Submitted: 02 January, 2021 Accepted: 01 February, 2021 Published: 08 July, 2021 DOI:10.22514/sv.2021.035

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ORIGINAL RESEARCH

The characteristics associated with alcohol co-ingestion in patients visited to the emergency department with deliberate self-poisoning: retrospective study

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Abstract

Objective: The aim of this study was to investigate the characteristics associated with alcohol co-ingestion by measuring blood alcohol concentration in patients visited to the emergency department with deliberate self-poisoning. Also, it was to evaluate the accuracy of self-reported alcohol ingestion.

Methods: The initial assessment forms, medical records and laboratory tests of patients visited to the ED after DSP between March 2017 and June 2020 were retrospectively reviewed. Based on the patients' BAC, two groups were formed: the non-alcohol group and the alcohol group.

Results: This study included 286 patients (56.6%, n = 162) in the non-alcohol group and 43.4% (n = 124) in the alcohol group. In multivariate logistic analysis, alcohol co-ingestion was independently associated with no history of psychiatric admission (Odds Ratio = 6.222, 95% Confidence Interval = 1.148-33.716, P = 0.034), lactate (mg/dL) (Odds Ratio = 1.961, 95% Confidence Interval = 1.274-3.019, P = 0.002), and C-reactive protein level (mg/dL) (Odds Ratio = 0.003, 95% Confidence Interval = 0.000-0.897, P = 0.046). The receiver operating characteristics analysis of lactate value for the association with alcohol co-ingestion showed a cutoff value of 1.45, with 88.1% sensitivity, 71.6% specificity, and an area under the curve of 0.845. There was no statistically significant difference in emergency department disposition between the two groups. Using the 261 subjects who completed the self-report of alcohol co-ingestion, self-report resulted in 77.6% sensitivity and 76.6% specificity for the assessment of alcohol co-ingestion. The positive and negative predictive values for self-reporting were 72.6% and 81.0%, respectively.

Conclusions: Alcohol co-ingestion was associated with no history of psychiatric ward admission, high lactate levels, and low C-reactive protein values in patients who visited the emergency department with deliberate self-poisoning. This study showed that self-reported alcohol co-ingestion was not a substitute for the blood alcohol concentration test.

Keywords

Alcohol drinking; Emergency medical service; Self-injurious behabior; Lactates; Self report

1. Introduction

Suicide continues to be a major cause of death worldwide. In terms of the suicide rate, Korea ranked first among the member countries of the Organization for Economic Co-operation and Development (OECD) in the 2003-2017 period and has ranked second place since 2018 [1].

There are several methods of suicide that individuals choose and the prevalence of each method varies by region [2]. Ajdacic-Gross *et al*. showed that the most common suicide method occurring in Latin America and most Asian countries is poisoning with pesticides, whereas poisoning with drugs is one of the common suicide methods in the UK and Nordic countries [3].

As a method of suicide, in countries such as the United States, with easy access firearms, the suicide method by firearms is high, resulting in about only 16.6% of poisoning with drugs. However, in Korea, where the use of firearms is restricted, suicide methods by poisoning are high at 71.7-94% [4–6].

Deliberate self-poisoning (DSP) is the intentional ingestion of more than the prescribed amount of any drug [7]. This also includes poisoning with non-ingestible substances, overdoses

of 'recreational drugs', and alcohol intoxication [8].

Alcohol plays a complex role in the etiology of suicidal behavior, with both chronic alcohol use disorders and acute alcohol consumption during or before the event considered risk factors for suicide attempts and mortality [9].

Alcohol co-ingestion may have a disinhibiting effect, with increased levels of impulsivity and/or self-aggressive tendencies [10]. There is empirical evidence that suggests that a proportion of those who consume alcohol prior to their DSP episode have lower 'suicidal intent' than those who do not, particularly those in which alcohol was consumed for non-facilitative (i.e., for recreation) purposes as opposed to facilitative reasons (i.e., to numb fears, enhance toxicity of poisons, etc.) [11].

While there are many reports that have evaluated alcohol and drug abuse, few studies have examined the clinical features of alcohol ingestion among acutely self-poisoned patients visiting the ED [12]. Thus, it is important to evaluate alcohol ingestion among patients with acute poisoning. Acute poisoning patients who presented to the ED may experience interactions between alcohol and poisonous substances. For example, antihistamines, antipsychotic drugs, tricyclic antidepressants, benzodiazepines, and opioids cause prolonged sedation, which can negatively impact the consciousness of patients with acute poisoning [13].

Therefore, the blood alcohol concentration (BAC) test is valuable in assessing alcohol ingestion when evaluating the consciousness of patients with acute poisoning. Unfortunately, it is difficult to use the BAC test in all patients [12].

Self-reported alcohol consumption has become an anchor for alcohol assessment, screening, and intervention [14, 15]. A previous report on injury patients found that self-reported alcohol consumption has been shown to have high sensitivity and high specificity for detecting alcohol ingestion [16].

