Effect of Lactate and Lactate Clearance Condition on the Prognosis of Sepsis in Children

Running title: Lactate and Lactate Clearance in Sepsis in Children

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ABSTRACT: ***Objectives:*** To investigate the value of early lactate dynamic monitoring index in predicting prognosis of patients with sepsis and septic shock. ***Methods:*** We performed our test on 50 patients. Out of 50 patients, 28 are male, and 22 are female. Prospectively studied pediatric patients with septic shock were performed. Vital signs, Lactate clearance, were obtained at presentation 6 h, 12 h, 24 h over the first 48 h of hospitalization. The therapy received, outcome parameters of mortality and duration of hospitalization were recorded. ***Results:*** The statistical data and comparative analysis showed that an average of 16.88 days after admission, 5 patients have died, 17 patients are poorly prognosis leaves the hospital, and the remaining 28 are recovered and discharged. The primary outcome variable of mean 16 days hospitalization mortality rate was 10%. Poor prognosis 34% and fully recovery 56 % were observed. In this retrospective cohort study, a lactate level of more than 2.5mmol/L was the best threshold to predict 28-day mortality among severe sepsis and septic shock patients. In our research, we found mean LC 6 h 3.08mmol/L, and after 48 h mean it is 1.79mmol/L. Significant LC 6 h found, which is 8.08mmol/L in the death group patient where 48 h mmol/L shows significant high. Poor prognosis also presents a clinical increase of lactate level high in the LC 6 h analysis, which is 3.32mmol/L. Recovered patients showed a significant improvement after administering treatment depending on the patient organ involvement and good decrease of lactate reports achieved, which is 1.20mmol/L, where admission reports show it was

1.91mmol/L in LC 6 h. Mean Heart rate 94/51mmhg, pulse 119, temperature 39℃, respiratory rate 32.26, and urine output 456 ml recorded during our study. Death patient shows a remarkable detonation of those reports but has a significant clinical report with the recovered patients. ***Conclusion:*** The early lactate dynamic monitoring index has a high value in predicting sepsis and septic shock patients' prognosis, thus worth popularizing.

Keywords: Sepsis, Septic shock, Lactic acid, Dynamic monitoring, Prognosis

1 INTRODUCTION

Sepsis is defined as a life-threatening organ dysfunction occurred by a deregulated host response to infection[1]. The third international consensus defined septic shock as a subset of sepsis in which particularly profound circulatory, cellular, and metabolic abnormalities are associated with an increased risk of mortality than sepsis alone[1]. Early recognition of patients at risk and aggressive treatment within the first few h after presentation may prevent the invariable progression and poor outcome, manifested clinically by end-organ damage, failure of multiple organ systems, and death[2-3]. Elevated serum lactate levels reflect the anaerobic metabolism related to cellular hypoxia and are thought to be an important marker of impaired tissue perfusion in patients with septic shock[4]. Small observational studies in adults and children have demonstrated that lactate can correlate with the severity of shock and prognosis in sepsis[5-6]. In contrast, the sensitivity and specificity of single lactate concentrations as markers of tissue hypoperfusion have been debated[7-8]. Studies have shown that serial measurements or lactate clearance (LC) over time may be better prognosticators of organ failure and mortality[9-13].

Further, studies in adults have established the use of lactate and LC as a diagnostic, prognostic, and therapeutic marker of global tissue hypoxia in sepsis and septic shock, however literature regarding its possible prognosticator role in pediatric septic shock isscanty[13]. Further, there is no data regarding the comparison of LC at different intervals during the resuscitation of pediatric septic shock. This study was designed to examine the clinical utility of LC as an indicator of mortality in pediatric septic shock, and to compare the efficiency of LC at 6, 12, and 24 h for predicting in-hospital and 60-day mortality. We also defined a cutoff for LC that is associated with improved outcome after 6 and 24 h of intensive care intervention. Patients were intubated and mechanically ventilated as required. We excluded neonates and patients above 17 years of age in the study.

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2 MATERIALS AND METHODS

2.1 Study design

This prospective observational study was performed in the pediatric intensive care unit (PICU) of Department of Pediatrics at Hebei Medical University 2nd hospital, one of the provincial, medical hospital centers in Hebei province Shijiazhuang city. The study was conducted over a period of 1.5 years from June 2018 to Dec 2019. The hospital ethical committee approved the study. Informed consent was taken from the parents/guardians of the study patients.

2.2 Participants

One hundred and twelve consecutive children in the age group of one month to 17 years, diagnosed with septic shock, constituted the study group. Sepsis and septic shock were defined as per International pediatric sepsis consensus definitions. (1) Included patients were admitted through the emergency department and immediately shifted to PICU. They received central venous and arterial catheterization and were managed as per the prescribed guidelines for goal-directed stepwise management of hemodynamic support in infants and children. (2) Targeted resuscitation end-points were as follows:

1. Blood pressure (systolic pressure at least 5th percentile)
For age: 60mmHg <1 month of age, 70mmHg (2 ages in years) in children 1 month to 10 years of age, 90mmHg in children (10 years of age or older).
2. Central and peripheral pulses (strong, distal pulse sequel to central pulses).
3. Normal mental status.
4. Adequate skin perfusion (warm, and capillary refill <2 s).
5. Urine output 51 mL/kg/h (after effective circulating volume is restored).

