Sensitivity and Specificity of Initial Lactate Level in Predicting 24-Hour Mortality in Multi-Trauma Patients in Comparison to Revised Trauma Score

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ABSTRACT

Objective — *To compare the ability of serum lactate levels and Revised Trauma Score (RTS) in predicting 24-hours mortality in hemodynamically unstable multi-trauma patients.*

Study design — *Cross-sectional analytic study.*

Place & Duration of study — *Dr. Ruth K. M. Pfau Civil Hospital Karachi, from February 2022 to August 2022*

Methods — *A total of 222 patients of 18 to 75-years of age who presented in the Emergency Department with multi-trauma were enrolled. The outcome variables noted were lactate level, Revised Trauma Score and mortality. All the collected data were entered into SPSS version 20 and analyzed.*

Results — *The mean age of the patients was 40.67±12.5 years. There was a male preponderance (n=170 – 76.6%). The most common mechanism of injury was stabbing (n=80 - 36%). The 24-hours' mortality among patients with multi-trauma was 6.8% (n=15) and the area under the curve of lactate levels and Revised Trauma Score in predicting 24-hours mortality were 0.497 and 0.451 respectively. The findings were statistically insignificant.*

Conclusion — *In patients with multi-trauma the lactate level and Revised Trauma Score were not reliable in predicting the 24-hours mortality.*

Key words — *Multi-trauma, Mortality, Lactate level, Revised Trauma Score.*

INTRODUCTION:

In low-income developing countries including Pakistan injuries and trauma are among the top ten contributors to disease burden resulting in disabilities. Younger age group including children below 18-years of age are most frequently involved.[1] There are various trauma scores currently being employed to assess the patients brought to Emergency Room as a result of assault, violence, falls, motor vehicle accidents, occupational, sports and other injuries including. The trauma scores including GAP (Glasgow Coma Score - GCS + Age + Blood Pressure), MGAP (Modified GAP), Revised Trauma Score, were designed to recognize severity of these injuries. However, the calculation at times becomes cumbersome and may not be useful.[2,3] Studies from different parts of the world and Pakistan have provided the incidence of trauma as well as utility of different tools used to predict the outcome.[4-6]

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Hypoperfusion in a hemodynamically unstable patient leads to the production of lactic acid because of tissue hypoxia. Serum lactate is a marker of this pathological mechanism. It also indicates inflammation, dysregulation of immune system and sepsis.[7,8] The serum levels of lactate can be used to predict the mortality in trauma patients.[9,10] In emergency departments, Revised Trauma Score is mostly used for assessment of trauma patients which is a clinical based scoring system that helps in quick assessment of patients. There is a dearth of literature on this subject from Pakistan. This study was planned to compare the predictive ability of serum lactate levels and RTS also called, Physiologic Trauma Score in predicting 24-hours mortality at presentation to Emergency Room.

METHODS:

Study design, place and duration: This cross sectional analytic study was conducted in Dr. Ruth K. M. Pfau Civil Hospital and SMBB Trauma Center Karachi, from February 2022 to August 2022.

Ethical considerations: An informed consent was taken from the attendants / patients where applicable. This was a dissertation-based article for which approval was obtained from College of Physicians & Surgeons Pakistan.

Inclusion criteria and exclusion criteria: All patients between 18-75-years of age of either gender, who presented within 12-hours of multi trauma (more than one organ system involved) and hemodynamic instability (a systolic blood pressure <90 mmHg and a heart rate >100 bpm at any point onwards from the time of reporting), were included in the study. Trauma victims who were hemodynamically stable were excluded.

Sample size estimation: Sample size was calculated by using PASS 11. By using the AUC 0=0.78, AUC1=0.87, [11] power 80% and confidence level 95% the required sample size was 222. Non-probability consecutive sampling technique was used.