We conducted this study to investigate the characteristics of alcohol co-ingestion by measuring BAC in patients who visited the ED after DSP. Ultimately, we investigated the effect of alcohol co-ingestion on disease severity through ED outcomes (disposition). We also evaluated the accuracy of self-reported alcohol ingestion to replace the BAC measurement.

2. Materials and methods

2.1 Study design and participants

This retrospective study was conducted with patients who visited the ED of a general hospital in a large urban city in South Korea from March 2017 to June 2020 following their DSP. The primary dependent variable was the patient' s BAC after being referred to the ED. Based on the patients' BAC, two groups were formed: the non-alcohol group and the alcohol group. Patient data were collected prospectively, and the researchers retrospectively reviewed the data.

An annual average of 65,000 patients visit this hospital's ED, and more than 9,600 patients are hospitalized each year. Over 1,300 patients are admitted to the intensive care unit (ICU) on average each year.

During the study period, 909 patients were referred to the ED following their self-harm behavior.

446 DSP patients were included in the study, excluding 44 hanging, 2 drowning, 2 collision/burns, 287 cutting and piercing, 32 fall/jumping from a height, and 96 others. However, the study had a final sample of 286 patients after the exclusion of 160 patients, including 19 cases referred to psychiatric hospitals after completion of ED evaluation, four dead cases, two patients who left the hospital against medical advice after registration, and 135 patients who did not have a blood test for alcohol. Patients were also excluded if they were referred to an outpatient psychiatry clinic other than the ED following their DSP (Fig. 1).

2.2 Methods and measurements

We referred all patients who visited the ED following DSP to the responsible case management team. The initial assessment forms were devised by this team under the supervision of a psychiatrist at the hospital. Patients who agreed to be managed by the case management team responded to all items on their forms. Meanwhile, the forms of those who did not agree were incomplete; therefore, we had to obtain as much information as possible from their electronic medical records (EMRs) (Fujitsu, Kawasaki, Japan). The initial assessment forms included information about their marital status, religious status, employment status, income level (with reference to the average monthly income of Korean workers, classified into $\geq$ 2.5 million KRW and $<$ 2.5 million KRW), education level (with reference to the mandatory education in Korea, classified into middle school graduate or lower and high school graduate or higher), family status, method of DSP, time from DSP to ED visit, location where DSP was attempted, request for help, companion at hospital visit, suicidal intent, history of prior suicide attempts, history of psychiatric care, psychiatric drug use, history of psychiatric ward hospitalization, family psychiatric history, self-harm behavior plan, and suicidal ideation during treatment and self-reported alcohol ingestion.

From the patients' EMR, we collected the following data: sex; age; vital signs (systolic blood pressure, diastolic blood pressure, and heart rate); consciousness (alert: alert mentality; drowsy, stupor, and coma: altered mentality); type of referral (referral during business hours, i.e., from 9AM to 5PM on weekdays, or referral during off-hours); presumptive psychiatric diagnosis (depression, psychiatric disease other than depression, and no intervention or inability to diagnose); physical status at the time of referral to the ED (chronic disease, acute disease, and physical health); and ED outcomes (ICU admission, GW admission, and discharge). The presumptive diagnosis of the patients was confirmed only after an interview by a psychiatrist for patients who had requested a psychiatric consultation. The presumptive diagnosis for self-harm attempt patients who refused psychiatric consultation was classified as uninterrupted. Next, for uninterrupted patients, past psychiatric diagnoses were used by the patient or guardian's statement. For statistical convenience, presumptive psychiatric diagnosis was divided into three categories: depression, psychiatric disease other than depression, and no intervention or impossible to diagnose. Laboratory findings were measured through blood sampling with venipuncture and arterial puncture within 30 min of ED arrival.

