

Prognosis of Haemodynamically Unstable Patients Secondary to Trauma Based on Lactate Clearance

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Abstract

TRAUMA is the third overall cause of death and the first cause of death before 40 yr of age [1]. Early recognition of haemorrhage and shock in traumatic patients can prevent death, most deaths (80%) occurring within 48 hrs, haemorrhage being the leading cause of death [1]. Estimation of lactate clearance can be used as a diagnostic and prognostic biomarker in case of trauma patients [1]. *Aims:* To establish the prognostic significance of the lactate clearance in unstable trauma patients. *Settings and Design:* This is a "prospective observational study" among the patients who presented to the Emergency Department of BGS Global Hospital. *Methods and Material:* The patients will undergo ABG or VBG, as feasible along with blood lactate estimation which shall be repeated after 4 hours and the lactate clearance is calculated for 4 hrs. *Statistical Analysis Used:* All quantitative data are analysed using mean, median and standard deviation. All qualitative data are analysed using the chi-square test. *Results:* According to the lactate clearance values, the death rate was high at higher lactate clearance values and the discharge rate was high with lower lactate clearance values. According to the initial lactate values, the discharge rates are high with low initial lactate levels than at higher initial lactate levels. *Conclusion:* This study concludes that all the trauma patients with lower Lactate clearance and lower initial lactate levels had better outcome when compared with those who had high lactate clearance and high initial lactate levels at the time of admission.

Keywords: Lactate Clearance; Trauma; Haemorrhage; Shock; Initial Lactate Values.

Introduction

TRAUMA is the third overall cause of death and the first cause of death before 40 yr of age, causing many handicaps and high cost burden to the patients [1].

Early recognition of haemorrhage and shock in traumatic patients can prevent death, most deaths (80%) occurring within 48 hrs, haemorrhage being the leading cause of death [1].

The three main principles of trauma patient care are

1. To recognize and treat the haemorrhage early [1].
2. To limit the consequences of shock, and [1]
3. To diagnose traumatic lesions [1].

Haemorrhage and shock is responsible for inadequate oxygen delivery, that results in tissue hypoxia, anaerobic metabolism, and lactate production [1]. Hence estimation of lactate clearance can be used as a diagnostic and prognostic biomarker in case of trauma patients [1].

Lactic acidosis may persist despite control of the haemorrhage, reflecting flow-demand mismatch or

loss of appropriate capillary density as a consequence of shock, vasoconstriction, or other dysfunctional responses [1].

Lactate clearance (LC) has recently emerged as an important concept in septic shock, as part of quantitative resuscitation that aims to reach the predefined physiological goals to be achieved within the first hours of trauma or sepsis [1].

Anaerobic glycolysis sharply increases production of cellular lactate, which diffuses into blood stream during pro-longed cell ischemia [2]. Elevated circulating lactate concentration thus often indicates the widespread inadequate tissue oxygenation due to inadequate oxygen delivery and/or consumption [2].

However, besides these anaerobic processes, the aerobic (metabolic) mechanisms that affect the host's efficiency of energy transfer also contribute to lactate production [2]. Cytokine-mediated glucose uptake and catecholamine-stimulated Na-K pump overactivity both can result in increased pyruvate production that will eventually overwhelm the catalytic capacity of pyruvate dehydrogenase and result in increased

lactate either due to mass effect, or due to sepsis-induced pyruvate dehydrogenase dysfunction, or due to both [2].

In addition, reduced lactate clearance may reflect globally impaired metabolic function by liver and kidney, both of which normally contribute to systemic lactate disposal through anaplerosis, a mechanism that carboxylates lactate and delivers it to the tricarboxylic acid cycle, independent of the action of pyruvate dehydrogenase [2].

