DOI: 10.7860/JCDR/2022/50903.16006

Original Article

Paediatrics Section

Blood Lactate Levels and PRISM III Scores for Prognosis of Shock during Paediatric Emergencies: A Prospective Observational Cross-sectional Study

S SRI RAKSHA[1], J KRISHNAPPA[2], KN SHASHIDHAR[3]

ABSTRACT

Introduction: The appropriate management of shock in paediatrics includes early recognition of tissue hypoxia and its timely intervention thus preventing shift to anaerobic metabolism, metabolic acidosis and cell death.

Aim: To determine the effectiveness of blood lactate levels as a prognostic indicator of mortality in children with shock admitted to Paediatric Intensive Care Unit (PICU) and to correlate between blood lactate levels and Paediatric Risk of Mortality III (PRISM III) scores.

Materials and Methods: This was a prospective observational cross-sectional study conducted between January 2018 to May 2019 in the PICU of a tertiary care centre in rural India. A total of 144 children presenting with shock to PICU were included in the study. The serum lactate values were assessed at 0, 12 and 24 hours of admission. The various parameters of PRISM III scores was documented for each child at 0, 12 and 24 hours of admission and score was calculated. Lactate levels and PRISM III score were analysed using the Receiver Operating Characteristic (ROC) curve and optimal cut-off points were chosen for the calculation of sensitivity, specificity, positive and negative predictive values. An area under the ROC curve above 0.8 indicated fairly good prediction.

Results: The most common aetiologies for shock in the present study included severe sepsis (42.3%), acute gastroenteritis (21.5%) and dengue fever (21.5%). Persistent hyperlactatemia was observed in non survivors and serum lactate values persistently greater than 4 mmol/L within the first 24 hours of admission were associated with greater risk of mortality. The area under the ROC curve for the serum lactate levels (0.958) suggested that, it was a strong predictor of mortality in study subjects when compared to PRISM III score which had area under the ROC curve 0.866.

Conclusion: Serum lactate values are an early useful predictor of mortality in children with shock and it is more feasible indicator when compared to PRISM III scores.

Keywords: Metabolic acidosis, Mortality, Paediatric risk of mortality III scores, Sepsis, Tissue hypoxia

INTRODUCTION

Shock is one of the most frequent life-threatening conditions which is encountered in Paediatric Intensive Care Unit (PICU). Shock is an acute process characterised by the body's inability to deliver adequate oxygen to meet the metabolic demands of vital organs and tissues [1,2]. Hypoxia at the tissue level is unable to support normal aerobic cellular metabolism and shift to the less efficient anaerobic metabolism. When there is an imbalance between oxygen delivery to the tissue and oxygen requirement there is oxygen debt which leads to progressive clinical deterioration and lactic acidosis [3,4].

The appropriate management of shock in paediatrics includes early recognition of tissue hypoxia and its timely intervention thus preventing shift to anerobic metabolism, metabolic acidosis and cell death [5-7]. Early indicators of mortality in paediatric patients with shock can be employed to assess and determine the risk of mortality so that early intervention can be followed in order to prevent adverse events [8-10].

Lactic acid is a metabolite generated as a result of anaerobic glycolysis [11,12]. Hyperlactatemia is a very important cardinal finding in paediatric shock. The mechanism of hyperlactatemia has two pathways, one in sepsis and the other one in cases of septic shock [13,14]. In case of sepsis, an increase in lactate levels implies increased glycolysis due to increase in metabolic rate and in cases of shock, the raised glycolytic flux is due to tissue hypoxia. Thus, this implies that there are two varieties of lactate that is "stress lactate" and "shock lactate" [15-17]. This lactic acid, thus, estimated can be used as a marker for predicting the outcome of patients in shock.

The paediatric risk of mortality score is one of the most important indicators that is used in the Paediatric ICU. It provides a good discriminatory performance and prediction; it is extensively used in many Paediatric ICUs as a prognostic score to assess gravity of disease [18,19].

