Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

Serum Lactate Level As A Predictor Of Outcome In Respiratory Intensive Care Unit Patients

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Abstract

Aim: The objective of the current study is to find out and correlate the predictive value of serum lactate level in the first 12h of ICU admission regarding mortality and length of ICU stay. **Methods:** Thirty-seven critically ill patients were enrolled. All patients' functional conditions were assessed on admission by the Acute Physiology and Chronic Health Evaluation (APACHE-IV), scoring system, Glasgow Coma Scale (GCS), Three samples of lactate were obtained. One on admission, one after 6 h and one after 12 h of admission. **Results:** Patients' in-hospital mortality was 12/37 (32.4%), Serum lactate in the three samples was shown to be significantly accurate in predicting non survivors, average blood lactate level were significantly (P<0.0001) high in deceased patients compared to survivors. Elevated levels had high not-survivors discriminative power (ROCAUC=0.945 [95%CI 0.89-0.99]; P<0.0001). Blood lactate <4mmol/L had a higher survival probability with statistically significant difference compared to patients with increased blood lactate >4mmol/L (P<0.0001). Cox regression analysis revealed that only blood lactate was an independent mortality predictor (AHR 20.1 [1.5-270.0], P=0.025). **Conclusions:** Non survivors had higher blood lactate levels at admission as well as at 6 and 12 h. Average blood lactate levels after 12 hours of ICU admission is a good prognostic marker and gives valuable information in initial critically ill patient evaluation.

Keywords: Lactate, intensive care unit, Prognosis

Introduction

Many variables measured in critically ill patients have been used to expect patient outcomes; however, it is unlikely that one measurement can replace all, but lactate levels may come close [1]. An elevated blood lactate concentration (a static index) at any time point may be due to an increase in its production, a decrease in its clearance, or both. Likewise, an increasing blood lactate concentration (a dynamic index) may be due to increasing production, decreasing clearance, or both simultaneously [2].

Blood lactate levels can be useful tool in identifying organic dysfunction, tissue hypoxia/hypoperfusion [3]. Among patients requiring ICU, hyperlactatemia is common and lactate levels may be reliable mortality and illness severity marker [4]. Lactate was included in multi-biomarker risk model for septic shock patients[5]. hyperlactatemia in intensive care has been regarded chiefly as a sign of tissue hypoxia[6]. It was reported that even within the high normal range admission blood lactate concentration (=2.00 m mol/L) is associated significantly with increased mortality, even with minute disturbance of lactate homeostasis may be serious[7]. So, the early and rapid treatment of these patients with hyperlactatemia is widely recognized as a vital step toward improving survival[8].

Aim of the work

The objective of the current study is to find out and correlate the predictive value of serum lactate level in the first 12 h of ICU admission regarding mortality and length of ICU stay

Patients and Methods

A prospective, study was carried out between 1st Jan, 2018, and 30 September 2018 in the ICU of the Bruida central hospital, Alqasim, Saudi Arabia. ,37 patients were enrolled. The age of patients ranged from 43–86 years, and median was 67 years. There were 26 (70.3%) males and 11 (29.7%) females.

Inclusion criteria:

Critically ill patients older than 16 years of both sexes admitted to the ICU due to primary respiratory diseases

Exclusion criteria:

Patients younger than 16 years.

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Epileptic fits
Malignancy (especially lymphoma), and patients on chemotherapy and/or radiotherapy were excluded
Surgical, Traumatic patients
Patients with known chronic organ failure e.g., liver cell failure, renal failure, heart failure
All patients were subjected to: Detailed medical history taking from the patient or one of his relatives. Complete clinical examination including general and chest examination
- conscious level, respiratory rate, temperature. heart rate, blood pressure (systolic, diastolic, and mean blood pressure)
All patients' functional conditions were assessed on admission by the Acute Physiology and Chronic Health Evaluation (APACHE-IV), scoring system, Glasgow Coma Scale (GCS),
Laboratory examination in the form of complete blood picture and renal function tests: liver function test, sodium, potassium. Arterial blood gases analysis were obtained on admission
Serum lactate: 3 samples in the first 12 h of ICU admission in form of 2 ml of venous blood was sent for analysis of blood lactate on ICU admission to all cases (H0), after 6 h (H6) then after 12 h (H12),. The normal reference values for lactate are 1 ± 0.5 mmol/L in normal patients and <2 mmol in critically ill patients

End point of the study

Length of stay in ICU. Outcome whether death or discharge for improvement.

