RESEARCH ARTICLE

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Received: 25.07.2022
Acceptance: 01.10.2022
DOI: 10.18521/ktd.1147742

Retrospective Analysis of Methyl Alcohol Poisonings Admitted to the Emergency Department

ABSTRACT

Objective: Methyl alcohol poisoning remains a significant cause of mortality and morbidity. This poisoning is still one of the important reasons for admission to emergency services. We aimed to examine the admission complaints, laboratory findings, treatment methods, clinical outcomes and examine the factors affecting the mortality of patients diagnosed with methyl alcohol poisoning in the emergency department.

Methods: In this retrospective descriptive study, we analysed the patients who were considered to be diagnosed with methyl alcohol intoxication among those who came to our emergency department due to alcohol intoxication from June 1, 2018 to June 1, 2020.

Results: The study included 20 (4.86%) individuals with methyl alcohol poisoning among 411 people who presented to the emergency department due to ethyl and methyl alcohol intake and resulting effects. The mean age of the patients was 47.35±14.2 years and 85% (n=17/20) were male. Upon reviewing the patients' admission symptoms, 70% were observed to have visual problems, 60% complaints of vomiting, 45% shortness of breath, and 40% changes in consciousness. In the study, it was revealed that 18.2%(n=2/11) females and 81.8%(n=9/11) males died, and the mortality rate was calculated as 55%(n=11/20).

Conclusions: The presence of visual problems, hypotension, and coma in clinical findings, high anion gap metabolic acidosis, marked osmolar gap, an increase in lactate level, and hyperglycemia in laboratory findings may be the early signs of mortality in patients with methyl alcohol poisoning. Therefore, patients with these signs should be followed up more closely and treated.

Keywords: Emergency Treatment, Laboratory Findings, Methyl Alcohol Poisoning, Mortality Rate.

Acil Servise Başvuran Metil Alkol Zehirlenmelerinin Geriye Dönük Analizi

ÖZET

Amaç: Metil alkol zehirlenmesi önemli bir mortalite ve morbidite nedeni olmaya devam etmektedir. Bu zehirlenme halen acil servislere başvurunun önemli nedenlerinden biridir. Bu çalışmada acil serviste metil alkol zehirlenmesi tanısı alan hastaların başvuru şikayetlerini, laboratuvar bulgularını, tedavi yöntemlerini, klinik sonuçlarını ve mortaliteyi etkileyen faktörleri incelemeyi amaçladık.

Gereç ve Yöntem: Bu retrospektif tanımlayıcı çalışmada 1 Haziran 2018 ile 1 Haziran 2020 tarihleri arasında alkol zehirlenmesi nedeniyle acil servisimize başvuran hastalardan metil alkol zehirlenmesi tanısı düşünülen hastaları inceledik.

Bulgular: Çalışmaya etil ve metil alkol alımı ve buna bağlı etkiler nedeniyle acil servise başvuran 411 kişiden metil alkol zehirlenmesi olan 20 kişi (%4.86) dahil edildi. Hastaların yaş ortalaması 47.35±14,2 yıl olup, %85'i (n=17/20) erkekti. Hastaların başvuru semptomları incelendiğinde %70'inde görme problemi, %60'ında kusma, %45'inde nefes darlığı ve %40'ında bilinç değişikliğinin olduğu görüldü. Araştırmada %18.2(n=2/11) kadın ve %81.8(n=9/11) erkekte ölüm saptanmış olup, ölüm oranı %55(n=11/20) olarak hesaplanmıştır.

Sonuç: Metil alkol zehirlenmesi olan hastalarda klinik ve laboratuvar bulgularında; görme sorunları, hipotansiyon ve koma, yüksek anyon açıklı metabolik asidoz, belirgin ozmolar boşluk, laktat düzeyinde artış ve hiperglisemi varlığı mortalitenin erken belirtileri olabilir. Bu nedenle bu belirtileri olan hastalar daha yakın takip ve tedavi edilmelidir.

Anahtar Kelimeler: Acil Servis, Laboratuvar Bulguları, Metil Alkol Zehirlenmesi, Ölüm Oranı.

