THE ROLE OF LACTATE CLEARANCE AS A PREDICTOR OF ORGAN DYSFUNCTION AND MORTALITY IN PATIENTS WITH SEVERE SEPSIS

Ehsan Bolvardi1, Jafar Malmir1, Hamidreza Reihani1, Amir Masoud Hashemian1, Mehran Bahramian2, Peyman Khademhosseini2, Koorosh Ahmadi2

1Department of Emergency Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
2Department of Emergency Medicine, Alborz University of Medical Sciences, Karaj, Iran

Corresponding author: Amir Masoud Hashemian, Mashhad University of Medical Sciences, Mashhad, Iran. Tel.: +989124244517. E-mail: hashemianam@mums.ac.ir

ABSTRACT

Background: Little is known about biomarkers which are used to classification of patients in order to diagnosis severity of sepsis among clients of emergency units. It seems that Lactate’s clearance can be used in this regard. This study aimed to determine the relationship between Lactate’s clearance, mortality and organ’s dysfunction with severe sepsis.

Materials and methods: In this study 90 patients with severe sepsis, were visited and examined exactly. Para clinical tests, serum venous lactate, organ’s dysfunction scores, Acute Physiology and Chronic Health Evaluation II (APACHE-II) and Sequential Organ Failure Assessment (SOFA) were applied upon admission and 6 hours after it. According to clinical and laboratory criteria, dysfunction in main organs were examined and Lactate’s Clearance was accounted. All the patients were cured according to early goal-directed therapy protocol.

Results: Among the participants 49 and 41 were male and female respectively. The mean age of the group was 49.37±1.41. The patients were classified to groups, less or more than 10% lactate’s clearance. Mortality rate of the patients was 18.9% (17 people). Mean age of the dead group was 49.71±13.33. The mean of dysfunctional organs which is assessed in terms of clinical, laboratory and SOFA criteria was significantly higher among the dead group than other. The Lactate’s clearance in the dead group was significantly lower than the other group (p<.05).

Conclusion: It was concluded that patients with severe sepsis is a marker which is related to tissue hypoxia, also lactate’s clearance increasing is related to drastic reduction in biomarkers, mortality, and incidence of organ’s dysfunction. Overall, patients with lower lactate’s clearance are counted a high risk group for mortality and organs’ dysfunction.

Key words: lactate, severe sepsis, prognosis, organ dysfunction.

1. INTRODUCTION

As a part of function promotion programs and based on the published researches, some emergency services and ICUs use lactate serum rate to qualitative resuscitation among patients with severe sepsis, but there is a general concept to use CVP and Scvo2 as physiological purposes of resuscitation. In spite of existing limitations to use CVP as a marker of quantity of intravenous and response to therapeutic liquid, the rate of CVP is relied and repeated measurements of Scvo2 rate is acceptable. If tissue hypo perfusion during the first 6 hours of resuscitation is continued and Scvo2 is less than 70%, inotrope infusion or Packed RBC transfusion can be used to reach hematocrit to 30%. There is a strong recommendation to promote CVP to 8 mm Hg and Scvo2 to 70% during the first 6 hours of resuscitation which is good; however, this is not confirmed as a standard procedure of the standard care. With respect to prevalence rate in patients with severe sepsis which represent with lactate ≥ 4 mmol/L and hypotension, hypotension solely or lactate ≥ 4 mmol/L solely, were 16.6%, 49.5 and 5.4% respectively, the mortality rate of septic patients with hypotension and lactate ≥ 4 mmol/L is high (around 1.46%) and the index among patients with severe sepsis and lactate (each separately) increase to 7.36% and 4.30% respectively. If Scvo2 is not reachable, normalization of lactate rate can be a practical choice among patients with tissue hypoperfusion due to sepsis. In a cohort study the role of serum lactate level and CRP among patients who were been in hospitals due to sepsis, is examined by Green et al. (2011) and it was finally found out that hyperlactemia is a good index to prediction of mortality rate among the group (1).

Krishna et al. (2009) in a non-intervention prospective
The Role of Lactate Clearance in Patients with Severe Sepsis

The role of lactate clearance in patients with severe sepsis was studied to determine the level of lactate serum as a predictive factor of shock, showing increasing in lactate levels were very accurate to predict morbidities among patients with sepsis and trauma (2).

Nguyen and colleagues in 2010 did a randomized prospective study and with assessment of lactate serum level and biomarkers (like IL-1, IL-6 receptor antagonist, IL-8, IL-10, TNF-α and so on) upon admission and 6 hours later as well as examination of organs’ dysfunction via APACHE2. Showed that fast lactate clearance as an alternative can predict healing of organs’ function, good consequence for severe sepsis as well as sepsis shock (3).

In 1999, James and colleagues found out high level of lactate serum among traumatic patients or septic ones is an index of tissue hypoxia and aerobic glycolysis, even when blood pressure, heart output, and urine volume are in an acceptable clinical extension, lactate serum is increased (4).

This study aimed to examine the early and serial serum and lactate clearance level to predict the probability of organs’ deficiency among hospitalized patients in emergency units due to severe sepsis or septic shock.

2. MATERIAL AND METHODS

This study is a cross sectional. Among referents to emergency unit of Mashhad’s Emam Reza (Iran) from August to December 2012, 90 adult volunteers with the first time sepsis and having research criteria, were studied. Sample size has been counted based on previous study by Jean Bakker et al. in 2006 (5).