Thus, lactate clearance biologically reflects more of the general homeostasis of the host and thus provides more meaningful data about the overall adequacy of the resuscitative processes [2]. Lactate clearance (LC) has recently emerged as an important concept in septic shock, as part of the quantitative resuscitation concept that aims to reach predefined physiological goals to be achieved within the first hours [1]. The lactate clearance was defined by the equation [1]:

Therefore this study is intended to study the prognostic effect of Lactate Clearance on the outcome of haemodynamically unstable patients secondary to trauma.

$$\text{Lactate clearance} = \left\{ \frac{[\text{Lactate (initial)} - \text{Lactate (delayed)}]}{\text{Lactate (initial)}} \times 100 \times \text{Delay}^{-1} \right\}$$

(expressed as %/h) [1]

Objectives of the Study

1. To determine whether the early lactate clearance (0 to 4 hr) is predictive of inhospital mortality of the haemodynamically unstable trauma patients.
2. To establish the prognostic significance of the lactate clearance in unstable trauma patients in the Emergency Department.

Inclusion Criteria

1. Presenting history of trauma.
2. Age more than 15 yrs.
3. GCS less than 10.
4. Haemodynamically unstable patients with tachycardia, systolic blood pressure of less than 90 and saturation less than 90% on room air with PaO₂ less than 60.

Exclusion Criteria

1. History or evidence multi organ failure.
2. No history of trauma.
3. Patient in sepsis.

4. Age below 15 yrs.
5. History of diabetes mellitus on treatment with metformin.
6. Patient treated outside.

Other Variables That Are Recorded Are

1. Age
2. Gender
3. Brief history of presenting symptoms
4. Mechanism of trauma
5. Coexisting diseases
6. Medications patient is receiving
7. Nystagmus

Materials and Methods

Source of Data

All patients who presented to the Emergency Department of BGS Global Hospitals during the period between July 2015 and June 2016 with history of trauma and who are haemodynamically unstable.

Method of Collection of Data

After attaining the required permissions from the Ethical Committee, all patients satisfying the inclusion criteria have been enrolled in the study. They will initially go through history taking and examination as per standard proforma.

The patients will undergo ABG or VBG, as feasible along with blood lactate estimation. The ABG or VBG shall be repeated after 4 hrs to estimate the blood lactate and the lactate clearance is calculated 4 hrs.

Type of Study

This is a "prospective observational study" among the patients who presented to the Emergency Department of BGS Global Hospital and have satisfactorily been included in the study after having satisfied the inclusion criteria.

Primary End Point: Death.

Secondary End Point

Shifting to Operating Room.

Adequacy of Resuscitation

Until the peripheral pulse is of good volume and the systolic blood pressure is more than 100 mg and there is adequate urine output.

Duration of Resuscitation

As long as the patient stays in Emergency Department.

Statistical analysis

All quantitative data are analysed using mean, median and standard deviation. All qualitative data are analysed using the chi-square test.

