Original Article

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Plasma Lactate Levels in Carbon Monoxide Intoxication, Can be Used at First Step?

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Abstract

Objectives: The aim of this study was to determine whether there was a significant relationship between carboxyhemoglobin levels and plasma lactate levels at the time of admission in patients who had been admitted to the emergency department due to carbon monoxide intoxication.

Materials and Methods: In this retrospective-cross-sectional study, patients diagnosed with toxic effects of carbon monoxide were evaluated among the patients admitted to the emergency department between 01.01.2013-01.01.2017. Patients were classified as Group 1 (10% -20%) and Group 2 (20% and above) according to their carboxyhemoglobin levels.

Results: A total of 404 patients were included in the study. The mean carboxyhemoglobin level was 21.2 ± 8% for all cases and 14.6 ± 3% for Group 1 and 27.8 ± 6% for Group 2. The difference between the two groups was statistically significant (mean difference 13.2; 95% CI = 12,198-14,157) (p <0.001). The number of patients with lactate levels above normal in Group 2 was higher than Group 1 (p <0.001). There was a significant difference in lactate levels between two exposure groups (p <0.001). There was a correlation between carboxyhemoglobin levels and lactate levels (r = 0,601, p <0,001). In the ROC analysis to determine the value of lactate levels in the diagnosis of severe exposure (Group 2), AUC was calculated as 0,791 (95% confidence interval, 0.748-0.835; p <0.001; Figure 1).

Conclusion: In the evaluation of cases of carbon monoxide poisoning, the question of whether plasma lactate level can be used as a marker is still being discussed. Based on the significant results that we found in our study, plasma lactate levels ,which is correlated with carboxyhemoglobin levels, may be helpful in the classification and evaluation of patients with carbon monoxide intoxication.

Key words: Carboxyhemoglobin, Carbon monoxide, Lactate, Poisoning

Özet

Amaç: Bu çalışmanın amacı karbonmonoksit zehirlenmesi nedeniyle acil servise başvurmuş olan olguların başvuru anındaki plazma laktat düzeyi ile COHb düzeyleri arasında anlamlı bir ilişki olup olmadığını değerlendirmektir.

Gereç ve Yöntem: Retrospektif-kesitsel bu çalışmada, 01.01.2013-01.01.2017 tarihleri arasında acil servise başvurmuş olgular arasından, hastane veri sisteminde 'Karbonmonoksitin toksik etkisi' tanı kodu mevcut olanlar incelendi. Hastalar karboksihemoglobin düzeylerine göre Grup 1 (%10-%20 arası) ve Grup 2 (%20 ve üstü) şeklinde sınıflandırıldı.

Bulgular: Çalışmaya toplam 404 olgu dahil edildi. Tüm olgular için ortalama karboksihemoglobin düzeyi %21,2±8 olup, Grup 1 için ortalama %14,6±3, Grup 2 için ise %27,8±6 olarak hesaplandı. İki grup arasındaki bu fark istatistiksel olarak anlamlıydı (ortalama fark, 13,2; %95 GA= 12,198-14,157) (p<0,001). Grup 2'de normalin üstünde laktat değerleri tespit edilen olgu sayısı, Grup 1'e göre fazlaydı (p<lt;0,001). İki maruziyet grubu arasında laktat değerleri açısından anlamlı fark tespit edildi (p<0,001). Karboksihemoglobin düzeyleri ile laktat seviyeleri arasında korelasyon mevcuttu (r=0,601, p<0,001). Ciddi maruziyet (Grup 2) tanısında laktat düzeylerinin değerliliğini araştırmak için oluşturulan ROC analizinde, AUC 0,791 olarak hesaplandı (95% güven aralığında , 0.748–0.835; p<0,001; Şekil 1).

Sonuç: Karbonmonoksit zehirlenmesi olgularının değerlendirilmesinde, plazma laktat düzeyinin bir belirteç olarak kullanılabileceği konusu hala tartışmalıdır. Çalışmamız, saptamış olduğumuz anlamlı sonuçlara dayanarak, karboksihemoglonin düzeyi ile korele bir yükseliş gösterdiğinden plazma laktat düzeylerinin olguların sınıflandırılmasında kullanılabileceğini göstermiştir.