Statistical analysis

Statistical analysis was performed using the GraphPad Prism (v.8) and the SPSS® (v.20) (Chicago, USA). Quantitative data were expressed as mean±SD based on normality distribution of the variable. Qualitative parameters were expressed as absolute numbers and/or percentage. Comparison was performed using Chi-square test ($\chi 2$) between categorical variables and independent student t test between continuous variables. At a two-sided, results were considered significant at P value <0.05. Receiver operating characteristic (ROC) curve was used for evaluating predicting power of blood lactate and scoring systems to predict mortality. Cox regression analysis with adjusting hazard ratio (AHR) and 95% confidence interval (CI) was performed. Also, Kaplan-Meier curve was used to estimate lactate survival probability of ICU patients and Log-Rank (Mantel-Cox) statistic was used to determine difference between patients without and with increased blood lactate levels

Results

A total number of 37 patients was enrolled. The age of patients ranged from 43–86 years, mean ± standard deviation age was 65.73± 10.33 years and median was 67 years. There were 26 (70.3%) males and 11 (29.7%) females, Vital signs, hematological data and kidney function tests were described in (Table 1)
Regarding their diagnoses,15 patients had Acute Exacerbation chronic obstructive pulmonary disease (AECOPD) (40.5%), 10 patients had pneumonia (27%), 6 patients had bronchiectasis (16.2%), 3 patients had acute severe asthma (8.1%),3 patients had acute exacerbation of interstitial pulmonary fibrosis (8.1%) (Table 2).
The median (range) of serum lactate at admission (H0) was 3.8 (0.56- 7.0) mmol/L and serum lactate 6 hrs. after admission (H6) was 2.70 (0.79- 6.0) mmol/L, whereas serum lactate 12 hrs. after admission (H12) was 1.99 (0.86- 6.12) mmol/L, the median (range) of APACHI IV score was 71.0 (60.0- 123.0) and GCS had a mean of 11.46± 2.61 (Table 2).
According to blood lactate levels at admission (H0) the study population was divided into two groups:

A- Hyperlactatemia group included 22 (59.45%) patients out of whom 12 (54.5%) survived and 10 (45.5%), died, with a very high statistically significant difference (P=0.002)
B- Normal blood lactate included 15 (40.54%) patients and all survived (100%),
length of ICU stay was higher in the hyperlactatemia group than in the normal group (p<0.001). (Table 3)

There was significant difference between the two groups regarding initial blood lactate levels (H0), where it had median of 1.02 mmol/l in the normal lactate group, whereas it was 5.0 mmol/l in the hyperlactatemia group. Like-wise, there was high significant difference between the two groups regarding H6. & H12 (p<0.001). There was no significant difference between normal blood lactate group and hyperlactatemia group regarding lactate clearance at H6.

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APACHI IV score was significantly higher in hyperlactatemia group compared to the normal lactate group (p<0.001), was highly significantly positively correlated with H0 (r=0.670, P<0.001), H6. (r=0.8.07, P<0.001) and with H12 (r=0.823, P<0.001) but there was no statistically significant correlation with lactate clearance (r= -0.330, P= 0.134).

whereas GCS was significantly lower in hyperlactatemia group compared to the normal lactate group (p<0.001), was highly significantly negatively correlated with H0 (r=−0.552, P=0.008), H6 (r = −0.739, P<0.001), and H12 (r=−0.693, P<0.001) but there was no statistically significant correlation with lactate clearance (r= 0.364, P= 0.096) (Table 4).

All the cutoff values: for APACHI (>80.0), GCS (<9.0), H0 (>5.5), H6. (>4.01), and H12. (>4.0) were significantly valid for the detection of mortality (Table 5). The most sensitive variables were H12. GCS and APACHI IV score (100%) and the most specific variables were the H0 (100%), H6. (100%), H12. (100%) and APACHI IV score (100%) (table 5). also,

Table 5 showed the superiority of H12. & APACHI IV score over other studied scores in mortality prediction as area under the curve (AUC), was 1.00 for APACHI IV score & H12, 0.993 for GCS, 0.985 for H6, 0.950 for H0 and 0.619 for lactate clearance.