Study protocol: The demographic data like age, gender, were collected. The assessment of initial lactate level (within 30-minutes of arrival to the triage) was done. Simultaneously calculation of the Revised Trauma Score was done for each patient after clinical examination. This score varied between 0 to 4 depending on the values of GCS score, systolic blood pressure and respiratory rate. Additional data collected included time of injury, mechanism of trauma, GCS score, systolic and diastolic blood pressure readings, heart rate, respiratory rate, co morbid conditions like diabetes mellitus, hypertension, smoking status..

Statistical analysis: SPSS Software Version 20 was used in this study for data entry and analysis. Continuous / quantitative variables (age, time of injury, GCS score, blood pressure, respiratory rate, lactate levels, Revised Trauma Score) were reported as mean and standard deviation or median interquartile range (IQR) based on the normality of data for which Shapiro-Wilk test was used. The categorical / qualitative variables such as gender, mechanism of trauma, diabetes mellitus, hypertension, smoking status, and 24-hours mortality were reported in frequencies and percentage level. Sensitivity and specificity of serum lactate level and the Revised Trauma Score for predicting mortality was determined by the area under the curve analysis. Effect modifiers such as age, gender, mechanism of trauma, diabetes mellitus, hypertension, and smoking status were controlled through stratification. Post-stratification sensitivity and specificity of serum lactate level and Revised Trauma Score for predicting mortality was determined by area under the curve analysis, taking p-value <0.05 as significant.

RESULTS:

A total of 222 patients were enrolled. The mean age of the patients was 40.67±12.5 years. There was a male dominance (n=170 - 76.6%). Vital signs at presentation and lactate levels are given in table I. The most common mechanism of injury was stabbing (n=80 - 36%). Diabetes mellitus was the most frequent co-morbid condition (n=66 - 29.7%) followed by hypertension (n=19 – 8.6%). A total of 144 (64.9%) patients were smokers. The 24-hour mortality among patients with multi- trauma was 6.8% (n=15). Details are given in table II.

This study showed a low diagnostic accuracy of both lactate levels and Revised Trauma Score in predicting 24-hours mortality with area under curve of 0.497 and 0.451 respectively. Details are given in table III. In addition, both lactate level (3.5) and Revised Trauma Score (2.5) had insignificant sensitivity and specificity in predicting mortality (Figure I).

AUC analysis of lactate level and Revised Trauma Score in predicting 24-hours mortality after the stratification of the effect modifiers (age, gender, mechanism of injury, smoking status and comorbid) is shown in table IV.

Table I: Demographic and Clinical Details

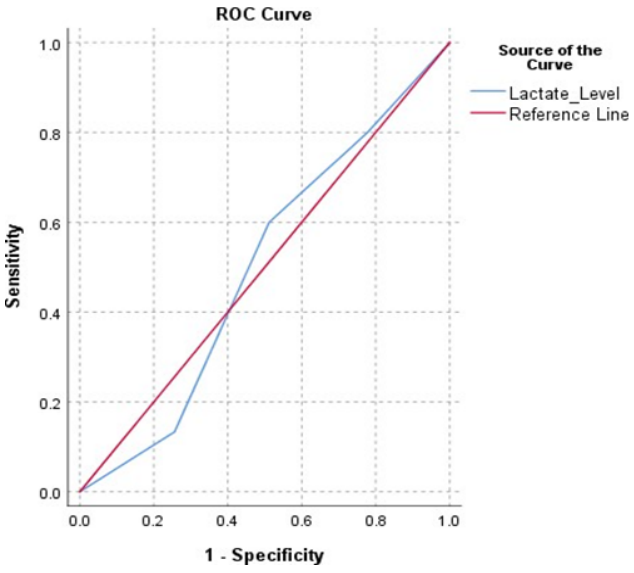
Characteristics	Mean (±SD)	Median (IQR)
Age (Years)	40.67 ± (12.55)	41 (30 - 51)
Duration After Injury (Hours)	2.07 ± 0.82	02 (1 - 3)
Glasgow Coma Scale Score	10.45 ± 2.55	10 (9 - 12)
Systolic Blood Pressure (mm of Hg)	84.88 ± 18.02	82 (76 - 89)
Diastolic Blood Pressure (mm of Hg)	44.19 ± 8.85	44 (36 - 52)
Respiratory Rate (per minute)	25.16 ± 12	30 (1 - 35)
Lactate Level (mmol/L)	3.55 ± 1.09	04 (3 - 5)
Revised Trauma Score	2.99 ± 0.68	03 (3 - 3)