The PRISM III scores were developed based on the parameters of PRISM scores with modifications and improvements. The physiological variable and ranges have been revaluated. Predictive power of various physiological variables was reassessed and those that did not contribute significantly to mortality were eliminated [18]. Using a scoring system which is practical and more objective, so as to provide clinical and/or laboratorial criteria to evaluate if, any delay in treatment is an important factor of impact on quality of care in critically ill patients. The ideal score is the one which should be easy to use, easy to reproduce, low cost, minimally invasive and accurate [19-21]. In the present study, study is intended to know relation between serum lactate levels and the outcome of the patient and to correlate the same with the PRISM III scores.

MATERIALS AND METHODS

A prospective observational cross-sectional study was conducted for a duration of one year four months from January 2018 to May 2019. A total of 144 patients were included in the present study. All the patients with shock , between the age group of one month and 18 years who were admitted to PICU in RL Jalappa Hospital and Research Centre, Kolar, Karnataka, India. Ethical Clearance Approval Number No. SDUMC/KLR/IEC/32/2017-2018 Dated:29-11-2017.

Inclusion criteria: All patients with shock, between the age group of one month and 18 years who were admitted to PICU were included. Shock in any phase that is compensated (Tachycardia, tachypnoea, normal or low urine output, normal or slightly elevated BP), decompensated phase (Altered sensorium, cool clammy extremities, blood pressure <-2 SD adjusted for age, oliguria, tachycardia, tachypnoea) and irreversible shock (comatose, cold cyanotic mottled extremities, not recordable BP, anuria, tachycardia, respiratory failure), were included.

Exclusion criteria: If the child died within <2 hours after admission or referred to other hospitals or discharged against medical advise.

Sample size calculation: Sample size was estimated based on the study conducted by Choudhary J et al., on the effectiveness of predicting outcome in critically ill children presenting in septic shock by assessing serum lactate levels [3]. The required sample size was 144.

Study Procedure

All patients with shock between age group of one month and 18 years irrespective of aetiology were included in the present study after detailed clinical evaluation and diagnosis The patients at admission were evaluated clinically based on the physiologic variables in the PRISM III score. Arterial and venous blood was drawn for routine investigations necessary for evaluating the patients. The clinical status, co-morbidities, therapeutic interventions and medications were recorded daily until discharge or death.

PRISM III Score Parameters [20,21]: Total PRISM III Score: (Cardiovascular and neurologic subscore)+(acid base and blood gas subscore)+(Chemistry subscore)+(haematologic subscore).

The higher the total score the higher is the mortality. A rising score indicates deterioration. Blood Lactate was analysed by colorimetric method [Table/Fig-1].

Variables	Age restrictions and range		Score
Systolic blood pressure in mmHg	Infants	Children	
	130-160	150-200	
	55-65	65-75	2
	>160	>200	
	40-54	50-64	6
	<40	<50	7
Diastolic blood pressure in mmHg	All ages	>110	6
Heart rate in beats per minute	Infants	Children	
	160	>150	4
	<90	>80	4
Respiratory rate in breaths per minute	Infants	Children	
	61-90	>150	1
	>90	>70	5
	Apnoea	Apnoea	5
PaO_2/FiO_2	All ages	200-300	2
		>200	3
$PaCO_2$ (mmHg)	All ages	51-65	1
		>65	5
Glasgow coma score	All ages	<8	6
Pupillary reactions	All ages	Unequal or dilated	4
		Fixed and dilated	10
PT/PTT	All ages	105 times control	2
Total bilirubin mg/dL	All ages	>3.5	6
Potassium in mEq/L	All ages	3.0-3.5	1
		6.5-7.5	1
		<3.0	5
		>7.5	5
Calcium in mg/dL	All ages	7.0-8.0	2
		12.0-15.0	2
		<7.0	6
		>15.0	6
Glucose in mg/dL	All ages	40-60	4
		250-400	4
		<40	8
		<400	8
Bicarbonate in mEg/L	All ages	<16	3
		>32	3

[Table/Fig-1]: PRISM III score parameters.

The VITROS LAC Slide method was performed which is a multilayered analytical element coated on a polyester support. Lactate in the sample is oxidised by lactate oxidase to pyruvate and hydrogen peroxide. The hydrogen peroxide generated oxidises the 3-aminoantipyrene, 1,7-dihydroxynaphthalene dye system in a horseradish-peroxidase-catalysed reaction and results in a dye complex [12-15]. The test is a colorimetric method the incubation period is five minutes at a temperature of 37°C at a wavelength of 540 nm. The volume of the sample required is 10 microliters. The measuring range is 0.5-12 mmol/L. Blood lactate levels was estimated at admission and at 12 and 24 hours. The PRISM III score and serum lactate values were correlated.

