity of illness in the form of use of respiratory supports or interventions.

Result: On cross tabulating, the chest x-ray grading showed no correlation (0.124) with severity of pneumonia.

Conclusion: Above study shows that any child with fever, cough and tachypnoea or retractions, need not mandatorily have a chest x-ray for further management, unless complications are anticipated.

Keywords: Chest x-ray, pneumonia, WHO, ARI control program, paediatric

Introduction

20-30% of paediatric hospital admissions per year is due to acute respiratory tract infections[4]. Lower respiratory tract infection can occur in the form of pneumonia, tracheobronchitis, bronchiolitis, lung abscess or empyema[4]. For early identification of children sick with respiratory ailments in resource limited settings, WHO introduced the ARI control programme. Lower respiratory tract infections can be clinically graded as no pneumonia, pneumonia and severe pneumonia using the criteria provided by ARI (Acute respiratory infection) control programme for children aged between 2 months to 5 years.

All children admitted to the hospital for treatment of pneumonia get chest radiograph as part of their routine investigations. But there is not much data on correlation between clinical severity and radiological findings in children with pneumonia. Our study aims to find whether the chest radiograph findings can be correlated with the clinical severity of pneumonia[5].

Method & Materials:

Study design: Cross-sectional analytic study

Study setting: Tertiary care hospital in Kerala

Study period: May 2017 - October 2017

Study subjects: Paediatric patients aged 2 months to 5 years who were admitted to paediatric unit for respiratory illness.

All children between 2month and 5 years admitted to paediatric ward with clinical diagnosis of lower respiratory tract infection, fever, cough with tachypnoea or chest retractions with chest x-ray (PA view) were recruited. Children with pre-existing chronic medical ailments were excluded from the study. They were classified as below based on their symptoms and signs as per ARI control programme by WHO[4] (Table 1)

The lung fields in the chest radiograph PA view were divided into three zones as follows[5]

Zone1: Lung field up to 2nd rib (upper zone)

Zone 2: Lung field between 2nd and 4th rib (middle zone)

Zone 3: Lung field between 4th and 6th rib (lower zone)

The chest radiographs taken in the Posteroanterior (PA) view with adequate exposure, well centred and no rotation[3] was evaluated for homogenous or heterogenous opacities in lung fields and graded as follows

Grade 0: No lung zone involvement

Grade 1: Single lung zone involvement

Grade 2: More than one lung zone or associated pneumothorax or pleural effusion

A pilot study was done, in order to make the above grading system more robust. Two paediatricians were requested to independently evaluate 11 children with lower respiratory tract infections with their chest radiographs as above. The interobserver agreement between the 2 paediatricians were analysed using κ statistics. κ value was found to be substantially correlated (0.621).

The grading of chest radiograph was compared with clinical symptoms, duration of hospital stay, and severity of illness in the form of use of respiratory supports or interventions.

Statistical tests: Descriptive and inferential analysis of the obtained data were done. The grading of chest radiographs was compared with the clinical stage and symptoms of the child. Spearman Rank test and other appropriate predictive tests and multi- variate analysis were done to look for correlation between chest radiograph grading and clinical grading. P value < 0.05 were taken as statistically significant. R value more than 0.7 were taken as relatively high correlation.

Result:

Of the 148 patients recruited for the study 71 were females and 77 males with mean age of 16 months (Table 2A and 2B). On cross tabulating the chest x-ray grading with severity of pneumonia there is no correlation (0.124) with p value of 0.133(Table 3A and 3B).

No significant correlation was found between fever, cyanosis, tachypnoea and grading of chest x-ray both by Kendall's tau-b and Spearman rho's tests (Table 4). Of the 148 patients one child required oxygen support and three children required ventilator support. All the three children who needed ventilator support had grade 2 findings in chest x-ray and were recognised as severe pneumonia at admission.

Discussion:

The diagnosis of pneumonia is mainly based on clinical features with imaging studies confirming the diagnosis[6,7]. As per the current WHO guidelines, a child needs to receive injectable antibiotics only if the child has features of severe pneumonia[2]. 14% of the current under 5 mortality and 22% of 1 to 5 year children mortality is secondary to chest infections[8]. 90% of these chest infections are secondary to pneumonia[9]. As per WHO statistics only one third of the children receive the antibiotics they need. Chest x-ray has always been considered as gold standard for diagnosis of pneumonia[7]. However findings of pneumonia may be seen in a chest x-ray depending on whether the imaging is done early or late in the disease[10]. It also depends on the interpreter's expertise. Hence pneumonia diagnosis using x-rays is not always possible[10]. In the study done in South Africa for development of a score to assess severity of pneumonia, they found that

Volume 6, Issue 5; September-October 2023; Page No 459-465

addition of chest x-ray did not enhance the chances of finding severity of pneumonia and hence was not included in their final scoring [9]. Similar findings have been reported in our study. Chest x-ray findings and grading of pneumonia showed no correlation. Thus routine chest x-ray for all children is not warranted. As per the latest recommendation by WHO management of pneumonia has been further simplified into two categories as pneumonia and severe pneumonia to be treated with high dose oral amoxicillin and intravenous antibiotics respectively[11]. Thus WHO recommends promoting immunization, adequate nutrition and appropriate administration of antibiotics to reduce under 5 mortality due to pneumonia[8].

