# **Evaluation of Lactate and Lactate Clearance as a** Marker of Outcome in Trauma ICU

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### Abstract

Hypo-perfusion is usual in patients suffering from traumatic injury that may be indicated by serum lactate elevation. This study was performed to analyze the relation of the lactate value with trauma mortality and its clearance. The research included a total of 202 trauma patients admitted into ICU. Study parameters such as patient demography, injury mechanism, Blood Pressure (BP), heart rate (HR), Glasgow Coma Scale (GCS) and level of lactate in the blood. All these parameters were documented in the first 3 hours of hospitalization, and lactate clearance was recorded between 3 and 9 hours afterwards. For the study point; death up to 7 days was considered as a direct impact of trauma and considered in study. The study was divided into two subgroups, either expired (n=79) or survivors (n=123) according to the final outcome. The mean age, mean body weight, sex ratio, HR, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) in both groups were comparable. The difference in lactate at admission, lactate at 6 hours and lactate clearance in between survivors and deaths were found to be insignificant statistically. Among trauma patients there is no significant relationship between lactate admission or lactate clearance and mortality. Higher sample size may be appropriate for definitive proof to be reached.

Keywords: Clearance, ICU, Lactate, Mortality, Trauma

### 1. Introduction

Trauma is the major cause of mortality in the world, having a marked impact on the population below age 40. Accident on the road is responsible for the highest number of accidents, among all causes. Around 3000 people die every day from injuries caused by Road Traffic Accident (RTA) worldwide. According to reports from the WHO, these especially affect the 15–29-year age range<sup>1,2</sup>.

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Hypoperfusion is often characterized by blood loss in traumatic cases, whereas the existence of vital sign abnormalities can guide to diagnose shock, their absence definitely does not rule out occult hypoperfusion<sup>3,4</sup>.

Lactate elevation helps distinguish patients where hypoperfusion of the tissue can initially be persistent in normal vitals<sup>5</sup>. Previous research showed that initial lactate levels were substantially elevated in non-survivors relative to the survivors of sepsis and cardiac arrest trauma patients<sup>3,6-11</sup>. The elevated lactate and lactate clearance levels are significantly associated with an increased risk of multi-organ failure and rehabilitation after traumatic injury, and lactate clearance which may serve as an endpoint for resuscitation guidance<sup>12-15</sup>. So, we designed this study to analyze the correlation between lactate value and its clearance with trauma mortality.

## 2. Materials and Methods

The research was performed over an 18-month period in a Trauma Center and Multispecialty Hospital of Medical Sciences Institute, Banaras Hindu University, Varanasi, UP, India. The report obtained approval from the Committee on Institute Ethics.

#### 2.1. Participants

We conducted longitudinal prospective study to investigate the role of lactate association with mortality patients in trauma. Enrollment of subjects was started on January 2017 to June 2019 with proper consent from patient's attendant.

#### 2.2 Inclusion and Exclusion Criteria

Previously healthy trauma patients with no comorbidity needed resuscitation and ICU care were also included in the study. Patients with extremes of age i.e. age < 15 years and > 65 years, patients with end stage renal disease, uncontrolled hypertension, uncontrolled diabetes, and liver failure, Acute Respiratory Distress Syndrome (ARDS) and obesity (BMI >  $30 \text{kg/m}^2$ ) and patients required vasopressors support were excluded from the study. Sixty patients were also excluded because of lack of second lactate collection. Finally, 202 patients were included for final analysis.

#### 2.3 Methods

For measuring the lactate value arterial sample was taken, preferably from radial artery and where radial is not possible sample drawn from femoral artery. The study variables i.e. age of patient, sex, injury mechanism, BP, HR, Glasgow coma scale and blood lactate were recorded in the first 3 hours of admission and 3 to 9 hours afterwards.

The lactate clearance was calculated by the following formula<sup>5</sup>:

Lactate clearance= $\frac{\text{Lactate admission} - \text{Lactate 6 hour}}{\text{Lactate admission}} \times 100$ 

For the study point; death up to 7 days was considered as a direct impact of trauma and considered in study. Beyond seven days death were supposed to be related to other cause and not considered in the study. For resuscitation of these patients' Intravenous fluids (crystalloids) and blood and blood product were used according to the hemodynamics and blood volume status. Patients with low GCS were intubated and ventilator supports were given according to the need. Depending on the final outcome the patients were categorized into two subgroups, expired (n=79) or survivors (n=123).

#### 2.4 Statistical Analysis

Statistical analysis was carried out using version 23.0 (IBM Inc. USA) of the SPSS program. For comparing two groups of mean Independent Simple Test was used. The discrete variables were compared by  $\chi^2$  test and Fisher's exact test. P < 0.05 has been found statistically significant.

### 3. Results

The mean age in survivors was  $31.89\pm6.74$  years and in expired group was  $32.54\pm6.88$  years, which was found to be statistically insignificant (p=0.507). The mean body weight in survivors was  $68.8\pm7.64$  kg and in expired group was  $67.03\pm6.32$  kg which was found to be statistically insignificant (p=0.087). There was no statistically significant association between the two groups in terms of sex ratio (p=0.820). The HR, SBP and DBP were comparable in both the groups (p=0.364, p=0.548 and p=0.633). On comparing Mode of Injury (MOI), motorcycle accident was higher in both the group. On comparing the car, fall from height and motorcycle accident in between the groups, it was found to statistically insignificant (p=0.364) (Table 1). The mean GCS score was significantly low in expired patients as compared to survivor (p<0.001) (Table 2).

