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외상 환자에서의 혈중 알코올 농도와 임상 관련 인자간의 관계

연세대학교 의과대학 외과학교실, [1]연세대학교 원주의과대학 외과학교실

홍태화, 장지영[1], 이승환, 김형원, 심홍진[1], 이재길

- Abstract -

Relation between Blood Alcohol Concentration and Clinical Parameters in Trauma Patients

Tae Hwa Hong, M.D., Ji Young Jang, M.D.[1], Seung Hwan Lee, M.D., Hyung Won Kim, M.D., Hong Jin Shim, M.D.[1], Jae Gil Lee, M.D.

Department of Surgery, Yonsei University College of Medicine, Seoul
[1]Department of Surgery, Yonsei University Wonju College of Medicine, Wonju, Korea

Purpose: The aim of this study was to evaluate the effects of blood alcohol concentration (BAC) on the clinical parameters in trauma patients.

Methods: From January 2011 to March 2013, the records of a total of 102 trauma patients with BAC data were analyzed retrospectively. The revised trauma score (RTS), injury severity score (ISS), presence of shock, use of mechanical ventilation and blood transfusion, length of hospital stay, and mortality were collected. Patients were divided into four groups in accordance with the level of BAC: group A (<100 mg/dL), B (100～200 mg/dL), C (200～250 mg/dL), and D (>250 mg/dL). Patients were also divided into two groups depending on the presence of the shock, and gender, ISS, BAC, and presence of active bleeding were compared between these two groups.

Results: No statistically significant differences in the ISS, RTS, presence of active bleeding, use of mechanical ventilation, and mortality were noted between groups A to D. However, the presence of shock was significantly higher in group D. After patients with severe chest injuries had been excluded, mechanical ventilation was found to have been applied more frequently in the higher BAC groups (C and D). A logistic regression analysis of these factors showed that extremely high BAC (>250 mg/dL) was an independent indicator of shock.

Conclusion: High BAC is a predicator of shock and the need for mechanical ventilation in patients with trauma, regardless of injury severity. Alcohol intoxication leads to an overestimate of the clinical condition and aggressive management for trauma patients. Thus, a guideline for the diagnosis and treatment of patients intoxicated with alcohol is necessary. [J Trauma Inj 2015; 28: 256-261]

Key Words: Trauma, Alcohol, Shock

∗ Address for Correspondence : **Jae Gil Lee, M.D., Ph.D.**
Department of Surgery, Yonsei University College of Medicine,
50-1 Yonsei-ro, Seodaemun-gu, Seoul 03722, Republic of Korea
Tel : 82-2-2228-2127, Fax : 82-2-313-8289, E-mail : jakii@yuhs.ac

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I. Background

Increased blood alcohol concentration (BAC) may reduce judgment and self-control, increasing the likelihood of severe injuries from accidents.(1-6) In heavy drinkers, the likelihood of mortality is higher after a trauma-traffic accidents, burns or fires-than that of the general population.(2) Alcohol consumption is the leading cause of trauma and reason for visitation to the emergency department (ED). Moreover, alcohol-related injuries are significantly more serious than non-alcohol-related injuries.(1) In trauma patients, 47 % had positive BAC on ED admission.(3-5) There were some studies that evaluate the effects of alcohol consumption on injury type and severity.(7-9) However, the effects of alcohol concentration on injury mechanism and severity are less clear.(10) Furthermore, treatment and appropriate assessments for trauma patients with alcohol intoxication have not been systematically established. Alcohol intoxication is one of the causes for changed mental status after a trauma. However, it is too difficult to discriminate and attribute the cause of altered mental status to alcohol. Furthermore, alcohol intoxication induces the hypotension due to systemic vasodilatation. Therefore, the aim of this study is to evaluate the effects of BAC in trauma patients.

II. Methods

From January 2011 to March 2013, three hundred and thirty-seven patients were admitted to ED after a traumatic injury. The medical records of these patients were reviewed retrospectively. This study was approved by the Severance Hospital Institutional Review Board (IRB No. 4-2014-0188), and informed consents were waived due to its retrospective nature.

123 Patients who checked BAC during this period were selected. Among them, 21 patients with head trauma were excluded, because head trauma itself can cause loss of consciousness. Age, gender, diagnosis, time, and causes of injuries, vital signs at admission (blood pressure, pulse rate, respiratory rate, body temperature), and level of consciousness using Glasgow Coma Scale (GCS) were checked. Revised Trauma Score (RTS) at the time of admission and injury Severity Score (ISS) were also analyzed to evaluate injury severity. In addition, the presence of shock, use of mechanical ventilation (MV), amount of blood transfusion, presence of active bleeding, length of hospital stay, and mortality were identified as patients' parameters. Patients were divided into four groups in accordance to the BAC level; Group A, BAC<0.1% (100 mg/dL), Group B, BAC 0.1~0.2% (100~200 mg/dL), Group C, BAC 0.2~0.25% (200~250 mg/dL), and Group D, BAC>0.25% (>250 mg/dL) [2]. The RTS, ISS, use of MV, presence of active bleeding, occurrence of shock, and mortality were compared between the groups. Patients were also divided into two groups in accordance to shock occurrence. Gender, ISS, BAC, and presence of active bleeding were compared between the two groups in order to evaluate the factors that may influence shock.

