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Research Article

A STUDY ON SERUM LACTATE LEVEL AS THE PREDICTOR OF OUTCOME IN PEDIATRIC SEPTIC SHOCK IN ICU AT SVPPGI CUTTACK & SCB MEDICAL COLLEGE, CUTTACK

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A R T I C L E I N F O

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A B S T R A C T

Introduction: Lactate is a normal end product of carbohydrate metabolism, other processes, unrelated to tissue hypoxia, may also cause lactate levels to rise. Blood lactate levels are used in shock patients, both for detection of hypoperfusion and adequacy of resuscitation. Tissue perfusion is the oxygen supplied at the tissue level to support normal aerobic cellular metabolism. Inadequacy of tissue perfusion causes increase in lactate levels. It reflects severity of illness with significant prognostic implications Material and **Method :** The study was conducted at Paediatrics Intensive Care Unit (PICU) from from October 2016 to September 2018y at SVP PG IP and S C B Medical College, Cuttack. This study was a prospective observational study. **Result:** Mortality in septic shock patients with hyperlactatemia was high (39%). The mean age of the hyperlactatemic group was 30.7 months with a M:F ratio of (1.9:1). The mean lactate level at admission, 6 hr and 24hr among survivor and non survivors were (4.13±1.1, 3.02±0.8,1.61±1.0 mmol/l) and (6.25±4.1, 5.98±1.15,3.65±2.3mmol) with (p=0.001) which is significant. Mean PRISM III score among survivors and non survivors were 5.9±3.0 and 15.63±4.1 with p=0.001 was a significant difference. **Conclusion:** Septic shock is a common cause for PICU admission with high mortality. This study demonstrated that most patients who died had higher blood lactate level than survivors at presentation.

INTRODUCTION

Lactate levels are commonly used to stratify risk and to assess adequacy of resuscitation in the intensive care unit (ICU) as it is the earliest marker of tissue hypoperfusion1,2. Tissue perfusion is the oxygen supplied at the tissue level to support normal aerobic cellular metabolism. Inadequacy of tissue perfusion causes increase in lactate levels3. It reflects severity of illness with significant prognostic implications4. The severity and duration of lactic acidosis in septic shock patient correlates with overall oxygen debt, and increased production2. A single lactate measurement has not been correlated to mortality consistently5. Lactate clearance is the rate of fall in lactate after resuscitation is started. This has shown more promise in predicting mortality .Resuscitation should be started as early as possible. This study is done to find out whether serial lactate level could help predict mortality in paediatric patients and also to find out the association of hyperlactatemia with outcome of the patient.Blood lactate levels are used in shock patients, both for detection of hypo perfusion and adequacy of resuscitation. Lactate levels are also increased in mitochondrial dysfunction, hepatic dysfunction, pulmonary and extra pulmonary disease, thiamine deficiency, drugs (epinephrine, metformin, NRTI) and intoxications (methanol, cyanide, ethylene glycol).

Lactate is a normal end product of carbohydrate metabolism, other processes, unrelated to tissue hypoxia, may also cause lactate levels to rise6.

Therefore, the exact aetiology of hyperlactatemia needs to be examined to be able to properly interpret the results, which requires sufficient understanding of lactate metabolism. Most cases of hyperlactatemia in septic shock patients are due to inappropriate tissue oxygenation. This condition may result from respiratory disorders with poor blood oxygenation or from circulatory disorders that cause tissue hypoperfusion . As patients do not always show clinical signs hyperlactatemia may be the only marker of this disorder7.

An important limitation of patient monitoring is that the standard vital signs such as heart rate and blood pressure often do not change until a patient reaches a critical stage8,9,10. Pain and anxiety, contributing to increased sympathetic tone, influence these vital signs and render them insensitive for monitoring the adequacy of tissue perfusion11,12. Many patients who appear to be haemodynamically stable based on normal vital signs have increased blood lactate levels (‘occult hypoperfusion’ or‘compensated shock’)13,14. Therefore, lactate levels are often considered to be better resuscitation endpoints than standard vital signs.

