A CROSS SECTIONAL STUDY OF ASSOCIATION BETWEEN BLOOD LACTATE AND OUTCOME IN CHILDREN WITH PNEUMONIA

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ABSTRACT

Background: Pneumonia is an inflammation of the lung parenchyma and is one of the leading infectious causes of death globally in children less than 5 years of age. **Material and methods**: A cross sectional study was conducted in PICU of a tertiary care hospital in children aged between 2 months to 5 years diagnosed to have WHO defined pneumonia. The Inclusion Criteria was all children aged between two months to five years diagnosed to have WHO defined pneumonia on admission to hospital. Exclusion criteria was children with associated co-morbid conditions like congenital abnormalities of airway and lungs, congenital heart disease, chronic respiratory diseases, skeletal deformities. Vital data with peripheral blood oxygen saturation (SpO2 %) by pulse oximetry, lactate level by arterial blood gas within first one hour of admission was noted. **Results**: A total of 80 subjects were included..47 (58.8%) children had Pneumonia and 33 (41.3%) had severe Pneumonia. Recovery was delayed i.e., more than 1 week of hospital stay was seen in 31 cases (38.8%). The mean lactate level in pneumonia was 1.1702±0.4885 and in severe pneumonia was 3.2636±1.9992. On comparing the duration of hospital stay to blood lactate levels, it was found that the mean duration of stay in children with normal lactate levels was

5±2 days compared to abnormal lactate levels was 10± 3 days which was statistically significant. **Conclusion**: The study concludes that higher lactate levels at admission are associated with increased severity of pneumonia and prolonged hospital stay in children with Pneumonia aged 2 months to 5 years.

Key words: Pneumonia, Lactate, Recovery

Introduction

Pneumonia is an inflammation of the lung parenchyma and is one of the leading infectious causes of death globally in children less than 5 years of age.[1] It accounts to 9,20,000 deaths annually.[1]Biomarkers that indicate disease severity and suggest timely intervention are of utmost significance in lowering the mortality and morbidity.[2] Severe pneumonia is respiratory insufficiency caused by tissue hypoxia and metabolic dysfunction triggering a series of inflammatory events resulting in hemodynamic changes. Thereby, lactic acidosis is an important measure of shock, hypoxia and oxygen metabolism. Lactate, a product of anaerobic cellular metabolism, directly reflects the disease severity and prognosis, especially in critically ill patients.[3] It is also a Point of Care test (POCT) in the emergency department, that helps in the identification of those children who can benefit from early and aggressive goal-directed therapy.[4,5] Muscles, intestine, red blood cells, brain and skin contribute to the daily total of roughly 1500 mmol of lactate, which is metabolized primarily by the liver (about 60%) and secondarily by the kidneys (30%) and other organs.[6] The typical blood lactate concentration is approximately 1mEq/l. Even small increments in lactate levels are directly proportional to high mortality rates.[7]

This study was aimed to determine the association of blood lactate levels on the outcome of children with pneumonia and to evaluate its prognostic significance when taken within the first hour of admission.

Materials and Methodology

A cross sectional study was conducted in PICU of a tertiary care hospital in children aged between 2 months to 5 years diagnosed to have WHO defined pneumonia, admitted from December 2023 to February 2024. Study was approved by institutional human ethics committee. Informed written consent was obtained from all the parents/guardians of the study participants prior to the study. The Inclusion Criteria was all children aged between two months to five years diagnosed to have WHO

defined pneumonia on admission to hospital. Exclusion criteria was children with associated co-morbid conditions like congenital abnormalities of airway and lungs, congenital heart disease, chronic respiratory diseases, skeletal deformities (chest deformities, kyphoscoliosis). All the relevant parameters were documented in a structured study proforma. Vital data with peripheral blood oxygen saturation (SpO2 %) by pulse oximetry, lactate level by arterial blood gas within first one hour

of admission was noted. They were categorized depending on the severity at presentation as per the revised WHO classification criteria into pneumonia and severe pneumonia.[8] Arterial lactate levels normal range is 0.5-1.6 mmol/L and they were grouped as having levels ≤ 1.6 mmol/L and > 1.6 mmol/L.The outcome was assessed from the total duration of hospital stay, ≤ 1 week was considered early and > 1 week was considered delayed.

