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Evaluation of Serum Lactate as Predictor of Morbidity and Mortality in Sepsis and Trauma Cases

[1]Dr. S.Umarani, [2]Dr. Iyyappa Arumugam, [2]Dr. Anand Prasath Jayachandiran
[1]*Assistant surgeon , Institute of general Surgery,Madras Medical College, Chennai*
[2]*Institute of general Surgery, Madras Medical College, Chennai.*

Abstract
Background and objectives:*Utility of serial serum lactate measurement to find patients in occult hypotension and its use in treating critically ill patients.*
Design:*Prospective non interventional observation study in RGGGH.*
Method:*50 patients admitted with either trauma or suspected sepsis, whose icu stay is more than 48 hours, were followed till mortality or icu stay >7 daya or <7 days. Serial serum lactate measured at 0th ,12th ,24th, 36th hour in all 50 patients. Serum lactate level and the patient outcome were compared.*
Result:*Serum lactate at zero hour (p=0.000), 12th hour(p=0.000), 24th hour(p=0.000) and 36th hour(p=0.000) were statistically more accurate in predicting the outcome of the critically ill patient. Serum lactate is an individual prognostic factor and is useful to identify sick patients early, before MODS sets in.*
Key words:*MODS – multiple organ dysfunction ; ICU – Intensive care unit ;*

I. Introduction

"**Multiple organ dysfunction syndrome**" is the leading cause of morbidity and mortality of patients admitted in an ICU, and its incidence is about 15% of all ICU admissions(1).Several studies have confirmed that, the development of multi organ dysfunction is a major determinant of mortality and morbidity in ICU patients(2). The evolution of multi organ dysfunction throughout the septic process provides us, with critical information on the host response, pathophysiology which helps in application of specific therapies in treating sepsis."Hence, serial sequential organ dysfunction monitoring provides us, the best chance to give better clinical care"(3).

Serial serum lactate level monitoring in patients has been demonstrated in several studies to predict mortality and morbidity of critically ill patients(4)(5). However, its use in predicting mortality and morbidity of sepsis in surgical patients in particular, is sparse(6). Early prediction of outcome in surgical sepsis is very likely to aid suitable modification of management strategies. This may improve prognosis in such surgical sepsis patients.

This study is a step in that direction. Also, can be a useful clinical research tool to evaluate effectiveness of various therapeutic interventions in early sepsis. "Serum lactate has been used as an indicator and predictor of severity of sepsis and MODS. If there is a strong correlation between serum lactate levels and outcome of patient, it may be possible to use the serum lactate as an independent predictive parameter of sepsis. This study aims to explore this possibility". The positive gain from this study may be of economic benefit to a patient and, as well as to the system in terms of expenditure and time.

The ultimate benefit could be in terms of improved outcomes. Because, of earlier and more accurate assessment of the septic threat and MODS, leading to earlier prediction of deterioration, quicker response, more effective and timely therapeutic strategies.

II. Materials And Methods

After acquiring hospital ethical committee approval, 50 adult surgical patients aged more than 15 with suspected/confirmed infection according to cultures from body fluids and two or more SIRS criteria positive admitted in the surgical intensive care unit of RGGGH &.MADRAS MEDICAL COLLEGE were recruited for the study. The exclusion criteria included children (below 15 years of age), non SICU patients, patients outside the ICU and moribund and terminally ill patients with impending mortality within 48 hours. Of the 50 patients, 25 patients had trauma and 25 patients had non-traumatic causes for infection. The sample included both operated and non-operated patients in both the groups.

The serum lactate was taken at zero hour, 12th hour, 24th and 36th hour. The patients were monitored during the full course of stay in the ICU and outcomes were noted in either of the following three categories- death, ICU stay <7 days and ICU stay>7 days.

III. Statistical Analysis

The sample size was calculated based on a pilot study. The Categorical variables are expressed as Frequency and Percentage. Discrete (categorical) variables were analyzed using the Chi-Square test, with a $P < 0.05$ considered statistically significant. The statistical analysis was carried out using statistical software package IBM SPSS 20.0

IV. Results

The patients were divided into three groups based on outcomes and then assessed.

	ICU <7days	ICU> 7days	Death
Non-traumatic causes	10	8	7
Traumatic causes	19	3	3

The demographic with respect to age, gender, whether operated or not were comparable without any significant difference between the recovered and succumbed patients.