Anahtar kelimeler: Karboksihemoglobin, Karbonmonoksit, Laktat, Zehirlenme

Introduction

Carbon monoxide (CO) gas poisoning rates in our country vary between 2.1% and 10.2% [1]. Carbon monoxide is a non-irritant, colorless and odorless gas which constitutes approximately half of fatal poisonings[2]. Over the years, CO poisoning remains an important cause of morbidity and mortality in winter, despite increasing public awareness efforts[3]. Carboxyhemoglobin (COHb), formed by CO binding to hemoglobin, blocks the release of oxygen to the tissues

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and creates hypoxia at the tissue level. Additionally, by disrupting the intracellular oxidative phosphorylation, it causes toxicity at the cellular level 4. When one CO molecule binds to the hem part of hemoglobin, allosteric alteration occurs, the binding affinities of remaining 3 oxygens are increased and the release of oxygen to the tissues is reduced[5]. The diagnosis of CO poisoning is best made by measuring the blood level of COHb[6]. Symptoms in CO poisoning are not specific. This causes an increase in delays and mortality in the diagnosis and treatment process[7]. Blood COHb levels are used to validate clinical suspicion of toxic gas exposure and to assess the severity of intoxication[8].

As an indicator of tissue hypoxia, lactate is a very important indicator of critical patient care. There are studies evaluating the validity of plasma lactate level as a prognostic marker in CO poisoning intoxication[9]. However, there is no clear decision about this topic. The aim of this study was to determine whether there was a significant relationship between COHb levels and plasma lactate levels at the time of admission in patients who had been admitted to the emergency department due to CO intoxication.

Materials and Methods

Study Design

This is a retrospective cross-sectional study. Between 01.01.2013 and 01.01.2017, the patients who were admitted to Atatürk University Faculty of Medicine Emergency Medicine Department and who were diagnosed as 'Toxic effect of carbon monoxide (T58)'in the hospital data system were studied. The study was approved by the ethics committee, by the same institution.

Patient Selection

Patients who had a COHb level of less than 10% and whose laboratory data could not be reached were excluded from the study. Patients aged below 18 years and above 65 years were not included in the study. Patients with chronic kidney and liver disease, atherosclerotic heart disease, diabetes, malignancy, coagulation disorder, hematological disease, antiplatelet and anticoagulant drugs were excluded from the study. Pregnant women were excluded from the study.

Study Protocol

Patients according to COHb level; 10% -20% were classified as 'mild exposure' (Group 1), 20% and above were classified as 'serious exposure' (Group 2)[6, 10]. Blood gas data obtained from the peripheral artery in the first 30 minutes of patients' admission to the emergency department were examined. Carboxyhemoglobin and lactate results were evaluated. For lactate, values below 2 mmol / L were considered normal.

Statistical Analysis

In the statistical evaluation of the data, IBM Statistics 20.0 (SPSS) statistical package program was used. The conformity of continuous variables to normal distribution was measured by Kolmogorov-Smirnov test. Student T test was used to compare the normal distribution of the data. Mann-Whitney U test was used for the comparison of the two groups of data that did not show normal distribution. Chi-square test was used to compare categorical variables. Percentage, frequency, mean and standard deviation values were given as descriptive statistics. Spearman correlation analysis was used to evaluate the relationship between lactate levels and COHb values. Receiver Operator Characteristics (ROC) analysis was used to determine the diagnostic value and cut-off value of lactate level in severe CO exposure. In the obtained ROC curve, the Area under the curve (AUC) value is close to 1, indicating that the value of the test is high. The significance level for the AUC obtained in the same test was also determined. Results were evaluated at 95% confidence interval and $p < 0.05$ at significance level.

Results

A total of 404 patients were included in the study. 172 (42.6%) of the cases were male and 232 (57.4%) were female. The mean age was 35 ± 12 years. There was no significant difference between genders in terms of age distribution ($p > 0.05$). No significant difference was found between the groups in Group 1 (81 males, 122 females, mean age 34 ± 12 years) with respect to age and sex distribution in group 2 (91 males, 110 females, mean age 36 ± 13 years) ($p > 0, 05$).

The mean COHb level was 21.2 ± 8 for all cases and the mean COHb for Group 1 was 14.6 ± 3 and the Group 2 was 27.8 ± 6. The difference between the two groups was statistically significant (mean difference 13.2; 95% CI = 12,198-14,157) ($p < 0.001$).

