ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 04 | April - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A STUDY ON SERUM LACTATE LEVEL - PREDICTOR OF OUTCOME IN PEDIATRIC SEPTIC SHOCK

Paediatrics

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ABSTRACT

Introduction: One of the most common reasons for admission to an intensive care unit is sepsis and septic shock. Every year, millions of children die from septic shock. Even with cutting-edge critical care, mortality is still high. Finding biomarkers that will aid in the early identification, prognostication, and treatment of critically sick children has been the subject of studies and ongoing study. As a result, morbidity and mortality will be decreased. Research on adults have shown that serum is a helpful indicator of septicshock prognosis. Little research has been done on kids. **Aim And Objective:** This study sought to determine whether blood lactate levels were associated with bad outcomes and whether they might be used to predict death in children with septic shock. To determine the association between serum lactate level and mortality in pediatric septic shock. To determine whether serial determination of serum lactate level is a predictor of out come in pediatric septic shock. To determine the association between organ dysfunction , presence of anemia , malnutrition, diagnosis and outcome in pediatric septic shock. **Materials And Methods:** This study was conducted from March-2021 to October-2022 on 55 patients comingto pediatric department Al-AmeenMedicalCollege Hospital, Vijayapura with septic shock. **Result:** Out of 55 children included in the study, boy children were 30, girl children were 25. 47.3 % of children were under age of 1 year, 38.2 % were between1 and5 years,14.5 %ofchildrenwerebetween5 and12 years, Pneumonia (65.5%) was the most common cause for septic shock, Anemia was observed in 69.1 % of cases and undernutrition was observedin72.7%ofcases,Organ dysfunction other than cardiovascular dysfunction was observed in36 (65.5%) children of which respiratory dysfunction was observed in 18cases,Mortality in our study was 43.6% out of 55 children with septic shock, 31children were survivors and24children were nonsurvivors. Nonsurvivors were high in 13–60monthsagegroup.Lactatemeasured at 0 to 3 hours and at 24 hours was significantly high innon survivors. Apart from serum lactate, presence of organ dysfunction and under nutrition were significantly associated with poor outcome. Initial serum lactate value≥ 41 mg/dl (4.55 mmol /L) and serum lactatevalue of≥ 39.2mg /dl (4.35 mmol /l) at 24 hours were significant predictors of poor outcome inchildren with septic shock. **Conclusion:** Septic shock is a prevalent reason for PICU admission and a leading cause of death. According to the findings of this study, the majority of patients who died had greater blood lactate levels than those who survived. Lactate levels (> 5 mmol/l) at 0, 3, 12, and 24 hours, as well as the PRISM III score (>10), were found to be predictive of mortality in septic shock. More investigations on lactate cut-off values in paediatric septic shock are needed. High lactate levels that persisted were linked to an increased risk of death. As a result, it may be used to predict the risk of mortality. Because the number of patients in our study was limited, more research is needed to validate the prognostic significance of lactate in paediatric patients admitted to the PICU.

KEYWORDS

Septic shock; pediatric; PRISM 3 score; Serumlactate.

INTRODUCTION

One of the main reasons for admission and fatalities in critical care units is septic shock. Patients with septic shock require prompt detection of poor tissue perfusion and vigorous care of this condition, especially given the rising prevalence and burden of controlling morbidity and death.[1] Many critically sick individuals who are normotensive and have an acceptable urine output may continue to be in a condition of compensated shock. Hence, depending exclusively on the normalisation of vital signs and urine output may not be sufficient[2].Anaerobic metabolism takes place while the body is in shock, releasing lactate into the circulation. High blood lactate levels can indicate that tissue perfusion is compromised. Lactate has been investigated as a biomarker for sepsis and septic shock in recent years.[3,4,5,6]Reduced lactate clearance may also be a sign of systemic metabolic impairment in the liver and kidneys, both of which ordinarily aid in the removal of lactate from the body. Hence, lactate elimination biologically reflects the host's homeostasis and offers more useful information regarding the general effectiveness of the resuscitative processes.[7,8]With a recent update, the Surviving Sepsis Campaign advises lactate normalisation as a resuscitation goal for patients with severe sepsis and septic shock.[9]However most studies using serum lactate in sepsis and septic shock have been done on adults. Few paediatric studies have examined the relationship between lactate levels and mortality in septic shock and sepsis.[10,11,12,13] The purpose of the current study was to evaluate if lactate clearance predicts the fate of children admitted to the paediatric intensive care unit (PICU) with septic shock and to establish the ideal cut-off value for predicting in-hospital death.