Table II: Mechanism of Injury and Revised Trauma Score

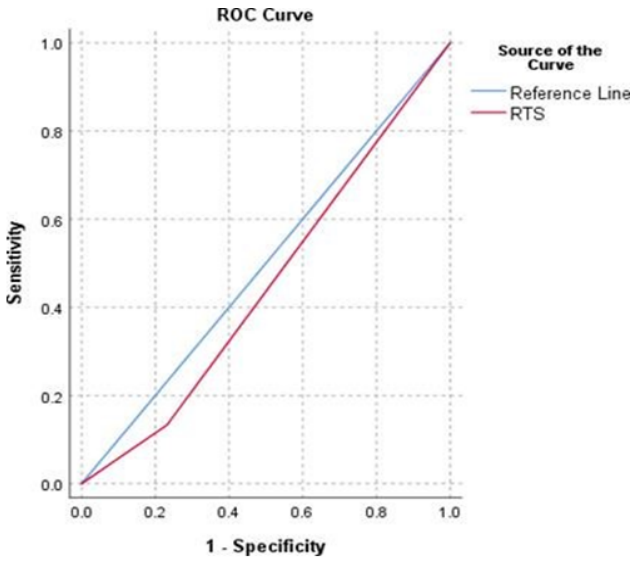
Characteristics	Frequency and Percentages n (%)
Mechanism of Injury	
Stabbing	80 (36%)
Fall	72 (32.4%)
Motor Vehicle collision	70 (31.5%)
Revised Trauma Score	
2	53 (23.9%)
3	119 (53.6%)
4	50 (22.5%)

Table III: Diagnostic Value of Lactate Level and Revised Trauma Score In Predicting 24-hours Mortality

Test Result Variables	AUC (95% CI)	Standard Error	p-value
Lactate Level	0.497 (0.361- 0.633)	0.07	0.965
Revised Trauma Score	0.451 (0.30 8- 0.593)	0.073	0.499



ROC of Lactate levels



ROC of Revised Trauma Score

Figure I: Receiver Operating Characteristic (ROC) Curve for Lactate Levels and Revised Trauma Score

Table IV: Post-stratification AUC of Lactate Level and Revised Trauma Score

Variable(s)	Lactate Levels / Revised Change Trauma Score	AUC (95% CI)	Standard Error	p-value
Gender				
Male	Lactate levels	0.402 (0.238-0.566)	0.084	0.243
	Revised Trauma Score	0.456 (0.277-0.636)	0.092	0.633
Female	Lactate levels	0.67 (0.486-0.854)	0.094	0.07
	Revised Trauma Score	0.451 (0.224-0.678)	0.116	0.673
Age				
< 40 Years	Lactate levels	0.383 (0.157-0.609)	0.115	0.309
< 40 Years	Revised Trauma Score	0.343 (0.161-0.525)	0.093	0.091
> 40 Years	Lactate levels	0.599 (0.461-0.736)	0.07	0.159
> 40 Years	Revised Trauma Score	0.544 (0.352-0.735)	0.098	0.654
Mechanism of Injury				
MVC	Lactate levels	0.33 (0.082-0.577)	0.126	0.177
	Revised Trauma Score	0.489 (0.122-0.855)	0.187	0.952
Fall	Lactate levels	0.568 (0.366-0.77)	0.103	0.507
	Revised Trauma Score	0.387 (0.209-0.565)	0.091	0.212
Stabbing	Lactate levels	0.552 (0.366-0.738)	0.095	0.584
	Revised Trauma Score	0.539 (0.334-0.744)	0.105	0.71
Diabetes Mellitus				
Diabetic	Lactate levels	0.417 (0.162-0.671)	0.13	0.521
	Revised Trauma Score	0.744 (0.523-0.964)	0.113	0.03*
Non-Diabetic	Lactate levels	0.506 (0.315-0.696)	0.097	0.953
	Revised Trauma Score	0.323 (0.168-0.477)	0.079	0.024*
Hypertension				
Hypertensive	Lactate levels	0.741 (0.574-0.908)	0.085	0.005*
	Revised Trauma Score	0.532 (0.339-0.725)	0.099	0.747
Non-Hypertensive	Lactate levels	0.425 (0.274-0.577)	0.077	0.334
	Revised Trauma Score	0.428 (0.256-0.599)	0.088	0.409
Smoking				
Smoker	Lactate levels	0.496 (0.306-0.686)	0.097	0.966
	Revised Trauma Score	0.457 (0.273-0.641)	0.094	0.647
Non-Smoker	Lactate levels	0.495 (0.335-0.654)	0.081	0.946
	Revised Trauma Score	0.438 (0.222-0.655)	0.11	0.577