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test or Fischer's exact test (for 2x2 tables only) was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables. P value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Results

A total of 80 subjects were included. 22(27.5%) were less than 1 year and 58 (72.5%) were in the age group of 1 to 5 years.36 (45%) were female and 44 (55%) were male.47 (58.8%) children had Pneumonia and 33 (41.3%) had severe Pneumonia. Recovery was delayed i.e., more than 1 week of hospital stay was seen in 31 cases (38.8%).

The mean lactate level in pneumonia was 1.1702±0.4885 and in severe pneumonia was 3.2636±1.9992. On comparing the blood lactate levels to severity of Pneumonia, it was found that the lactate levels was higher in Severe Pneumonia which was statistically significant as shown in table 1 & 2. It was also seen that the recovery was delayed in children with higher lactate levels which was statistically significant as shown in table 1 & 2.

Table 1:

		ABG LACTATE		P value
		Mean	**SD**	
Pneumonia grade	**Pneumonia**	1.1702	0.4885	<0.001

Severe pneumonia	3.2636	1.9992	

Recovery	Delayed	3.4613	1.9143	<0.001
	Early	1.1306	.4736	

Table 2

	Lactate				P value
	Normal		Abnormal		
	N	%	N	%	
Pneumonia grade					
Pneumonia	40	85.1%	7	14.9%	<0.001
Severe pneumonia	9	27.3%	24	72.7%	
Recovery					
Delayed	6	19.4%	25	80.6%	<0.001
Early	43	87.8%	6	12.2%	

Table 3

	Normal		Abnormal		
	Mean	SD	Mean	SD	
Duration of hospital stay	5	2	10	3	<0.01

On comparing the duration of hospital stay to blood lactate levels, it was found that the mean duration of stay in children with normal lactate levels was 5±2 days compared to abnormal lactate levels was 10± 3 days which was statistically significant. There were no deaths among the children included for the study.

Discussion

This study showed the serum lactate levels was associated with severity of pneumonia and duration of hospital stay in children aged 2 months to 5 years. Children with severe pneumonia with signs such as grunting, severe chest indrawing; and especially those unable to feed/drink, those with decreased conscious level or coma, had significantly higher serum lactate concentration.[8] Therefore, serum lactate concentration was higher in the severe pneumonia group than in the pneumonia group.

708

In a study done by El Ghawas et al[7] concluded that reduced survival rates have been linked to elevated blood lactate levels in critically ill infants in pediatric intensive care units (PICU). Similarly in a study done by Bui-Binh-Bao et al[9] found that there was an association between hyperlactatemia and severity as well as mortality in children aged 2 months to 5 years with pneumonia. In a study done by Ma C,Gunaratnam LC et al[5] concluded that Lactate level at admission of < 2.0, 2.0–4.0, and > 4.0 mmol/L accurately riskstratified children, with 5-day mortality of 2%, 11% and 26%, respectively (P < 0.001). Slow lactate clearance also predicted subsequent mortality in children with repeated lactate measurements. Since our study had a smaller sample size, there was no mortality, yet the elevated lactate levels at admission had delayed recovery with prolonged hospital stay. Hence our study concludes that the lactate measurement is a clinically informative and convenient tool in low-resource settings for triage and risk stratification of children with pneumonia.

Conclusion

The study concludes that higher lactate levels at admission are associated with increased severity of pneumonia and prolonged hospital stay in children with Pneumonia aged 2 months to 5 years. Hence blood lactate level measured at the time of admission is a good predictor of recovery and point of care test in emergency department.

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