The significant highest mortality risk was reported with H6 cutoff value more than 4.014 mmol/L (OR= 18.041, P= 0.014), followed by H0. cutoff value more than 5.5 mmol/L (OR=4.83. p= 0.009), and the least risk reported was with lactate clearance cutoff value less than 25.15 (OR=0.123). Accordingly, the best independent predictors of mortality in our study were H0 and H6. (Table 6). Also, the mean blood lactate levels in the first 12 hours after admission were significantly (P<0.0001) high in deceased patients compared to survivors (Figure 1). ROC curve analysis revealed high not-survivors discriminative power of mean blood lactate (AUC=0.945 [95%CI 0.89-0.99]), APACHE IV (AUC=0.999 [95%CI 0.99-1.00]) and GCS (AUC=0.999 [95%CI 0.99-1.00]) (Figure 2).ROC curves for all three variables were significantly different from the reference line (P<0.0001). Average mean blood lactate derived cutoff point was 4.0 mmol/L. In Kaplan-Meier curve analysis, patients with average blood lactate <4mmol/L had a higher survival probability, which showed statistically significant difference compared to patients with increased blood lactate >4mmol/L (Log Rank (Mantel-Cox) (P<0.0001) (Figure 3). Cox regression analysis (Table 7) of blood lactate, APACHE IV and GCS revealed that only blood lactate was an independent mortality predictor (AHR 20.1 [1.5-270.0], P=0.025).

Table 1. Clinico-demographic characteristics of the studied patients (n= 37)	
Age (years)	
mean± SD	65.73± 10.33
Median (range)	67.0 (43.0- 86.0)
Sex	
Male, N (%)	26 (70.3%)
Female, N (%)	11 (29.7%)
Smoking	
Smoker, N (%)	11 (29.7%)
Non- smoker, N (%)	15 (40.5%)
Ex-smoker, N (%)	11 (29.7%)
Vital signs	
Temperature (oC), mean± SD median (Range)	 37.99± 0.94 38.0 (36.0- 40.0)
RR (breaths/min), mean± SD median (Range)	 31.11± 4.35 31.0 (21.0- 41.0)
HR (beats/min), mean± SD median (Range)	 98.73± 23.23 97.0 (11.0- 197.0)
SBP (mmHg),	

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mean± SD median (Range)	107.97± 26.29 110.0 (55.0- 155.0)
DBP (mmHg), mean± SD median (Range)	 70.14± 17.62 70.0 (30.0- 95.0)
Hematological data	
WBCs (*103/L), mean± SD median (Range)	 14.70± 7.95 15.0 (6.0- 27.0)
Hb (g/dL), mean± SD median (Range)	 12.37± 2.74 12.0 (7.0- 18.0)
Platelets (*103/L), mean± SD median (Range)	 284.97± 142.86 250.0 (95.0- 600.0)
Kidney functions tests	
Bl. Urea, mean± SD median (Range)	 49.05± 12.63 45.0 (25.0- 80.0)
S. Creatinine (mg/dL), mean± SD median (Range)	 1.64± 0.76 1.32 (0.85- 3.0)

Table 2. Distribution of the studied patients as regards to lactate level, APACHI, GCS, MV, diagnosis and outcome (n= 37)

S. Lactate level at admission H0 (mmol/l)	
mean± SD	3.28± 2.12
Median (range)	3.80 (0.56- 7.0)
S. Lactate level at 6 hrs. after admission (mmol/l)	
mean± SD	2.79± 1.76
Median (range)	2.70 (0.79- 6.0)
S. Lactate level 12 hrs. after admission (mmol/l)	
mean± SD	2.64± 1.65
Median (range)	1.99 (0.86- 6.12)
APACHI IV	
mean± SD	77.14± 16.61
Median (range)	71.0 (60.0- 123.0)
GCS	
mean± SD	11.46± 2.61
Median (range)	12.0 (7.0- 15.0)
Length of stay (days)	
mean± SD	6.11± 2.196
Median (range)	6.0 (2.0- 11.0)
MV	
No, N (%)	17 (45.9%)
NIV, N (%)	8 (21.6%)
IV, N (%)	12 (32.4%)
Diagnosis	
AECOPD, N (%)	15 (40.5%)

