

Predictive Factors for the Necessity of Hospitalization of Patients With Acute Alcohol Intoxication

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Abstract

Background: The aim of the study was to identify factors related to the need for hospitalization due to acute alcohol intoxication.

Methods: The data of 42 patients with acute alcohol intoxication who visited our hospital from April 1, 2014 to September 30, 2015 were available for analysis. Factors related to outcome included hospitalization or release to home, Glasgow coma scale (GCS), temperature, pulse rate, blood pressure, oxygen saturation of the peripheral artery (SpO₂), and respiratory rate. A retrospective survey was done that included estimated blood alcohol concentration, osmotic pressure, and serum lactate level. The following formula was used to estimate blood alcohol concentration: (measured osmotic pressure - estimated osmotic pressure × 4.6 mg/dL). Univariate analysis of each variable was done for the two outcome groups, hospital admission or release to home, then statistically significant items were subjected to multivariate analysis.

Results: Of the 42 patients (average age 22.8 ± 8.6 years, 33 men, six women), 29 were admitted and 13 were released to home. There was a weak correlation between estimated blood alcohol concentration and GCS. There was no significant difference in alcohol concentration or GCS between the hospitalized and released to home groups. In multivariate analysis using the outcome as the objective variable, a serum lactate level of 26 mg/dL or higher was associated with the need for hospitalization (odds ratio: 6.7).

Conclusion: A serum lactate level of 26 mg/dL would be useful for deciding if hospitalization is necessary for patients with acute alcohol intoxication.

Keywords: Alcohol intoxication; Serum lactate level; Hospitalization

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Introduction

Emergency department (ED) visits for acute alcohol intoxication are common [1-4]. Most are mild cases, but sometimes severe cases are experienced. Although often the estimated alcohol concentration is related to the level of consciousness, other causes must be considered if there is dissociation between the estimated alcohol concentration and the symptoms. Some patients have strong symptoms even with a low estimated alcohol concentration, and a decision on admission or release to home can be difficult in cases with few symptoms despite a high estimated alcohol concentration. Previous studies have shown that the blood alcohol level is not directly associated or correlated with severity or consciousness disorder [5].

The serum lactate level has become an important prognostic indicator for patients receiving emergency treatment [6]. Blood lactate is an anaerobic metabolite that reflects the severity of the disease state and that can be used as an index of circulatory and respiratory failure. In particular, it is a useful index for predicting the outcome from changes over time and determining the therapeutic effect [7, 8].

During heavy drinking, the nicotinamide adenine dinucleotide oxidized/reduced (NADH/NAD⁺) ratio increases due to the metabolism of ethanol. An increased NADH/NAD⁺ ratio also promotes conversion of pyruvic acid to lactate, which tends to accompany hyperlactacidemia [9]. It has been reported that the lactic acid level does not fluctuate significantly between venous blood and arterial blood, making it easy to test [10]. The plasma lactate level has been reported to be an independent prognostic factor for drug overdose patients [11], and we hypothesized that it might also be useful for monitoring excessive alcohol consumption. In previous reports [12], alcoholic liver damage caused by chronic alcohol intake was associated with elevated lactate. A recent report [13] found that alcohol intake contributed to an increase in lactic acid, regardless of disease.

Even if Glasgow coma scale (GCS) is bad when intoxicated patients arrive at the hospital, some people will eventually recover by intravenous drip, while others will need to be hospitalized and may not wake up for hours; thus, the lactate level might be a useful index for determining the need for hospitalization of patients in a drunken stupor.

This paper was done to identify factors other than the level of consciousness and blood alcohol level on arrival that would be useful for determining the severity and for predicting the

necessity of hospitalization of patients with acute alcohol intoxication.

Materials and Methods

Subjects

This was a retrospective review of the data of patients who were transported to Fukuoka University Hospital by ambulance because of acute alcohol intoxication between April 2014 and September 2015. Of the 42 patients, 29 were hospitalized and 13 were released to home. The decision to admit the patient to the hospital depended on the examining physician. Blood tests were performed upon arrival at the emergency room. Data on the following clinical items were collected: age, sex, outcome in terms of hospitalization or release to home, GCS, body temperature, pulse rate, blood pressure, SpO₂, respiratory rate, estimated alcohol concentration, and serum lactate (mg/dL × 0.11101 = mmol/L). For the calculation of estimated alcohol concentration, the formula “(measured osmotic pressure - estimated osmotic pressure) × 4.6 mg/dL” was used. In addition, patients who presented with other conditions, for example, shock, bacterial infection, disseminated intravascular coagulopathy, diabetes mellitus, or liver failure that might affect plasma lactate concentration were excluded. This study was conducted in compliance with the ethical standards for human subjects and the Declaration of Helsinki and was approved by the Institutional Review Board of Fukuoka University Hospital (Reference No. 16-8-12).

