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Original Research Article

THE PATTERN OF LACTATE CLEARANCE AND ITS ABILITY TO PREDICT 28-DAY MORTALITY IN PATIENTS WITH SEPTIC SHOCK

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ABSTRACT

Background: Sepsis and septic shock are the leading causes of death worldwide. Many studies were done to determine the prognostic utility of blood lactate and lactate clearance in predicting mortality. The significance of lactate clearance from 6 hours of resuscitation is already proven and has been used for treatment protocol. However, literature does not provide much information on the usefulness of lactate clearance beyond 6-hour period in predicting mortality and lactate clearance-guided therapy.

Materials and Methods: This is a hospital-based, prospective observational study. The patient data of 125 patients with septic shock in the medical ICU were analysed. The hemogram (CBC), lactate (these levels were repeated every six hours), and routine examinations were done. The statistical software for the social science system, version SPSS 17.0, was used for statistical testing.

Results: Out of 125 patients, there were 78 males and 47 females. 125 patients ranged from 18 to 80 years with a mean age of 60.49 years. Among patients with septic shock, 71 did not survive for 28 days, whereas only 54 patients survived. The association between % Lactate Clearance at 6 hours, 12hours, 18hours, 24hours, and 28-day mortality was found to be significant with P-value = <0.0001.

Conclusion: The current study revealed that lactate clearance at 24 hours is helpful in predicting mortality in septic shock. The median lactate clearance value is used to identify clearers and non-clearers. Further studies are required to determine optimal cut-off values to guide the therapy.

Keywords: Lactate clearance, Septic shock, Mortality rate.

INTRODUCTION

A condition of cellular and tissue hypoxia brought on by insufficient oxygen delivery or use is known as shock.[1] Although shock is initially reversible, it must be identified and treated right away to stop the development of irreversible organ damage.[2] Septic shock, a form of distributive shock, is the most common form of shock among patients admitted to the intensive care unit.[3] One of the main causes of death and serious sickness in the world is sepsis. There is decreased utilisation of oxygen that can lead to cellular hypoxemia, dysfunction even death of cells if untreated.[4] A higher likelihood of survival is provided by early detection and treatment.[5] Early sepsis diagnosis is currently difficult, though. The lactate and lactate clearance monitoring play a major role in the prediction of mortality in sepsis.[6] The lactate clearance in the first 6 hours was associated with an improvement in outcome in severe sepsis and septic shock patients and hence was proposed to guide treatment.[7] Moreover, lactate measurements beyond 24 hours from the initiation of resuscitation also have predictive and prognostic utility.[8] Hence, the present study was conducted to study lactate clearance in the first 24 hours as a predictor of 28-day mortality in septic shock patients and to study the pattern of lactate clearance in the first 24hours in septic shock patients.

MATERIALS AND METHODS

A Hospital-based prospective observational study was conducted on group of 125 patients admitted to the intensive care unit with septic shock at Batra Hospital and Medical Research Centre. Patients of suspected septic shock aged between 18-80 years were included in the study. Patients not giving consent to participate in the study, age <18 years and > 80 years, any other causes of shock, pregnancy were excluded in the study.

Prior studies on the sensitivity of lactate clearance in septic shock during the first 24 hours in the intensive care unit were conducted by Philippe Marty et al. These papers show sensitivity ranging from 45 to 95%. Consequently, the minimum necessary sample size at the 5% level of significance is 125 patients, assuming (p)=80% as the sensitivity of lactate clearance predicting death with a 7% margin of error. All septic shock patients who met the specified inclusion criteria were enrolled in the study group, and they were monitored for 28 days. For every member of the chosen population, a thorough general, physical, and systemic examination was conducted after a thorough history was obtained. The results were recorded on a pre-made proforma. Every patient suspected of having septic shock had their temperature, blood pressure, lactate, tachycardia, tachypnea, and other constitutional symptoms evaluated.

The following tests were recorded: hemogram (CBC), lactate (these levels were repeated every six hours), routine and microscopic urine examination, chest X-ray, electrocardiograph, 2DECHO, liver function tests, renal function tests, Patients who showed any signs of infection had their appropriate bodily fluids, secretions, or vascular access devices cultured or stained. The statistical software for the social science system, version SPSS 17.0, was used for statistical testing. For non-normally distributed data, continuous variables were displayed as mean (SD) or median (IQR). Frequencies and percentages were used to express categorical variables. Student's t-test was used to compare normally distributed continuous variables between the groups. The Chi-squared test or Fisher's exact test, depending on the situation, was used to compare nominal categorical data between the groups. The Mann-Whitney U test was used to compare continuous variables with non-normal distributions. The ideal cut-off value for lactate readings was determined using a receiver operating characteristic (ROC) analysis. The area under the curve, the sensitivity, and the specificity will also be calculated to analyse the diagnostic accuracy of lactate clearance scores during 24 hours, predicting mortality in septic shock patients. For all statistical tests, a p-value less than 0.05 was taken to indicate a significant difference.