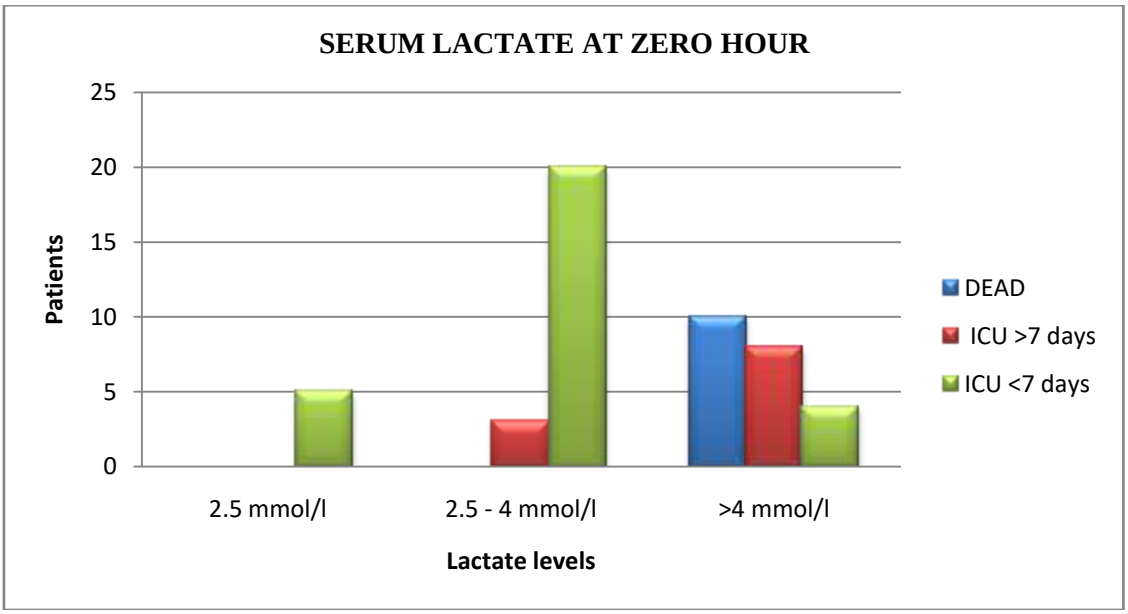
		ICU <7days	ICU> 7days	Death	p-value
AGE (years)	15-25	5	2	1	.832
	26-50	15	7	7	
	51-75	9	2	2	
SEX	Female	6	2	1	.750
	Male	23	9	9	
OPERATED	No	9	3	3	0.973
	Yes	20	8	7	

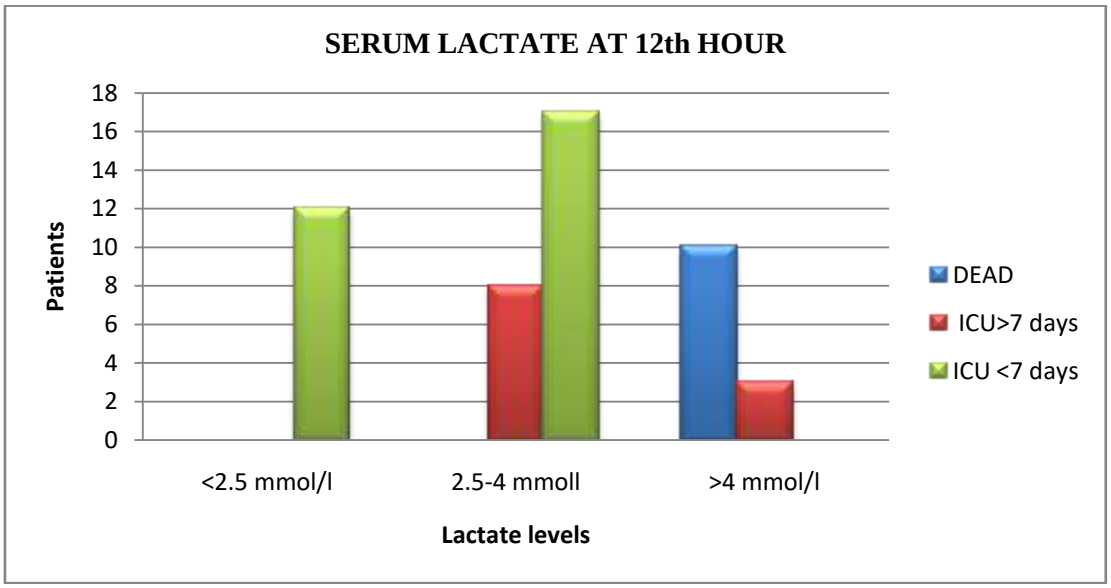
The serum lactate levels were assessed based on the final outcomes. In the zero hour, nearly all patients with high initial serum lactate came under dead or >7 days ICU stay category with statistically significant difference. In the 12^{th} hour, some patients with initial high serum lactate had their value reduced. All those who responded to treatment which is evident with decreasing serum lactate were survivors. In the 24^{th} hour, Patients who were not having serum lactate below 4 mmol/l showed MODS. All other patients, inspite of their initial serum lactate level were not having MODS. All patients with elevated serum lactate at 36^{th} hour were succumbed to death. All others were survivors. Patients with < 2.5 mmol/l serum lactate had lessen ICU stay than others. There is a statistically significant difference in the serum lactate levels at all time points between the survivors and those who succumbed to death.