STATISTICAL ANALYSIS

The collected data was entered into Microsoft Excel data sheet. This data was analysed using SPSS 22.0 version software. Categorical data was represented in the form of frequencies and proportions. The test of significance for qualitative data was determined using Chi-square test or Fischer's-Exact test (for 2×2 tables only, the data has been modified). 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. Lactate levels and PRISM III score were further analysed using the ROC and optimal cut-off points were chosen for the calculation of sensitivity, specificity, positive and negative predictive values. A test that predicts an outcome no better than chance has an area under the ROC curve of 0.5. An area under the ROC curve above 0.8 indicated fairly good prediction. The relationship of lactate at admission with the PRISM III score was determined by calculating the Spearman's correlation co-efficient and two-tailed significance. The 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

The most common aetiology in children who presented with shock in the present study was sepsis in septic shock. Bronchopneumonia was the most common aetiology of septic shock. About 42% of the children had septic shock [Table/Fig-2]. Most children presented with warm shock and hyperdynamic circulation. However, few children presented with cold shock. Of the total 42 cases, blood culture and sensitivity revealed growth of organism in 28 cultures. The organism which was isolated includes *Enterococcus, Klebsiella Pneumonia, Staphylococcus aureus, Acinetobacter* species and *Pseudomonas aeruginosa*. The other cases had positive septic screen.

The second most common aetiology for shock was acute gastroenteritis with severe dehydration. A 31% of the children studied had AGE with severe dehydration. A total of 19 (13.2%) children presented with dengue fever with warning signs and 12 children had severe dengue fever (8.3%). Children with dengue fever with warning signs presented with hypotension (compensated shock), thrombocytopenia, excessive vomiting, pain abdomen. These children were in the compensated phase and responded

to fluid resuscitation. Children with severe dengue fever presented with acute respiratory distress syndrome, dengue hepatitis, dengue haemorrhagic fever. Dengue encephalitis and multiorgan dysfunction syndrome. Fourteen (9.7%) children presented with diabetic ketoacidosis, out of which 10 cases were newly diagnosed type I diabetes and four cases were old cases of Type 1 diabetes with poor compliance to insulin therapy. All 14 children presented with severe diabetic ketoacidosis. The various other aetiologies for shock include, OP compound poisoning, submersion injury, late presentation of consumption of rat poison (zinc phosphide), and pubertal menorrhagia [Table/Fig-2].

Diagnosis	Frequency	Percent
Acute encephalitis syndrome	1	0.7
Acute GE with severe dehydration	31	21.5
Dengue fever with warning signs	19	13.2
Diabetes ketoacidosis	14	9.7
Submersion injury	2	1.4
OP compound poisoning	1	0.7
Pubertal menorrhagia	1	0.7
Rat poisoning with shock	1	0.7
Respiratory failure	1	0.7
Severe dengue fever	12	8.3
Severe sepsis in shock	61	42.3
Total	144	100.0

[Table/Fig-2]: Distribution of patients according to diagnosis.

As it can be observed the serum lactate values in survivors at time of admission was very much lower in comparison to non survivors at the time of presentation. There is progressive reduction in serum lactate values in survivors. Serum lactate values of non survivors at presentation were elevated significantly when compared to survivors. In non survivors, there is persistent hyperlactatemia even following resuscitation. Thus, concluding that high serum lactate values at presentation (according to the present study lactate values above 4 mmol/L) and persistent hyperlactatemia are associated with increased mortality.

There was a statistically significant difference found between survivors and non survivors with respect to serum lactate levels at all the time intervals intervals [Table/Fig-3].