Table 1.	Mechanism	of Injury in	two groups
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MOI	Survived (n=123)		Expired (n=79)		p-value
	No.	%	No.	%	
Car	12	9.8	7	8.9	
Fall from height	21	17.1	20	25.3	0.364
Motorcycle	90	73.2	52	65.8	
Total	123	100	79	100	

Table 2. GCS values of patients in two groups

Variable	Survived (n=123)	Expired (n=79)	p-value
GCS	8.07±1.073	6.30±1.304	< 0.001

The mean lactate level at admission among survivors was 2.557mmol/l and among deaths was 2.954mmol/l. The mean lactate level after 6 hours was 1.667 mmol/l in survivors, and 1.871 mmol/l in expired patients. The mean lactate clearance among survivors was 28.73 and among deaths were 31.368. On comparing lactate level at admission, after 6 hours and lactate clearance in between survivors and expired patients were found to be statistically insignificant (Table 3 & Figure 1).

Table 3.Comparison of Lactate level and Lactate<br/>Clearance

Variable	Survived (n=123)	Expired (n=79)	p-value
Lactate at 0 hr.	2.557±1.4806	2.954±1.3658	0.056
Lactate at 6 hr.	1.667±.7716	1.871±.8370	0.077
Lactate clearance	28.733±19.5987	31.368±14.2998	0.304

The statistically insignificant difference was observed when lactate clearance was graded as low (0 to 29%), moderate (30 to 59%) and high (60% or more) and compared in the expired and survivor groups (Table 4).

Table 4.	Lactate	Clearance	in	Two	Groups
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Lactate clearance	Survived (n=123)	Expired (n=79)	p-value
0-29	55 (44.7)	26 (32.9)	0.094
30-59	64 (52.0)	48 (60.8)	0.223
>60	4 (3.3)	5 (6.3)	0.301



Figure 1. Mean Lactate level in two groups.

# 4. Discussion

Our study compared the value of serum lactate at admission and lactate clearance as a biomarker in predicting the patient mortality, in patients of trauma and found no correlation with mortality. However, some studies were found lactate value to be useful in predicting the mortality<sup>16,17</sup>.

Lactate is produced by anaerobic glucose metabolism and can be used as a marker of deficient tissue perfusion and or hypoxia, as in various shock states. Initial high lactate level on admission of patients with multiple traumas is correlated with higher mortality rates<sup>18-21</sup>. Because of higher death rate patients affected by septic shock<sup>22</sup> and predicting the need for blood products, it can also help to diagnose severity early<sup>19</sup>. The use of lactate as an indicator of severity and mortality was established by several investigators<sup>14,18-20,22-24</sup>. Lactate value > 4 mmol/l is rare, and is associated with systemic inflammation and needs ICU care.<sup>25,26</sup>

In 2013, 4742 trauma patients were included in their analysis by Stephen R. Odom, who concluded that lactate values <4 mEq/l were the best death predictors in trauma patients<sup>14</sup>. Unlike previous research in 2015, Freitas and

Franzon found that in patients treated with multiple traumas there is no association between lactate admission and mortality<sup>25</sup>.

In the present study serum lactate value at admission in trauma patients found to be insignificant in survivor and expired group of patients. In an Abramson study that first assessed the correlation of lactate rates with death in trauma patients. They observed that the time required to normalize the lactate level over 24 and 48 hours was associated with increased incidence. Before 24 hours, early normalized lactate values had a survival rate of 100%<sup>13</sup>.

After 48 hours of admission, Lefering *et al.*, revealed a strong correlation between serum lactate levels and death, with the highest levels present in patients with late death<sup>22</sup>. They stated that increased lactate clearance is related to reduce mortality. In fact, for every 10% increase in lactate clearance, death was decreased by around 11%. Patients with a lactate clearance > 10 percent experienced a better increase in the Acute Physiology and Chronic Health Assessment score (APACHE II) and a lower 60-day mortality<sup>18</sup>.

Stephen R. Odom also conducted the lactate clearance measurement in 2013, with a time period of 6 hours, and they also stated that low clearance is related to greater mortality<sup>14</sup>. Over the time, Chana *et al.* also observed a significant reduction in the lactate value related to lower mortality; suggesting therapeutic intervention<sup>24</sup>. Contrary to previous Freitas and Franzon report in 2015, there was no association between lactate clearance and death in multiple trauma-treated patients<sup>25</sup>. In the present study the relation between lactate clearance and mortality was not found to be statistically significant.

# 5. Conclusion

No significant relationship exists in our study between lactate admission or lactate clearance and death rates in trauma patients. Higher sample size can be appropriate to arrive at definitive evidence.

# 6. Source(s) of Support

No financial support was received for this study.

# 7. Conflicting Interest

The authors declare no conflict of interest.

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