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Definitions

1. Septic shock: Septic shock is severe sepsis plus acute circulatory failure characterized by persistent arterial hypotension despite adequate volume administration, unexplained by causes other than sepsis15.
2. Serum lactate level: While the normal lactate concentration in unstressed individuals is 1.0 ± 0.5 mmol/l16,17, patients with critical illness are considered to have normal lactate levels at concentrations of less than 2 mmol/l18. A value of less than or equal to 2.0 mmol/ l is defined as the normal institutional arterial serum lactate level. At this point, we achieved end points of resuscitation.
3. Duration of ICU stay: prolonged stay in ICU defined as staying in ICU for > 13 days.[20]

There are few Studies of paediatric septic shock patients on hyperlactatemia. The duration of stay in PICU and the expenditure puts a great burden on the patient and community. We want to find out whether hyperlactamia could predict mortality and improve goal directed outcome. Early identification and rapid treatment of these patients is widely acknowledged as a vital step towards improving survival .The study was designed to find out the level of serum lactate in septic shock children and association of outcome with lactate at admission in PICU, 6 hours, and 24 hr.

MATERIALS AND METHOD

This study was a prospective observational study conducted in ICU of S.V.P.P.G.I.P, Cuttack from September 2016- August 2018.

All the patients getting admitted to ICU diagnosed as septic shock were considered for the study. Then the patient hospital course followed as per ICU protocol. Antibiotics, I.V fluids, vasopressors, inotropes were given as indicated by patient clinical and hemodynamic status. After obtaining the lactate level at admission, patients were selected according to inclusion and exclusion criteria.

Inclusion criteria: Patient from 1 month to 14 years of age with shock requiring PICU admission. Elevated baseline lactate concentration >2 mmol/l.

Exclusion criteria: 1.Discharge from PICU in less than 24h after admission.2.Suspected cases of mitochondrial dysfunction (MELAS), thiamine deficiency, drug therapy (NRTI, metformin) and intoxications (methanol, cyanide, ethylene glycol) are excluded from study. 3. Inborn error of metabolism, trauma, poisoning, neuromuscular disorder and surgical cases are excluded from the study.4.Those patients who left against medical advice before discharge from PICU.

Data Collection

After obtaining informed written consent from the parents and clearance from Institutional Ethics Committee, patient are selected from PICU according to inclusion and exclusion criteria .The following variables are recorded :name ,age, sex, religion, weight for age, provisional diagnosis and associated disorders (Chromosomal abnormality, non-operative cardiovascular diseases, Cancer, Previous ICU admission, Pre ICU CPR, Post operative, Acute diabetic complication). At the time of admission in ICU, any physiological derangement (shock, respiratory distress and coma) or organ dysfunction were recorded. Complications like hypoglycaemia, hyperglycaemia, electrolyte imbalance, anaemia, and thrombocytopenia were also recorded.

Shock: Despite administration of isotonic intravenous fluid bolus >60 ml/kg in 1 hr : decrease in BP (hypotension) systolic <90 mm Hg,MAP < 90 mm Hg, <5th percentile for age , systolic BP <2SD below normal for age or need for vasoactive drug to maintain BP in normal range(dopamine >5 mcg/ kg/min or dobutamine, epinephrine, norepinephrine at any dose).

Respiratory Distress: Mean respiratory rate >2 standard deviation above normal for age or acute need for mechanical ventilation not related to neuromuscular disease or general anaesthesia.

Coma: Glasgow coma score <11 or acute change in mental status with a decrease in Glasgow coma score >3 points from abnormal baseline. LIVER FAILURE: Total bilirubin >4 mg/dl or Serum alanine transaminase>2 times upper limit of normal for age.

Renal Failure: Serum creatinine >2 times upper limit of normal for age or 2 fold increase in baseline creatinine.

Cardiac Failure: inability to deliver adequate oxygen to meet the metabolic demands of vital organs and tissues due to congenital or acquired heart disease.

Respiratory Failure: Pao2/fio2 <300 in the absence of cyanotic heart disease or pre-existing lung disease or PaO2 <60 torr or 20 mmHg over baseline PaCO2 or proven need for > 50% FIO2 to maintain saturation> 92% or need for non invasive elective or non invasive mechanical ventilation.

Hypoglycemia and Hyperglycemia: Normal fasting blood glucose level is 60-100mg/dl. Value below 60 mg/dl is hypoglycemia and value above 126 mg/dl is hyperglycemia.

Dyselectrolytemia

Serum Sodium: Normal serum sodium level is 135 to 145 meq/l. Value below <1 35 meq/ l is hyponatremia and value above 1 45 meq/ l is hypernatremia.

Serum Potassium: Normal serum potassium level is 3.5 to 5.5meq/l. Value below <3.5 meq/l is hypokalemia and value above 5.5meq/l is hyperkalemia.