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Pneumonia, N (%)	10 (27.0%)
AE Bronchiectasis, N (%)	6 (16.2%)
Acute severe asthma, N (%)	3 (8.1%)
AE IPF, N (%)	3 (8.1%)
Outcome	
Discharge, N (%)	27 (73.0%)
Died, N (%)	10 (27.0%)

Table 3. Comparison between normal lactate group and hyperlactatemia group regarding outcome and lactate level & clearance and length of stay

	Normal lactate group (n= 15)	**Hyperlactatemia group (n= 22)**	**Test value**	**p- value**
Lactate level at admission H0 (mmol/l)				
Median (range)	1.02 (0.56- 1.75)	5.0 (2.09- 7.0)	ZMWU= 5.11	<0.001
Lactate level at 6 hrs. after admission (mmol/l)				
Median (range)	1.0 (0.79- 1.5)	4.01 (1.87- 6.0)	ZMWU= 5.13	<0.001
Lactate level 12 hrs. after admission (mmol/l)				
Median (range)	1.07 (0.86- 1.30)	3.09 (1.45- 6.12)	ZMWU= 4.84	<0.001
Lactate clearance				
Median (range)	11.11 (1.25- 66.07)	12.59 (0.67- 45.0)	ZMWU= 0.757	0.772
APACHI				
Median (range)	66.0 (60.0- 77.0)	77.5 (64.0- 123.0)	ZMWU= 3.39	<0.001
GCS				
Median (range)	13.0 (11.0- 15.0)	9.5 (7.0- 15.0)	ZMWU= 3.85	<0.001
Length of stay (days)				
mean± SD	3.93± 1.03	7.59± 1.37	T= 8.77	<0.001
Outcome				
Survivors, n (%)	15 (100.0%)	12 (54.5%)	X2= 9.34	0.002
Non- survivors, n (%)	0 (0.0%)	10 (45.5%)		

p≤0.05 is considered statistically significant, p≤0.01 is considered high statistically significant, **SD:** standard deviation, -comparison between groups done by *Mann-Whitney U test, Student T test, Chi-square Test

Table 4. Correlation between APACHI IV Score, Glasgow Coma Scale, , and initial, 6hrs & 12hrs. lactate levels and lactate clearance in the hyperlactatemia group

	APACHI		**GCS**	
	r	**p-value**	**r**	**p-value**
Initial lactate level H0 (mmol/l)	0.670	0.001	- 0.552	0.008
Lactate level after 6 hrs. (mmol/l)	0.807	<0.001	- 0.739	<0.001
Lactate level 12 hrs. after admission (mmol/l)	0.823	<0.001	- 0.693	<0.001
Lactate clearance (%)	- 0.330	0.134	0.364	0.096

p≤0.05 is considered statistically significant, p≤0.01 is considered high statistically significant

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Table 5. Validity of cutoff values of between APACHI Score II, Glasgow Coma Scale, and initial, 6hrs & 12hrs. lactate levels and lactate clearance as predictors for mortality

	Cutoff value	AUC	p- value	Sensitivity (%)	Specificity (%)
Initial lactate level L0 (mmol/l)	>5.5	0.950	<0.001	80.0%	100.0%
Lactate level after 6 hrs. (mmol/l)	>4.01	0.985	<0.001	90.0%	100.0%
Lactate level 12 hrs. after admission (mmol/l)	>4.0	1.00	<0.001	100.0%	100.0%
Lactate clearance (%)	≤25.15	0.619	0.204	90.0%	51.85%
APACHI	>80.0	1.00	<0.001	100.0%	100.0%
GCS	≤9.0	0.993	<0.001	100.0%	96.30%