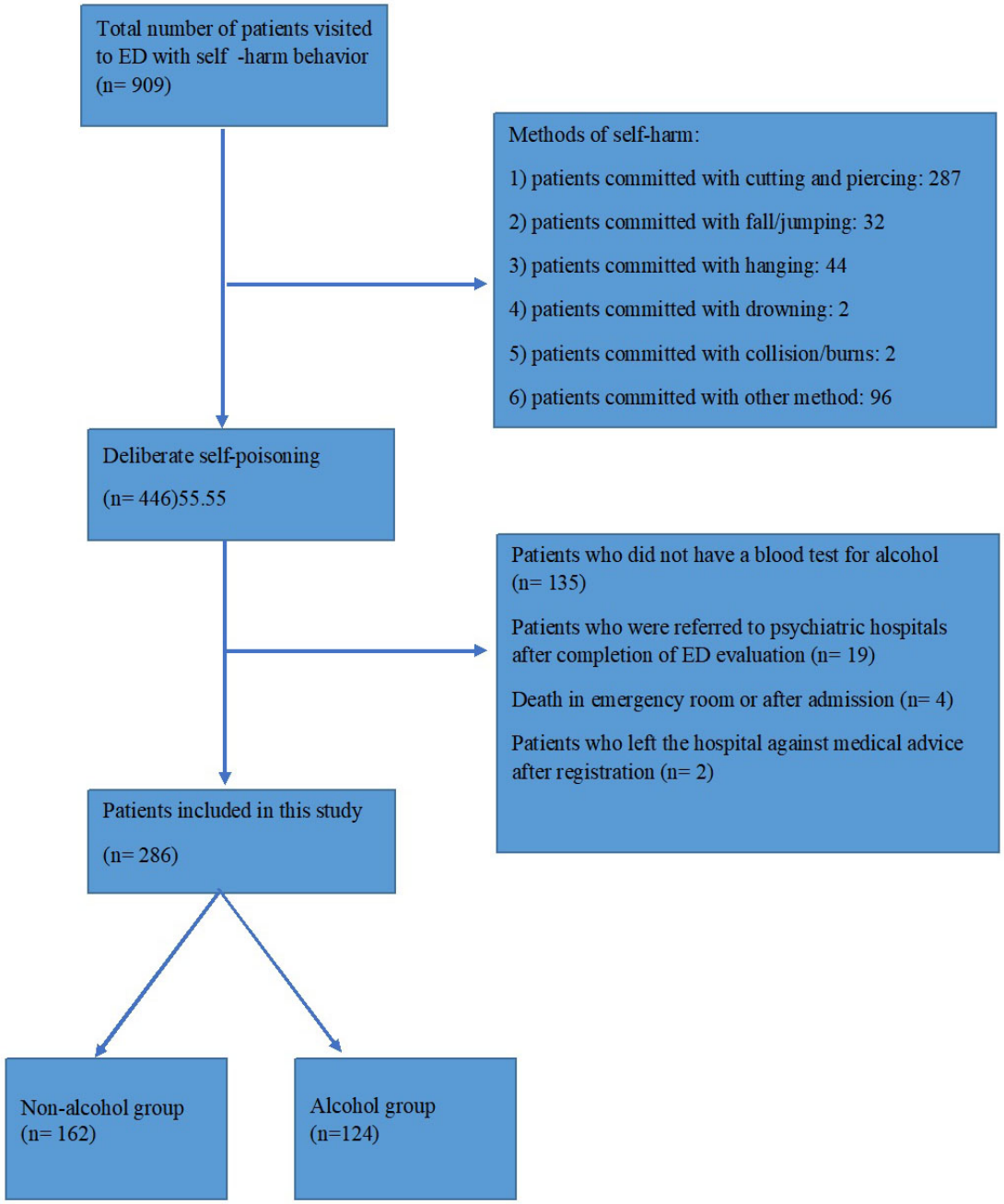


FIGURE 1. Study patient flow diagram.

The kinetic assay using enzymatic oxidation with alcohol dehydrogenase can accurately quantitate BAC within a range of 10-400 mg/dL. Subjects with a BAC higher than 10 mg/dL were included in the alcohol group, and those with a BAC lower than 10 mg/dL were included in the non-alcohol group.

We divided the patients into alcohol and non-alcohol groups and compared demographic variables, self-harm-related variables, ingested substance, laboratory findings, and ED disposition between the two groups. Additionally, we compared ED disposition according to BAC level.

Nominal variables were analyzed using the chi-square test or Fisher's exact test and continuous measures were analyzed using the independent *t*-test or Mann-Whitney U test.

Multivariate logistic regression analysis was used to investigate factors associated with alcohol co-ingestion in patients with deliberate self-poisoning. The multivariate logistic regression analysis process used backward stepwise selection (likelihood ratio). Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were computed using logistic regression. The significance level was set at $P < 0.05$ and all statistical analyses were performed using SPSS (version 18.0; SPSS Inc., Chicago, IL, USA).

3. Results

3.1 Characteristics of patients who visited the ED after deliberate self-poisoning (DSP)

The mean age was 43.8 ± 20.0 and 45.7 ± 17.7 and the number of males was 62 (38.3%) and 43 (34.7%) in the non-alcohol and alcohol groups, respectively ($P = 0.39$, $P = 0.53$). In the

TABLE 1. General characteristics of patients who visited the emergency department after a deliberate self-poisoning

Characteristics	Non-alcohol group (n = 162)	Alcohol group (n = 286)	Total	*P*-value
Sex (male)	62 (38.3)	43 (34.7)	105 (36.7)	0.53
Age (years)	43.8 ± 20.0	45.7 ± 17.7	44.6 ± 19.0	0.39
Referral during business hours	29 (17.9)	18 (14.5)	47 (16.4)	0.44
Educational level (middle school or lower)	27 (21.8)	23 (28.4)	50 (24.4)	0.28
Marital status (married)*	66 (44.6)	57 (52.3)	123 (47.9)	0.22
Religion	28 (25.9)	17 (23.3)	45 (24.9)	0.69
Occupation (employed)	79 (55.6)	46 (49.5)	125 (53.2)	0.35
Housemate (presence)	53 (36.6)	54 (48.6)	107 (41.8)	0.05
Income (< 2.5 million KRW per month)	61 (49.2)	55 (64.0)	116 (55.2)	0.03
Companion when visiting ER				0.01
Acquaintance	133 (89.9)	98 (84.5)	231 (87.5)	
Unknown person including 119	3 (2.0)	12 (10.3)	15 (5.7)	
Alone	12 (8.1)	6 (5.2)	18 (6.8)	
Physical status				0.46
Healthy	103 (67.3)	80 (69.6)	183 (68.3)	
Acute illness	2 (1.3)	0	2 (0.7)	
Chronic illness	48 (31.4)	35 (30.4)	83 (31.0)	