Konuralp Medical Journal
e-ISSN1309–3878
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INTRODUCTION

Methyl alcohol (methanol), also known as wood alcohol, is a raw material that is taken intentionally, accidentally, or for a suicidal purpose and turns into a toxic substance in the body due to its intoxicative properties and easy producibility (1). In industries, methyl alcohol can be found in cleaning materials, carburetor cleaners, antifreeze, photocopying liquids, chemicals such as paint and wax, glass cleaning solutions, model aircraft fuels, modified cars, alternative fuels, and homemade moonshine (2). It is reported that the use of hand disinfectants and cologne due to the COVID-19 outbreak may cause methyl alcohol poisoning (3). Methyl alcohol poisoning (MP) is an important emergency that can lead to severe morbidity and mortality (4). Clinical diagnosis is usually difficult, and the diagnosis of poisoning is difficult, and it is often diagnosed late (4,5). In recent years, the number of poisonings and resulting deaths due to the illegal production or sale of MA for liquor has increased substantially. Therefore, the patient's complaints and laboratory findings may be effective in predicting possible morbidity and mortality. Also, it is crucial to diagnose and treat this poisoning early.

This study aimed to examine the demographic data, admission complaints, laboratory findings, treatment approaches and examine the factors affecting the mortality of the patients, who were diagnosed with MP in the our emergency department(ED) and started treatment, and the correlation of these findings with clinical outcomes.

MATERIAL AND METHODS

In this retrospective descriptive study, patients with MP were screened through the hospital information management system (HBYS) and the archive records of the ED and intensive care unit(ICU). The International Classification of Disease (ICD) 10 coding system was used to select patients(T51.0, T51.1, T51.9, X45, X65, Y15, Y91, Y91.0, Y91.1, Y91.2 and Y91.3 codes was used). The patients included in the study were selected from among the patients who applied to the tertiary ED of Kayseri City Hospital between June 1, 2018, and June 1, 2020. A total of 411 patients were found to have used alcohol. Individuals with incomplete data in the patient file, individuals with ethyl alcohol or other alcohol intake, individuals referred to another institution, and individuals under the age of 18 were excluded from the study. As a result, a total of 391 patients were excluded. The study included 20 patients who were assumed to be poisoned due to MA intake based on the anamnesis taken from patients or their relatives in light of the information obtained from patient files.

Blood samples taken from the all patients were recorded. Venous blood gas samples taken from the patients were recorded 3 times (at the patient's admission, at the end of antidote therapy, and before discharge or mortality). According to the blood results obtained, anion gap, base deficit, osmolarity, and osmolar gap were calculated. The diagnosis of MP was established with the history of alcohol intake, presence of MP findings, pH <7.3 in blood gas and serum bicarbonate <20 mmol/L (6-8). After the patients were diagnosed and provided with initial treatment in the ED, they were found to continue their follow-up in the internal service or ICU.

Due to the absence of an MA kit in our hospital at the time of the study, the MA level could not be measured. The patients' routes of alcohol intake, admission complaints, vital and physical examination findings, ECG findings, history, the month of admission, the status of taking other drugs or ethyl alcohol together with MA, and laboratory results were recorded in the patient follow-up form. Moreover, treatment methods applied to the patients, changes in their laboratory values during hospitalization, their lengths of hospital stay, and clinical outcomes were also recorded. The obtained data were analyzed.

The study was approved by the Kayseri City Hospital Ethics Committee with the date and number 25.06.2020/99.

Statistical Analyses: Descriptive statistics were presented with frequency, percentage, mean and standard deviation values. The Mann-Whitney U test was conducted to analyze the measurements according to the study groups. Chi-squared analysis was performed to examine the relationships between the proportional values according to the groups. In the study, the Friedman test was carried out to examine the difference of the 1st, 2nd, and 3rd laboratory measurements. P-values less than 0.05 were considered significant in the study. SPSS 25.0 program was used for analyses.

RESULTS

In this study, the rate of MP in people with methyl, ethyl and other alcohol intake was calculated as 4.86% (n=20/411). The mean age of the patients was found to be 47.35±14.2 years (range: 22-66 years). The patients' mean Glaskow Coma Scale(GCS) value was 10.95±4.62, mean systolic blood pressure (SBP) value was 114.9±23.66 mmHg. The patients' mean length of hospital stay was 9.05±10.07 days. Upon reviewing by group, it was observed that the patients' ages, SBP measurements, pulses, respiratory rates, saturation, and durations of hospital stay were not significantly correlated with their survival levels (p>0.05) (Table 1).