Upon admission, a complete description of demographic variables, history of medical visits and tests were gathered by researcher, and the tests were repeated 6 hours later. Finally, after definite diagnosis of sepsis, scores for APACHE2, SOFA, and lactate clearance were recorded from hospitalization to 24 hours after that; the mortality rate was also recorded. The organ dysfunction in 6 main organs, according to table 3 criteria, was checked and the checklists were completed. All patients were informed before including in the study, and they (or relatives) signed a consent which showed that fast lactate clearance as an alternative can predict healing of organs’ function, good consequence for severe sepsis as well as sepsis shock (3).

Variables | Frequency | Mean | Min. | Max. | Standard deviation
--- | --- | --- | --- | --- | ---
Age (years) | 90 | 49.73 | 18 | 65 | 13.41
Temperature | 90 | 38.68 | 35 | 41 | .854
Arterial blood pressure | 90 | 63.67 | 5.50 | 110 | 13.47
Respiration rate | 90 | 28.47 | 10 | 44 | 6.46
Heart rate | 90 | 108.59 | 54 | 160 | 12.63
APACHE2 score | 90 | 20.5 | 9 | 30 | 3.88
SOFA score | 90 | 8.82 | 4 | 13 | 2.01
Lactate serum rate mmol/L | 90 | 2.68 | 1.5 | 4.6 | .755

Table 1. Physiological, laboratory Assessment of Hospitalized Participants

Variables | Death | Alive
--- | --- | ---
Male | (11) 64.7% | (38) 52.1%
Female | (6) 36.3% | (35) 47.9

Table 2. Prediction of mortality rate of genders

In the Table 1, variable such as age, temperature, and other related variables are presented and indexes like frequency, mean, minimum, maximum, and standard deviation are included. Among 90 patients, 17 people passed away (mean age=49.71±13.33), no significant difference between the subgroups’ mean and the main groups age. Among the subgroups 64.7% were male and the rest was female, and among alive group 52.1 were male and the rest was female; again no significant difference was seen between the gender groups in terms of mortality rate (p=.597).

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Mean of arterial blood pressure at 6 hours of study among alive group was 24.21±5.05 and for the passed away group was 26.11±2.64 which is sig-

3. RESULTS

Demographic information

Age: mean age of the male group was 52.16 ± 12.44; the index for females was 46.82 ± 14.09. Chi-square statistics showed no significant difference between the groups. The mean age of the group as a whole was 49.73 ± 1.41
Heart rate of the patients per minute among the lively subgroup was 102.2±14.77 and among the other subgroup 104.1±5.99 with no significant difference based on Mann-Whitney test (p=0.0365). Score SOFA, 6 hours of study among the alive subgroup was 5.28±2.26, and in the passed away group 11.1±1.36, so the difference was significant in Mann-Whitney test (p<0.0001). The rate of lactate clearance at 6 hours of study among the alive subgroup was 10.9±4.99 and for the other subgroup 6.88±3.1, a significant difference in Mann-Whitney test (p<0.0001). The mean of deficient organs, 6 hours after study for the alive and passed away groups were 0 and 3 respectively (p=0.042).

Lactate Clearance

In this study, lactate clearance was tested for 2 times (upon admission and 6 hours later); results are included in the Table 4. Patients were classified into 2 groups according to Lactate clearance and previous studies results, (less than 10% and more than 10% Lactate clearance). The index at 6 hours of study for male was 25 (52.1%) and 24 (57.1%) for less and more groups respectively. The situation for female group was 23 (47.9%) and 18 (42.1) respectively as the above mentioned order.

Mortality rate among the groups was 13 (76.5%) and 4 (23.5%) for the less and more groups which is significant in chi-square statistics (p=0.05). From total amount, 63 patients showed no deficiency in organs (70%), 12 people (13.3%) one organ, 2 patients (2.2%) 2 organs, 5 people (5.6%) 3 organs and in 8 patients (8.9%) 4 organs or more had deficiency.

In our study, significant relationship was found between number of deficient organs and mortality rate and increasing in APACHE2 score. The situation can be ascribed to severity of diseases as well as insufficient early treatments or delayed resuscitation activities.

In some studies, mortality rate of severe septic patients among 41% early lactate level and more than 3.5mmol/L was reported.

Rivers et al. (14) used early goal-directed therapeutic protocol during the first 6 hours which led to tissue hypoxia
reduction, 16% reduction in mortality rate of severe septic group and in effect reduction in lactate level.

There was also an improvement in tissue hypoxia after a short term prescription of vasopressors; however, long term taken of the medicine can lead to reduction in lactate clearance as well as improvement (15). In a randomized study, it was also found that the early intervention led to 16% reduction in mortality rate. In several studies it was reported that having fluids, vasopressors and blood in experimental groups with increasing lactate to 20% during 2 hours, led to drastic reduction among hospitalized group with severe sepsis.

We did not examine infectious origin of patients. According to Kobayashi et al. (16) hematologic disorders (like leukocytosis, anemia, and thrombocytosis) are common among severe septic group. Change in coagulation mediators and fibrinolysis is associated with DIC and increasing in mortality rate. Patients with severe sepsis who suffer from DIC show serial lactate serum level. Mortality rate increases with number of deficient organs, so that one organ’s deficiency is associated with zero mortality, 2 the organs (15.99% mortality), 3 the organs (22.4% mortality) and 4 organs (28.6% mortality) which are in line with the previous studies.

In previous studies lactate level per se was used to predict situation of hospitalized patients in ICUs. Lee TR et al. study (17) a significant relationship was found between neurological consequences among patients with lactate clearance during 6 hours of beginning treatment.

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- **Conflict of interest:** none declared.

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