Data are presented as frequency (percentage) or mean ± standard deviation.
** The variable "marital status" had three values: married, having a registered relationship, and having a de facto relationship.*

alcohol group, the mean BAC was 146.9 ± 83.0.

To compare the demographic and self-harm-related characteristics between the two groups, 64.0% were low income was in the alcohol group and 49.2% in the non-alcohol group (P = 0.03). Education level, marital status, employment status, and physical status were not statistically different (Table 1).

History of psychiatric ward hospitalization was higher in non-alcohol group (20.6%) than in the alcohol group (0.1%, P = 0.001) The presumptive diagnosis was significantly different. In the non-alcohol group, major depressive disorder (MDD), and 66.6% had other psychiatric disorders was 13.6%. In the alcohol group, the incidence of MDD was 61.8% and that of other psychiatric disorders was 5.7%. In the comparison of motivation for self-harm between the two groups, DSP due to economic problems was higher in the alcohol group, while illness-related problems were higher in the non-alcohol group (5.6% vs. 11.5%, 9.3% vs. 3.3%, respectively), though the difference was not statistically significant (P = 0.11). Suicidal ideation during treatment was higher in the non-alcohol group (47.0%) than in the alcohol group (30.0%, P = 0.09) (Table 2).

The co-ingested substances showed a statistically significant difference. In comparison to co-ingested substances, the rate of co-ingestion of antidepressants was higher in the non-alcohol group than in the alcohol group (21.0% vs. 8.1%). Co-ingestion of analgesics was higher in the alcohol group than in the non-alcohol group (3.7 vs. 6.5%, P = 0.03, Table 3).

In comparison of laboratory findings between the two groups, C-reactive protein (CRP), blood urea nitrogen (BUN), creatinine, alkaline phosphatase (ALP), sodium, potassium, creatinine kinase (CK), lactate, bicarbonate and pH using arterial blood gas analysis showed a statistically significant difference (Table 4).

3.2 Outcome of ED assessments

The number of ICU admissions was 28 (17.3%) and 17 (13.7%) and the number of general ward admissions was 9 (5.6%) and 3 (2.4%) in the non-alcohol and alcohol groups, respectively. There was no statistically significant difference in the ED outcomes between the two groups (Table 5). ED disposition did not show any difference according to BAC level in the alcohol group (Table 6).

3.3 Factors associated with alcohol co-ingestion in patients who visited the ED with DSP

In multivariate logistic analysis, alcohol co-ingestion was independently associated with no history of psychiatric admission (OR = 6.222, 95% CI = 1.148-33.716, P = 0.034), lactate (mg/dL) (OR = 1.961, 95% CI = 1.274-3.019, P = 0.002), and C-reactive protein level (mg/dL) (OR = 0.003, 95% CI = 0.000-0.897, P = 0.046) (Table 7). The receiver operating characteristics (ROC) analysis of lactate value for the association with alcohol co-ingestion showed a cutoff value of 1.45, with 88.1% sensitivity, 71.6% specificity, and an area under the curve of 0.845 (Fig. 2).

TABLE 2. Self-harm related characteristics of patients who visited the emergency department after a deliberate self-poisoning