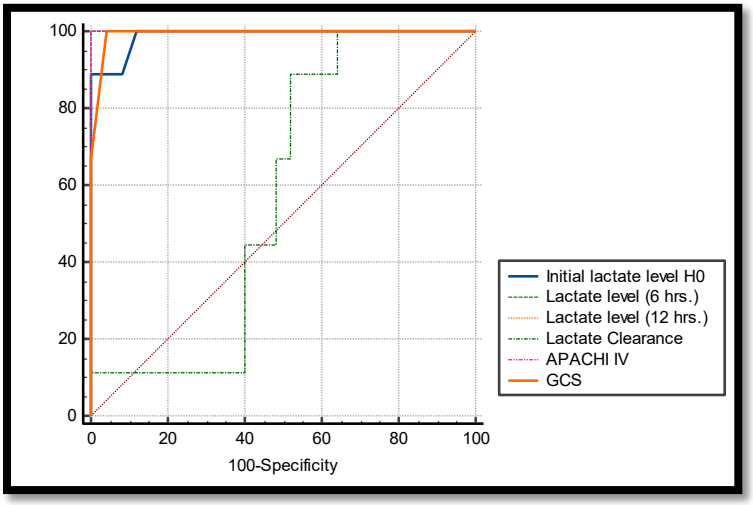

Fig. (1); ROC curves of APACHI Score II, Glasgow Coma Scale and initial, 6hrs & 12hrs. lactate levels and lactate clearance as predictors for mortality

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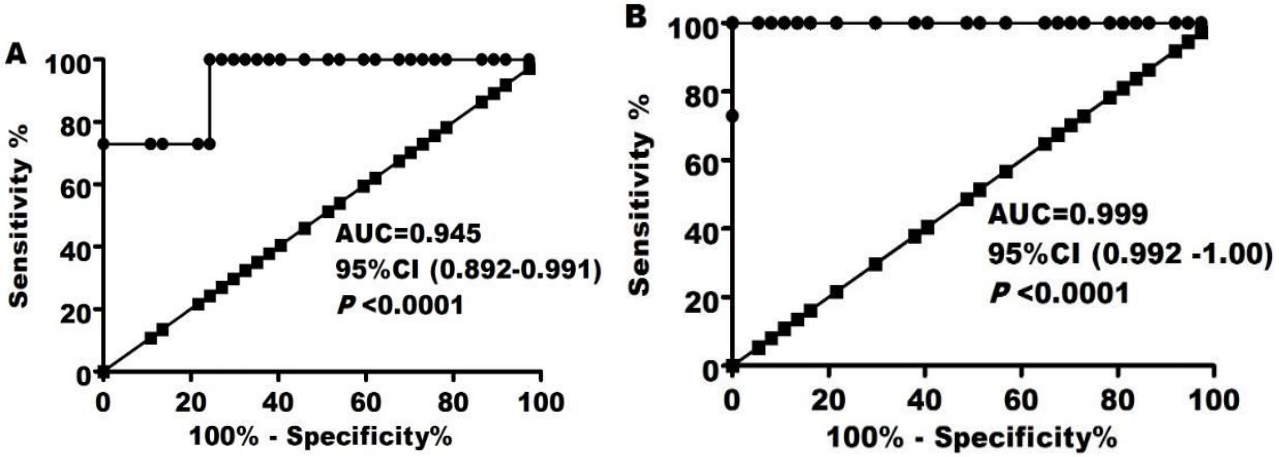
Table 6. Multivariate logistic regression for independent predictors of mortality					
	Wald	**p- value**	**OR**	**95% CI**	
				Lower	**Upper**
Initial lactate level (mmol/l)	0.605	0.009	4.83	1.474	15.813
Lactate level after (6 hrs.)	6.0	0.014	18.41	1.790	189.366
Lactate level (12 hrs.)	0.721	0.396	0.804	.485	1.331
Lactate clearance (%)	2.376	.123	.953	.897	1.013
APACHE IV	.030	.863	1.004	.961	1.049
GCS	.007	.932	.988	.745	1.309

AHR: adjust hazards ratio; IC: confidence interval; APACHE, Acute Physiology and Chronic Health Evaluation; GCS: Glasgow Coma Scale

Table 7. Cox regression analysis of average lactate levels, APACHE IV and GCS.