Serum Calcium: Normal serum calcium level is 8.8-10.8mg/dl. Value below < 8 mg / dl is hypo calcemia and value above 11 mg / dl is hypercalcemia.

Haematological Parameters

Anemia: The WHO criteria were taken for defining anaemia:

<6months < 12g/dl
6 months to 5 years < 11g/dl
5 to 12 years < 11.5g/dl

Thrombocytopenia and Coagulopathy

Platelet count < 100,000/mm3 or a drop in platelet count of 50% from highest value recorded over the past 3 days (for chronic haematology / oncology patients) or International normalized ratio >1.5 or activated prothombin time >60 seconds.

Leucocytosis: when TLC count >15000 cells/mm3.

Leucopenia : when TLC count <4000 cells/mm3

Severity of illness was measured by using the PRISM-III (Paediatric Risk of Mortality) score within 12 hours of admission in ICU. Following Parameters were obtained as determined by PRISM-III system for scoring and predicting mortality.

Cardiovascular: systolic blood pressure, heart rate.

Central nervous system: mental status (GCS), pupillary response, and temperature.

Acid base and blood gas findings: acidosis, pH, PaCO2,Total CO2, PaO2

Biochemistry tests: serum glucose, potassium, creatinine, BUN.

Haematological tests: WBC count, total platelet count.

Blood was collected within first 12 hours of ICU stay and sent for above investigations. Other tests which were required for diagnosis and management of the patients were done as per ICU Protocol. All investigations were carried out in the department of microbiology and pathology of S.C.B medical college and S.V.P.P.G.I.P, Cuttack.

Serum Lactate Estimation

Blood sample for estimation of lactate was collected during PICU stay. 0.1 ml of arterial blood was collected from radial artery in a pre heparinised 1 ml syringe and analysis was done within 15 minutes of collection using GEMprimeir3000 blood gas analyser with the help of cartridge which uses ionic method for lactate estimation and gives the results in 30 seconds. Lactate clearance was noted at 6 hours and 24 hour serum lactate levels were monitored at 6,12,24, hr till its level falls below 2 mmol/L or till death of the patient.

Lactate clearance (at 6 hours)=$\frac{\text{Lactate(baseline) - Lactate(at 6 hr)}}{\text{Lactate (baseline)}} \times 100$

Data collected was entered in an online PRISM III Calculator available at www.medal.org.[113]. Studied patients were classified in 6 groups according to their PRISM total score:0-5,6-10, 11-15, 16-20, 21-25 and >25.

Data obtained were noted down using SPSS data chart and analysis was done using SPSS version 21. For univariate variables, frequencies were calculated using descriptive statistics. Survivors and non survivors were compared by chi-square test for multivariate variables. A p value (pearson coefficient) of <0.05 was taken as statistically significant. For comparing the difference between means between continuous variables, student t –test was used in which assuming equal variance, a p value of <0.05 was considered to be significant.

Observation

Table 1 Age and Sex Distribution in the Studied Population (N=90)

Age group	Frequency(n)			Percentage(%)
	male	female	total	
1m-1 year	30	18	48	53.4
1 year to 12 years	28	13	41	45.5
12 years to 14 years	1	0	1	1.1
Total	59(65.5%)	31 (34.5%)	90	100.0

Mean age =30.7 months. SD = 40.65. Range = 1month-168 months

In this study maximum number of patients admitted in the age group of 1 month to 1 year (53.4%) followed by (1-12) year group (45.5%).Only 1.1% were above 12 years. In this study Males (65.5%) outnumbered females (34.5%) in a ratio of 1.9:1

Table 2 Diagnosis at the Time of Icu Admission In The Studied Population (N=90)

Diagnosis	Frequency(n)	Percentage(%)
Septicaemia	52	57.7
Meningo-encephalitis	14	15.6
Pneumonia	14	15.6
CHD with pneumonia	6	6.7
Complicated malaria	4	4.4
Total	90	100.0

In the study population the leading cause of septic shock needing ICU admission was Septicaemia (57.7%) followed by Meningoencephalitis (15.5%). Pneumonia accounted for 15.5% of cases.