2.3 Data collection and data elements

The primary outcome variable was the 60-day mortality. Demographic characteristics and admission diagnoses were recorded at the baseline. Glasgow Coma Scale (GCS), baseline vital signs (temperature, heart rate, mean arterial pressure, central venous pressure), arterial lactate, laboratory values, and therapy received were recorded. The severity of critical illness was assessed using the Pediatric Risk of Mortality III (PRISM III) score within 24 h of hospital admission. Organ dysfunction was analyzed and followed using pediatric logistic organ dysfunction (PELOD)score at 0 (at presentation), 6, 24, 48, and 72 h while in the hospital.

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Lactate levels were measured on admission to PICU along with other baseline investigations and septic work-up, and repeat lactate levels were taken at 6, 12, and 24 h post-admission.

3 RESULTS

Table 1: Lactate Range and Clearance

S/N	Patient number	6 h. mmol/L	12h mmol/lL	24h mmol	48h mmol/L	Prognosis	Outcome
1	2219774	7.8	2.8	2.4	1.9	Death	
2	2218957	15	15	15	15	Death	
3	2106795	0.8	1.3	1.2		Death	
4	2110787	1.8	2.2	1.4	2.6	Death	
5	2056034	15	1.77	1.27	1.9	Death	
6	2214460	5.2				Poor	Stop treatment
7	2213627	3.3	2.7	1.4	0.9	Poor	
8	2202400	2.4	1.16	0.6	0.9	Poor	Stop treatment
9	2199578	1.2	1.04	0.7	1.1	Poor	Stop Treatment
10	2200766	7.41	8.4	9	8.4	Poor	Stop Treatment
11	2173103	2.46	2.1	1.2	1.5	Poor	Stop Treatment
12	2160501	4.4	3.5	3.9	2.9	Poor	Stop Treatment
13	2165571	12.7	1.9	2.2	2.5	Poor	Stop Treatment
14	2115119	0.7	0.74	0.9	1.13	Poor	Stop Treatment
15	2094981	1.7	1.2	1.6	1.1	Poor	Stop Treatment
16	2135402	3.39	4.2	4.7	2.3	Poor	Stop Treatment
17	2124264	1.6	1.7	1.5	0.9	Poor	Stop Treatment
18	2105185	1.5	1.5	1.5	1.8	Poor	Stop Treatment
19	2086416	1.7	1.7	1.8	0.92	Poor	Stop treatment
20	2085364	2.2	2.81	1.64	1.33	Poor	Stop Treatment
21	2054021	3.01	2.43	2.92	1.22	Poor	Stop Treatment
22	2094981	1.7	3.1	1.6	1.8	Poor	Stop Treatment
23	2216470	1	1.5	1.4	1.1	Good	
24	2197241	1.9	0.3	0.7	0.9	Good	
25	2207437	1.1	0.9	0.8	0.6	Good	
26	2192077	1.5	0.9	1.2	0.8	Good	
27	2176797	1.2	1.4	0.4	0.6	Good	
28	2183460	1.0	3.2	1.3	1.2	Good	
29	2178301	1.2	2.3	2.1	0.9	Good	
30	2002726	1.1	2.3	1.4	1.9	Good	
31	2169128	1.0	0.6	1.1	0.8	Good	
32	2157435	1.2	3.2	2.1	2.7	Good	
33	2151377	9.8	3.2	1.0	2.0	Good	
34	2145015	1.4	0.9	1.2	0.6	Good	
35	2131298	1.5	1.9	0.5	1.54	Good	
36	2141183	1.9	1.2	1.5	1.1	Good	
37	2137040	0.71	1.2	1.7	0.98	Good	
38	1638611	5.1	7.0	3.5	2.3	Good	
39	2122281	2.8	2.1	1.9	2.0	Good	
40	2119718	1.1	0.9	1.0	1.2	Good	
41	2122753	5.6	1.2	1.3	0.9	Good	
42	2114428	1.4	1.7	1.1	0.7	Good	
43	2115119	0.7	2.1	0.6	0.9	Good	
44	2102797	0.7	0.9	0.8	1.0	Good	
45	2097573	1.5	1.1	1.2	1.7	Good	
46	2088984	0.8	1.2	0.7	0.3	Good	
47	2095684	1.7	1.2	1.8	1.2	Good	
48	2223159	2.0	1.0	1.0	1.33	Good	
49	2083190	2.3	2.3	0.9	1.2	Good	
50	2067318	2.0	2.83	2.1	1.4	Good	

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Table 2. Age Sex Hospital Arrival and Leaving time.