AIM AND OBJECTIVE.

1) To determine the association between serum lactate level and mortality in pediatric septic shock.
2) To determine whether serial determination of serum lactate level is a predictor of out come in pediatric septic shock.
3) To determine the association between organ dysfunction , presence of anemia, malnutrition, diagnosis and outcome in pediatric septic shock.

MATERIALS AND METHODS

This hospital based crosssectional study was conducted on patients in the age group of 3months-12 years who were admitted to PICU with septic shock visiting Department of Pediatrics, Al-Ameen MedicalCollege Hospital, Vijayapura. The patients were selected based on inclusion and exclusioncriteria.Study was conducted from March2021 toOctober2022.

Inclusion Criteria:

Throughout the research period, all kids between the ages of 3 months and 12 were admitted to the PICU with septic shock.

Exclusion Criteria:

1. Children who got fluid boluses as prehospital care.
2. Metabolic errors that are inherited Neonates (less than 1 month of age) and children above 5 years

METHODOLOGY

The study was approved by Institutional Ethical Committee. Informed parental consent was obtained from all the parents of patients enrolled in the study after explaining to them in detail about the study in their own language. Clinical history taking and analysis of old records was done which included the following: preliminary data, history regarding parents' consanguinity, family history. Apart from examination for Vitalsincluding Heartrate, Respiratoryrate, Blood pressure and Temperature, Anthropometry was done which included

measurement of height, weight and body surface area of the patients. General Physical Examination was performed followed by Systemic examination which included: Cardiovascular system examination for murmursandrhy thmab normalities, Respiratory system examination to rule out lunginfections, and Per Abdomen examination was doneto assess for Hepatosplenomegaly. Investigations were done such as Complete hemogram, serum latacte, chest xray.

Statistical Analysis:

Data wereanalyzed using SPSS softwareversion 17 and Med Calcsoftware version 15. Data were inter preted using descriptive and in ferential statistics. The Chi-square test was used to test the statistical significance ofrelationship between two variables. Student **T** test was used to determine if there is a significant difference between the mean of two groups. The cut off value wase stimated by using Receiver Operating Characteristics Curve (ROC) analysis[43]. Area under the ROC curve more than 0.5 indicates that the test predicts outcome better than no chance. The curve represents graphical relationship between sensitivity and 1 -specificity. Odds ratio is calculated from me asure of association between exposure and outcome

RESULTS AND OBSERVATIONS

This study was conducted from March-2021 to October-2022 on 55 children aged between 3 to 12 years coming to PICU Al-Ameen Medical College Hospital, Vijayapura. Out of 55 children studied,26 (47.3) children were between 3month and 1 year. 21children (38.2%) were between1 and5 years.8 children(14.5%) were between5 and12 years.(Table 1).(Fig1).Among the study population, 30 were male children and 25 were female children. (Table 2). (Fig2). Out of 55 patients,3 children showed Urosepsis (5.5%), 36 children developed bronchopneumonia(65.5%),8 had acute diarrheal disease(14.5%), one had liver abscess (1.8%),7 patient had meningitis (12.7%).(Table3) Out of 55 patients 38 had anemia (69.1%), 40 patients (72.7%).