Statistical analysis

All statistical analyses were performed with EZR [14], a modified version of R commander designed to add statistical functions frequently used in biostatistics. We regarded $P < 0.05$ as statistically significant. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. Univariate analysis was done with all variables to determine differences between the hospitalized and released to home groups. Multivariate logistic regression analysis was done with body temperature, respiratory rate, and lactate as explanatory variables and hospitalization or release to home as objective variables. The discriminative ability of the multivariate model was evaluated by receiver operating characteristic (ROC) curve. Cutoff values were set with “hospitalization or release to home” as the objective variable and “serum lactate level”, “respiratory rate”, “body temperature”, and “blood pressure” as the explanatory variables. The sensitivity, specificity, and likelihood ratio of the identified independent variables were calculated.

Results

Figure 1 shows the relation between GCS and the estimated alcohol concentration at the time of the emergency visit. Estimated alcohol concentration and GCS had a weak negative correlation (correlation coefficient minus 0.42). Our results

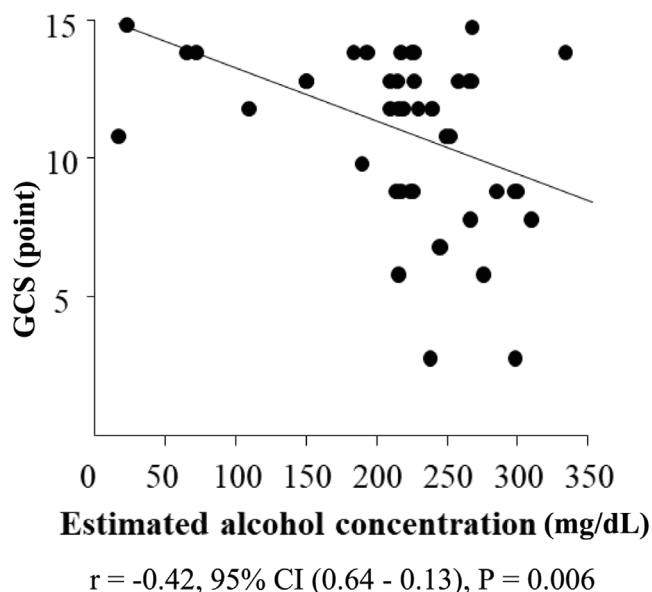


Figure 1. Relation between GCS and estimated alcohol concentration at the time of the emergency visit. Analysis of the estimated alcohol concentration and GCS showed a weak negative correlation coefficient of 0.42. GCS: Glasgow coma scale.

also showed a decrease in the level of consciousness when the estimated alcohol concentration was from 160 to 200 mg/dL.

Table 1 shows a comparison of the hospitalized and released to home groups for each background factor. There was no significant difference in GCS or estimated alcohol concentration, but there were significant differences in age, body temperature, respiratory rate, and serum lactate level. The age of the patients was concentrated around 20 years.

Table 2 shows the results of multivariate analysis. The only factor extracted that was related to the necessity of hospitalization was the serum lactate level. When the serum lactate level was 26.0 mg/dL (2.9 mmol/L) or higher, the patient was hospitalized 6.67 times more often than if the level was lower than 26.0 mg/dL (2.9 mmol/L).

Table 3 is a summary of the characteristics of diagnostic prediction in cases where a serum lactate level of 26.0 mg/dL (2.9 mmol/L) or more was indicated for hospitalization. The sensitivity was 0.769 and the specificity was 0.667.

Discussion

This is the first study to show that the serum lactate level is useful for predicting the need for hospitalization due to acute alcoholism intoxication.

Studies of alcohol concentration and disturbance of consciousness have related 100 mg/dL to impaired judgment, 200 mg/dL to amnesia, and 400 mg/dL to respiratory depression and coma [15]. Although we found weak correlations, as shown in Figure 1, we were unable to show accurate correlations or to evaluate these data because the distributions were too diverse. In addition, the consciousness level of patients with alcohol in-