The median plasma lactate value of all cases was 1.9 (IQR 1.6), and in 201 (49.8%) patients lactate level was found to be above normal. The number of patients with lactate levels above normal in Group 2 was higher than Group 1 ($p < 0.001$). There was a significant difference in lactate levels between two exposure groups ($p < 0.001$). There was also a correlation between COHb levels and lactate levels when all parameters were evaluated ($r = 0.601$, $p < 0.001$).

We developed a ROC curve to investigate the value of plasma lactate levels in the diagnosis of severe exposure

cases categorized as Group 2. AUC for lactate was calculated as 0.791 (95% confidence interval, 0.748-0.835; p <0.001; Figure 1). We also found that a plasma lactate level of 3 mmol /L had a positive predictive value of 88% and a negative predictive value of 63%, which could be used as a cut-off value for Group 2 patients.

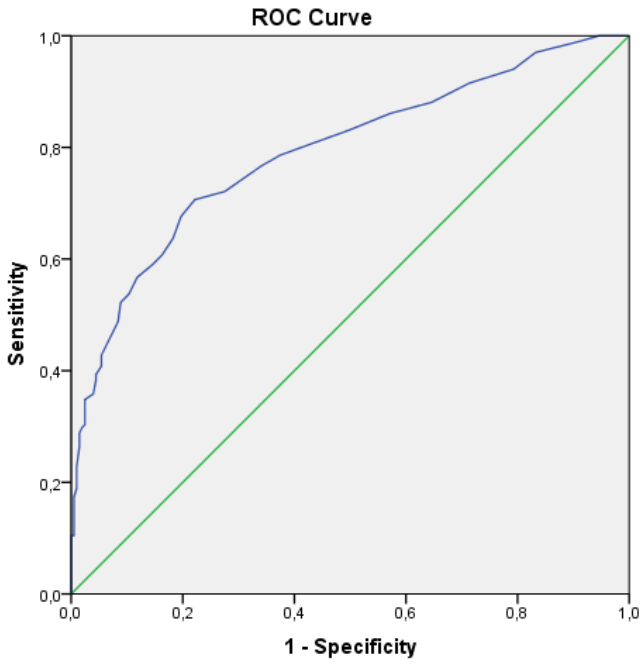

Figure 1. The ROC curve analysis for plasma lactate level.

Discussion

In the evaluation of patients who presented to the emergency department with CO poisoning, there are different opinions that plasma lactate levels can be used in the diagnosis and treatment process, similar to COHb levels. Considering that the poisoning mechanism is tissue hypoxia, it is still controversial that high lactate levels may be an important predictor of the patient clinic. Benaissa et al. in their study with 146 patients in CO poisoning, did not support evidence of lactate measurement is useful[11]. On the other hand, Cervellin et al. stated that high lactate levels are important in patient triage and may be used as a prognostic marker for the follow-up period[9]. Similarly, there are studies in the literature that support plasma lactate levels correlated with COHb levels in cases of CO intoxication[12, 13]. Taken together, the published evidence about the clinical significance of plasma lactate levels in CO-poisoned patients is insufficient and controversial, so the results of our study may have some meaningful clinical implications.

In our study, we found a significant correlation between COHb levels and plasma lactate levels of CO intoxication cases. This was consistent with similar literature[12]. As stated in Doğan et al. we also think that the strong correlation coefficient between these two laboratory parameters may be related to the high COHb levels in our study[13].

In our study, we found that the plasma lactate levels of patients with a COHb level 20% or higher, who were classified as 'serious exposure', were above normal range. In addition, due to the high specificity and high positive predictive value that has been found for plasma lactate level 3 mmol /L in our study, we believe that it can be used as a cut-off value for severe exposure.

There are some limitations in our study. Since the study was conducted at a single center, the characteristics of different patient populations from different regions could not be evaluated. regional differences could not be evaluated in terms of data heterogeneity. However, due to the large patient population in our study, we believed that we have eliminated this limitation by providing a heterogeneous patient distribution. Due to the retrospective nature of the study, there is a lack of data about patient files in 4 years. Therefore, it was not possible to collect the data of patients' clinical symptoms.

Conclusion

It is still controversial that plasma lactate levels can be used as a marker for the evaluation of CO intoxication cases in emergency departments. Based on the significant results that we found in our study, plasma lactate levels ,which is correlated with COHb levels, may be helpful in the classification and evaluation of patients with CO intoxication.

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