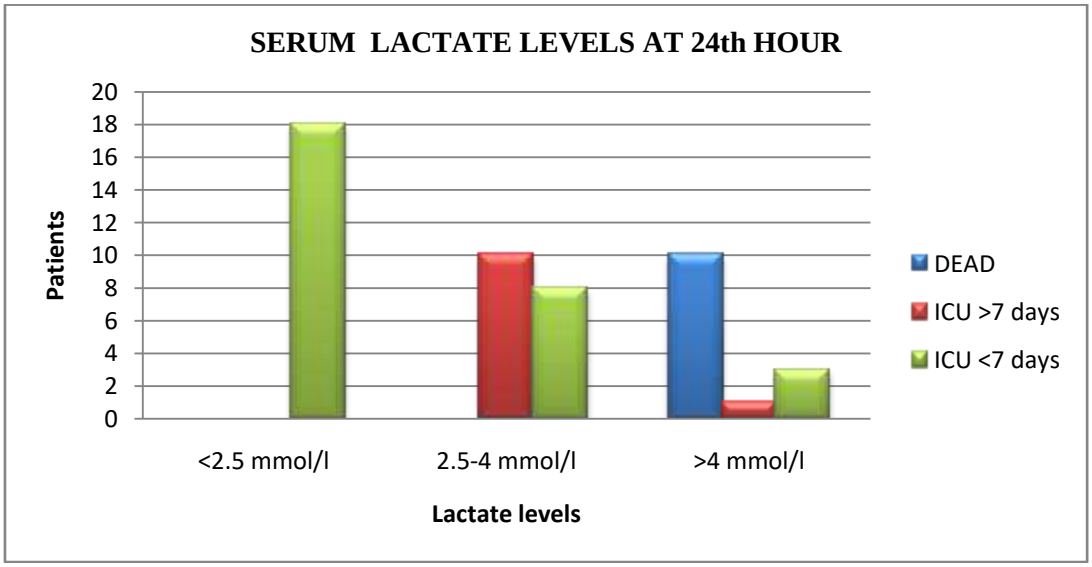
Time	Lactate levels	ICU <7days	ICU> 7days	Death	p-value
Zero hour	0-2.5	5	0	0	.0001
	2.6-4	20	3	0	
	4.1-20	4	8	10	
12^{th} hour	0-2.5	12	0	0	0.0001
	2.6-4.0	17	8	0	
	4.1-20	0	3	10	
24^{th} hour	0-2.5	18	0	0	0.0001
	2.6-4.0	9	10	0	
	4.1-20	2	1	10	
36^{th} hour	0-2.5	29	0	0	0.0001
	2.6-4.0	0	11	0	
	4.1-20	0	0	10	

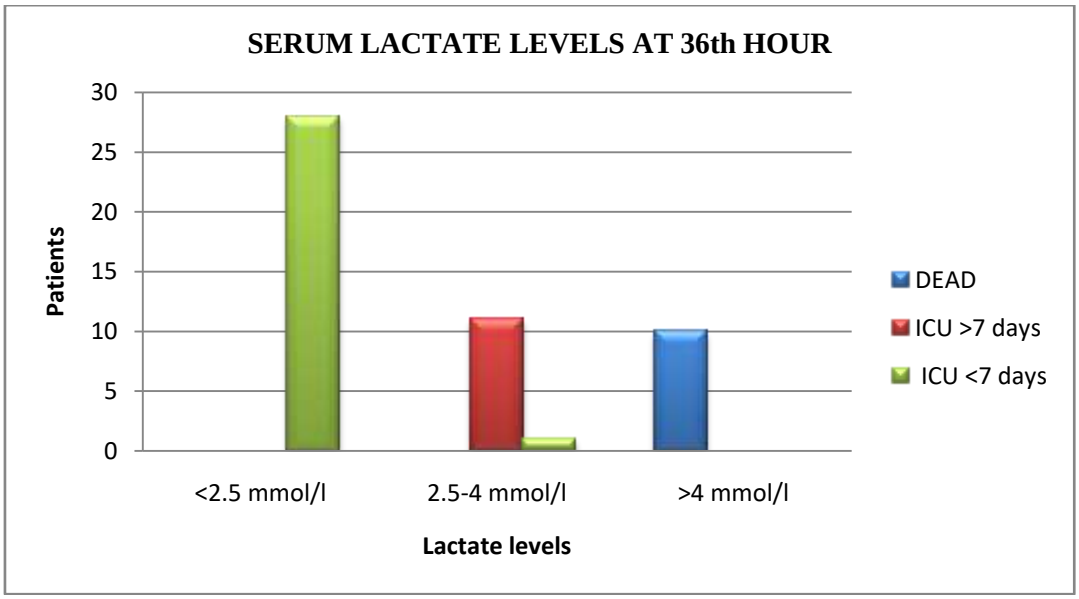
		ICU <7days	ICU> 7days	Death	p-value
MODS	No	29	11	0	0.0001
	Yes	0	0	10	

MODS is the cause of death in all 10 dead patients. Its relation to outcome of patient is significant. But we can sense MODS only after it sets in. By the time it's too difficult to correct sepsis in those patients. So we have to treat patients aggressively before MODS sets in for that serum lactate values helps us to identify patients who might land up in MODS soon.