Table 1. Comparison of vital findings and lengths of hospital stay by group

Variables	Total patients	Group		*P*-Value*
		Discharged	Exitus	
	Mean±SD	Mean±SD	Mean±SD	
Age	47.35±14.2	45.89±16.61	48.55±12.6	0.82
GCS	10.95±4.62	14.67±0.71	7.91±4.18	0.01*
SBP	114.9±23.66	118.89±17	111.64±28.39	0.36
Pulse	91.65±15.64	93.22±10.23	90.36±19.42	0.29
Respiratory rate	18.00±3.93	18.56±3.57	17.55±4.32	0.70
Saturation (Spo2)	94.4±5.31	96.44±3.57	92.73±6.03	0.12
Length of hospital stay (days)	9.05±10.07	4.78±4.18	12.55±12.19	0.21

*GCS: Glasgow Coma Scale, SBP: Systolic Blood Pressure *Significant difference at the 0.05 level*

Upon examining the patients' admission symptoms, 75% (n=15) were observed to have visual problems, 60% (n=12) complaints of vomiting, 45% (n=9) shortness of breath, 40% (n=8) changes in consciousness. Of the patients, 50% (n=10) were conscious, 15% (n=3) were confused, 10% (n=2) were lethargic, and 25% (n=5) were in a coma at the admission to the hospital. Of the patients, 10%(n=2) were observed to have normal physical examination findings. The mortality rates of the group with reduced vision, in a coma and with change in consciousness were found to be higher (p=0.02 and p=0.01). Of the patients, 75%(n=15) had reduced vision, and 40%(n=8) had pathology in the neurological examination. The incidence of coma, hypotension, and optic disc hyperemia was seen to be higher in the exitus group (p<0.05). The presence of pancreatitis was revealed in 40% of the patients at their first admissions. The mortality rates of the patients with pancreatitis were observed to be higher (p=0.03)(Table 2).

Table 2. Comparison of the patients' exitus statuses according to admission symptoms and examination findings

Complaints		Total	Group		*P*- Value*
			Discharged	Exitus	
		n(%)	n(%)	n(%)	
Reduced vision	Yes	15(75)	5(55.6)	10(90.9)	0.02*
	No	5(25)	4(44.4)	1(9.1)	
Pathological finding in the neurological examination	Yes	8(40)	0(0)	8(72.7)	0.09
	No	12(60)	9(3)	3(27.3)	
Coma	Yes	8(40)	0(0)	8(72.7)	0.01*
	No	12(80)	9(100)	2(18.2)	
Nausea-vomiting	Yes	12(60)	5(55.6)	7(63.6)	0.15
	No	8(40)	4(44.4)	4(36.4)	
Shortness of breath-respiratory distress	Yes	9(45)	1(11.1)	8(72.7)	0.01*
	No	11(55)	8(88.9)	3(27.3)	
Change in consciousness	Yes	8(40)	0(0)	8(72.7)	0.01*
	No	12(60)	9(100)	3(27.3)	
Agitation	Yes	1(5)	0(0)	1(9.1)	0.26
	No	19(95)	9(100)	10(90.9)	
Hypotension	Yes	4(20)	0(0)	4(36.4)	0.03*
	No	16(80)	9(100)	7(63.6)	
Mydriasis	Yes	9(45)	4(44.4)	5(45.5)	0.91
	No	11(55)	5(55.6)	6(54.5)	
Retinal Edema	Yes	13(65)	5(55.6)	8(72.7)	0.16
	No	7(35)	4(44.4)	3(27.3)	
Optical Disc Hyperemia	Yes	11(55)	3(33.3)	8(72.7)	0.02*
Abdominal pain	Yes	2(10)	0(0)	2(18.2)	0.12
	No	18(90)	9(0)	9(81.8)	

**Significant difference at the 0.05 level*

Of the patients, 15% (n=3) were female, and 85% (n=17) were male. Concerning the admission times of the patients, they presented to the hospital rather in March 25% (n=5). Thirty percent of patients(n=6) produced MA at home, 50% (n=10) of patients drank cologne, and 20%(n=4) of patients bought from a small shop. 30% (n=6) of patients were found to take ethanol together with MA. Mortality rates differed according to the way of procuring MA. Mortality rates of the individuals who drank cologne and the patients who took ethanol together with MA were high (p=0.03). In addition to MA, 30%(n=6) patients were observed to take ethanol, and 5%(n=1) psychostimulant and other drugs. Mortality rates of the patients with a history of alcohol abuse, psychiatric illnesses, liver failure, and kidney failure were not different (p>0.05). The patients were given bicarbonate 55% (n=11), thiamine %70 (n=14), ethanol %80 (n=16), and calcium folinate %70 (n=14) treatment together with fluid therapy. Eighty percent of the patients were on hemodialysis. Mortality rates of the group