Table 3 Lactate Level of the Studied Population At Admission At Different Period Of Time

PARAMETER (n=90)		0	<2	02-2.9	03-3.9	04-4.9	05-5.9	06-6.9	≥7	
BASELINE	Frequency(n)	0	0	18	3	20	29	12	8	Mean = 5mmol/l SD = 1.50
	Percentage	0	0	20	3.3	22.2	32.2	13.4	8.9	Range = 8.64-2.24
AT 6 HOURS	Frequency(n)	0	4	19	30	7	12	12	6	Mean=4.2mmol/l SD =1.7mmol/l,
	Percentage	0	4.5	21.1	33.3	7.8	13.3	13.3	6.7	range=1.26-8.25mmol/l
AT 24 HOURS	Frequency(n)	8	41	12	9	8	6	6	0	Mean= 2.4 mmol/l
	Percentage	8.9	45.6	13.3	10	8.9	6.7	6.7	0	SD = 1.9 mmol/l, range = 0.01-6.56mmol/l.

32.2% of the studied population had baseline lactate concentration lying between (5-6) mmol/l . Only 13.4% had lactate levels between (6-7) mmol/l and 8.9% had lactate levels above 7 mmol/l. The mean baseline lactate level was 5mmol/l5.

In the study population at 6 hr of admission the mean serum lactate is decrease from 5 to 4.2 mmol/l, 33.3% have lactate value 3-4 mmol/l and 6.7% have >7 mmol/l.

At 24 hr of admission the mean serum lactate was 2.4mmol/l with 45.6% have <2 mmol/l of lactate value. 8.9% were either declared or discharged for which serum lactate could not be measured.

Table 4 Lactase Clearance at Different Period of Time

parameter		Neg /increased	0-9.9	10-19.9	20-29.9	30-30.9	≥40	
At 6 hours	Frequency	7	20	22	23	14	4	Mean =18.03% SD =13.4%
	percentage	7.8	20.3	24.4	25.5	15.5	4.4	
At 24 hours	Frequency	4	6	5	2	12	61	Mean = 34.4% SD = 30.9%
	percentage	4.4	6.7	5.6	2.2	13.3	61.8	

25.5% of the studied population had lactate clearance between (20-30%). 4.4 % had clearance above 40% and 7.8% had no clearance or increasing level of lactate. The mean lactate clearance was 18.03 % . 67.8% of the studied population had lactate clearance >40%. 4.4% had no clearance or increasing

level of lactate. 13.3% had lactate clearance between30-40%. The mean lactate clearance was 54.4 % .

Table 5 Prism Iii Score of the Studied Population (N=90)

PRISM III Score	Frequency(n)	Percentage (%)
0-5	23	25.6
06-10	34	37.8
10-15	10	11.1
16-20	20	22.2
21-25	3	3.3
>25	0	0
Total	90	100

Mean score = 10,SD = 6,Range = 0-22

In the studied population 37.8% of the patients were having PRISM score between (6-10) . None were having score above 25. The mean score was 10.

Table 6 Relationship of Demographic Characteristics of the Study with Outcome (N=90)

Variables		outcome		P Value
		Surviver n=55	Nonsurviver n=35	
Age	Months	30.7±40.6	31±43.1	0.978
Sex	Male: Female	39:16(2.4:1)	20:15(1.3:1)	0.180
Religion	Hindu	51 (56.6%)	35 (100.0%)	0.145
	Muslim	4 (4.5%)	0%	
Weight in Kg		9.42±6.4	9.94±9.2	0.752

This table shows that demographic parameters i.e age, sex, religion and wt does not carry any significant value in outcome of the study papulation. The mean age in survivors & non survivors was 30.7 months,31 months respectively. The sex ration male: female between survivors & non survivors was 2.4:1, 1.3:1 respectively. The mean weight was 9.42 kg in survivors whereas 9.94 kg in non survivors.

Table 7 Clinical Characteristic of the Study with Outcome (N=90)

variable		Outcome		P value
		Surviver n=55	Nonsurviver n=35	
Diagnosis at IC U admission	Septicemia	32(58.2%)	20(57.1%)	0 .0 9 9 C h ix 2 7. 8 0
	Meningoencephalitis	6(10.9%)	8 (2 3 .0 %)	
	Pneumonia	12(21.8%)	2 (5 . 7%)	
	CHD with Pneumonia	2 (3 .6 %)	4 (1 1. 5 .0 %)	
	Complicated Malaria	3 (5 .5 %)	1 (2 . 9%)	
Respiratory Distress	Present	47 (85 .5 %)	2 9 (8 2. 9 %)	0 .7 4 0
	Absent	8 (1 4 .5 %)	6 (1 7 .1 %)	
Blood pressure	Normotensive	39(70.9%)	17(48.5%)	0.033
	Hypotensive	16(29.1%)	18 (51 . 5 %)	
Liver Failure	Present	0 %	1(2 .8 %)	0 .2 1 6
	Absent	5 5 .0 (1 00 .0 %)	3 8(9 7 .2 %)	
Cardiac Failure	Present	2 (3 .7 %)	2 (5 . 7%)	0 .6 4 0
	Absent	53 (96 .3 %)	36 (94 . 3. 0 %)	
Renal failure	Present	3 (5 .5 %)	1(2. 8 %)	0.560
	Absent	5 2 (94. 5 %)	34 (9 7 .2 %)	
Respiratory failure	Present	3 4 (6 1 .8 %)	35(100%)	
	Absent	2 1 (3 8 .2 %)	0	