S/N	Patient number	Sex	Age	Arrival time	Leaving time	Duration of stay-Day
1	2219774	M	2.0	26/11/2019	03/12/2019	07
2	2218957	M	0.3	24/11/2019	27/11/2019	03
3	2106795	M	2.0	10/5/2019	12/05/2019	02
4	2110787	M	11	25/12/2018	07/01/2019	13
5	2056034	M	1.9	05/09/2018	30/11/2018	85
6	2214460	F	13	10/11/2019	13/11/2019	03
7	2213627	M	3.0	07/11/2019	08/11/2019	01
8	2202400	M	7.0	03/10/2019	25/10/2019	22
9	2199578	F	0.1	22/09/2019	20/10/2019	28
10	2200766	F	0.7	25/09/2019	01/10/2019	06
11	2173103	M	0.1	02/07/2019	05/07/2019	03
12	2160501	M	5.0	23/05/2019	28/06/2019	35
13	2165571	F	0.3	09/06/2019	21/06/2019	11
14	2115119	F	12	07/01/2019	11/01/2019	04
15	2094981	F	9.0	07/01/2019	28/03/2019	80
16	2135402	F	4.0	11/03/2019	18/03/2019	07
17	2124264	F	6.0	10/02/2019	16/02/2019	06
18	2105185	F	4.0	08/12/2018	07/01/2019	30
19	2086416	M	0.1	13/10/2018	06/11/2018	23
20	2085364	M	0.4	09/10/2018	22/10/2018	12
21	2054021	M	2.0	03/07/2018	10/07/2018	07
22	2094981	F	9.0	07/01/2019	28/03/2019	79
23	2216470	M	6.0	15/11/2019	25/11/2019	10
24	2197241	F	8.0	12/11/2019	15/11/2019	03
25	2207437	F	0.1	18/10/2019	02/11/2019	15
26	2192077	F	13	28/08/2019	03/09/2019	06
27	2176797	F	06	13/07/2019	19/08/2019	06
28	2183460	F	10	02/08/2019	09/08/2019	06
29	2178301	M	0.8	17/07/2019	22/07/2019	05
30	2002726	M	4.0	25/06/2019	07/07/2019	13
31	2169128	M	4.0	19/06/2019	26/06/2019	07
32	2157435	M	7.0	13/05/2019	22/05/2019	09
33	2151377	M	6.0	25/04/2019	13/05/2019	20
34	2145015	M	5.0	08/04/2019	01/05/2019	21
35	2131298	F	4.0	31/03/2019	25/04/2019	25
36	2141183	M	1.0	01/04/2019	18/04/2019	17
37	2137040	M	1.0	16/03/2019	26/03/2019	09
38	1638611	M	2.0	11/02/2019	11/03/2019	30
39	2122281	M	3.0	30/01/2019	01/03/2019	30
40	2119718	M	10	21/01/2019	20/02/2019	31
41	2122753	F	0.1	31/01/2019	17/02/2019	17
42	2114428	F	9.0	06/01/2019	16/01/2019	10
43	2115119	F	12	07/01/2019	11/01/2019	04
44	2102797	M	1.0	01/12/2018	16/12/2018	15
45	2097573	M	0.9	15/11/2018	27/11/2018	12
46	2088984	F	5.0	20/10/2018	09/11/2018	20
47	2095684	F	1.0	09/11/2018	18/11/2018	09
48	2223159	M	1.0	08/12/2019	16/12/2019	08
49	2083190	F	13	04/10/2018	11/10/2018	07
50	2067318	M	0.2	13/08/2018	24/08/2018	11

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Table 3: Average Blood Pressure, Heart Rate, Temperature, Respiratory Rate & Urine Output first 24 H

S/N	Patient number	Sex	Blood pressure mm HG	Heart Rate/Min	Temperature(C)	Respiratory rate	Urine Output
1	2219774	M	90/50	99	38.5	25	210 ml
2	2218957	M	75/40	120	39.4	35	150 ml
3	2106795	M	95/55	102	38.3	26	207 ml
4	2110787	M	105/65	110	39.5	23	750 ml
5	2056034	M	90/55	115	39.7	27	300 ml
6	2214460	F	115/70	98	39.5	20	960 ml
7	2213627	M	92/52	110	38.6	22	540 ml
8	2202400	M	105/67	99	38.30	23	650 ml
9	2199578	F	75/40	135	39.20	43	175 ml
10	2200766	F	72/43	145	38.70	42	290 ml
11	2173103	M	75/45	175	39.00	45	170 ml
12	2160501	M	110/55	110	40.01	25	650 ml
13	2165571	F	85/45	138	39.70	43	165 ml
14	2115119	F	100/60	102	40.10	22	655 ml
15	2094981	F	105/62	95	39.50	27	620 ml
16	2135402	F	104/57	111	37.90	29	450 ml
17	2124264	F	104/56	125	40.20	27	560 ml
18	2105185	F	79/42	125	39.70	30	565 ml
19	2086416	M	85/34	185	38.90	54	110 ml
20	2085364	M	89/34	178	39.50	56	135 ml
21	2054021	M	97/49	135	40.00	39	330 ml
22	2094981	F	95/54	103	40.01	27	655 ml
23	2216470	M	97/55	115	38.90	29	570 ml
24	2197241	F	103/63	110	38.60	28	585 ml
25	2207437	F	80/39	187	38.30	47	120 ml
26	2192077	F	95/55	75	37.03	22	710 ml
27	2176797	F	93/53	77	38.02	29	645 ml
28	2183460	F	100/60	73	39.05	25	660 ml
29	2178301	M	75/39	139	39.01	47	320 ml
30	2002726	M	90/47	115	38.80	27	480 ml
31	2169128	M	91/48	112	38.90	28	470 ml
32	2157435	M	99/63	109	39.04	27	575 ml
33	2151377	M	102/65	111	39.03	28	565 ml
34	2145015	M	103/63	113	38.70	26	550 ml
35	2131298	F	105/67	109	38.80	27	555 ml
36	2141183	M	98/44	125	39.30	33	288 ml
37	2137040	M	97/45	124	39.40	36	290 ml
38	1638611	M	98/43	135	38.70	36	390 ml
39	2122281	M	100/45	133	39.10	34	420 ml
40	2119718	M	102/62	108	37.90	25	550 ml
41	2122753	F	90/39	167	38.40	50	195 ml
42	2114428	F	97/55	85	39.00	28	860 ml
43	2115119	F	100/67	87	39.30	27	870 ml
44	2102797	M	95/44	119	38.40	35	330 ml
45	2097573	M	94/43	125	39.90	37	320 ml
46	2088984	F	90/43	115	38.90	27	590 ml
47	2095684	F	93/43	118	39.80	36	335 ml
48	2223159	M	90/45	117	40.00	39	330 ml
49	2083190	F	110/68	90	39.40	18	750 ml
50	2067318	M	80/39	177	39.30	52	190 ml