Characteristics	Non-alcohol group (n = 162)	Alcohol group (n = 124)	Total (n = 286)	*P*-value
Altered mental status	78 (48.1)	55 (44.4)	133 (46.5)	0.52
Attempted suicide before	65 (43.3)	54 (48.6)	119 (45.6)	0.39
History of psychiatric admissioin	29 (20.6)	8 (0.1)	37 (0.2)	< 0.01
Current psychiatric medication use	51 (52.6)	33 (45.8)	84 (49.7)	0.43
Family history of psychiatric disease	30 (21.6)	17 (16.8)	47 (19.6)	0.36
Presumptive diagnosis				
MDD	107 (66.0)	76 (61.8)	183 (64.2)	0.01
Psychiatric disorder other than MDD	22 (13.6)	7 (5.7)	29 (10.2)	
Uninterrupted or absence of psychiatric disease	33 (20.4)	40 (32.5)	73 (25.6)	
Suicidal intent	123 (75.9)	97 (79.5)	220 (77.5)	0.47
Motivation of self-harm				
Psychiatric	39 (24.2)	26 (21.3)	65 (23.0)	
Interpersonal	28 (17.4)	19 (15.6)	47 (16.6)	
Job-related	8 (5.0)	4 (3.3)	12 (4.2)	
Economic	9 (5.6)	14 (11.5)	23 (8.1)	
Illness-related	15 (9.3)	4 (3.3)	19 (6.7)	0.11
Death of family member or pet	4 (2.5)	3 (2.5)	7 (2.5)	
Legal problem	0	3 (2.5)	3 (1.1)	
Loneliness	4 (2.5)	1 (0.8)	5 (1.8)	
Fighting or punishment	38 (23.6)	30 (24.6)	68 (24.0)	
Other traumatic event	10 (6.2)	7 (5.7)	17 (6.0)	
Asked for help	17 (11.3)	18 (17.5)	35 (13.8)	0.16
Time from self-poisoning to ER visit (hours)	5.7 ± 7.3	5.2 ± 22.5	5.5 ± 15.8	0.78
Self-harm behavior plan	20 (13.0)	11 (10.0)	31 (10.0)	0.39
Suicidal ideation during treatment	71 (47.0)	38 (30.0)	109 (40.0)	0.09
Psychiatric consultation	84 (58.7)	55 (51.9)	139 (55.8)	0.28
ED Length of stay (hours)	18.7 ± 34.1	10.9 ± 12.6	15.8 ± 28.2	0.11

Data are presented as frequency (percentage) or mean ± standard deviation.
MDD, major depressive disorder; ER, emergency room; ED, emergency department.

TABLE 3. Ingested substance of patients who visited the emergency department after a deliberate self-poisoning

N (%)	Non-alcohol group (n = 162)	Alcohol group (n = 124)	Total (n = 286)	*P*-value
				0.03
Analgesics	6 (3.7)	8 (6.5)	14 (4.9)	
STH	92 (56.8)	70 (56.5)	162 (56.6)	
Antidepressants	34 (21.0)	10 (8.1)	44 (15.4)	
Other drugs	13 (8.0)	19 (15.3)	32 (11.2)	
Pesticide	12 (7.4)	9 (7.2)	21 (7.3)	
Gas poisoning	5 (3.1)	8 (6.5)	13 (4.5)	

The data are presented as frequencies (percentages). STH, sedatives, tranquilizers, hypnotics.

TABLE 4. Laboratory finding of patients who visited the emergency department after a deliberate self-poisoning

	Non-alcohol group (n = 162)	Alcohol group (n = 124)	Total (n = 286)	*P*-value
BAC (mg/dL)	0	146.9 ± 83.0	146.9 ± 83.0	
White Blood Cells (K/μL)	8,474.9 ± 3,584.1	7,710.4 ± 3,249.6	8,145.0 ± 3,458.7	0.06
Hemoglobin (g/dL)	13.4 ± 1.9	13.8 ± 1.7	13.5 ± 1.8	0.08
C-reactive protein (mg/dL)	0.6 ± 2.1	0.1 ± 0.2	0.4 ± 1.6	< 0.01
Platelet (×1,000/mL)	252.3 ± 70.3	252.0 ± 69.2	252.2 ± 69.7	0.98
Blood urea nitrogen (mg/dL)	14.0 ± 6.5	11.5 ± 3.9	12.9 ± 5.6	< 0.01
Creatinine (mg/dL)	0.8 ± 0.3	0.7 ± 0.1	0.7 ± 0.2	< 0.01
AST (IU)	30.0 ± 29.0	38.5 ± 59.8	33.7 ± 45.1	0.11
ALT (IU)	19.3 ± 17.2	24.3 ± 33.3	21.5 ± 25.5	0.10
Glucose (mg/dL)	117.9 ± 34.5	119.2 ± 35.1	118.4 ± 34.7	0.76
Alkaline phosphatase (U/L)	65.9 ± 21.1	74.1 ± 27.6	69.4 ± 24.4	< 0.01
Amylase (U/L)	65.3 ± 47.2	67.3 ± 76.8	66.2 ± 61.7	0.78
Lipase (U/L)	26.0 ± 61.2	28.2 ± 16.5	27.0 ± 47.4	0.70
Sodium (mEq/L)	136.9 ± 3.1	138.3 ± 2.6	137.5 ± 3.0	< 0.01
Potassium (mEq/L)	3.8 ± 0.5	3.5 ± 0.3	3.7 ± 0.4	< 0.01
Creatinine kinase (U/L)	519.5 ± 1,789.3	174.4 ± 292.6	372.3 ± 1,377.6	0.04
CK-MB (ng/mL)	3.5 ± 7.8	2.3 ± 4.0	3.0 ± 6.5	0.13
Troponin-I (ng/mL)	0.02 ± 0.15	0.00 ± 0.01	0.01 ± 0.11	0.15
Lactate (mg/dL)	1.4 ± 1.6	2.5 ± 1.3	1.9 ± 1.6	< 0.01
pH	7.40 ± 0.06	7.38 ± 0.07	7.4 ± 0.1	0.02
Bicarbonate (mg/dL)	25.0 ± 2.8	23.5 ± 2.5	24.3 ± 2.8	< 0.01
PaO_2 (mmHg)	88.6 ± 27.1	84.3 ± 18.2	86.7 ± 23.6	0.15
SBP (mmHg)	123.2 ± 26.4	120.4 ± 26.5	122.0 ± 26.4	0.38
DBP (mmHg)	73.9 ± 16.6	72.2 ± 14.7	73.2 ± 15.8	0.37
HR (beats/min)	88.0 ± 21.9	99.9 ± 26.2	90.5 ± 23.9	0.04
RR (breaths/min)	19.6 ± 2.4	19.6 ± 3.1	19.6 ± 2.7	0.91
Body temperature (°C)	37.0 ± 4.4	37.0 ± 3.6	36.8 ± 0.7	0.31