Outcome		Mean	Std. Deviation	Probablity value
0 hr	Survivors	2.922	0.662	<0.001
	Non survivors	4.017	0.291	
12 hrs	Survivors	2.488	0.627	<0.001
	Non survivors	4.250	0.319	
24 hrs	Survivors	2.065	0.664	<0.001
	Non survivors	4.187	0.506	

[Table/Fig-3]: Comparison of serum lactate level among survivors and non survivors at various interval.
Probability Value: Independent t-test was used

The PRISM III values measured at admission in survivors was low and there was progressive reduction in the PRISM III scores. The PRISM III scores in non survivors was found to be elevated at presentation when compared to non survivors and there is increase in the scores at 12 hours of admission in non survivors. A persistently elevated scores above 20 was found to be associated with increase in the risk of mortality among children with shock shock [Table/Fig-4]. There was a statistically significant difference found between survivors and non survivors with respect to PRISM III score at all the time intervals. A highly significant positive correlation existed between the PRISM III score and lactate level at admission (r=0.678; p-value <0.001) [Table/Fig-5].

The area under the ROC curve for the serum lactate levels (0.958) suggests that, it was a strong predictor of mortality in study subjects when compared to PRISM III score which had area under the ROC curve 0.866. Area under the ROC curve for both PRISM III score and serum lactate levels had a significant p-value <0.001) [Table/Fig-5].

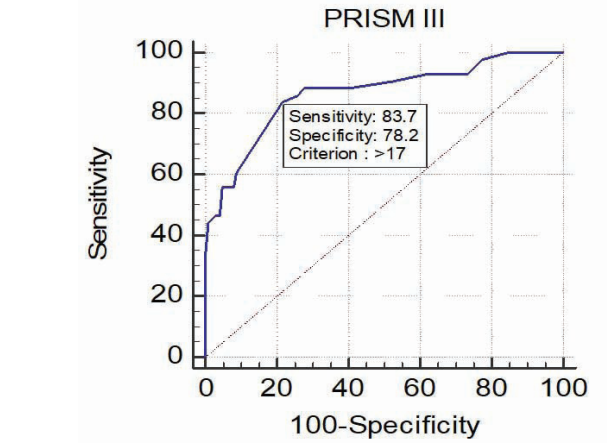
Outcome		Mean	Std. Deviation	Probablity value
0 hr	Survivors	13.28	4.693	<0.001
	Non survivors	23.05	7.730	
12 hrs	Survivors	8.43	3.371	<0.001
	Non survivors	26.86	9.486	
24 hrs	Survivors	6.19	3.280	<0.001
	Non survivors	21.53	9.007	

[Table/Fig-4]: Comparison of PRISM III score among survivors and non survivors at various interval.
Probablity value: Independent t-test was used

Variables	PRISM III score	Serum lactate level
Area under the ROC curve (AUC)	0.866	0.958
Standard Error	0.0357	0.0171
95% Confidence interval	0.799 to 0.917	0.911 to 0.984
Significance level (p-value)	<0.0001	<0.0001

[Table/Fig-5]: Comparison of area under the ROC curve for PRISM score and serum lactate level.

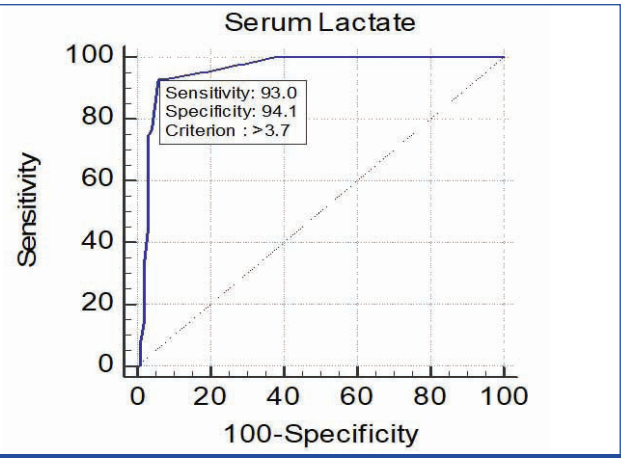
This is the ROC curve for the PRISM III scores. The x-axis depicts specificity (true negative rate) rate and the y-axis depicts the sensitivity (true positive rate). From this ROC curve, it can be seen that the sensitivity of the PRISM III scores, that is the ability of the PRISM III scores to truly identify the children in shock who have poor prognosis and higher risk of mortality above the value of 17 is 83.7% and the specificity of PRISM III scores to identify the children who are not at the risk of mortality is 78.2% [Table/Fig-6].



[Table/Fig-6]: Receiver Operating Characteristic (ROC) curves for PRISM III score.