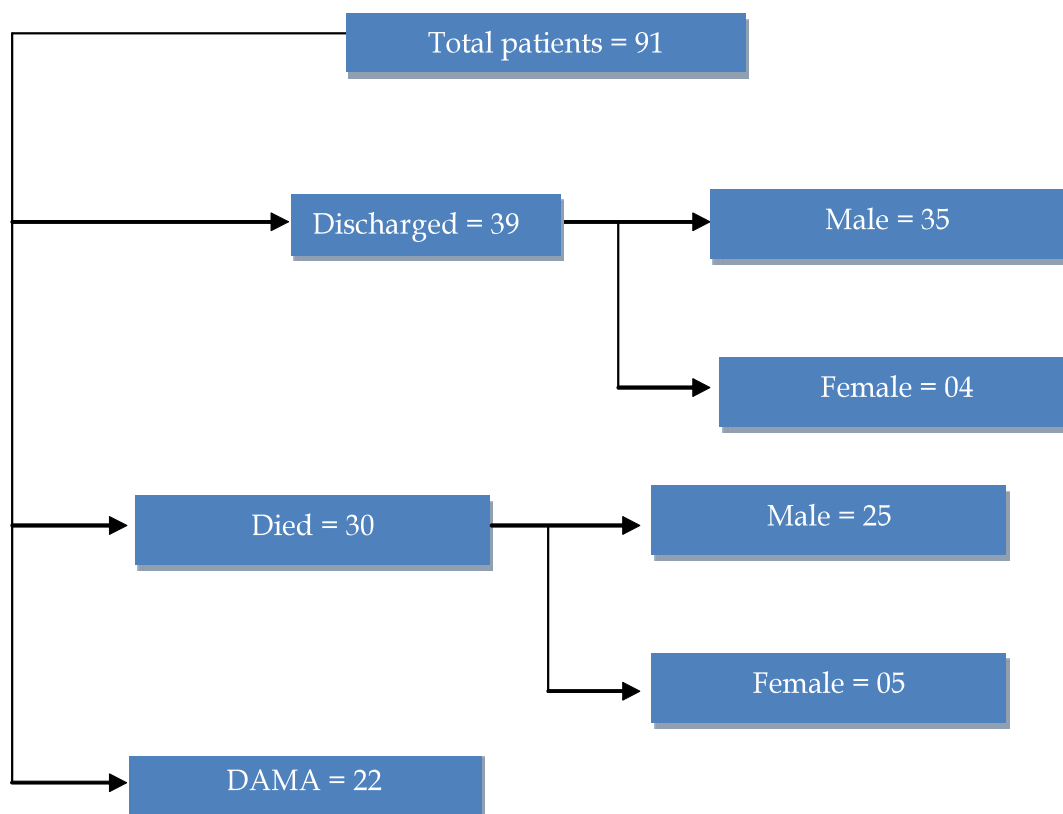
Investigations Needed during the Study

ABG or VBG depending on the feasibility.

Ethical Committee

Clearance has been obtained from the Ethical Committee of the institution before the study has started.

Flow Chart of the Study:



Results

Total number of patients evaluated were 91 out of which 22 patients have left against medical advice, 39 patients have been discharged in neurologically intact state and 30 patients have died during the course of their stay in the hospital. No bias had occurred while recruiting the patients into the study. Out of 39 patients discharged in neurologically intact state 35 patients were male and 4 patients were female. And out of 30 patients died during the course of their stay in the hospital, 25 patients were male and 5

patients were female. According to the lactate clearance values, the death rate was high at higher lactate clearance values with 16 people dying within the range of 0 to 50. The discharge rate was high with lactate clearance values between 0 to 8 than at higher values of lactate clearance.

According to the initial lactate values, the discharge rates are high with low near to normal initial lactate levels than at higher initial lactate levels. The death rates were high between the initial lactate levels between 4 to 10 than at higher initial levels.

Table 1: Patient distribution

Total number of patients	91
Number of patients discharged	39
Number of patients died	30
Number of patients DAMA	22

Table 2: Death and Discharge distribution among male and female

Total number of patients = 91			
Death = 30		Discharge = 39	
Male	25	Male	35
Female	5	Female	4

Table 3: Death and discharge distribution as per lactate clearance

Lactate Clearance	Number of Deaths	Number of Discharges
-150 to -100	1	0
-99.9 to -50	2	0
-49.9 to 0	11	1
0.1 to 5	1	9
5.001 to 10	2	23
10.001 to 15	10	2
15.001 to 20	3	4

Table 4: Death and discharge distribution as per initial lactate

Initial Lactate Levels	Number of Deaths	Number of Discharges
0 to 2.2	6	9
2.2 to 4	4	9
4 to 6	8	7
6 to 8	3	8
8 to 10	5	3
10 to 15	3	3
>15	1	0

Table 5: Age distribution of discharge and death

Age	Death	Discharge
16-25	14	5
25-35	6	8
35-45	10	8
45-55	8	5
55-65	1	0
65-75	0	4

Table 6: Calculation of p value

	Death	Discharge	Marginal Row Totals
Lactate clearance < 10	14	33	47
Lactate clearance >10	16	6	22
Marginal column totals	30	39	69 (Grand total)

The chi square statistic is 11.2437. The p value is 0.000799. The result is significant at $p < 0.05$.