treated with bicarbonate and hemodialysis were found to be higher (p=0.01). Of the patients, 20% (n=4) were followed up in the wards, but 80% (n=16) were followed up in ICUs. Twenty five percent of the patients were discharged after ICU follow-up. Of the patients, 45% (n=9) were discharged in total, but 55% (n=11) of the patients died (Table 3). Among the patients' laboratory values, WBC, MPV, Cr, Glucose, K, AST, Lipase, CK, and Troponin measurements were found to be higher in the exitus group (p<0.05). (Table 4).

Table 3. Comparison of patient characteristics, time of application, way of methyl alcohol procurement, concomitant ethanol intake, treatment method and clinical outcomes

Variables			**Group**		***P*-Value***
			Discharged	**Exitus**	
			n(%)	n(%)	
Gender	Female	3(15)	1(11.1)	2(18.2)	0.56
	Male	17(85)	8(88.9)	9(81.8)	
	Total	20(100)	9(45)	11(55)	
Application month	October	1(5)	0(0)	1(9.1)	-
	June	2(10)	1(11.1)	1(9.1)	
	November	2(10)	2(22.2)	0(0)	
	March	5(25)	3(33.3)	2(18.2)	
	May	3(15)	1(11.1)	2(18.2)	
	April	2(10)	0(0)	2(18.2)	
	January	2(10)	1(11.1)	1(9.1)	
	February	2(10)	1(11.1)	1(9.1)	
	July	1(5)	0(0)	1(9.1)	
Way of procurement	Made at home	6(30)	4(44.4)	2(18.2)	0.03*
	Drank cologne	10(50)	3(33.3)	7(63.6)	
	Bought from a small shop	4(20)	2(22.2)	2(18.2)	
Was ethanol taken together with MA?	Yes	6(30)	4(44.4)	2(18.2)	0.03*
	No	14(70)	5(55.6)	9(81.8)	
Treatment Method					
Sodium Bicarbonate	Yes	11(55)	2(22.2)	9(81.8)	0.01*
	No	9(45)	7(77.8)	2(18.2)	
Thiamin	Yes	6(30)	2(22.2)	4(36.4)	0.21
	No	14(70)	7(77.8)	7(63.6)	
Ethanol	Yes	16(80)	6(66.7)	10(90.9)	0.08
	No	4(20)	3(33.3)	1(9.1)	
Fomepizole	Yes	0(0)	0(0)	0(0)	-
	No	20(100)	9(100)	11(100)	
Calcium Folinate	Yes	14(70)	7(77.8)	7(63.6)	0.21
	No	6(30)	2(22.2)	4(36.4)	
Hemodialysis	Yes	16(80)	5(55.6)	11(100)	0.01*
	No	4(20)	4(44.4)	0(0)	
Clinical outcome					
Hospitalization in the ward	Yes	4(20)	4(44.4)	0(0)	0.01*
	No	16(80)	5(55.6)	11(100)	
Hospitalization in the ICU	Yes	16(80)	5(55.6)	11(100)	0.01*
	No	4(20)	4(44.4)	0(0)	
Discharged	Yes	9(45)	9(100)	0(0)	-
	No	11(55)	0(0)	11(100)	
Exitus	Yes	11(55)	0(0)	11(100)	-
	No	9(45)	9(45)	0(0)	

*MA: Methyl Alcohol, ICU: Intensive Care Unit *Significant difference at the 0.05 level*