This is the ROC curve for the serum lactate values. The x-axis depicts specificity (true negative rate) rate and the y-axis depicts the sensitivity (true positive rate). From this curve, it can be seen that sensitivity of the serum lactate values, that is ability of the serum lactate values to truly identify the children in shock who have poor prognosis and higher risk of mortality above the value of 3.7 is 93% and specificity of serum lactate values to identify the children who are not at risk of mortality is 94.1% [Table/Fig-7].

It was observed that blood lactate values were found to be important useful tool in predicting mortality in patients in shock, the values achieved AUC of 0.958 with standard error of 0.0171 with 95% confidence interval between 0.911-0.984. Many studies done previously have demonstrated that lactate values at admission or peak lactate values at any given time of admission is associated with mortality in adults. However, a very few studies have been conducted in children and demonstrated the use of hyperlactatemia as a prognostic indicator of mortality in critically ill children in PICU.



[Table/Fig-7]: Receiver Operating Characteristic (ROC) curves for serum lactate.

In the present study, serum lactate values have been correlated to PRISM III scores and compared as to which is a better indicator in predicting mortality in children presenting with shock. The PRISM III score is a good valid measure of illness severity of the critically ill children during the initial 24 hours of admission. It reflects on overall clinical picture of the child. It is the sum total of the physiological, biochemical and haematological parameters assessed. The PRISM III scores in non survivors were found to be elevated at presentation when compared to non survivors and there is increase in the scores at 12 hours of admission in non survivors. A persistently elevated scores above 20 was found to be associated with increase in the risk of mortality among children with shock.

The AUC for PRISM III scores was 0.866 with standard error of 0.0357 with 95% confidence interval of 0.799 to 0.917. Area under ROC curve was compared between serum lactate values and PRISM III scores. Area under ROC curve for serum lactate values was found to be 0.958 and area under ROC curve for PRISM III score was 0.866. Hence, this proves that serum lactate values are better predictors of mortality when compared to PRISM III score. Area under ROC curve for PRISM III score and serum lactate levels had a significant p-value <0.001. In the present study, sensitivity and specificity of serum lactate values and PRISM III scores was determined along with positive predictive values and negative predictive values. Using this data ROC curve was plotted. Also, optimal cut-off values were obtained for determining mortality.

A total of 75% of the children included in the present study had a blood lactate concentration of >2.5mmol/l at presentation. Blood lactate values had a sensitivity of 95.5% and specificity of 82.18% at values greater than 3.5 mmol/L with a PPV of 69.5 and NPV of 97.6 and at values >3.7 blood lactate values had a sensitivity of 93% and specificity of 94.5% with a PPV of 87 and NPV of 96.9. Overall any blood lactate values above 4 mmol/L within initial 24 hours of admission even after extensive resuscitation indicated very poor prognosis and higher risk of in hospital mortality.

The above analysis was compared with PRISM III scores which at values greater than 15 had a sensitivity of 88.37% and a specificity of 72.28% with PPV of 57.6 and NPV of 93.6 and at values greater than 17 it displayed a sensitivity of 95.35% and a specificity of 78.22% with a PPV of 62.1 and a NPV of 91.9. And it was observed that a PRISM III score of greater than 20 at any given time of admission within initial 24 hours indicates poor prognosis and carries a higher risk of mortality [Table/Fig-8].

Variables	Sensitivity (%)	Specificity (%)	PPV	NPV
PRISM III score (>15)	88.37	72.28	57.6	93.6
PRISM III score (>17)	83.72	78.22	62.1	91.9
Serum lactate (>3.5)	95.35	82.18	69.5	97.6
Serum lactate (>3.7)	93.0	94.1	87	96.9

[Table/Fig-8]: Cut-off points for the PRISM III score and lactate levels along with Sensitivity, specificity, PPV and NPV of PRISM III score and serum lactate levels.