This table shows that 57.1% of deaths occurred in patients with septicemia in comparison to 23% death in patients with meningoencephalitis; 5.7% of total deaths was attributed to pneumonia, with no significant association (p=0.245), hence the outcome does not depend on the diagnosis at the time of admission.

Among the non survivors 51.5% had hypotensive (decompensated) and 48.5% had normotensive shock (compensated) with (p= 0.033) which is significant. There was no significant difference in any other organ failure among survivors and non survivors.

Table 8 Mean Lactate Level in Study with Outcome (N=90)

Mean lactate	Outcome		P value
	Survivors (n=55)	Non survivors (n=35)	
At admission in mmol/l	4.13±1.15	6.25±1.1	0.001
at 6 hr in mmol/l	3.02±0.84	5.98±1.5	0.001
at 24 hr in mmol/l	1.61±1.03	3.64±2.32	0.001

This table shows in our study that all the mean lactate levels at admission, at 6hr and at 24 hr were significantly higher in non survivors as compared to survivors.

Table 9 Ppv, Npvand Odds Ratio for Prism Iii Score>10 And Lactate Level>2mmol/l and >5mmol/l

Parameter		Non survivors	survivors	ppv	npv	Odd ratio	P value
Prism iii Score	>10	31	2	93.9%	92.9%	205	0.001
	<10	4	53				
Lactate at admission	>2mmol/l	35	55	38.9%	-	-	-
	<2mmol/l	0	0				
Lactate at 6 hr	>2mmol/l	35	51	40.7%	100%	-	-
	<2mmol/l	0	4				
Lactate at 24hr	>2mmol/l	25	16	60.9%	79.6%	6.09	-
	<2mmol/l	10	39				
Lactate at admission	>5mmol/l	29	20	59.1%	85.3%	8.45	0.001
	<5mmol/l	6	35				
Lactate at 6hr	>5mmol/l	29	1	96.6%	90%	261	0.001
	<5mmol/l	6	54				
Lactase at 24hr	>5mmol/l	11	1	91.6%	69.2%	24.7	0.001
	<5mmol/l	24	54				

This table shows the cutoff point of PRISM III score and lactate levels. PRISM III score more than 10 and lactate level more than 5 mmol/l at admission, 6hr and at 24 hr significantly differentiated nonsurvivors from survivors. On analysis the serial values of lactate, it was found that the lactate level remained high in nonsurvivors even at 24 hr of PICU admission.

Table 10 Area under the Curve

Test results Variables	Area	Std Error [a]	Asymptomatic sig [b]	Asymptomatic 95% Confidence interval	
				Lower	Upper
Prism score	.970	.016	.000	.939	1.000
Base line lactate	.915	.032	.000	.852	.978
Lactate at 6 hrs	.984	.009	.000	.967	1.000
Lactate at 24 hrs	.754	.071	.000	.616	.892

The test result variable (s): PRISMSCORE, LACTATE6HRS, LACTATE24HRS has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased. a. Under the nonparametric assumption b. Null hypothesis: true area = 0.5

The PRISM III score and lactate level were further analysed using ROC curve. The area under the ROC curve for the PRISM III score (0.970) suggest that it was a strong predictor of mortality in septic shock patient. For baseline lactate at

admission, at 6 hr and 24 hr the area under the ROC curve0.915,0.984 and 0.754 respectively. Which indicates fair correlation between the three lactate level.

DISCUSSION

Table 1 shows In this study maximum number of patients admitted in the age group of 1 month to 1 year(53.4%) followed by (1-12) year group (45.5%).Only 1.1%were above 12 years. The mean age is 30.7 months which is comparable to the study conducted by Puliyel *et al.*2014[19] where the mean age was 40.15 months. Males (65.5%) outnumbered females(34.5%) in a ratio of 1.9:1 which is similar to the study of paediatric ICU patients by Garcia Sanz *et al.*,2002[20] who found a male predominance in the range of 1.5:1.