Factor	**AHR**	**95%CI**	**P value**
Average lactate levels (mmol/L)	20.1	1.5-276.0	0.025
APACHI IV	0.950	0.83-1.1	0.435
GCS	0.973	0.31-3.1	0.963

AHR: adjust hazards ratio IC: confidence interval;



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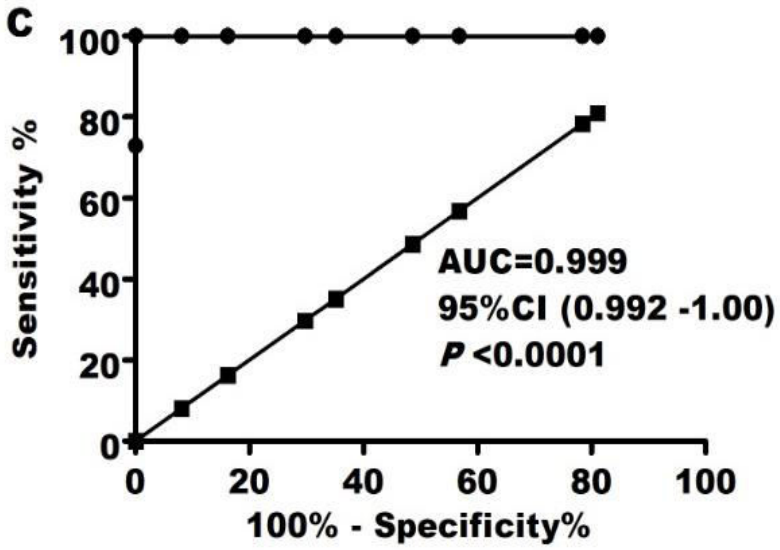

Figure 2. Receiver operating characteristic curves for mortality prediction of (A) blood lactate levels, (B) APACHE IV and (C) GCS.

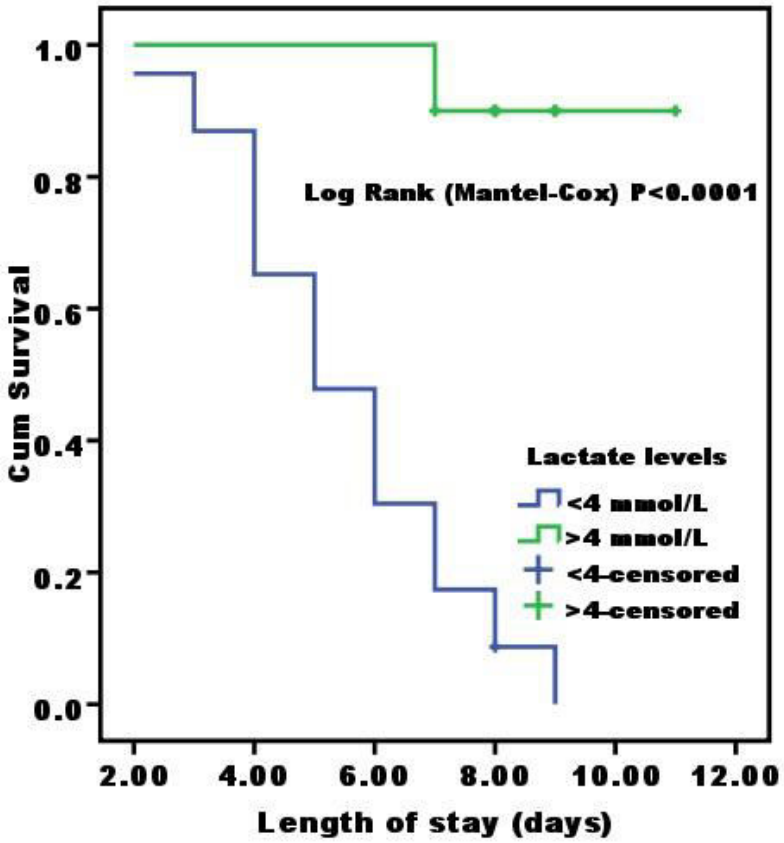

Figure 3. Kaplan-Meier curve analysis for patients' survival probability regarding average blood lactate levels after first 12 hours of RICU admission.

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DISCUSSION

In critically ill patient and to prevent the patient from the no return point, a doctor has to determine disease severity, decide on treatment, monitor and predict the response degree [3]. Also, evaluations of patients care effectiveness and clinical outcomes in RICU are affected by predictive markers that determine disease severity and related death probability [9] . Thus in those critical moments, it is very important to have predictive marker as an aid to treatment planning [3]. In such situations, blood levels of lactate have been suggested as useful tool [10]. Within the first 6 hours of admission, elevated lactate clearance has been reported to be related to decline in 60-day mortality. In a heterogeneous ICU population, there was survival benefit for patients with lactate normalization within six hours [10].