DISCUSSION

The present study was compared to a study done by Bai Z et al., in assessing blood lactate levels as prognostic indicator in critically ill children admitted to PICU [2]. Median blood lactate levels were found to be 3.2 mmol/L (2.2-4.8 mmol/L). This study showed that elevated blood lactate levels at admission was associated with greater risk of mortality while the present study correlated PRISM III scores and serum lactate values, Morris KP et al., others conducted a retrospective cohort study in PICU to investigate whether blood lactate concentration on admission predicts mortality in PICU and if its addition can improve the performance of the Paediatric Index of Mortality 2 (PIM2) mortality prediction score and also to compare as to which is a better predictor of mortality [5]. It was observed that the admission lactate in non survivors was higher than in survivors, had a positive association with mortality and significantly improved the model fit of PIM2 when it replaced absolute base excess. While in the present study, PRISM III scores were used instead of PIM2 scores. In both the studies, the mortality scores were correlated with serum lactate values to find out which was better as a prognostic indicator. Both PRISM III scores and serum lactate levels were found to be good indicators of mortality.

Another similar study was conducted by Jat KR et al., [12]. This study was conducted to assess serum lactate values as prognostic indicator of mortality in children admitted to PICU with septic shock. It was observed that the initial as well as the subsequent lactate values were higher in the non survivors when compared to survivors. They correlated serum lactate values with PRISM III scores and observed that highly positive correlation existed between serum lactate and PRISM III scores. A PRISM III score greater than 10 and a lactate values greater than 5 mmol/L at all time periods discriminated survivors from non survivors. This study was similar to the present study, where PRISM III scores were correlated to serum lactate values as prognostic indicator in children admitted with shock. Similar to the above study, in the present study it was found that highly positive correlation existed between serum lactate and PRISM III scores. In the present study, as compared to the above study, it was found that a persistently elevated PRISM III values above 20 and serum lactate values above 4 mmol/L at all periods of time was a poor prognostic indicator.

Kim YA et al., conducted a retrospective study on paediatric patients presenting with septic shock at Seoul Korea [1]. A total of 65 patients were enrolled and overall mortality of these patients was studied. In this study serial blood lactate levels was assessed at the time of admission and every six hourly after admission upto 24 hours. They assessed lactate values and lactate associated parameters that is lactate clearance and lactate area. The study concluded, that, blood lactate values and also lactate associated parameters were potentially very useful markers of mortality. In the present study, only serum lactate values was assessed and not lactate associated parameters. The above study did not correlate with the PRISM III scores.

Limitation(s)

The sample size is small. Blood lactate is very unstable when exposed to atmospheric temperature, hence immediate processing of the sample has to be done to avoid errors in the values.

CONCLUSION(S)

Monitoring of patients admitted to PICU on the basis of PRISM III score and lactate levels is beneficial for the overall outcome and should be incorporated into early resuscitation strategies. As early recognition of shock and aggressive intervention has a better outcome.

Acknowledgement

We are grateful to Dr. Chethan (Statistician) for helping us with the statistical analysis. We are grateful to the laboratory services in R

L Jalappa Hospital, Kolar for helping us in timely processing of the samples and obtaining results.