Table 2 shows that the leading cause of ICU admission was septicemia (57.8%) followed by meningoencephalitis (15.6%). Pneumonia accounted for 15.6% of cases . Koliski et al , 2005[23] observed bronchopneumonia (29%) to be the most common cause followed by septicaemia (25.8%) and meningitis accounted for 22.5% of cases.

Table 3 shows that 32.2% of the study population had baseline lactate at admission lying between (5-6) mmol/l. Only 13.4% had lactate levels between (6-7) mmol/l and 8.9% had lactate levels above 7mmol/l. The mean baseline lactate was 5 mmol/l which corresponds to the observation made by Koliski *et al.*,2005[23] where the mean baseline lactate was 4.6mmol/l and the distribution at of lactate levels at 6 hr the mean serum lactate decrease from 5 mmol/l to 4.2mmol/l with 33.3% patient had (3-4) mmol/l,13.3%patients had (5-6) mmol/l and 6.7% were more than 7mmol/l. serum lactate level at 24 hr of admission was less than 2 mmol/l in 45.6% patient, 10% had (3-4)mmol/l and 8% patients had (4-5) mmol/l with mean lactate value being 2.4 mmol/l which was decreasing order from lactate values at admission and at 6 hr.

Table 4 shows that 25.5% of the study population had lactate clearance between (20 -30)% at 6 hours. 4.4% had clearance above 40% and 7.8% had no clearance or increased lactate at 6 hours. The mean lactate clearance was 18.03 % which was lower in comparison to observation made by Puliyel *et al.*,2014[19] where mean lactate clearance at 6 hours was 27%. 67.8% of the study population had lactate clearance more than 40% at 24 hours. 4.4% had no or increasing level of lactate. 13.3% had lactate clearance between 30-40% lactate at 6 hours. The mean lactate clearance was 54.4 % which was higher in comparison to observation made by Puliyel *et al.*,2014[19] where mean lactate clearance at 6 hours was 27%. Lactate clearance is lower in non survivor as compared to survivor, which is a strong predictor of mortality. Gouthami P *et al* 2017[22].

Table 5 shows that in the studied population 37.8% of the patients were having PRISM Score between (6-10).None were having score above25. The mean PRISM Score was 10 which was slightly lower in comparison to study by Hatherill *et al.*,2000[23] where the mean PRISM score was 19,as we took a time limit of 12 hours for calculating the PRISM score .This also shows that lactate is earliest marker to get deranged when vital parameters are not significantly altered.

Table 6.shows age, sex religion and weight were no significantly different between survivors and nonsurvivors.

Table 7 shows that 57.1% of deaths occurred in patients with septicaemia in comparison to 23% death in patients with meningoencephalitis; 5.7% of total deaths was attributed to pneumonia, with no significant association (p=0.245), hence the outcome does not depend on the diagnosis at the time of admission and organ dysfunctions(liver failure, cardiac failure, renal failure) are comparable between survivor and non survivor with no significant association with outcome. Hypotensive septic shock was more in non survivor(551.5%) in comparision to survivor(29.1%) with significant (p=0.033) difference.

Table 8 This table shows in our study that all the mean lactate levels at admission, at 6hr and at 24 hr were significantly higher in non survivors as compared to survivors i.e 4.13±1.15mmol/l, 3.02±0.84 mmol/l and 1.61±1.03 in survivors and 6.25±1.09 mmol/l, 5.98±1.15 mmol/l and 3.64±2.32 mmol/l in non survivor respectively with significant (p=0.001) difference. Vinod k gupta *et al*, 2016[24] observed in his study that higher serum lactate value i.e. more than 5 mmol/l in nonsurvivors, which is a strong predictor of mortality in septic shock.

Table 9 shows that cut-off point for the PRISM III score and lactate level with positive predictive value(PPV), negative predictive value(NPV) for the prediction of outcome . PRISM II score >10,

PPV93.9%,NPV92.9% with significant (p=0.001) . serum lactate cut-off value >5 mmol/l at admission, 6hr and 24 hr were significantly higher among nonsurvivors compared to survivors at a significant level with PPV of 59.1%,96.6%,91.6% and NPV of 85.3%,90% and 69.2% respectively Duke *et al*[25]. Koliski *et al*. observed a lactate level of > 3mmol/l significantly predicted mortality. This value was high in our study the reason for this may be patient selection. Duke *et al*[25] included patient with sepsis with or without shock; Koliski *et al*[21] included al patient admitted to PICU where as in our study only patient with septic shock were included where a high lactate level was expected.