Table 4. Laboratory values of the patients at the time of admission

Variables	Total	Group		*P*-Value*
		Discharged	Exitus	
	Mean±SD	Average ±SD	Mean±SD	
WBC (Ref:4.5-10,000)	11.92±5.53	9.07±3.48	14.25±5.93	0.02*
Hg (Ref:13-17g/dL)	14.54±2.71	14.73±3.03	14.37±2.55	0.73
PLT (150-450*thousand)	261.8±148.05	252.33±59.95	269.55±196.54	0.47
N/L ratio (%)	4.12±3.49	3.4±1.73	4.71±4.46	0.73
NRBC (%)	0.15±0.36	0.06±0.07	0.23±0.47	0.93
MPV (Ref:9-12 fL)	10.04±1.11	9.49±0.89	10.49±1.11	0.04*
BUN (Ref:6-20 mg/dL)	14.43±11.72	11.46±3.94	16.85±15.3	0.88
Cr (Ref:0.70-1.20 mg/dL)	1.21±0.77	0.83±0.27	1.52±0.91	0.01*
Glucose (Ref:70-110 mg/dL)	172.75±75.13	135.33±61.68	203.36±73.41	0.04*
Na (Ref:136-145 mmol/L)	137.6±6.13	136.22±3.03	138.73±7.8	0.22
K (Ref:3.5-5.1 mmol/L)	4.70±0.78	4.19±0.61	5.11±0.67	0.01*
Cl (Ref: 98-107 mmol/L)	100.75±7.87	102.11±3.3	99.64±10.29	0.65
AST (Ref:0-40 U/L)	74.35±66.18	38.22±31.16	103.91±73.55	0.02*
ALT (Ref:0-41 U/L)	39±25.85	28.67±19.53	47.45±28.1	0.14
Amylase (Ref: 28-100 U/L)	169.4±256.48	95.67±35.85	229.73±339.2	0.14
Lipase (Ref:13-60 U/L)	212.6±554.14	47.11±29.93	348±733.42	0.01*
CK (Ref:0-190 U/L)	361.8±667.78	131.33±56.43	550.36±870.52	0.01*
CKMB (Ref:0-36 U/L)	42.15±21.36	39.56±25.17	44.27±18.68	0.23
Troponin I (Ref:0-0.30 µg/L)	0.72±2.18	0.21±0.34	1.14±2.92	0.01*
Ethanol (mg/dL)	17±37.7	35.33±51.32	2.00±6.63	0.05

*WBC, white blood cell; Ref, reference interval; Hg, hemoglobin; PLT, platelet; N/L, neutrophil/lymphocyte; NRBC, nucleated red blood cells; MPV, mean platelet volume; BUN, blood urea nitrogen; Cr, creatinine; Na, sodium; K, potassium; Cl, chloride; AST, aspartate aminotransferase; ALT, alanine aminotransferase; CK, creatinine kinase; CKMB, creatinine kinase myocardial band, *Significant difference at the 0.05 level*

In the patients' blood gas analysis, mean pH, HCO3, PCO2, PO2, lactate values, and osmolarities did not differ over time. Base deficit(BD) and osmolar gap were initially lower (p=0.01). The anion gap was higher in the beginning (p=0.01). The patients' first measured blood gas pH, HCO3, and BD base deficit measurements were lower in the exitus group, whereas PO2, anion gap, and lactate values were higher in the surviving group(p=0.01). The patients' second measured blood gas pH, HCO3, and anion gap levels were observed to be lower in the exitus group (p<0.05). BD was at higher levels in the exitus group (p=0.04). The patients' third measured blood gas pH, HCO3, and BD base deficit measurements were lower in the exitus group, while anion gap, lactate, and osmolarity values were at higher levels in the exitus group(p=0.01) (Table 5).

Table 5. Examination of the patients' blood gas measurements according to their survival status

Variables		Group		*P*-Value*
		Discharged	Exitus	
		Mean±SD	Mean±SD	
pH	Measurement 1	7.25±0.17	6.96±0.21	0.01*
	Measurement 2	7.38±0.06	7.14±0.17	0.01*
	Measurement 3	7.41±0.04	7.20±0.22	0.01*
HCO3	Measurement 1	17.87±6.09	8.71±5.6	0.01*
	Measurement 2	21.89±2.88	14.78±6.19	0.02*
	Measurement 3	25.71±3.09	17.08±6.26	0.01*
PCO2	Measurement 1	37.89±8.28	33.91±15.53	0.14
	Measurement 2	36.74±5.87	43.06±19.11	0.34
	Measurement 3	41.53±9.34	46.87±24.98	0.68
PO2	Measurement 1	39.46±15.81	70.85±26.37	0.01*
	Measurement 2	45.72±15.17	54.2±24.98	0.57
	Measurement 3	44.23±25.05	52.68±28.29	0.68
BD	Measurement 1	-7.86±8.52	-24.43±9.28	0.01*
	Measurement 2	-2.44±5.62	-13.25±10.31	0.04*
	Measurement 3	2.24±4.11	-6.80±9.94	0.02*
Anion Gap	Measurement 1	21.91±7.89	34.49±5.93	0.01*
	Measurement 2	16.13±4.27	24.76±6.6	0.01*
	Measurement 3	11.33±2.94	24.25±6.34	0.01*
Lactate	Measurement 1	3.27±3.8	9.73±6.53	0.01*
	Measurement 2	2.86±2.40	5.72±4.24	0.14
	Measurement 3	2.28±3.37	8.49±7.59	0.01*
Osmolarity	Measurement 1	291.11±13.59	295.09±17.92	0.38
	Measurement 2	301.67±8.62	292.82±11.91	0.12
	Measurement 3	286.32±5.03	310.09±25.89	0.01*
Osmolar gap	Measurement 1	-19.31±17.8	-14.91±17.92	0.24
	Measurement 2	22.33±8.96	30±10.92	0.06
	Measurement 3	25.33±4.12	18.36±17.71	0.42