RESULTS

The majority of patients were in the age group of 35-65 years, which comprised 46%, 44% of patients were age group of more than 65 years, and 8.8% of patients were in the age group 20- 35 years. The average age of the study population was 60.49 +/- 15.18 years. In terms of the distribution of patients by gender, our analysis revealed that 62.4% of patients were male (78 patients) and 37.6% were female (47 patients). Serum lactate levels in our study group ranged from 0.2 to 15 mmol/L at admission, with a mean lactate clearance level of 7.97+/-3.76 and a median value of 7.70. The mean serum lactate clearance level was 6.36 +/- 4.54 after six hours of admission with a clearance median of 4.40. The mean serum lactate clearance level was 5.12 +/- 4.87 after 12 hours of admission, with a median level of 3.10. The mean serum lactate clearance level was 3.82 +/- 4.52 after 18 hours of admission 1.80 being the median level. The median level of lactate clearance at 24 hours of admission was 0.90, while the mean level was 2.98 +/- 4.27 [Table 1].

Table 1: Lactate clearance at various intervals of time.

Time	Clearance (mean)	Median
Baseline	7.97 ± 3.76	7.70
6 hr	6.36 ± 4.54	4.40
12 hr	5.12 ± 4.87	3.10
18hr	3.82 ± 4.52	1.80
24 hr	2.98 ±4.27	0.90

In our study group, the lactate clearance level from 12 hours vs 6 hours, 18 hours vs 12 hours, and 24 hours vs 18 hours lactate clearance level associated with statistically significant P values of <0.01, <0.001, and <0.01, respectively. Over all Lactate clearance significantly decreased from baseline to 6hr and from 6 hr to 12hr,18 hrs, and 24 hrs, respectively [Table 2].

Table 2: Comparison of lactate clearance values at different intervals of time.

Time	P value	Time
6 hr vs Baseline	<0.01	6 hr vs Baseline
12 hr vs 6 hr	<0.01	12 hr vs 6 hr
18hr vs 12 hr	<0.001	18hr vs 12 hr
24 hr vs 18 hr	<0.01	24 hr vs 18 hr

In our study population of 125 patients, 71 (56.8%) patients had mortality at 28 days. Survivors were 54 patients (43.2%) [Table 3].

Table 3: Mortality rate of the patients

Outcome	No of patients	Percentage
Survivor	54	43.2
Non survivor	71	56.8
Total	125	100

The association of percentage of lactate clearance at baseline, 6,12, 18 and 24 hours with 28 days mortality was performed, The test showed that there is a significant association between percentage of lactate clearance at baseline, 6,12,18 and 24 hours of admission at 28 days mortality with statistically significant P value of 0.001, 0.001, 0.001, 0.001 and 0.001 with correlation coefficient of 0.50, 0.61, 0.64,0.64 and 0.62 respectively (table 4). The Mann-Whitney test used to assess the association of percentage of lactate clearance at baseline, 6,12, 18, and 24 hours with 28-day mortality also showed a similar significant association. Survivors had better lactate clearance percentage than the non-survivors [Table 5].

Table 4: Correlation of mortality with lactate clearance.

Outcome	Correlation coefficient	P value
Baseline	0.50	0.001
6 hr	0.61	0.001
12 hr	0.64	0.001
18hr	0.64	0.001
24 hr	0.62	0.001

Table 5: Association between percentage of lactate clearance and mortality rate

Mortality rate	Percentage of lactate clearance	Mann-Whitney test p-value
At 6 hours Non-Survivors Survivors	 10.02 ± 29.21 43.40 ± 22.54	 <0.0001
At 12 hours Non-Survivors Survivors	 11.75 ± 31.20 45.25 ± 23.79	 <0.0001
At 18 hours Non-Survivors Survivors	 7.02 ± 43.92 41.81 ± 36.23	 <0.0001
At 24 hours Non-Survivors Survivors	 14.35 ± 19.52 34.42 ± 56.42	 <0.0001

DISCUSSION

The association of %Lactate Clearance at 6 hours with 28-day mortality was performed by the Mann-Whitney test. The association between % Lactate Clearance at 6 hours and 28-day mortality was found to be significant with P-value = <0.0001. This was comparable with the results of Nguyen et al, and Arnold RC et al.[9,10] The association of %Lactate Clearance at 24 hours with 28-day mortality was performed by the Mann-Whitney test. The association between % lactate Clearance at 24 hours and 28-day mortality was found to be significant with P-value = 0.0001. This was comparable with the results of Jason Chertoff et al, and Philippe Marty et al.[11,12]

Since there is no standard cutoff value of lactate clearance mentioned in the literature, the median lactate clearance values obtained by ROC analysis are used as a cutoff, and the patients were classified as clearer and non-clearer.[13] Accordingly, 27 and 38 were used as cutoffs for %LC at 6 hours and %LC at 24 hours, respectively.

The odds of death were 3.73 times higher among patients with %LC at 6 hours < 27 compared to patients with %LC at 6 hours > 27, and this was statistically significant (P value<0.0001). The odds of death were 5.44 times higher among patients with %LC at 24 hours < 38 compared to patients with %LC at 24 hours > 38, and this was also statistically significant (P value<0.001). Hence, mortality is found significantly more among non-clearers than clearers. The comparison of the above two P-values indicates that the %LC at 24 hours is more helpful in predicting the 28-day mortality.

Limitations of the study: A small sample size of the study group. This was a single-center study at a tertiary care facility so the results cannot be applied to the whole population. The observational nature of the study, unobserved variables may exert a confounding effect on the results.

CONCLUSION

In the present study, it was found that both the lactate clearance at 6 hours and 24 hours are significantly associated with 28-day mortality. The results also indicated that for septic shock patients, there is a significant correlation between lactate clearance at 24 hours and 28-day mortality. Hence, lactate clearance at 24 hours is helpful in the management of patients in septic shock beyond 6 hours of resuscitation and to predict mortality.

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