Table 10 The PRISM III score and lactate level were further analysed using ROC curve. The area under the ROC curve for the PRISM III score (0.970) suggest that it was a strong predictor of mortality in septic shock patient. For baseline lactate at admission, at 6 hr and 24 hr the area under the ROC curve0.915, 0.984 and 0.754 respectively. Which indicates fair correlation between the three lactate level observed by Vinod k gupta *et al*., 2016[24].There was no significant difference with respect to mean duration of ICU stay, this may be because those patients who were very sick, died earlier and those who were adequately resuscitated recovered earlier and were sent to regular wards for follow up.

Summary: The present study was conducted in the PICU of Department of Paediatrics of S.V.P.P.G.I.P, Cuttack. 90 patients of septic shock were taken for study. Mortality in septic shock patients with hyperlactatemia was high (39%). The mean age of the hyperlactatemic group was 30.7 months with a M:F ratio of (1.9:1). mean weight in survivor and non survivor was 9.4±6.5,9.94±9.2kg respectively, septicaemia and meningoencephalitis were the leading causes of ICU admission; respiratory distress was present in almost 84.5% of patients at admission; most common organ dysfunction at

admission was respiratory failure(76.6%); half of the population was anaemic(51%);
57% presented with hyperglycemia, 11.1% with hyponatremia at admission and 80% of the patients required vasopressors. Mean baseline lactate at admission was 5mmol/l. The hyperlactatemic patients had a mean PRISM Score of 10 Mean duration of ICU stay in patients with hyperlactatemia was 3 days and mean duration of mechanical ventilation was 1.6 days. Out of all patients with hyperlactatemia admitted to PICU, 61% were survivors and 39% were non survivors.

The mean lactate level at admission, 6 hr and 24hr among survivor and non survivors were (4.13±1.1, 3.02±0.8,1.61±1.0 mmol/l) and (6.25±4.1, 5.98±1.15,3.65±2.3mmol) with (p=0.001) which is significant.

A lactate value >5mmol/l at admission, 6hr,24 hr had an odd ratio for death of 8.45, 261, 24.7 with a PPVof 59.1%, 96.6%, 91.6% and a NPV of 85.3%, 90%, 69.2% respectively with p=0.001 which is significant.

Mean PRISM III score among survivors and non survivors were 5.9±3.0 and 15.63±4.1 with p=0.001 was a significant difference. A PRISM III score of >10 with odd ratio 205, PPV93.9%, NPV92.9% with p=0.001 had a strong prediction of outcome and these patient had a high mortality. They required more use of vasopressor and ventilator support (p=0.005).

Out of all patients with hyperlactatemia admitted to PICU; at admission, non survivors had more organ dysfunction (respiratory failure) more physiological derangements, higher incidence of anaemia (p=0.004).

CONCLUSION

Septic shock is a common cause for PICU admission with high mortality. This study demonstrated that most patient who died had higher blood lactate level than survivors at presentation. Lactate level of>5mmol/l either at admission or with in 24hr of interval periods from admission and PRISM III score (>10) were predictor of death in septic shock. Measuring lactate level was a more sensitive way of identifying a population at risk in addition to vital parameter in order to begin resuscitation within the golden hours. The persistence of high lactate was associated with higher mortality. There is a need for larger studies on cut off values of lactate levels in pediatric septic shock above which mortality increases significantly.