*pH: potential hydrogen, HCO3: bicarbonate, PCO2: partial carbon dioxide, PO2: partial oxygen BD: base deficit (reference range: [(-2.5) - (+2.5)], Anion Gap: calculated with the formula [(Na+K) - (Cl+HCO3)] (reference range: 8-12 mEq/L). Osmolarity: calculated with the formula [2*Na+Glucose/18+BUN/2.8+Ethanol/4.6] (reference range: 275-285 mOsm/L), Osmolar gap: calculated with the formula [(measured osmolarity-calculated osmolarity) + (Add 2.17 mOsm/L to the osmolar gap for every 10 mg/dl ethanol increase)] (target value: 310 mOsm/L). *Significant difference at the 0.05 level*

DISCUSSION

In recent years, an increase has been observed in admissions to EDs due to MP and relevant complications owing to reasons such as the increase in the prices of ethyl alcohol products and the increase in the illegal production of MA (4,9). Cases of poisoning with dermal exposure to MA have also increased with the increase in the use of cologne and hand disinfectants along with the COVID-19 outbreak (10). Rather than MA itself, its metabolites, such as formaldehyde, formic acid, and formate, are toxic (3). Despite improvements in treatment opportunities, the rates of morbidity and mortality in MP are still high. Because the findings of MP differ from person to person, the diagnosis is established late, thus, the treatment is initiated late, which contributes to increased morbidity and mortality rates (3,4,9). It is of great importance to quickly diagnose and treat this poisoning in EDs. In our study, the rate of people diagnosed with MP was 4.86%. The majority of the individuals included in our study were male (85%). The mean age of the patients was calculated as 47.35±14.2 years(range: 22-66 years). Of the patients with signs of poisoning, 80% were monitored in ICUs. Mortality rate was 55% (n=11). Among people who consumed alcohol, the mortality rate related to MA was calculated as 2.67%. In the literature, it is seen that MP and resulting deaths have tended to increase in numerous people, particularly during the COVID-19 pandemic in Asian countries, while they are generally in the form of case reports in European countries (11). In a study, Aghababaeian H. et al. stated that 768 people presented to ED in Iran in 2018 due to MP, 10.1% (76 people) died, and the ages of the poisoned people varied between 25-36 years (12). Another study from Turkey reported that 39 male and 8 female patients between the ages of 18-67 presented to a tertiary care hospital between 2016 and 2020 due to MP, and 12.7%(n=6) of these patients died (13). Similar to the literature, MP is usually observed in the young age group in our study. The rate of mortality caused by this poisoning differs according to countries. In our study, people were found to mostly take MA by drinking cologne 50% (n=10). The fact that 30% of the patients took MA together with ethanol. In a study conducted in our country, the sources of MA were cologne (72.6%) in 113 patients with MP (14). In our study, the route of exposure to MA was mostly cologne drinking and mortality was observed to be higher in people with cologne-related MP. Cologne, which is inexpensive and easily accessible. Some people who cannot afford to buy alcohol in our country try to meet their alcohol needs by drinking cologne. Cologne produced in an uncontrolled manner can also contain MA. This type of cologne with MA content can cause poisoning and death, as revealed in our study.In the literature, MP is observed every month of the year, but an increase is observed in the number of poisoned patients in some months. In their study, Hadipourzadeh M. et al. mentioned an increase in MP cases in November, January, and March (15). In our study, the number of poisoning cases was higher in winter and spring. On a monthly basis, the highest number of applications was in March (n=5).The half-life of MA dispersion is about 8 minutes, which is longer than the absorption half-life (16). Clinical signs of pure MA toxicity start from 0.5 to 4 hours following ingestion and include gastrointestinal disorders and central nervous system (CNS) suppression (17). In our study, the most common first three admission complaints in patients were visual problems, nausea-vomiting, and shortness of breath, respectively. The occurrence of MP findings is associated with the amount of alcohol taken, the time of intake, and the route of exposure (18,19).The patients' vital signs were generally stable at first time in our study. 75% of the patients had reduced vision. In the literature, it is reported that ocular symptoms may occur in half of the poisoned patients, and these symptoms usually develop 6 hours after taking MA (20,21). In MP, pupils are mydriatic and reported to give delayed response to light or be unresponsive (17). In their study, Brahmi N. et al. stated that the clinical symptoms of patients with MP included central nervous system symptoms (69%), gastrointestinal complaints (87%), and visual impairment (69%) (20). Similar to the literature, 75% of the patients had eye-related findings in our study. Depending on the dose, MA can lead to intoxication and CNS depression. Usually, serum MA concentrations of 25-50 mg/dL may accompany toxicity (22). In their study, Brahmi N et al. reported that mortality was more common in patients with vision loss, in shock and coma (20). In our study, changes in consciousness due to influence in the CNS were observed in 40% of the patients, 15% were confused, 10% were lethargic, and 25% were in a coma at their first admission. Likewise, mortality was higher in patients with visual problems, hyperemia of the optic disc, hypotension, and in a coma in our study. This was thought to possibly result from the damage to tissues and organs due to increased MA in the blood and blood acidosis elevated by its metabolites. In patients with anion gap acidosis of unknown cause and mostly with a history of alcohol intake, the possibility of MP is first suspected. Unless otherwise is suggested by clinical evidence, it is important to exclude metabolic acidosis with ketoacidosis and high lactate concentration, which are the most common causes of anion gap acidosis, before initiating MP treatment in these patients (6). In some hospitals, there are almost no laboratory facilities to evaluate the blood levels of toxic alcohol and its metabolites. In such cases, the diagnosis of MP can be established with anamnesis, clinical and laboratory findings (6,7). It is stated in the literature that