Data are presented as mean ± standard deviation.
BAC, Blood alcohol concentration; AST, Aspartate transaminase; ALT, Alanine transaminase; CK-MB, Creatine kinase-MB; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; HR, Heart rate; RR, respiratory rate.

TABLE 5. Dispositions of ED assessments in deliberate self-poisoning patients

	Non-alcohol group (n = 162)	Alcohol group (n = 124)	Total (n = 286)	*P*-value
Discharge	121 (74.7)	101 (81.5)	222 (77.6)	0.45
Psychiatric ward admission	4 (2.5)	3 (2.4)	7 (2.4)	
General ward admission	9 (5.6)	3 (2.4)	12 (4.2)	
ICU admission	28 (17.3)	17 (13.7)	45 (14.7)	

The data are presented as frequencies (percentages). ED, emergency department; ICU, intensive care unit.

3.4 Accuracy of self-reported alcohol ingestion

Using the 261 subjects who completed the self-report on alcohol ingestion, self-report resulted in 77.6% sensitivity and 76.6% specificity for the assessment of alcohol ingestion. The positive and negative predictive values for self-reporting were 72.6% and 81.0%, respectively. A total of 116 (44.4%) patients had a BAC higher than 10 mg/dL. Of these 116 patients with a positive BAC, 26 (22.4%) reported that they did not consume alcohol. Of the 145 patients with a negative BAC, 34 (23.4%) reported that they consumed alcohol (Table 8).

TABLE 6. Dispositions of ED according to blood alcohol concentration (BAC) level

BAC (mg/dL) (n = 124)	10 ≤ BAC < 100 (n = 41)	100 ≤ BAC < 200 (n = 47)	200 ≤ BAC < 300 (n = 34)	300 ≤ BAC (n = 2)	*P*-value
Discharge	36 (87.8)	35 (74.5)	28 (82.4)	2 (100)	0.54
Psychiatric ward	2 (4.9)	1 (2.1)	0 (0)	0 (0)	
General ward	0 (0)	2 (4.3)	1 (2.9)	0 (0)	
ICU admission	3 (7.3)	9 (19.1)	5 (14.7)	0 (0)	

Data are presented as frequency (percentage). BAC, blood alcohol concentration; ED, emergency department; ICU, intensive care unit.

TABLE 7. Factors related to alcohol co-ingestion in deliberate self-poisoning patients by multivariate logistic regression analysis

	Odds ratio	95% Confidential interval	*P*-value
Income (≥ 2.5 million KRW per month)	0.769	0.298-1.980	0.586
MDD (reference: Uninterrupted or absence of psychiatric disease)	0.577	0.187-1.780	0.339
No history of psychiatric admissioin	6.222	1.148-33.716	0.034
Creatinine kinase (U/L)	1.000	0.999-1.001	0.488
Lactate (mg/dL)	1.961	1.274-3.019	0.002
C-reactive protein (mg/dL)	0.003	0.000- 0.897	0.046

MDD, major depressive disorder.

TABLE 8. Self-reported alcohol ingestion

Self-report	BAC (-) (n = 145)	BAC (+) (n = 116)
Drink alcohol, n	34	90
Did not drink, n	111	26
Sensitivity, %	77.6	
Specificity, %	76.6	
PPV, %	72.6	
NPV, %	81.0	

BAC, blood alcohol concentration; PPV, positive predictive value; NPV, negative predictive value.