To understand the importance of an increased lactate level, it is important not only to consider anaerobic production, but also aerobic mechanisms and changes in lactate clearance. Despite this complex evaluation, increased lactate levels usually reflect increased morbidity and high mortality [1]. Physicians need accurate and very early indicator concerning the prognosis, and both initial blood lactate levels and early lactate clearance were appropriate tools [11]. Blood lactate level can be measured using various devices (central laboratory, point-of-care blood gas analyzers, hand-held devices), and generally most devices used at the bed side have acceptable limits of agreement compared with laboratory devices [12,13]. In addition, the sampling site of the blood (arterial, venous, capillary, etc.) also does not seem to affect the results much [14,15].

The objective of the current study is to find out and correlate the predictive value of serum lactate level first 12 h of ICU admission regarding mortality and length of ICU stay. Three samples of lactate were obtained. One on admission, one after 6 h of admission and one after 12 h of admission. A comparison was done between survivors and non survivors regarding serum lactate. According to Blood lactate levels at admission (H0) there was 2 groups

Group 1 including 22 (59.45%) patients with hyperlactatemia

Group 2 including15 (40.54%) patients with a normal blood lactate level. there was high significant difference between the two groups regarding blood lactate levels at 6 hrs.(H6). & 12 hrs. (H12). After admission ($p<0.001$). There was no significant difference between normal blood lactate group and hyperlactatemia group regarding lactate clearance at H6

The current study reported 100 % survival rate in the normal lactate group, whereas it was 54.5%in the hyperlactatemia group, and this is nearly matched with the results of **Hussein, R et al.** included 52 patients admitted to RICU with different chest diseases, reported 100% survival rate in the normal lactate group, whereas it was 60% in the hyperlactatemia group[16] and in line with the results of **van Beest et al.** [10] where hospital mortality of their population was 18% and was higher in patients with hyperlactatemia during ICU stay compared with those without hyperlactatemia **Bhandari, R et al.** concluded that the elevated lactate level has been shown to be adversely associated with outcome[17]. Also, in the **Pasha et al.'s** [18] study there were 25% non survivors out of 125 patients, and was higher in patients with hyperlactatemia during ICU stay when compared with those without hyperlactatemia

Also the study showed that patients with hyperlactatemia had prolonged length of hospital stay, with statistically significant difference, these finding are in line with **Shalaby, Alaa, et al** who conducted study on 33 patients admitted to respiratory intensive care unit in kasr- Elaini teaching hospitals and concluded that mean serum lactate was significantly lower in the survivors than non survivors in the three samples, and was positively correlated with length of hospital stay[19] also **Jat et al** enrolled 30 patients with septic shock and serum lactate was measured on admission, at 12 h and after 24 h of admission. In agreement with this study results the three different lactate levels were significantly higher among non survivors as compared to survivors and, a lactate value of more than 5 mmol/L predicted death at a significant level[20]. Also was in concordance with the study done by **Vanni et al** where patients who died had significantly higher plasma lactate level than did survivors with a P value <00,001[21] **Zhang et al**. [22] used initial lactate (H0) with normalization time (lactate clearance) to assess the predictive value of lactate in unselected critically ill patients. In contrast, the lactime in the hyperlactatemia group ($P>0.05$) as well as lactate clearance at H6 were non-significant. Also the study showed that, APACHI IV score was significantly higher in hyperlactatemia, Glasgow Coma Scale (GCS) was significantly lower in hyperlactatemia group

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,**Zhang et al**[22], concluded that non survivors had higher SAPS II, SOFA scores than survivors, and there was a significant correlation between H0 and lactime with the SOFA score and the SAPS II score, also **Yolbaş et al.** [23] showed that there is a considerably significance difference between lactate level and GCS in a study about the relationship between different lactate levels and mortality rate.