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Table 4: Vitals and Urine Output

S/N	Patient	BP	PULSE	TEMP. (C)	RESPIRATORY	URINE OUTPUT (ML)
1	All	94/51	119	39.06	32.26	456
2	Death	91/48	109	39.08	27.20	323
3	Poor	93/50	127	39.03	33.76	451
4	Good	95/55	116	38.89	32.25	482

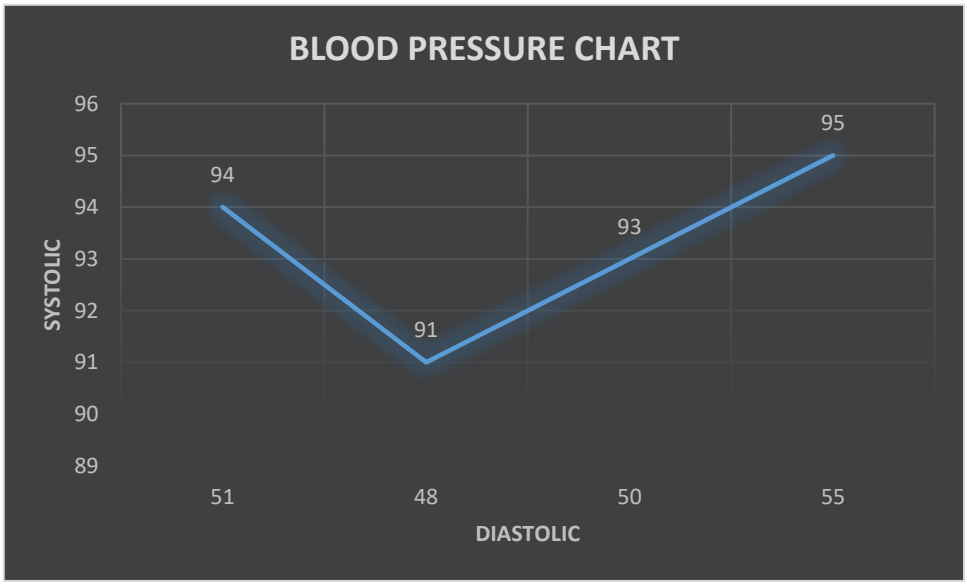

Figure 1: Average range of blood pressure in patients.

It shows systolic 94 mm of Hg and diastolic 51mm of Hg. Their blood pressure during admission does not show any significant differences.

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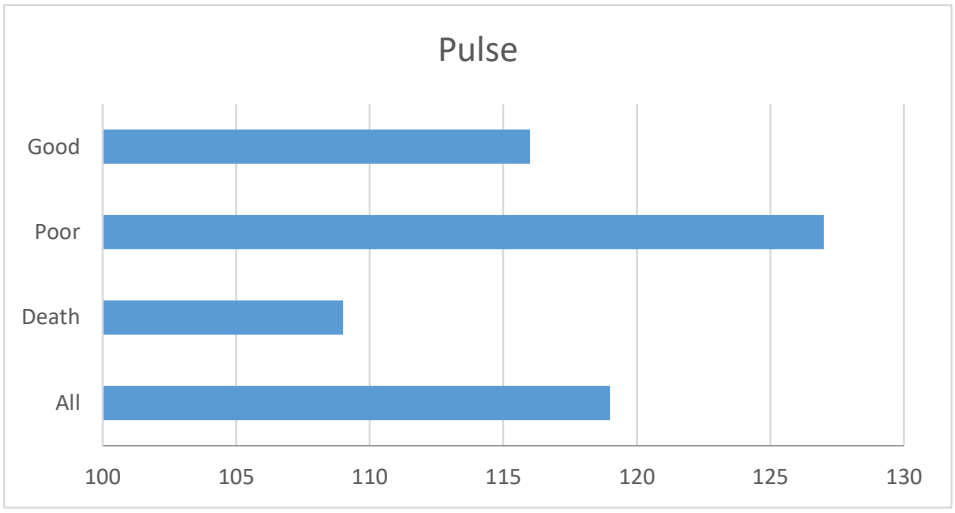

Figure 2: Pulse rate in recovered patients.

It shows an average of 116. In poor prognosis, the patient's pulse rate is 127, and the mortality group shows an average pulse rate of 119.