DISCUSSION:

Trauma is a common surgical emergency with significant morbidity and mortality. Counseling of the family and predicting the outcomes are equally important while resuscitation is being attempted. Various tools are used to help to predict the mortality. This study showed a low diagnostic accuracy of both lactate level and Revised Trauma Score in predicting 24-hours mortality in multi-trauma patients. This raises concern about the application of such tools in a particular geographical region. However, the need of new and improved scoring system cannot be underestimated.

In patients with trauma, severity of shock, assessment and adequacy of resuscitation are the key measures taken in ER. Vital signs are regularly monitored as initial step to assess the stability and adequacy of the management. However, they are known to underestimate the severity of shock.[12]

Measurement of base deficit and central venous oxygen saturation provide more accurate information compared to the vital signs.[13]

In the era of damage control resuscitation, limiting the volume of crystalloid administered, using blood and plasma and massive transfusion protocol early if indicated, has demonstrated improved outcome.[14] Lactate, the metabolic byproduct of anaerobic metabolism, is a sensitive marker of shock and adequacy of resuscitation, as they are associated with hypoperfusion, along with other parameters.[15] Serum lactate level measurement was also included in the performance measure developed by researchers. It is used to predict death in patients with sepsis as well as trauma.[16, 17] In this study the lactate levels were used to predict the mortality.

Number of studies have examined the predictability of different scoring systems in multi-trauma patients. New Injury Severity Score (NISS) is a benchmark score in this context. Other scales used include Battle Casualty Severity Scores and the Military Battle Injury Scale (MBIS) as well as Abbreviated Injury Scale 2005-Military (mAIS).[18] For brisk evaluation, one of the studies with large number of trauma patients New Injury Severity Score was preferred over Trauma Mortality Prediction Model.[19] According to a study the New Injury Severity Scale had a high prediction potential for an in-hospital mortality.[20] Our study showed the unsatisfactory performance of Revised Trauma Score in predicting the mortality. This is in contrast to a study that reported better predictive ability of Revised Trauma Score for prognosis.[21] High lactate concentrations at presentation correspond to an elevated likelihood of death, and lactate clearance is an additional factor of death for patients with high lactate levels.[22] However, same is not found in our study as ROC curve analysis predicted mortality that was not significant statistically.

Our study reported a male-dominant study population that coincides with the previous studies.[23,24] The mean age of the study cohort is also in line with other studies.[24] The mortality after multi-trauma in this study was high as compared to the literature.[25] The stratification of the effect modifiers including age, gender, mechanism of injury, and smoking status did not show any statistically significant results.

Limitations of the study: The present study had several limitations. Firstly, the record of the organ-systems damaged in multi-trauma victims were not analyzed. This was an important confounding variable in trauma patients. Secondly, the details of the management were also not included that has a bearing on the mortality. Lastly, it was a single-center study. Further, larger multicenter studies are needed to evaluate the performance of these tools while addressing all the shortcomings mentioned above.

CONCLUSION:

In patients with multi-trauma the lactate level and Revised Trauma Score at arrival to ER did not help in predicting 24-hours mortality.

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