clinicians' clinical MP evaluations should be based on clinical history, physical findings, anion gap, and osmolal gap when MA levels cannot be checked (8). In our study, MP was diagnosed with anamnesis, clinically and laboratory findings. Since there was no methanol kit in our hospital at the time of our study, the MA level could not be checked. In the study by Desai T et al., laboratory research included a complete hemogram, hematocrit level, plasma bicarbonate levels, serum electrolyte levels, complete liver and kidney function test results, arterial blood gas analysis, blood methanol concentrations, and serum proteins in patients with suspected MP (23). In our study, blood parameters were compared after the patients were divided into two groups as discharged and exitus. As a result, there was a significant difference in WBC, MPV, Cr, Glucose, Potassium, AST, Lipase, CK, and Troponin I measurements according to blood analysis in the exitus group compared to the discharged group. In the patients' blood gas analysis, mean pH, HCO3, PCO2, PO2, lactate values, and osmolarities did not differ over time. BD and osmolar gap were lower, and the anion gap was higher in the beginning. Concerning serial blood gas measurements, there was a significant difference in pH, HCO3, BD and lactate values. In the last measurement, there was a significant difference in mean osmolarity values of the exitus group compared to the discharged group. Unlike the present studies, blood gases, lactate, osmolality, osmolar gap, and anion gaps were checked 3 times in total, first at the time of admission, at the end of antidote therapy, and lastly before discharge or exitus. In their study, Kacer I et al. reported that the mean pH value was 7.17±0.7, the mean HCO3 value was 10.55±7.02 mmol/L, and the mean glucose value was 156±118 mg/dL(13). In our study, the mean pH value in the blood gases first taken from the patients was 7.25±0.17 in the discharged group and 6.96±0.21 in the exitus group. The mean HC03 was 17.87±6.09 in the discharged group and 8.71±5.6 in the exitus group. The mean glucose value of all patients was 203.36±73.41. The mean glucose values of the exitus group were found to be higher. In their study, Kute et al. reported that pH ≤6.9 was highly associated with mortality (24). In our study, the mean pH value of the exitus group was 6.96±0.21 in the first blood gas analysis, and the values were significantly lower both in the first and the other two measurements compared to the discharged group. Moreover, in our study, HCO3 values were also measured significantly lower in the exitus group in all three measurements in blood gas analysis. Low pH and HCO3 values in the blood gas measured at the first admission and during follow-up can be markers of mortality in MP. In their study, Zahra N et al. stated that lactate values might increase in MP (6). In our study, the patients' lactate levels measured when they first arrived were 3.27±3.8 in the discharged group and 9.73±6.53 in the exitus group. Considering these values, it can be interpreted that high lactate levels in MP can be a marker of mortality. However, there is a need for more comprehensive studies on this subject. It has been reported that, in MP, patients with abdominal pain should also be tested for the possibility of associated hepatitis and pancreatitis, and hyperglycemia may also play a role in the development of acute pancreatitis (6,25). In our study, amylase and lipase were routinely checked in all patients against the risk of pancreatitis. In the exitus group, both amylase and lipase levels were found to be significantly higher. According to these results, the risk of mortality may be higher in MP if pancreatitis has started to develop. Due to the quick absorption of alcohol, the use of gastric lavage or activated charcoal does not affect poisoning in MP. Treatment of MP is based on the use of an antidote (fomepizole or ethanol) to prevent the oxidation of methanol, folic acid to facilitate formic acid catabolism, and hemodialysis for accelerating the removal of methanol and acidosis modification (5). Moreover, sodium bicarbonate (NaHCO3) is recommended to fix acute acidosis (pH<7.3) (26). Fomepizole is more likely to inhibit alcohol dehydrogenase (ADH) and has a longer action duration. Its use is also easier. Ethanol binds to ADH more than toxic alcohol (3). The presence of ethanol inhibits the formation of toxic metabolites, and it has been reported that ethanol may be adequate for ADH blockade if fomepizole is not present. Hemodialysis eliminates both MA and its toxic metabolites from the blood and fixes acid-base disorder. Within the first few hours after dialysis, MA concentrations may be elevated due to redistribution of MA. Therefore, dialysis should be continued until the MA level drops to zero and acidosis disappears (18). Folinic acid (calcium folinate) makes the hydrolysis of formic acid, the toxic intermediate of MA, to carbon dioxide and water easier. Thus, lactate formation is reduced as a result of deterioration of mitochondrial functions caused by formic acid accumulation in tissues and a decrease in the NAD +/NADH ratio (5). Thiamine can be administered as a supportive treatment in people with CNS and eye findings due to its neuroprotective effect (27). In our study, 80% of the patients were administered ethanol, 70% thiamine, 70% calcium folinate, and 55% sodium bicarbonate, and 80% underwent hemodialysis. Fomepizole could not be started as antidote therapy for the patients since it was expensive and limited in number in the hospital. Instead, 10% IV ethanol treatment was started in all patients as antidote therapy. Patients with clinically severe signs of toxicity and high anion gap deep metabolic acidosis underwent hemodialysis, and ethanol treatment was continued by monitoring the blood levels. Interestingly, mortality was higher in patients who were given sodium bicarbonate treatment and underwent hemodialysis in our study. It was