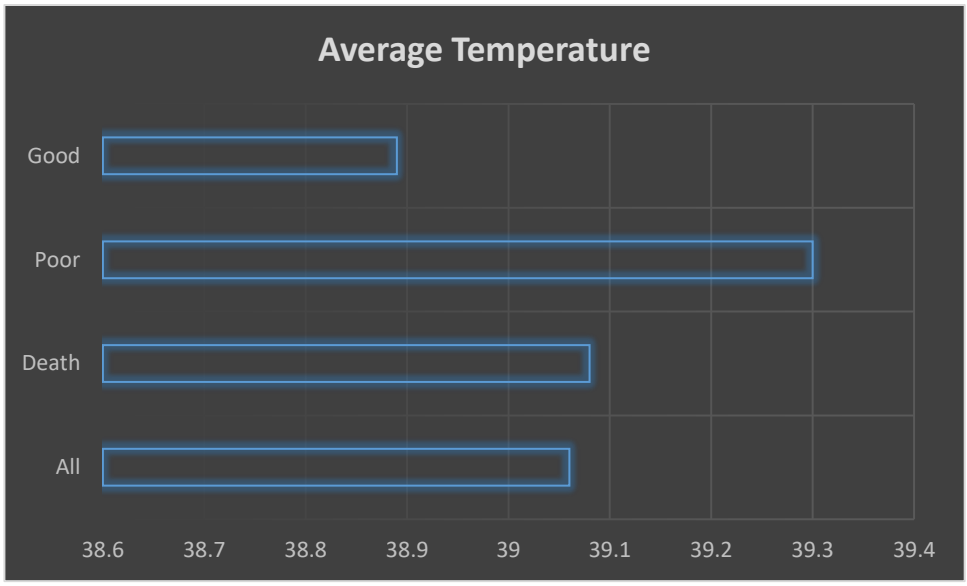

Figure 3: Mortality group.

It shows an average temperature of 39.08-degree calicoes and a poor prognosis of 39.03 C and recovered patients with 38.89 C.

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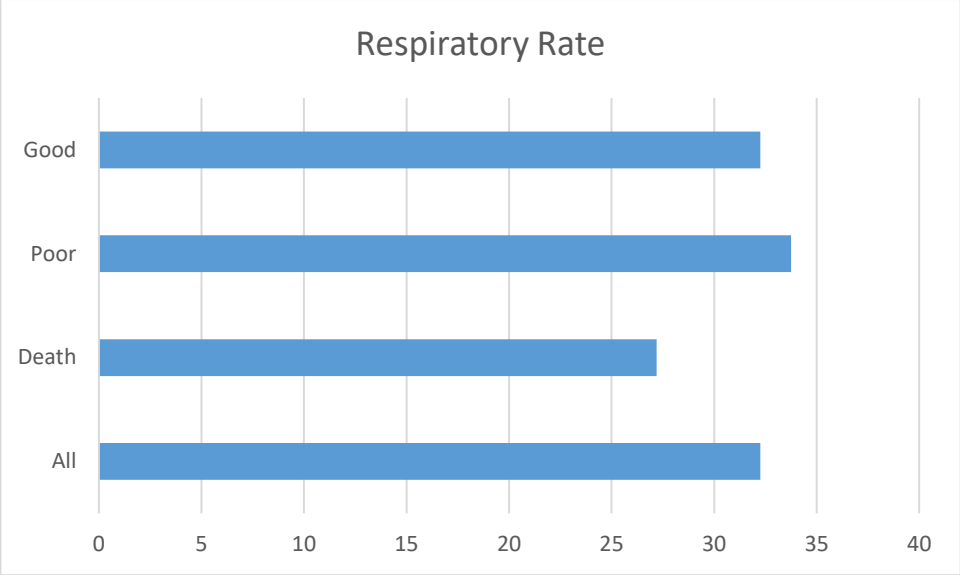

Figure 4: Death group.

It shows an average of 27.20-time respiration per minute. Poorly recovered patients showed a moderate elevation average of 33.76 times per minute with a good prognosis group 32.25 times per minute.

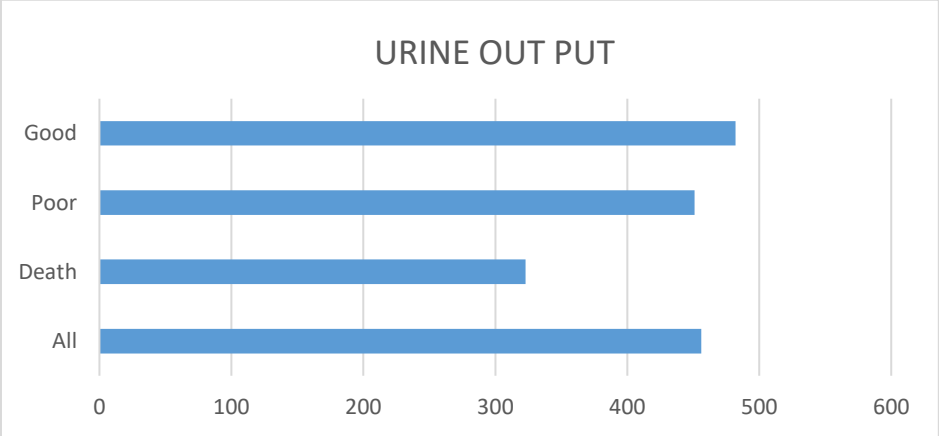

Figure 5: Urine output mortality group.

It shows an average of 323 ML. Poor prognosis group 451 ML and the recovered group is 482 ML, which shows a greater prognosis in the recovered group of patients.