Among the study population, ventilation was require din 27 (49.1) cases. In the study population, organdys function was observed in 36 (65.5%) cases. Among the study population, survivors were 31 (56.4%) casesandnon survivors were 24 (43.6%) cases. The Chi square value is 36.2; p value < 0.001. There is a significant association between lactate level (0-3hours) and outcome. From the tableit can be inferred that with increase in lactate level, the number of nonsurvivors increase. Above the cut off value of ≥ 41mg/dl (from ROC analysis) number of non survivors are 23. Lactate level greater than 70mg/dl, had100% mortality. (Table 4) The Chi Square valueis 40.2; pvalueis <0.001. The reisasignificant association between lactate level 24hours and outcome. From the table it can be inferred that with increase in lactate level, the number of nonsurvivors increase. Above the cut off value of ≥ 39.2 mg/dl (from RO Canalysis) number of nonsurvivors are21.(Table 5) The T value (9.33) for mean difference in lactate level measured at 24hours between survivors and non survivors is significant (p<0.001).the mean lactate level among survivor sand nonsurvivors was 24.7mg/dland53.2mg/dlrespectively. It can be in ferred that lactate level at 24 hours issignificantly highin nonsurvivors compared with survivors (Table6). The area under ROC curve for lactate measured at 24 hours is 0.926which is statistically significant. The optimum cut off value for lactate at 24 hours as observed from receiver ope rating character is ticscurveis ≥39.2mg/dl(4.35mmol/l). The sensitivity was 90.3% and specificity was 95.8%. (Table 7). The odds ratio, positive predictive value and negative predictive valuefor the cut off value of lactate ≥ 41 mg/dl measured at 0 to 3 hoursare119.6,82.1%and96.2% respectively. These were statistically significant. The odds ratio, positive predictive value for the cutoff value of lactate≥ 39.2mg/dlmeasured at 24 hours are 65.33,85.1% and 96.4% respectively. These were statistically significant. (Table8).

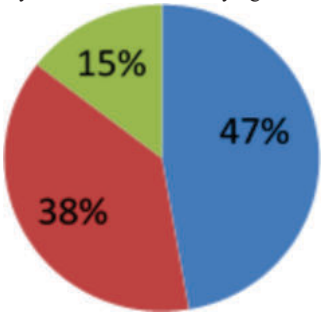

Figure 1

AGE 3months- 12months 13months- 60months 61months-144months

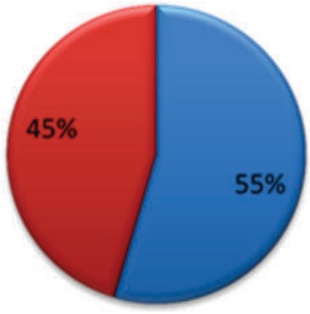

Figure 2 Gender Male Female

Table 1 Age Distribution Of Study Population

Age	Frequency	Percent
3months-12 months	26	47.3%
13months-60 months	21	38.2%
61months-144 months	8	14.5%
Total	55	100%

Table 2gender

Sex	Frequency	Percent
Male	30	54.5%
Female	25	45.5%
Total	55	100%

Table 3 Diagnosis

Diagnosis	Frequency	Percent
Urosepsis	3	5.5%
Bronchopneumonia	36	65.5%
AcuteDiarrhoealDisease	8	14.5%
LiverAbscess	1	1.8%
Meningitis	7	12.7%
Total	55	100%

Table 4 lactate at (0to3) hoursvs Outcome

LACTATEAT	OUTCOME	
0-3 hrs	Survivors	Non-Survivors
20.1 –30.0	19(95.0 %)	1(5 .0%)
30.1 –40.0	7(100.0 %)	-
40.1 –50.0	3(33.3 %)	6(66.7 %)
50.1 –60.0	1(20.0 %)	4(80.0 %)
60.1 –70.0	1(10.0 %)	9(90.0%)
70.1 –80.0	-	4(100.0 %)