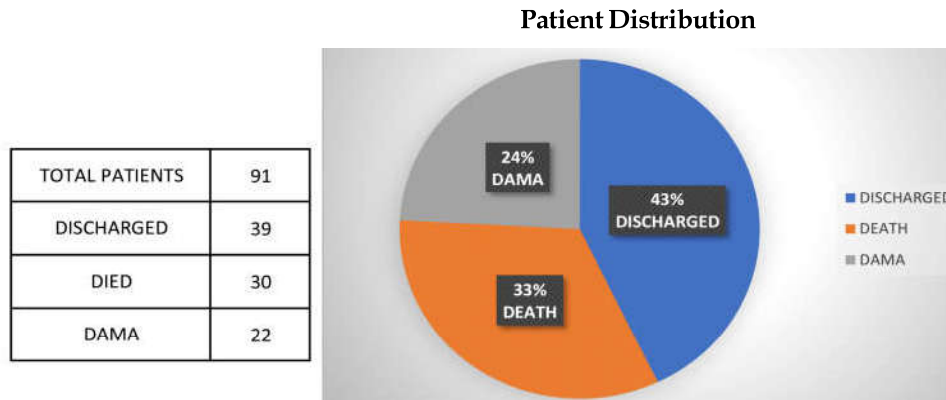


Fig. 1: Patient distribution

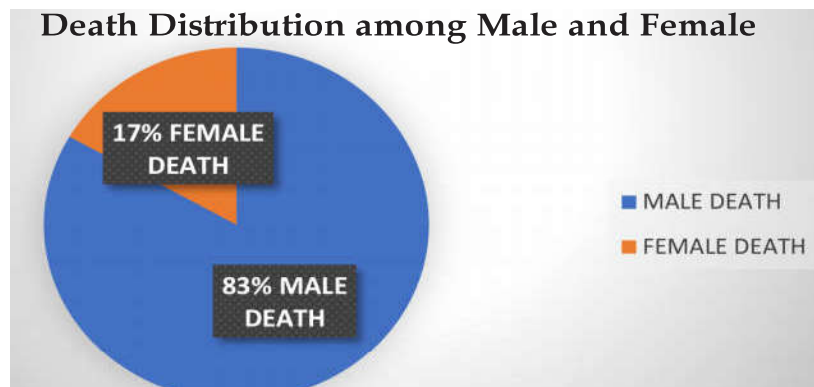


Fig. 2: Death distribution among male and female

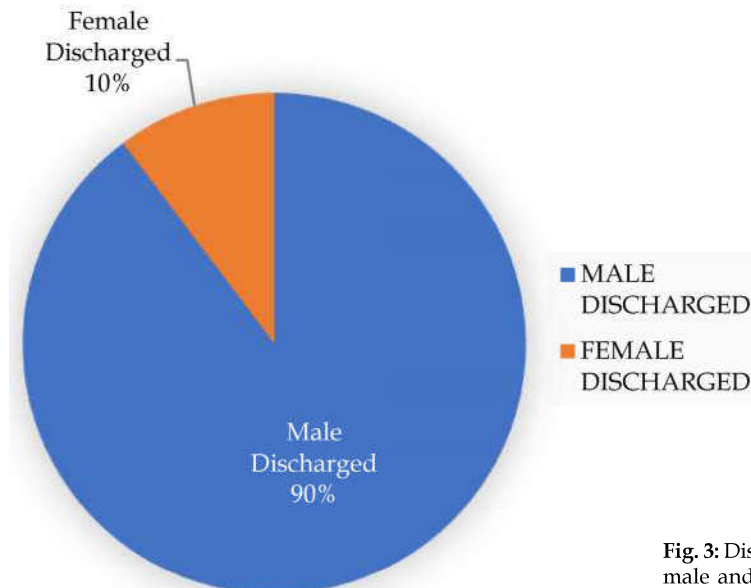


Fig. 3: Discharge distribution among male and female

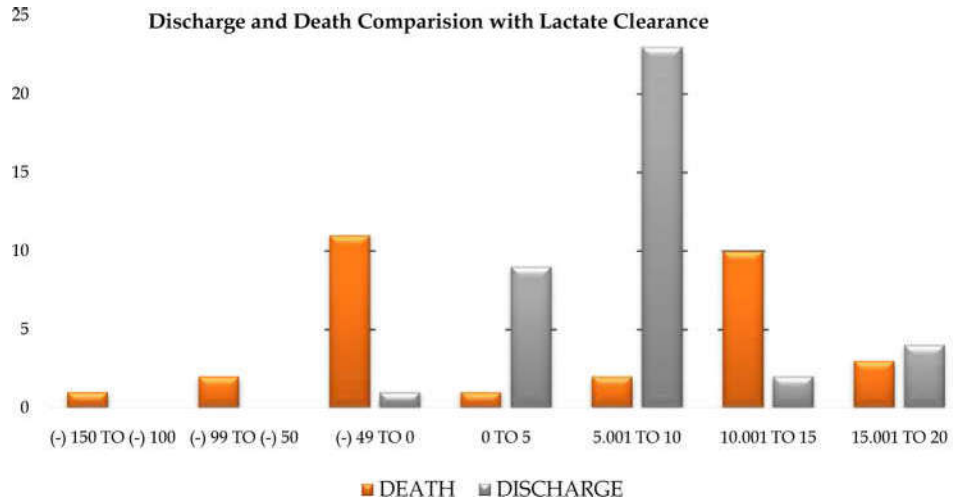


Fig. 4: Death and discharge comparison as per Lactate clearance

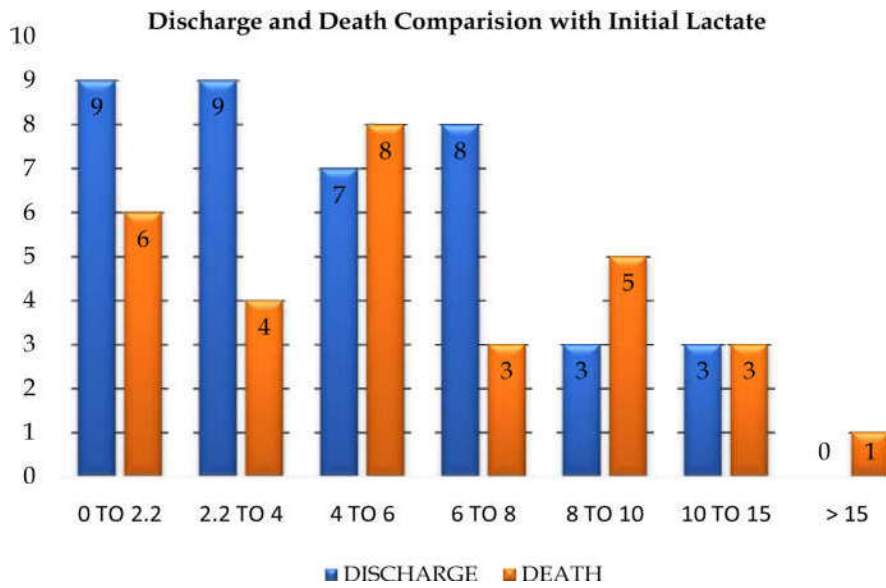


Fig. 5: Discharge and Death comparison as per initial lactate levels

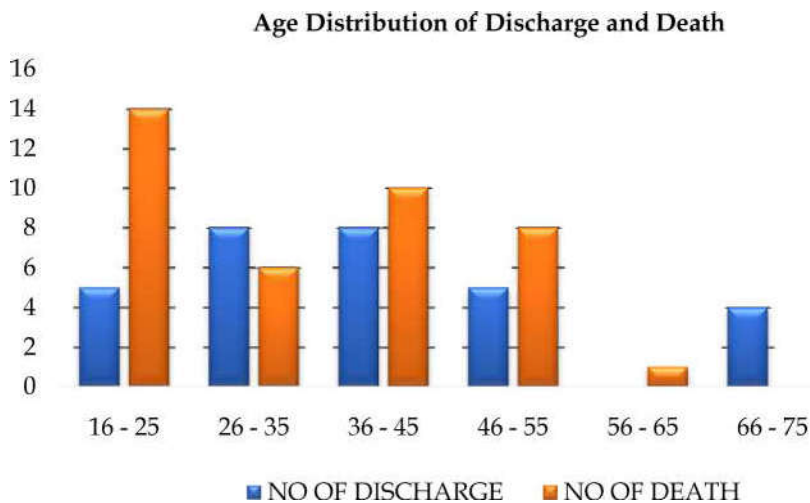


Fig. 6: Age distribution of discharge and death

Discussion of the Study

Our study was done in a sample of 91 trauma patients admitted in BGS Global Hospital, Bengaluru.

Various studies have proved the predictive value of lactate clearance levels and initial lactate levels in predicting the outcome in trauma patients.

In his study, "Prognostic Significance of Blood Lactate and Lactate clearance in Trauma patients" Regnier et al. has shown that the mortality is high in case of high lactate clearance levels (~28%) and high initial lactate levels (~80%) in comparison to low lactate clearance (~18%) and low initial lactate levels (~30%). Our study also has shown that the lactate clearance calculated in the initial 4 hrs of admission has shown that