SERUM LACTATE AT ZERO HOUR
25
20
15
10
5
0
Patients
2.5 mmol/l
2.5 - 4 mmol/l
>4 mmol/l
Lactate levels
DEAD
ICU >7 days
ICU <7 days


SERUM LACTATE AT 12th HOUR
18
16
14
12
10
8
6
4
2
0
Patients
<2.5 mmol/l
2.5-4 mmoll
>4 mmol/l
Lactate levels
DEAD
ICU>7 days
ICU <7 days


SERUM LACTATE LEVELS AT 24th HOUR
20
18
16
14
12
10
8
6
4
2
0
Patients
<2.5 mmol/l
2.5-4 mmol/l
>4 mmol/l
Lactate levels
DEAD
ICU >7 days
ICU <7 days



V. Discussion

This study compared the trend of serum lactate in patients with surgicalsepsis. In the group of patients that succumbed to their illness, an increasing trend of serum lactate was seen. Previous investigations have reported the usefulness(7), During ICU care to assess outcome. In this study persistently elevated serum lactate not touching the below 4 mmol/L was found to be statistically significant predictors of mortality. In our study, there was no significant relationship between age of patient and outcome (p=0.832). It is consistent with the findings of Acharya,*et a*(8)*l*.

Serial blood lactate evaluation(9) can be useful to predict shock in the presence of normal physiological parameters and also to predict the development of multiorgan dysfunctions a complication of shock. Sex of the patient has no effect on outcome (p = 0.750). Operated and conservatively managed patients, there was no significant influence on outcome (p = 0.036). Trauma and sepsis cases individually influences the outcome, but there was overlapping of two. Comparing zero hour (p = 0.000), 12^{th} hour (p=0.000), 24^{th} hour (p=0.000), 36^{th} hour (p=0.000) serum lactate to outcome, there is strong correlation between the two.MODS had strong correlation between the MODS and outcome (p=0.000). But MODS can be documented only after organ failure sets in. Comparatively serum lactate predicts the impending shock, MODS quickly and we can manage patients effectively.In a recent publication, Meregalli,*et al.* have shown that despite similar hemodynamic variables, serum lactate values can categorize post surgical patients into survivors and non-survivors within 12 hours of ICU admission(10). They came to the conclusion that lactate,especially when hemodynamic variables were taken into consideration, seemed to have a similar value in identifying survivors as the SAPS and APACHE II scoring systems and offered even better relevant bedside clinical information in terms of patient condition at the moment.

This study has several limitations.

First the small sample size would have resulted in a less precise estimation of theaccuracy of the serial serum lactate level. This number further decreased during the course of stay due to mortality/ discharge.

Second, adaptations to the cardiovascular and central nervous system components were made as follows: as noradrenaline was the inotropic of choice in our hospital and minute to minute adjustments in the dose were made, the total need per day was calculated and was adjusted accordingly. GCS of intubated patients was taken as 15 to avoid discrepancy. It is possible that the results would have been different if these adaptations were not made.

Thirdly, this study was conducted in a single centre, so the results may not be generalized to other centers dedicated specifically for the management of surgical patients. Finally, patients were only followed up till 7 days of ICU stay/discharge from hospital. Also, data collection by a single investigator may have been associated with investigator bias.

Larger multicentre studies with longer patient follow up will be useful.

Using absolute values or changes over time, the serial serum lactate monitoring appears to be a potentially useful tool for either the clinician during bedside assessment or for purposes of clinical research trials of sepsis.

VI. Conclusion

This study reconfirms the prognostic value of serial serum lactate monitoring for mortality and morbidity.Serial lactate levels can be used to predict a grave outcome in patients of trauma orsepsis(11). However, it would be wise to state that the process of recovery from such an insult is a very long one(11). Lactate values probably need to be followed for longer periods of time in critical patients even when they have tided over the present crisis. The utility of regular lactate analysis in these patients would depend on factors such as availability and cost of tests as well. There are no existing studies to support the above premise.

Serial blood lactate evaluation will continue to be useful to predict shock in thepresence of normal physiological parameters, to predict the development of multiorgan dysfunction as a complication of shock, and to evaluate the response to early resuscitation.

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