Table 1. Clinical Characteristics

	Admitted (n = 29)	Released to home (n = 13)	P-value
Age (years) ^a	20.9 ± 1.8	26.8 ± 14.8	0.038
Male (%)	21 (72.4%)	12 (92.8%)	NS
Body temperature (°C)	36.2 ± 0.8	35.8 ± 0.4	0.033
SBP (mm Hg) ^a	115.2 ± 15.8	113.9 ± 16.5	0.812
DBP (mm Hg) ^a	64.7 ± 13.5	66.5 ± 14.3	0.683
Pulse rate (/min) ^a	83.1 ± 21.9	89.4 ± 15.0	0.354
Respiratory rate (/min) ^a	20.5 ± 6.4	15.7 ± 4.4	0.021
GCS (point)	10.7 ± 3.0	12.1 ± 3.0	0.167
Estimated alcohol concentration (mg/dL) ^a	198.7 ± 71.4	219.5 ± 45.7	0.343
Serum Na	145.8 ± 2.6	145.4 ± 3.2	0.634
BUN	10.3 ± 3.1	11.0 ± 4.1	0.528
Glucose	112.1 ± 23.6	108.8 ± 19.8	0.666
Serum lactate (mg/dL) ^a	35.9 ± 12.4	25.8 ± 12.4	0.030

^aData are shown as average ± standard deviation (range). SBP: systolic blood pressure; DBP: diastolic blood pressure; GCS: Glasgow coma scale; NS: no significant difference; BUN: blood urea nitrogen.

toxication can be easily changed by the appropriate hydration.

The most common cause of elevated blood lactate, in general, is circulatory shock. Acute or chronic alcohol abuse predisposes a person to sepsis, gastrointestinal hemorrhage, pancreatitis, and other disorders that can lead to shock. In emergency medicine, lactic acid is a useful metabolite of anaerobic glycolysis. It is used as an index to the severity of peripheral circulatory insufficiency, such as shock. We hypothesized that the serum lactate level might also be a useful marker as an index of the need for hospitalization for acute alcohol intoxication. In our study, lactate levels were measured in venous blood. A previous study reported that the lactate level of venous blood was increased 1.7 times after drinking alcohol [13], and ethanol intoxication was associated with a higher lactate level (mean difference: 0.69 mmol/L; 95% CI, 0.11 to 1.27 mmol/L) [16]. A blood lactate concentration in excess of 45 mg/dL (5 mmol/L)

on intensive care unit admission was associated with 3- and 30-day mortality rates of 59% and 83%, respectively [17]. Acute alcoholism may result in hospitalization due to social problems, slow awakening, or violent behavior. We found that an increase in lactate was useful for determining the needed hospitalization or release. The increase in the lactic acid level in acute alcohol intoxication is due to the effect of alcohol decomposition, a decrease in tissue perfusion due to dehydration, and increases in anaerobic metabolism and pyruvate. Hospitalization is necessary when there is heavy alcohol consumption over a short period of time and dehydration. Severe lactic acidosis usually has a poor prognosis [18]. Plasma lactate concentrations were reported to be significantly higher than normal in patients who have recently consumed alcohol, even in patients without conditions known to increase lactate concentration [13].

Another important consideration in Japan is that acute

Table 2. Multivariate Analysis of Factors Related to Acute Alcohol Intoxication

	OR	95% CI	P value
Serum lactate level of 26 mg/dL or over	6.67	1.01 - 44.1	0.049
Body temperature (°C)	1.27	0.11 - 14.9	0.84
Respiratory rate (/min)	2.32	0.23 - 23.5	0.47

OR: odds ratio; CI: confidence interval.

Table 3. Accuracy of a Serum Lactate Level of 26 mg/dL or Over as a Predictor of Hospitalization

	Estimated value	95% CI
Sensitivity	0.769	0.564 - 0.910
Specificity	0.667	0.229 - 0.925
Positive predictive value	0.870	0.664 - 0.972
Negative predictive value	0.500	0.211 - 0.789

CI: confidence interval.

alcohol intoxication tends to be common among young people [19]. There are reports [20] that education on alcoholism shapes the environmental impact of alcohol use, thus more such intervention is necessary in Japan.

This study has several limitations. The first is the small number of cases, but the results provide a basis for more in-depth study. Second, the weak correlation of GCS may be because it is a calculated value rather than a direct measurement of alcohol concentration. Third, no hospital wide guidelines presenting criteria for hospitalizing a patient were in place at the time of the study. Lastly, this is a cross-sectional study, thus future prospective studies are needed.

Conclusion

We found that a serum lactate level of 26.0 mg/dL (2.9 mmol/L) or higher would be useful for predicting the necessity for hospitalization due to acute alcohol intoxication.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Informed Consent

All subjects provided written informed consent.

Author Contributions

Drs. Takeoka and Horibata were the lead researchers and analyzed the data. Drs. Masui, Suzuyama, and Ajisaka examined and treated the patients. Dr. Nabeshima supervised and helped design the study.

Data Availability

The authors declare that data supporting the findings of this study are available within the article.

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