Table 5 Lactate At 24 Hours Vs Outcome

LACTATEAFTER24hrs	OUTCOME	
	Survivors	Non-Survivors
10.1 –20.0	13(92.9 %)	1(7.1 %)
20.1 –30.0	14(100.0%)	-
30.1 –40.0	1(33.3 %)	2(66.7 %)
40.1 –50.0	2(25.0 %)	6(75.0%)
50.1 –60.0	-	7(100.0%)
60.1 –70.0	1(12.5%)	7(87.5%)
70.1 –80.0	-	1(100 %)

Table6 Lactateat24hoursvsoutcome

Outcome		N	Mean	Std. Deviation
Lactate at 24hrs afteradmission	Survivor	31	24.729	10.3953
	NonSurvivor	24	53.283	12.2881

Table 7

Variable	LACTATEat24 Hours	
Sample size		55
Positivegroup	OUTCOME=1	31
Negativegroup	OUTCOME=0	24

Table 8

Lactate	Cut-offvalue	Odds Ratio	PPV	NPV	P-Value
0 to 3hours	≥41 mg/dl	119.6	82.1%	96.2 %	<0.0001
24hours after	≥39.2 mg/dl	65.33	85.1 %	96.4 %	<0.0001

DISCUSSION

There were 55 kids hospitalised with septic shock overall during the

research period. 25 females and 30 boys were present. In 38 instances, anaemia was noted. In 40 instances, undernutrition was detected. 24 people did not survive, leaving 31 survivors. Death rates were 43.6%.In our study, bronchopneumonia (65.5%), acute diarrheal illness (14.5%), meningitis (12.7%), and ureosepsis (5.5%) were the main causes of septic shock. This research by Kolski et al., in which bronchopneumonia was the prevalent infection, is analogous. This is analogous to a research by Kana Ram Jat et al. in which bronchopneumonia was the primary diagnosis in 73.3% of patients. Mortalityinourstudywas43.6%. This is analogous to the findings of Kana Ram Jat and colleagues. Their research had a 50% mortality rate. E. coli was the causing organism in children with uraerosepsis. In 36 (65.5%) instances, organ failure other than cardiovascular disease was noted. Comparable research by Kana Ram Jat et al found that organ dysfunction occurred in 66.7% of patients. Next to cardiovascular organ system malfunction, respiratory dysfunction (50%) was the most prevalent. From ROC analysis, the optimal cut off value for lactate measured at0to 3 hourswas≥41mg/dl (4.55mmol/l).For lactate measuredat 24 hours the optimal cut off value was >39.2mg/dl (4.35mmol/L). Both initial and lactate at 24hourd were significantly high in non survivors($p<0.001$).The association between lactate measured at 0 to 3 hours outcome was significant.Also there was significant association between lactate measyred at 24 hours and outcome. Initial lactate level of >41mg/dl had sensitivityof 87% and specificity of 95.8%.Lactate level at 24hours had sensitiivity of 90% and specificity of 95.8%.High lactate level,presence of organ dysfunction and under nutrition were independantly associated with poor outcome. In our study , initial lactate level of≥ 41mg/dl (4.55 mmol/l) and 24 hours lactate level of ≥39.2mg/dl (4.35mmol/l) was significantly associated with poor outcome. This is comparable to previous study conducted by **Kana Ram Jat et al**[23]in which lactate ≥ 5 mmol/l or 45 mg/dlwas significantly associated with poor outcome .In contrast to our study,**Duke et al**[26]reported lactate level of≥ 3 mmol/lwas a significant predictorof outcome. But in the study conducted by **Duke et al**[26], children with sepsiswere the study population. Barat Ramakrishna et al studied children with pneumonia and reporteda cut off>2mmol/l.Age, gender, and the existence of anaemia did not differ substantially between nonsurvivors and survivors. Death was substantially related with the presence of malnutrition and organ failure.

CONCLUSION

Children frequently die and suffer from morbidity due to septic shock. To avoid problems, early detection and goal-directed therapy are essential. Our research showed that increased mortality was linked to higher blood lactate levels. Serial measurement of blood lactate levels was a more accurate predictor of unfavourable results.

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