Shock was defined as when systolic blood pressure was less than 90 mmHg or serum lactate was more than 2 mmol/L.(11) Moreover, the presence of active bleeding was defined when contrast extravasation was noted by a contrast computed tomography scan or clinically suspected.

All statistical analyses were performed using SPSS version 20.0 (SPSS, Inc, Chicago, Ill). Continuous variables were expressed as the mean±standard deviation (SD) or median (interquartile range), and analyzed by student t-test, Mann-Whitney U test, or analysis of variance (ANOVA). For comparison of categorical variables, chi-square test or Fisher's exact test was used. Statistical significance was accepted for $p<0.05$.

III. Results

1. Demographics

A total of 102 patients were enrolled in this study. Eighty-three patients were male (81.6%), and the mean age was 39.5±15.0 years old. Traffic accidents were the most common cause of injuries (65 patients, 63.7%), followed by falls (24 patients, 23.5%) and stab wounds (12 patients, 11.8%). Thirtyone (30.4%) patients underwent an emergency surgery, and 49 (48.0%) patients had chest injury with AIS (abbreviated injury scale) of 2 or greater (Table 1).

2. Effects of BAC

Of the 102 patients, 36 (35.3%) were in group A, 24 (23.5%) in group B, 18 (17.6%) in group C, and 24 (23.5%) in group D. There were no significant differences in RTS, ISS, presence of active bleeding, and mortality among the four groups. However, shock was significantly higher in group D (70.8%) than in group A (33.3%) and C (27.8%) (p=0.009). There was no significant difference in the use of mechanical ventilation (p=0.087) among the four groups. However, when patients with chest injury (AIS≥2) were excluded, the use of mechanical ventilation was significantly higher in group D (54.5%) than in group B (0 %) (p=0.046) (Table 2).

Table 1. General characteristics of trauma patients.

Total		N=102 (%)
Age (mean±SD)		39.5±15.0
Gender		
Male		83 (81.4)
Female		19 (18.6)
GCS		12.4±4.1
Mechanism of trauma		
TA	Pedestrian	28 (27.5)
	Bicycle	24 (23.5)
	In-car	13 (12.7)
Fall		24 (23.5)
Stab wound		12 (11.8)
Others		1 (1.0)
Emergency operation		31 (30.4)
Chest injury (AIS≥2)		49 (48.0)

Values are expressed as the mean±standard deviation or number (percentage).
GCS: Glasgow Coma Scale, TA: traffic accident, AIS: abbreviated injury scale

3. Factors affecting shock

ISS, BAC, and presence of active bleeding were significantly correlated with shock occurrence (p= 0.001, 0.05, 0.014) by a uni-variate analysis (Table 3). By a multi-variate analysis using logistic regression, ISS and BAC (Group D) were significant factors related to shock occurrence (p=0.002; OR 1.068; CI 1.025-1.112, p=0.004; OR 5.947; CI 1.764-20.052) (Table 4).

IV. Discussion

It has been demonstrated that alcohol intoxication results in marked alterations in the hemodynamic and metabolic responses to hemorrhage.(1) Alcohol results in the change of circulation, tissue responses to cytokines, and imbalance of host-defense mechanisms. Moreover, alcohol intoxication leads to slowed counter-regulatory responses to blood loss.(12) An animal study in a hemorrhagic shock

Table 2. Difference of clinical variables according to BAC.

	BAC<100 (n=36)	BAC 100-200 (n=24)	BAC 200-250 (n=18)	BAC>250 (n=24)	p value
RTS	7.03±0.95	6.28±2.10	6.95±1.45	6.24±1.75	0.131†
ISS	17.1±11.2	19.0±11.9	15.5±12.1	17.4±11.5	0.817†
GCS	13.0±3.7	13.3±3.8	12.3±4.0	10.7±4.8	0.251†
MV	9 (25.0)	6 (25.0)	6 (33.3)	13 (54.2)	0.087*
MV (without chest injury)	5 (26.3)	0 (0)	5 (38.5)	6 (54.5)	0.046**
Shock	12 (33.3)	8 (33.3)	5 (27.8)	17 (70.8)	0.009*
Active bleeding	12 (33.3)	5 (20.8)	3 (16.7)	8 (33.3)	0.454*
Mortality	2 (5.6)	2 (8.3)	1 (5.6)	2 (8.3)	1.000*

Values are expressed as the mean±standard deviation or number (percentage). BAC denotes blood alcohol concentration; RTS: revised trauma score, ISS: injury severity score, GCS: Glasgow Coma Scale, MV: mechanical ventilation
† Result of Analysis of variances
* Result of Chi-square test
** Result of Fisher's exact test

Table 3. Clinical variables related with shock.