Bibliography

1. Smith I, Kumar P, Molloy S, Rhodes A, Newman PJ, Grounds RM, Bennett ED: Base excess and lactate as prognostic indicators for patients admitted to intensive care. Intensive Care Med 2001, 27:74-83.
2. Bakker J, Gris P, Coffernils M, Kahn RJ, Vincent JL: Serial blood lactate levels can predict the development of multiple organ failure following septic shock. Am J Surg 1996, 171:221-226
3. Weil MH, Afifi AA. Experimental and clinical studies on lactate and pyruvate as indicators of the severity of acute circulatory failure (shock). Circulation. 1970;41:989-1001.
4. Bone RC, Balk RA, Cerra FB, Dellinger RP, Fein AM, Knaus WA, Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis – The ACCP / SCCM Consensus Conference Committee. Chest. 1992;101:1644-55.
5. Bernardin G, Pradler C, Tiger F, Deloffre P, Mattei M. Blood pressure and arterial lactate level are early indicators of short-term survival in human septic shock. Intensive Care Med. 1996;22:17-25.
6. Levy B, Gibot S, Franck P, *et al*. Relation between muscle Na+K+ ATPase activity and raised lactate concentrations in septic shock: a prospective study. Lancet 2005;365(9462):871-875.
7. Meregalli A, Oliveira RP, Friedman G. Occult hypoperfusion is associated with increase mortality in hemodynamically stable, high- risk, surgical patients. Critical Care. 2004;8:R60-64.
8. Rady MY, Rivers EP, Nowak RM: Resuscitation of the critically ill in the ED: responses of blood pressure, heart rate, shock index, central venous oxygen saturation, and lactate. Am J Emerg Med 1996, 14:2 18-225.
9. Rixen D, Siegel JH: Bench-to-bedside review: oxygen debt and its metabolic correlates as quantifiers of the severity of hemorrhagic and post-traumatic shock. Crit Care 2005,9:441-453.
10. Dunham CM, Siegel JH, Weireter L, Fabian M, Goodarzi S,Guadalupi P, Gettings L, Linberg SE, Vary TC: Oxygen debt and metabolic acidemia as quantitative predictors of mortality and the severity of the ischemic insult in hemorrhagic shock. Crit Care Med 1991, 19:231-243.
11. Rady MY, Rivers EP, Martin GB, Smithline H, Appelton T, Nowak RM: Continuous central venous oximetry and shock index in the emergency department: use in the evaluation of clinical shock. Am J Emerg Med 1992, 10:538-541.
12. Arnold RC, Shapiro NI, Jones AE, Schorr C, Pope J, Casner E, Multi-center study of early lactate clearance as a determinant of survival in patients with presumed sepsis. Shock. 2009;34:36-40.
13. Tisherman SA, Barie P, Bokhari F, Bonadies J, Daley B, Diebel L, Eachempati SR, Kurek S, Luchette F, Carlos Puyana J, Schreiber M, Simon R: Clinical practice guideline: endpoints of resuscitation. J Trauma 2004, 57:898-912.
14. Moomey CB Jr, Melton SM, Croce MA, *et al*: Prognostic value of blood lactate, base deficit, and oxygen-derived variables in an LD50 model of penetrating trauma. Crit Care Med 1999; 27:154–161
15. Levy MM, Fink MP, Marshall JC, *et al*. 2001. SCCM/ESICM/ACCP/ATS/SIS International Sepsis Definitions Conference. Crit Care Med. 2003;31(4):1250–1256 .
16. De Backer D: Lactic acidosis. Intensive Care Med 2003, 29:699-702.
17. De Backer D: Lactic acidosis. Minerva Anestesiology 2003, 69:281-284
18. Mizock BA: Lactic acidosis. Dis Mon 1989, 35:233-300
19. Puliyel, A munde, N kumar, RS beri "Lactate clearance as a marker of mortality in paediatric intensive care unit" indian pediatrics volume 51:july 15, 2014
20. Garcí aSan z C, Ru p érez Lu cas M Ló p ez-Herce Ci d J VigilEscribanoD; GarridoCantarero G, "Prognostic value of the pediatric index of mortality

(PIM) score and lactate values in critically- ill children", An Esp Pediatr;57(5):394-400, 2002 Nov.
21. Koliski A, Cat I, Giraldi DJ, Cat ML. Blood lactate concentration as prognostic marker in critically ill children. J Pediatr (Rio J) 2005;81:287–92.
22. Kondle V.K, Gouthami. P. A comparison study of blood lactate and lactate clearance with SNAP II score as predictors of outcome in sick neonates. J PediatrRes.2017;4(06):388396.doi:10.17511/ijpr.2017.06.07.
23. Hatherill M, McIntyre AG, Wattie M, Murdoch IA: "Early hyperl actataemia in critically ill children". Intensive Care Med 2000,26(3):314-8 .
24. Jat KR, Jhamb U, Gupta VK. Serum lactate levels as the predictor of outcome in pediatric septic shock. Indian J Crit Care Med. 2011;15:102–7.
25. Duke TD, Butt W, South M. Predictors of mortality and multiple organ failure in children with sepsis. Intensive Care Med. 1997;23:684–92.

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