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Table 5: Mean Value of All patients LC

Group	LC $_{0\text{-}6}$ mmol/L	$LC_{0\text{-}12}$ mmol/L	$LC_{0\text{-}24}$ mmol/L	$LC_{0\text{-}48}$ mmol/L
All	3.0436	2.32	1.93	1.79
Death	8.08	4.61	4.25	5.35
Poor	3.32	2.55	2.32	1.91
Good	1.91	1.80	1.29	1.20

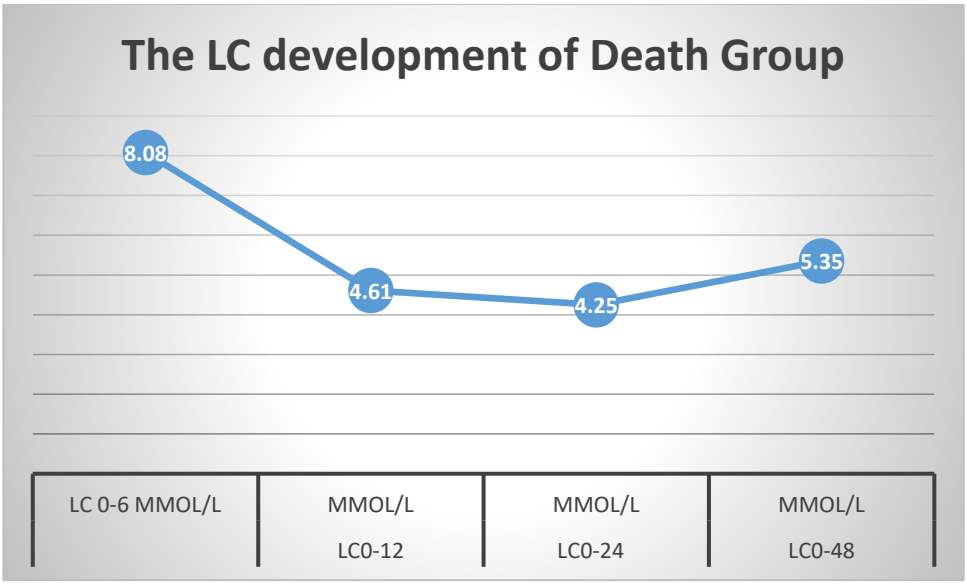

Figure 6: The LC development of the Death group.

Here it shows clearly LC in 6 h shows 8.08MMOL/L, which falls to 4.61MMOL/L in 12 h with a slight decrease up to 4.25MMOL/L in 24 h and finally in the little rise of value in 48 h on an average of all the patients 5.35MMOL/L.

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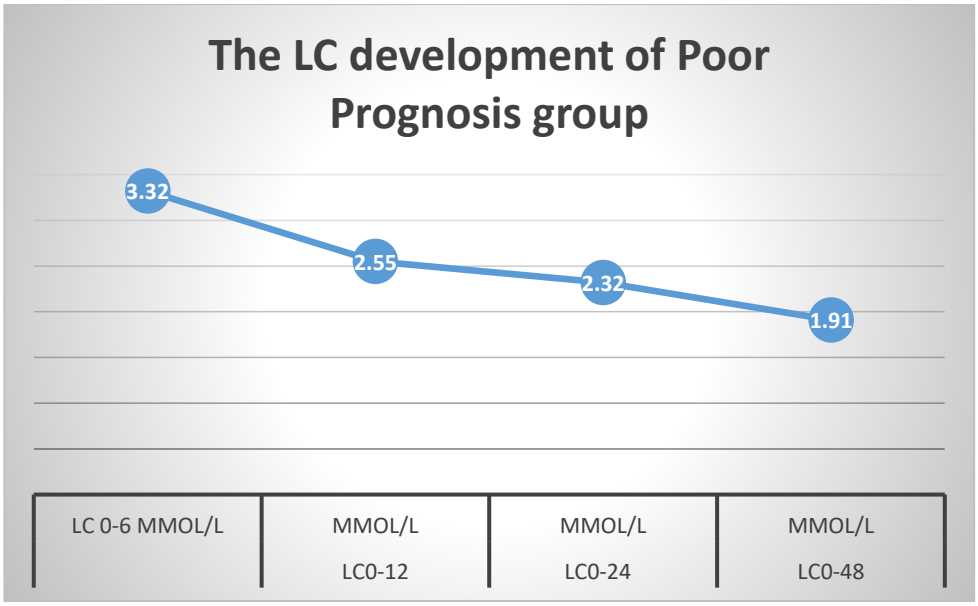

Figure 7: The LC development of Poor Prognosis group.

Here it shows clearly LC in 6 h shows 3.32MMOL/L which falls to 2.55 MMOL/L in 12 h with slightly decrease up to 2.32 MMOL/L in 24 h and finally ended up with the of value in 48 h on an average of all the patients 1.91MMOL/L.