Limitations:

1. Patients with pneumonia who didn't have x-ray findings initially may have had findings if taken a few days later. A follow up chest x-ray would have been able to prove that but that would mean additional radiation to a child who is getting better
2. We have not recruited patients with respiratory symptoms who were treated on outpatient basis. Our results may have been different if chest x-rays were taken for those patients and their findings recorded, but that would mean additional radiation to a not so sick child

Conclusion: Above study shows that any child with fever, cough and tachypnoea or retractions, need not mandatorily have a chest x-ray and if the chest x-ray has heterogenous opacity in any of the zones then the child should be referred to an inpatient facility and treated with intravenous antibiotics. It also means that for the health workers in remote areas, the basic training provided by the WHO ARI control program is enough to identify sick children early and refer them to an inpatient facility on time.

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Volume 6, Issue 5; September-October 2023; Page No 459-465

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Table 1: Classification of pneumonia as per WHO criteria[4]

Classification	Fever and cough	Chest wall indrawing +/-Fast breathing : 2months to 1 year > 50/ minute 1 to 5 years > 40/minute	Danger signs
No pneumonia	Present	Absent	Absent
Pneumonia	Present	Present	Absent
Severe pneumonia	Present	Present	Present

Table 2A: Baseline Charecteristics

		Age	hospital stay	RR	HR
N	Valid	148	148	148	148
	Missing	0	0	0	0
Mean		15.97	6.82	56.36	111.11
Median		12.00	7.00	56.00	115.00
Std. Deviation		13.181	1.765	10.948	13.090
Minimum		2	2	38	72
Maximum		60	13	74	136
Percentiles	25	6.00	6.00	45.50	100.00
	50	12.00	7.00	56.00	115.00
	75	24.00	8.00	68.00	120.00

Table 2B: Chest retractions, clinical diagnosis and chest x-ray grading

		Chest Retractions		Clinical Diagnosis as per ARI Program		Chest Xray grading	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Grade	0	96	64.9	8	5.4	14	9.5

Volume 6, Issue 5; September-October 2023; Page No 459-465

	1	50	33.8	99	66.9	41	27.7
	2	2	1.4	41	27.7	93	62.8
	Total	148	100.0	148	100.0	148	100.0

0- No retractions, 1- subcostal retractions present, 2- subcostal retractions, intercostal and suprasternal retractions present

Table 3A: Clinical Diagnosis * Chest Xray grading Crosstabulation

			Chest Xray grading			Total
			0	1	2	
Clinical Diagnosis	0	Count	0	2	6	8
		% within Chest Xray grading	0.0%	4.9%	6.5%	5.4%
	1	Count	12	31	56	99
		% within Chest Xray grading	85.7%	75.6%	60.2%	66.9%
	2	Count	2	8	31	41
		% within Chest Xray grading	14.3%	19.5%	33.3%	27.7%
Total		Count	14	41	93	148
		% within Chest Xray grading	100.0%	100.0%	100.0%	100.0%

Table 3B: Non parametric correlations

			Clinical Diagnosis	Chest Xray grading
Spearman's rho	Clinical Diagnosis	Correlation Coefficient	1.000	0.124
		Sig. (2-tailed)		0.133
		N	148	148
	Chest Xray grading	Correlation Coefficient	0.124	1.000
		Sig. (2-tailed)	0.133	
		N	148	148

Volume 6, Issue 5; September-October 2023; Page No 459-465

Table 4: Correlation between chest Xray grading, fever, tachypnoea and cyanosis

			Chest Xray grading	Fever	Tachypnoea	Cyanosis
Kendall's tau_b	Chest Xray grading	Correlation Coefficient	1.000	.041	.109	.023
		Sig. (2-tailed)		.559	.152	.744
		N	148	148	136	148
	Fever	Correlation Coefficient	.041	1.000	.052	-.009
		Sig. (2-tailed)	.559		.453	.888
		N	148	148	136	148
	Tacchynoea	Correlation Coefficient	.109	.052	1.000	.012
		Sig. (2-tailed)	.152	.453		.866
		N	136	136	136	136
	Cyanosis	Correlation Coefficient	.023	-.009	.012	1.000
		Sig. (2-tailed)	.744	.888	.866	
		N	148	148	136	148
Spearman's rho	Chest Xray grading	Correlation Coefficient	1.000	.050	.124	.029
		Sig. (2-tailed)		.547	.151	.726
		N	148	148	136	148
	Fever	Correlation Coefficient	.050	1.000	.065	-.006
		Sig. (2-tailed)	.547		.449	.938
		N	148	148	136	148
	Tacchynoea	Correlation Coefficient	.124	.065	1.000	.014
		Sig. (2-tailed)	.151	.449		.870
		N	136	136	136	136
	Cyanosis	Correlation Coefficient	.029	-.006	.014	1.000

Volume 6, Issue 5; September-October 2023; Page No 459-465

		Sig. (2-tailed)	.726	.938	.870	
		N	148	148	136	148

Volume 6, Issue 5; September-October 2023; Page No 459-465