The current study determined that the most sensitive variables as predictors of mortality were H12., GCS and APACH IV score, the most specific variables were the initial lactate level (H0), Lactate level after 6 hrs.(H6)., Lactate level after 12 hrs. (H12). and APACHI IV score also. the superiority H12 & APACHI score over other scores in mortality prediction such as area under the curve (AUC), which was 1.00 for APACHI IV score & H12., 0.993 for GCS, 0.985 H6., 0.950 H0 and 0.619 for lactate clearance **Hussein, R et al**. [16] showed that, the most sensitive variables were the SOFA score, GCS, lactime, and lactate clearance at H6 and the most specific variables were the initial lactate level (H0) and SAPSII also, and the superiority of lactate over studied scores in mortality prediction. **Bakker et al**. [24] showed that in patients with septic shock, the lactime was the best predictor of outcome in a multiple regression analysis. Similarly, in trauma patients, lactate normalization within 24 h was associated with 100% survival [25]. Further data showed that a decrease in lactate of at least 10% during the first 6 h of septic shock was associated with an improved outcome, and an 11% decrease in mortality was observed with each 10% increase in lactate clearance [26]. **Badreldin et al**. [27] compared the predictive value of lactate with complex physiological scores in a cohort of cardiothoracic surgery patients, where they found that the diagnostic performance of lactate was significantly superior to these scores, as reflected by an AUC of 0.88 for lactate against 0.83, 0.79, and 0.76 for SOFA, SAPS II, and APACHE II, respectively, which are in accordance with the current study.

The current study reported that the best independent predictors of mortality in our study were. H6 >4.014 mmol/L and H0 >5.5 mmol/L although **Hussein, R et al.** [16] showed that the best independent predictors of mortality were H0 more than 3.9, lactime more than 48 h, and GCS less than 10.5.also, **Maarslet et al.** [28] found that an increased H0 more than 4.5 mmol/l resulted in an odds ratio of 8.4 (95% confidence interval: 1.5–46.1) for mortality and this is also confirmed in the study of **Hajjar et al**. [29] in which the lactate level measured at 6 h after ICU admission was also found to be an independent predictor of complications after major cardiothoracic surgery, This difference between cutoffs values in different studies can be explained by the differences in sample size, excluded patients, and the specialty of the study.

Also, the study revealed, mean blood lactate levels in the first 12 hours after ICU admission were significantly high in deceased patients compared to survivors. It had strong discriminative power for not-survivors. High blood lactate levels (>4mmol/L) were significantly associated with long time of stay in ICU, invasive mechanical ventilation and poor prognostic scores (APACHE IV, GCS). Cox regression analysis revealed that only mean blood lactate was an independent mortality predictor compared to APACHE IV and GCS scores, in line with study results, , Soliman et al [30]reported that elevated serum lactate levels as a static value over time are associated with higher mortality , reported direct relationship between risk of death and lactate levels, it was 64% in patients with concentrations > 8 mEq/L compared to 17% in patients with concentrations between 2-4 mEq/L. Also, elevated levels were associated with higher APACHE II and longer ICU stay. Another study on severe sepsis patients admitted to an emergency unit reported mortality of 15.4%, 37% and 46.9% in patients with low lactate level <2 mEq/L, intermediate lactate levels 2-3.9 mEq/L and high lactate levels >4 mEq/L, respectively [31]. Durmuş et al [32] and MacDonald et al [33] reported that lactate clearance can be useful marker in COPD patients and its elevated levels were associated with adverse outcomes and clinical severity. Also, in patients with severe pneumonia, Liu et al [34] demonstrated that blood lactic acid dynamic monitoring and CRP levels can be used to evaluate therapeutic efficiency and serving as prognostic marker. Also, there was strong association between lactate levels and patient's age as its high serum values in the emergency department were associated with greater mortality in admitted patients over age 65 years, regardless of absence or presence of infection [35].According to a study on patients with hyperlactatemia in ICU admission, lactate-guided therapy significantly reduced hospital fatal outcomes, which suggests that initial lactate monitoring has much clinical benefit[36].

Conclusion

initial blood lactate levels are valuable prognostic tools for the prediction of RICU outcomes

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

This study demonstrated that patients who died had higher blood lactate than patients who survived. initial blood lactate levels are valuable prognostic tools for the prediction of ICU outcomes

Mean serum lactate was positively correlated with length of hospital stay with statistical significance

The study recommends the measurement of blood lactate level on ICU admission, and monitoring lactime and lactate clearance during ICU stay for prediction of outcome and application of lactate-guided therapy

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