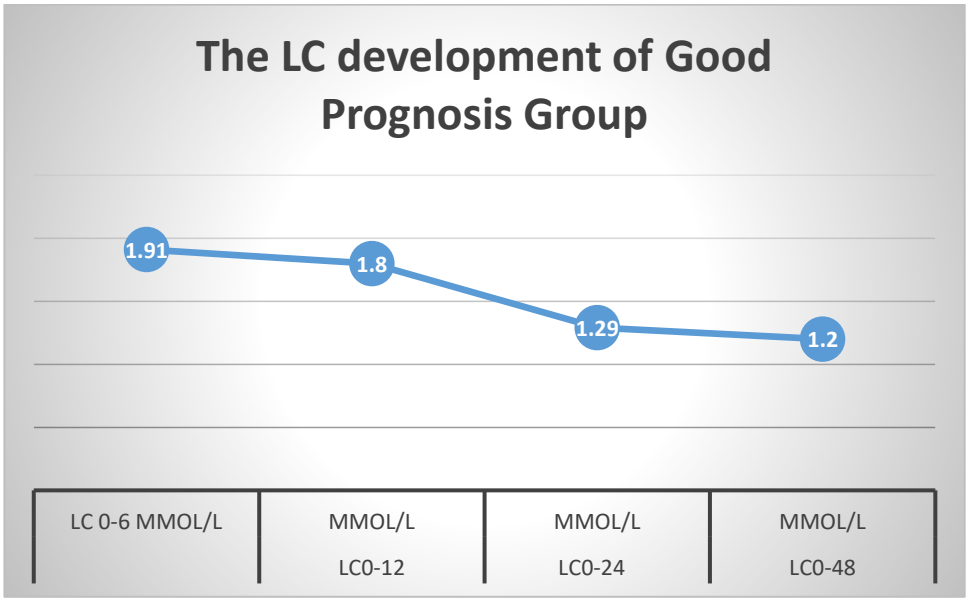

Figure 8: The LC development of a Good prognosis group.

Here it shows clearly LC in 6 h shows 1.91 MMOL/L which drops to 1.8 MMOL/L in 12 h with slightly decrease up to 1.29 MMOL/L in 24 h and finally ended up with the of value in 48 h on an average of all the recovered patients 1.2MMOL/L. from the figure we clearly can figure it out in the recovered group, we can see a clear recovery of a group of patients with a decrease of lactate clearance.

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Table 6: Patients Condition Numbers Age Limit and Duration of Stay in PICU

Patient Condition	Sex (Male/Female)	Age Limit Month-Year	Duration of stay Average
All	Total-50(M28, F22)	0.1-13	16.86 days
Death	Total-5(M-5)	0.3-11	22days
Poor	Total-17(M-7, F10)	0.1-13	21days
Good	Total-28(M16, F12)	0.1-13	13.55days

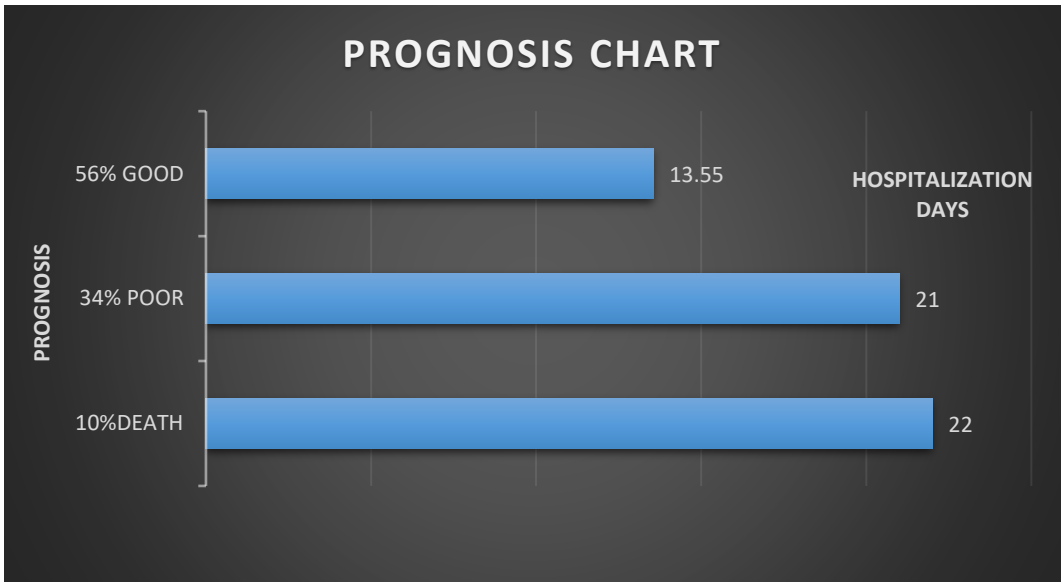

Figure 9: Hospitalization Days of Mortality group.

34% Poor Prognosis group with 21 days of hospital admission age limit 0.1-13 years old with 7 male and 10 female patients. Good Recovery group consists of 16 male patients and 12 female patients with the age limit of 0.1-13 years old and hospitalization discharge was 13 days on an average. Mortality showed in 16 days of hospital admission and admitted patients all are male.