anticipated that there might be an increase in mortality rates in these patients due to their deep acidosis and higher toxicity levels.

In our study, patients who were found to have ethanol in blood analysis together with MA generally had symptoms such as abdominal pain, nausea-vomiting, and headache in the early period. However, more serious findings such as visual problems, lethargy, and coma were observed in the later period since ethanol remaining in the blood was not enough to inhibit alcohol dehydrogenase. In other words, the concomitant intake of ethanol and MA may have masked MP and prevented the appearance of symptoms.

CONCLUSIONS

There has been an increase in patients' admission to EDs due to MP in recent years. The early diagnosis of MP and quick initiation of its treatment is extremely important to reduce morbidity and mortality. Especially cologne and hand disinfectants can cause toxicity since they may contain MA. The early diagnosis of MP and quick initiation of its treatment are extremely important to reduce morbidity and mortality. It should be remembered that the presence of visual problems, hypotension, and coma in clinical findings, high anion gap metabolic acidosis (pH<7.25, low HCO3 level), marked osmolar gap, increase in lactate level, and hyperglycemia in laboratory findings can be the signs of mortality in patients diagnosed with MP. Therefore, the early treatment and close follow-up of patients with the said findings are required.

Acknowledgments: We would like to thank the emergency department staff of Kayseri City Hospital who had to work in difficult conditions.

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