	Without shock (60)	With shock (42)	*p*-value
Gender (male)	50 (83.3)	33 (78.6)	0.543**
ISS	14.1±9.0	21.8±13.0	0.001*
BAC	155 [0.00-215.60]	237.3 [1.95-277.40]	0.023†
Active bleeding	11 (18.3)	17 (40.5)	0.014**

Values are expressed as the mean±standard deviation, median or number (percentage). ISS denotes injury severity score, BAC: blood alcohol concentration

* Results of Student's t-test

† Results of Mann-Whitney U test

** Results of Pearson chi-square test

Table 4. Logistic regression analysis of clinical variables related with shock.

		OR	95% CI	*p*-value
ISS		1.068	1.025-1.112	0.002
BAC	Group A			0.012
	Group B	0.985	0.303-3.202	0.981
	Group C	0.830	0.218-3.164	0.784
	Group D	5.947	1.764-20.052	0.004

ISS denotes injury severity score, BAC: blood alcohol concentration, OR: odd ratio, CI: confidence interval

Inserted variables were ISS, BAC and occurrence of active bleeding.

model reported that the alcohol ingestion group has a more severe hypotension than the control group, and a poor response to fluid resuscitation despite less bleeding.(13,14) The mechanism of the lower mean arterial blood pressure in the alcohol intoxicated group is likely due to alterations in systemic vascular resistance.(15-17) Also, the diuretic effect of alcohol causes relative hypovolemia in alcohol intoxication. Inhibition of vasopressin release by acute alcohol intoxication stimulates free water diuresis.(18,19) Furthermore, alcohol reduces the myocardial contractility after hemorrhage by suppressing the vasopressors, such as epinephrine or vasopressin.(12-14,20)

As a result, acute alcohol intoxication impairs the counter-regulatory responses to hemorrhagic shock and the recovery of blood pressure during resuscitation.(12,14,20) In addition, metabolic acidosis, which occurs in subjects with traumatic brain injury by acute ethanol intoxication, may contribute to secondary brain injury.(21) Although the results of the animal study may not be completely accurate for its applicability to humans, alcohol intoxication can cause dysregulation of the hemodynamic and metabolic homeostatic mechanisms, which may motivate to assess the damages and establish treatment plans in trauma patients.

This study focused on identifying the overestimation of the injury severity in drunken patients, and making a comparison to those with non-drunken patients with similar injury severity. Although many previous studies have reported that alcohol ingestion increases the risk of injury, there are controversies regarding the influence of alcohol consumption on injury severity or treatment outcomes.(6,22,23)

In this study, when patients were categorized into four groups in accordance to their BAC, group D (BAC>250 mg/dL) had more shock occurrences than the other groups, in spite of no significant differences in RTS, ISS, and occurrence of active bleeding. According to this, it can be concluded that BAC above a certain level may affect the shock occurrence regardless of injury severity. There was no significant difference in the use of mechanical ventilation among the four BAC groups. However, when patients with chest injury of AIS 2 or greater were excluded, mechanical ventilation was applied more in group D (BAC>250 mg/dL). Because chest injury is one of the important causes of mechanical ventilation in trauma patients, this result shows that high BAC levels may compromise respiration without chest injury.

ISS and BAC were independent factors for the shock occurrence in this study. There is a correlation between high BAC levels and shock occurrence regardless of injury severity, which means that early assessment and treatment can be confusing in patients with high BAC levels.(17)

This study shows that high BAC increases the shock occurrence and the application of mechanical ventilation in trauma patients with similar injury severity. In addition, in the analysis of risk factor regarding shock occurrence, BAC above 250 mg/dL and ISS were significant risk factors.

However, this study has several limitations. First, we included only a single institution, and a small number of trauma patients. Therefore, there were limitations in the classification of patients in accordance to the types and causes of trauma, or injured organs, and control of variables. Second, we omitted head trauma patients, because it was difficult to investigate whether the change of consciousness was due to brain injury or alcohol. Further studies including head trauma patients are necessary with several control variables.

V. Conclusion

In conclusion, high BAC increases the shock occurrence and the chance of mechanical ventilation application. Furthermore, extremely high BAC (>250 mg/dL) is a significant risk factor of shock with ISS in trauma patients. We suggest that alcohol intoxication leads to an overestimation of injury severity and overtreatment. Physicians should consider the effect of alcohol when examining alcohol intoxicated trauma patients. Also, the guidelines for the diagnosis and treatment of alcohol intoxicated trauma patients are needed.

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