4 DISCUSSION

Many other studies have shown patients of septic shock had 50% mortality usually. In various studies, the mortality in pediatric septic shock varied from 9.8% to 50%[16-21]. We found 10 % mortality and a 34 % poor prognosis in our studies and a recovery rate of 56 % out of the 50 patients. Mortality in our study may be due to the fact that the majority of septic shock patients admitted to PICU were fluid refractory and also refractory to one inotrope. With presently

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available bed strength, it is not possible to admit all cases with septic shock to PICU, and those who respond to fluid boluses or small doses of inotropes were managed in the wards and survived. They have not been included in our study. Therefore, patients coming to our PICU were sicker and had a higher mortality rate. In infants, the incidence of sepsis and associated mortality is higher anywhere in the world. All patients in our study were infants, so contributing to high mortality along with the poorly prognoses. In our research, we found mean LC 6 h 3.08 mmol/L and after 48 h mean is 1.79 mmol/L. Significant LC 6 h found is 8.08 mmol/L in the death group patient were 48 h 5.35mmol/L high. Duke et al. found that lactate allowed distinguishing survivors from non-survivors among children with sepsis at 12 and 24 h of admission[22]. In our studies, we found significant-high lactate in the death group which is 0-6 h 8.08mml/L, 0-12 h 4.61mmol/L and in 24 h it is 4.25mml/L and 48 h it is 5.35mml/L which shows survivor rate of the patients are till 48 h after admission in the hospital. Hatherill et al. suggested that hyperlactatemia can indicate death on admission and if it persists after 24 h of treatment [23]. In another study, as a predictor of death, the blood lactate level at 24 h of PICU admission presented the best sensitivity and specificity[24]. These results reflect in our study as well (see tables 1-6 and figures 1-9).

Further, a lactate value of more than 45 mg/dl (5 mmol/l) predicted death at a significant level in previous other studies by Duke et al. and Koliski et al., a lactate level of >3 mmol/l significantly predicted mortality[22, 24]. The severity of critical illness and organ dysfunction assessed using the lactate levels at presentation were similar in survivors and non-survivors' cases. However, the LC0–6 and LC0–24 were higher in non-survivors compare with non-survivor in our findings. Our observations suggest that LC, as defined by the percentage of lactate cleared over a period of time after disease presentation, is an independent variable associated with decreased mortality rate. Assessment of the utility of serum lactate in critically ill patients has shown that lactate levels in the emergency department and the intensive care setting have a role in risk-stratification[25-27]. Recovered patients showed a significant improvement after administering treatment depending on the patient's organ involvement and good decrease of lactate reports achieved, which is 1.20mmol/L, where admission reports show it was 1.91mmol/L in LC 6 h. But in the mortality information, we found mean LC 6 h 3.08mmol/L, and after 48 h mean it is 1.79mmol/L. Significant LC 6 h found, which is 8.08mmol/L in the death group patient, was 48 h mmol/S high. Besides serial measurements, the duration and area under the curve of increased lactate levels have relationships with morbidity and mortality in different patient groups[28-29]. Studies have shown that during the

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most proximal stage of resuscitation, lactate levels seem to be more closely related to outcome than frequently used hemodynamic measurements, including oxygen delivery and oxygen consumption[29]. We observed that mortality was high in both sets of patients, with LC0–6 of <10% and the ones with LC0–24 of <20%. However, LC0–24 was a better predictor of mortality than LC0–6 on the comparison. Several studies in adults, in severe sepsis, pointed out the value of blood LC in the first 6 h of resuscitation for the prediction of day-28 survival[30-31].

5 CONCLUSION

Septic shock is a common cause of PICU admission and high mortality. Lactate levels at 6, 12, and 24 h (>5 mmol/l) were predictors of death in septic shock. This study demonstrated that most patients who died had higher blood lactate levels than those who survived. There is a need for larger studies on cutoff values of lactate levels in pediatric septic shock above which mortality increases significantly. The persistence of high lactate was associated with higher mortality. This makes it useful as a prognostic marker for the risk of death. The numbers of patients were small in our study; therefore, further studies are necessary to confirm the predictive value of lactate in pediatric patients admitted to PICU. This study indicates that all three serial blood lactate levels, that is, on admission to the PICU and after 24 and 48 h were significantly associated with mortality in children with septic shock. Based on this study's findings, we conclude that rising or persistently high lactate levels, as shown by <10% lactate clearance at 48 h, is a predictor of mortality in such patients. These findings suggest an important role for serial lactate sampling rather than isolated measurement for predicting outcomes in children with septic shock.

Septic shock is one of the major causes of admission and death in intensive care units. Prompt identification of inadequate tissue perfusion and its aggressive management is essential in treating patients with septic shock, particularly with the increasing incidence and burden of managing the morbidity and mortality. Many critically ill patients, who are normotensive and have adequate urine output, which we can find in our clinical finding in the study, may remain in a state of compensated shock. Hence, relying solely on the normalization of vital signs and urine output may be inadequate. In the state of shock, anaerobic metabolism ensues, releasing lactate into the bloodstream. Elevated blood lactate levels provide an insight into the presence of impaired tissue perfusion. In recent years, lactate has been studied as a biomarker for sepsis and septic shock. Therefore, lactate clearance biologically reflects the homeostasis of the host

and provides more meaningful data about the overall adequacy of the resuscitative processes. However, most research with serum lactate in sepsis and septic shock has been conducted in adults. Pediatric data on the association of lactate levels with mortality in sepsis and septic shock are scarce. The present study was aimed to ascertain whether lactate clearance predicts the outcome of children with septic shock admitted to the Pediatric Intensive Care Unit (PICU) and to determine the optimal cutoff value for in-hospital mortality prediction.

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Declaration of Conflicting Interests

The authors report no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data and Material Availability

Available on request to the corresponding author.

Author Contributions

DMKH: conceptualization, conducting research, statistical analysis and manuscript writing; SHE and MRK: Manuscript writing and manuscript review; XYM: manuscript review; ZH and CY: supervision, statistical analysis and critical review of the manuscript.

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