in higher lactate clearance levels the mortality is high (72.72%) and when the lactate clearance is less than 10 the admission to discharge rate was high (mortality is low). In case of initial lactate levels also the mortality is high when the initial lactate is > 4 mmol/L (66.66%) when compared to high lactate levels (33.33%).

In the systematic review "Blood lactate as a predictor for in-hospital mortality in patients admitted acutely to hospital" Kruse et al., reviewed the usefulness of a single blood lactate measurement obtained at the time of admission in predicting the adverse outcomes in trauma patients and also the dose-response relationship that states the higher the lactate levels, the higher the mortality rates ($p < 0.001$). Our study also has demonstrated that the mortality rate is higher when the initial lactate levels are higher (66.66%).

In his research article "Serum lactate as a predictor of early outcomes among trauma patients in Uganda", Okello et al., has shown that the initial lactate measurement of > 4 mmol/L has been associated with high admission rates (37%) and a 72 hr non discharge from hospital (44%). Our study has shown that there is high mortality associated with trauma patients with initial lactate levels of > 4 mmol/L (66.66%).

In his systematic review "Do lactate levels in the Emergency Department predict outcome in adult trauma patients", Baxter et al., has concluded that there is increase in the mortality with increasing lactate levels ($p < 0.001$ - significant). Our study has also shown that there is increasing mortality with higher lactate levels of > 4 mmol/L (66.66%).

Henceforth the study had similarities with other studies in stating that higher lactate clearance levels and higher initial lactate levels have been associated with high mortality rates. Therefore it can be stated

again that the lactate clearance levels and the initial lactate levels either singly or both combined prove to be an effective tool in the prediction of outcome in trauma patients.

Conclusion

This study concludes that all the trauma patients with lower Lactate clearance and lower initial lactate levels at the time of admission had better outcome when compared with those trauma patients who had high lactate clearance and high initial lactate levels at the time of admission.

Limitations

1. The group studied is small.
2. Conducted in a single centre.
3. There is no geographical representation.
4. This study was not conducted in different races.

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