4. Discussion

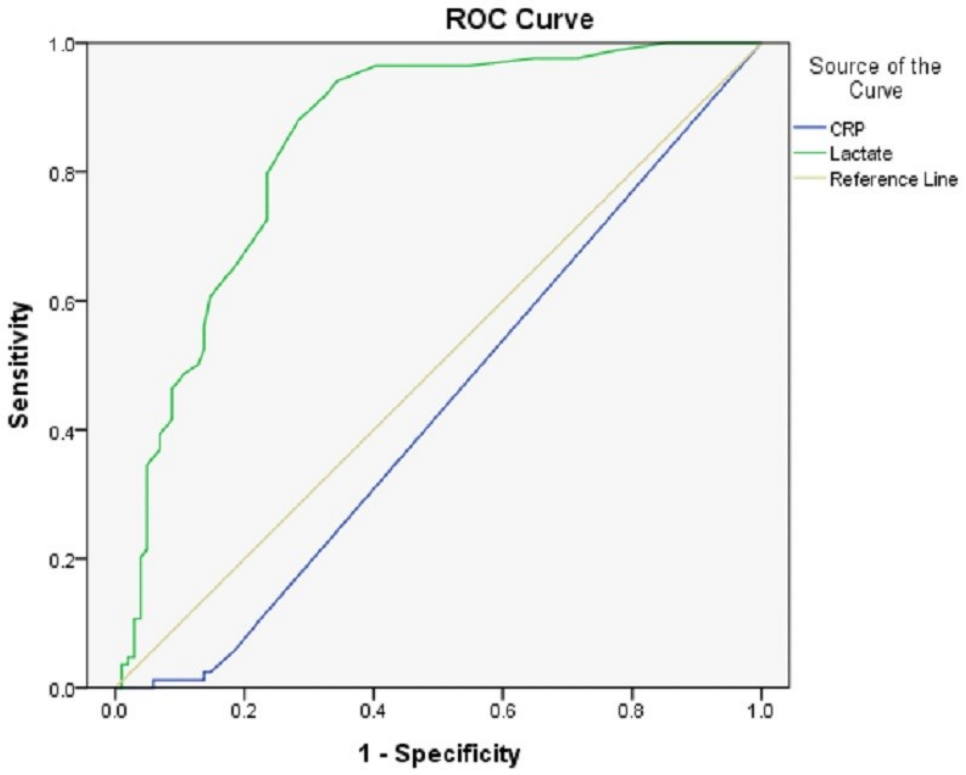
This study investigated the clinical characteristics and laboratory tests related to alcohol co-ingestion in patients who visited the ED with DSP by measuring BAC. Alcohol co-ingestion was independently associated with no history of psychiatric ward admission, high lactate levels, and low CRP levels. It was presumed that patients with a history of psychiatric admission had a strong suicidal intent and did not need alcohol co-ingestion for facilitative reasons.

Measuring serum lactate levels plays an important role in determining the severity of toxicity in patients at the risk of vital organ damage [17]. Golaghaei *et al*. [18] showed that serum lactate could be used as a possible prognostic factor because it rapidly increased in the serum and was easily detectable. MacDonald *et al*. [19] investigated the frequency and severity of ethanol-induced lactic acidosis. They revealed that significant elevations in blood lactate are uncommon in acute ethanol intoxication. They concluded that in patients with ethanol intoxication who were found to have lactic acidosis, other etiologies for elevated lactate levels should be considered.

In this study, lactate levels were independently related to alcohol co-ingestion. The ROC analysis of lactate value for the association with alcohol co-ingestion showed a cut-off value of 1.45, with 88.1% sensitivity and 71.6% specificity. We estimated that the high lactate value in the alcohol co-ingestion group was due to the accumulation effect of the simultaneous administration of alcohol and other substances.

Sawiniec *et al*. [20] evaluated the feasibility of determining the level of CRP as a diagnostic and prognostic marker in acute poisoning. They revealed that alcohol and CNS acting agents increased CRP values in over 33% of the patients, whereas in the case of patients under the influence of cardiac drugs or carbon monoxide, the same effect was observed in more than 16% of the cases. They regarded alcohol as an independent drug and investigated its effect on CRP, along with other substances. However, in this study, the two groups were divided according to whether alcohol was taken simultaneously with other drugs. As a result of the study, the alcohol group showed lower CRP values than the non-alcohol group. This was presumed to be because the non-alcohol group contained many substances related to the CRP increase.

An empirical review of published studies reported that a median of 37% of suicides and 40% of suicide attempts are preceded by the acute use of alcohol (AUA) [21]. These figures are controlled for the limited number of suicidal acts preceded by AUA, with fewer than 50 such cases in each study. Nonetheless, each controlled study demonstrated that AUA confers increased risk at a statistically significant level, with point estimates in the range of 5-10-fold risk. There are also data indicating that risk for suicidal behavior is increased at high drinking levels [22–24] and that the use of firearms and



	Cutoff value	Sensitivity	Specificity	AUC	95% CI	*p*-value
Lactate(mg/dL)	1.45	88.1%	71.6%	0.845	0.788-0.902	<0.001
CRP (mg/dL)				0.435	0.353-0.517	0.126

CRP, C-reactive protein; AUC, area under the curve; CI, confidence interval

FIGURE 2. The receiver operating characteristics (ROC) analysis for factors associated with alcohol co-ingestion.

hanging, deadly methods of suicide, are associated with high drinking levels [25]. Eventually, this association can lead to an increase in patient severity and mortality by alcohol co-ingestion during or before suicide attempts.

However, the empirical evidence is surprisingly mixed with regard to the acute use of alcohol and proximal premeditation and intent, with some studies showing no differences in such measures in attempts preceded by alcohol use and those that are not [26] and other studies showing lower proximal suicide premeditation in alcohol-involved attempts [27].