REFERENCES

[1] Kim YA, Ha EJ, Jhang WK, Park SJ. Early blood lactate area as a prognostic marker in paediatric septic shock: Intensive Care Med. 2013;39:1818-23.
[2] Bai Z, Zhu X, Li M, Hua J, Li Y, Pan J, et al. Effectiveness of predicting in hospital mortality in critically ill children by assessing blood lactate levels at admission. BMC Paediatrics. 2014;14:83-91.
[3] Choudhary J, Roul Ray SS, Dash LD. Effectiveness of predicting outcomes in septic shock in critically ill children by assessing serum lactate levels. Paediatric Rev Ind J Paediatr Res. 2016;3:09-12.
[4] Munde A, Kumar N, Beri RS, Puliyel JM. Lactate clearance as a marker of mortality in PICU. Indian Paediatrics. 2014;51:565-67.
[5] Morris KP, McShane P, Stickley J, Parslow RC. The relationship between blood lactate concentration, the Paediatric Index of Mortality 2 (PIM2) and mortality in paediatric intensive care. Intensive Care Medicine. 2012;38:2042-46.
[6] Jansen TC, van Bommel J, Schoonderbeek FJ, Sleeswijk Visser SJ, van der Klooster JM, et al. Early lactate-guided therapy in intensive care unit patients: A multicenter, open-label, randomized controlled trial. American Journal of Respiratory and Critical Care Medicine. 2010;182:752-61.
[7] Epstein D, Randall CW. Cardiovascular physiology and shock. Nichols DG, ed. Critical Heart Disease in Infants and Children. 2nd ed. Philadelphia, PA: Mosby Elsevier; 2006. 17-72.
[8] Nadel S, Kissoon N, Ranjit S. Recognition and initial management of shock. Nichols DG. Roger's Textbook of Paediatric Intensive Care. Philadelphia, PA: Lippincott, William & Wilkins; 2008. 372-83.
[9] Kleigman RM, Stanton BF, Schor NF, St Geme JW, Beherman RE. The acutely ill child. Nelson Textbook of paediatrics (vol 1) 20th ed. South East Asia: Elsiever 2019;516-528.
[10] Shaw KN, Bachur RG. Resuscitation and Stabilization. Paediatric Emergency Medicine. 7th ed. Philadelphia: Wolters Kluwer 2016;55-69.
[11] Nazir M, Wani W, Dar SA, Mir IH, Charoo BA, Ahmad QI, et al. Lactate clearance prognosticates outcome in paediatric septic shock during first 24 h of intensive care unit admission: Journal of the Intensive Care Society. 2019;175-80.
[12] Jat KR, Jhamb U, Gupta VK. Serum Lactate levels as predictor of outcome in paediatric septic shock. Indian J Crit Care Med. 2011;15:102-07.
[13] Bakker J, Erasmus MC, Jansen TC. Lactate monitoring in the ICU. Newgen 2016;139:644-48.
[14] Aramburo A, Todd J, George EC, Kiguli S, Olupot PO, Opoka RO. Lactate clearance as a prognostic marker of mortality in severely ill febrile children in East Africa : BMC Medicine. 2018;16:16-37.
[15] Gorgis N, Asselin JM, Cynthia F, Scott R, Flori HR, Ward SL. Evaluation of the association of early lactates with outcomes in children with severe sepsis or septic shock. Paediatric Emergency Medicine. 2017;234:345-67.
[16] Siddiqui I, Jafri L, Abbas Q, Raheem A, Haque AU. Relationship of serum procalcitonin, c-reactive protein, and lactic acid to organ failure and outcome in critically ill paediatric population. Indian J Crit Care Med. 2018;22:91-95.
[17] Gunnerson KJ, Saul M, He S, Kellum JA. Lactate versus non-lactate metabolic acidosis: A retrospective outcome evaluation of critically ill patients. Crit Care. 2006;10(1):R22.
[18] Slater A, Shann F. The suitability of the Paediatric Index of Mortality (PIM), PIM2, the Paediatric Risk of Mortality (PRISM), and PRISM III for monitoring the quality of paediatric intensive care in Australia and New Zealand : Paediatric Critical Care Medicine. 2004;5:447-53.
[19] Bilan N, Galehgolab BA, Emadaddin A, Shiva SH. Risk of mortality in paediatric intensive care unit, assessed by PRISM-III. Pakistan Journal of Biological Sciences. 2009;12:480.
[20] Gonçalves JP, Severo M, Rocha C, Jardim J, Mota T, Ribeiro A. Performance of PRISM III and PELOD-2 scores in a paediatric intensive care unit. European Journal of Paediatrics. 2015;174:1305-10.
[21] Pollack MM, Patel KM, Ruttimann UE. PRISM III: an updated Paediatric Risk of Mortality score: Critical Care Medicine. 1996;24:743-52.

PARTICULARS OF CONTRIBUTORS:
1. Senior Resident, Department of Paediatrics, Sri Devaraj URS Medical College, Kolar, Karnataka, India.
2. Professor, Department of Paediatrics, Sri Devaraj URS Medical College, Kolar, Karnataka, India.
3. Professor, Department of Biochemistry, Sri Devaraj URS Medical College, Kolar, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. J Krishnappa,
Professor, Department of Paediatrics, Sri Devraj URS Medical College, Tamaka, Kolar-563101, Karnataka, India.
E-mail: drjkgowda@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jun 16, 2021
- Manual Googling: Sep 18, 2021
- iThenticate Software: Sep 28, 2021 (24%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jun 15, 2021**
Date of Peer Review: **Jul 22, 2021**
Date of Acceptance: **Oct 04, 2021**
Date of Publishing: **Feb 01, 2022**