In this study, there was no statistically significant difference in ED outcomes (disposition) between the alcohol and non-alcohol groups. In addition, in the alcohol group, there was no statistically significant difference in ED outcomes according to BAC level.

Bagge *et al.* [28] showed that alcohol-involved suicide attempts were characterized by lower premeditation and intent, but only when the use of alcohol was not motivated by the desire to facilitate the attempt. In contrast, individuals who drank to facilitate the attempt were similar to non-alcohol users on these indices. They concluded that clinical implications include that individuals making suicide attempts with facilitative motives for drinking cannot be assumed to be at a lowered risk of a drop in BAC.

In this study, the proportion of patients with suicidal intent in the alcohol group was 79.5%, which was higher than the 75.9% in the non-alcohol group. These results suggest that alcohol group patients co-ingested alcohol as a facilitative motive to overcome the fear of suicidal behavior. However, the difference was not statistically significant ($P = 0.47$).

The sensitivity and specificity of self-reported alcohol ingestion in trauma patients have been reported to be high. A report by Treno *et al.* [29] showed that 87.1% of those testing positive for alcohol reported drinking prior to injury, and 93.1% of those testing negative reported no drinking. Similarly, Sommers demonstrated that of 141 patients who had a BAC higher than 10 mg/dL, 134 (95.0%) self-reported drinking alcohol [30].

According to Woo *et al.* [12], self-reported alcohol ingestion had a sensitivity of 96.9% and a specificity of 86.7%. They demonstrated that the evaluation of self-reported alcohol ingestion is a reliable method for determining whether a patient has been drinking alcohol.

On the other hand, in this study, self-report resulted in

77.6% sensitivity and 76.6% specificity for the assessment of alcohol co-ingestion. The positive and negative predictive values for self-reporting were 72.6% and 81.0%, respectively. Of the 137 patients who did not report alcohol co-ingestion, 26 (19.0%) were positive in the BAC test. To explain these results, Sommers *et al*. [30] interpreted mismatches in self-reporting as a problem arising from the inability to accurately report the pattern or the start of drinking due to poor memory in the drinking patients rather than an attempt to hide alcohol ingestion. In this study, it was possible that the above effects were reinforced by co-ingestion of substances other than alcohol alone. In addition, the possibility of conceiving alcohol consumption could not be ruled out. Of the 124 patients who reported alcohol co-ingestion, 34 (27.4%) were negative as a result of the BAC test. This study showed that self-reported alcohol co-ingestion was not a substitute for the BAC test.

The limitations of this study are as follows: First, there was no distinction between alcohol use disorder and AUA. There was no evaluation of abnormal blood tests due to chronic alcoholism, such as decreased liver function.

Second, there was no distinction between index and repeated DSP episodes. Index DSP episodes may have different purposes and characteristics of alcohol co-ingestion compared to repeated DSP episodes.

Third, no investigation was conducted on the time taken to reach the ED after alcohol ingestion. If patients were in the post-absorption phase and the elimination rate of alcohol was high, such a patient would have been classified as a non-alcohol group despite alcohol co-ingestion.

After drinking on an empty stomach, the elimination rate of ethanol is 10-15 mg/dL per hour [31] Alcohol excretion and metabolism can vary according to the patient's gender, age, body weight, stomach contents, and current use of medication [32].

Fourth, the institution where this research took place provides consultation and support services to all patients admitted for suicide attempts. Patients who agreed to receive these services fully completed the initial assessment items. However, some patients who did not agree to receive these services declined to respond to the initial assessments. Although the missing data were supplemented with EMR to the maximum extent possible, the fact that these assessments were not complete could also constitute a limitation of this study.

Fifth, the study was conducted in a single hospital located in a large city and may not be representative of ED situations in more rural areas. We suggest that a similar study should be conducted in the future with a larger, multicenter, prospective design.

5. Conclusions

Alcohol co-ingestion was independently associated with no history of psychiatric ward admission, high lactate levels, and low CRP values in patients who visited the ED with DSP. However, alcohol co-ingestion did not worsen disease severity. In addition, self-reported alcohol ingestion was not a substitute for the BAC test.

AUTHOR CONTRIBUTIONS

DH Lee & HJ Kim designed the research study, analyzed the data, wrote the manuscript equally.

All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Sanggye paik hospital institutional review board (2019-12-012-001) and was approved by the ethical principles of the Declaration of Helsinki. Informed consent had taken by patient and guardians in written form by the case management team. Patient information was anonymized before the analysis.

ACKNOWLEDGMENT

We thank Young-ho Shin and Hyo-jin Han (Sanggye Paik Hospital's case management team) for their data management support.

FUNDING

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No.2018R1C1B5046096). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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How to cite this article: Hye Jin Kim, Duk Hee Lee. The characteristics associated with alcohol co-ingestion in patients visited to the emergency department with deliberate self-poisoning: retrospective study. Signa Vitae. 2021;17(4):108-117. doi:10.22514/sv.2021.035.