

A growing problem of methanol poisonings: A retrospective analysis of 47 patients in a single-center in Turkey

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Abstract

Aim: The present study was aimed to determine the epidemiological features, clinical signs, and risk factors of methanol poisonings in our region. As all countries, methanol poisoning continues to be a serious problem in Turkey. The epidemiology of methanol poisoning varies between countries, even between regions of the same country. It is important to evaluate the regional factors to decrease morbidity and mortality.

Materials and Methods: This descriptive retrospective study was conducted in a regional tertiary hospital. The medical records of all methanol poisoning-related admissions to the emergency department between January 2016 and December 2020 were retrospectively reviewed. Etiology of poisoning, demographic characteristics, laboratory results including methanol levels, administered treatments, and mortality were recorded.

Results: 47 patients aged 18–67 years (mean 31.55 ± 14.88 years) were included in the study. Thirty-nine (82.9%) of the patients were male and 8 (17.1%) of them were female. The vast majority of patients ($n = 33$, 70.3%) had nausea and vomiting. Twenty (42.5%) patients had blurred vision and 1 (2.1%) patient had blindness. Three (6.3%) patients were in a stupor and 4 (8.5%) were in a coma. The mortality rate of methanol poisonings was 12.7% ($n=6$). 28 (59.5%) patients survived without complications, whereas, 13 (27.6%) patients survived with a neurological sequel.

Conclusions: Methanol poisoning is a serious problem among developing countries, where alcohol is not legal and cheap. High serum methanol levels are associated with a poor prognosis. Time spent from ingestion to treatment is critical to avoid complications and mortality, therefore clinicians should keep in mind methanol poisoning during differential diagnosis in such patients.

Keywords: Blurred vision; emergency medicine; home-made alcohol; illegality; methanol level; mortality; poisoning

INTRODUCTION

Methanol poisoning continues to be a serious problem in Turkey as in worldwide. The use of methanol instead of ethanol as cheap alcohol is the main cause of methanol. In addition, accidental and suicidal methanol ingestions are the other causes of poisonings (1,2).

Alcohol dehydrogenase and aldehyde dehydrogenase produces the toxic metabolites of methanol. The metabolic acidosis with an anion gap is a result of active metabolite accumulation (3). Methanol poisoning can cause an irreversible vision defect (4). It has high rates of morbidity and mortality even after hospital discharge (5,6). Sodium bicarbonate and ethanol are the main treatment options to delay the production of metabolites and correct metabolic acidosis. In addition, hemodialysis can prevent the development of irreversible vision defects, and decrease the mortality rate (3,7).

The epidemiology of methanol poisonings is different between countries, even between regions of the same country. It is important to evaluate the regional factors to decrease morbidity and mortality. Therefore, the present study was aimed to determine the epidemiological features, clinical signs, and risk factors of methanol poisonings in our region.

MATERIALS and METHODS

This retrospective descriptive study was conducted between January 2016 and December 2020, in a regional tertiary hospital. The medical records of all methanol poisoning-related admissions to the emergency department (ED) were retrospectively reviewed. The ethical approval was obtained from the regional ethical committee (2021/01-53).

Patients older than 18 years old and diagnosed with acute methanol poisoning were included in the study. Patients who ingested another toxic substance in addition to

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methanol, those with missing data, and those younger than 18 years old were excluded from the study.

Age (18-30, 30-50, 50-65, and >65 years), gender, type of exposure (intentional and unintentional), a region of residence (urban and rural), medical history of previous psychological disorder or addiction, time from methanol ingestion to admission to the ED, clinical signs, laboratory results [glucose, sodium, potassium, blood urea nitrogen (BUN), creatinine, international normalized ratio (INR), white blood cell (WBC)], and administered treatment were recorded. Methanol levels were measured via the Alcotes Pro test kit during the study period and divided into five groups (<50, 50-99, 100-149, 150-199, and ≥ 200 mL/dL).

Data were analyzed using Statistical package social sciences (SPSS, version 22.0 Inc., Chicago IL, USA). Descriptive analyzes were expressed as number (%) for categorical variables, and mean ± standard deviation (SD) for continuous variables.

RESULTS

During the study period, 63 patients were diagnosed with acute methanol poisoning at the ED. 6 patients who had missing data and 10 patients who ingested another toxic substance in addition to methanol were excluded from the study. Finally, 47 patients aged 18-67 years (mean 31.55 ± 14.88 years) were included in the study.

Table 1. Demographic characteristics of patients with methanol poisoning

Age, years	31.55 ± 14.88
Age groups (years)	
18-30	12 (25.5)
30-50	24 (51)
50-65	5 (10.6)
≥65	6 (12.7)
Gender	
Male	39 (82.9)
Female	8 (17.1)
Living area	
Rural	23 (45)
Urban	24 (51)
Kind of alcohol	
Industrial	26 (55.4)
Home-made	21 (44.6)
Time from ingestion to the ED (hours)	
<6	8 (17)
6.0-11.9	24 (51)
12-24	10 (21.2)
>24	5 (10.6)
Exposure type	
Unintentional	36 (76.6)
Intentional	11 (23.4)
Occupational exposure	
Yes	7 (14.8)
No	40 (85.2)
History of suicide attempt	
Yes	8 (17)
No	39 (83)
History of addiction	
Yes	7 (14.8)
No	40 (85.2)

Data were presented as n (%) except age (mean ± SD)

Thirty-nine (82.9%) of patients were male and 8 (17.1%) of them were female. Most of the patients (n = 24, 51%) were in the 30-50 years of age group. The mean age in males and females is respectively 33.5 ± 16.2 and 22.1 ± 8.5 years. Twenty-five (51%) of the patients were admitted to the ED between 6 and 11.9 hours after ingestion. Eight (17%) patients had a history of a suicide attempt, and 7 (14.8%) patients had a history of addiction. Demographic characteristics of patients were summarized in Table 1.

The vast majority of patients (n = 33, 70.3%) had nausea and vomiting. Twenty (42.5%) patients had blurred vision and 1 (2.1%) patient had blindness. Among the 21 symptomatic patients, the ophthalmic examination showed a mild disc swelling in 1 (4.7%) patient, papillary edema in 2 (9.5%) patients, and intraocular hemorrhage in 3 (14.2%) patients. Three (6.3%) patients were in a stupor and 4 (8.5%) were in a coma. The clinical findings of the study population were summarized in Table 2.

Table 2. Clinical characteristics of the study population

Body temperature (°C)	36.8 ± 0.30
Respiratory rate (per minute)	21.2 ± 6.4
Pulse rate (per minute)	92 ± 21
Blood pressure (mmHg)	
Systolic	118 ± 28
Diastolic	71.3 ± 10.4
Consciousness status	
Alert	16 (34)
Lethargic	19 (40.4)
Obtundation	5 (10.6)
Stupor	3 (6.3)
Coma	4 (8.5)
Gastrointestinal symptoms	
Nausea	14 (29.7)
Nausea and vomiting	33 (70.3)
Ophthalmic examination	
Asymptomatic	26 (55.3)
Blurred vision	20 (42.5)
Blindness	1 (2.1)
Mild disc swelling	1 (4.7)
Intraocular hemorrhage	2 (9.5)
Papillary edema	3 (14.2)
Normal optic disc	15 (71.4)
Pupil examination	
Normal size	33 (70.3)
Midriasis	13 (27.6)
Miosis	1 (2.1)

Data were presented as mean ± SD and n (%)

The most of patients (n = 17, 36.1%) were in the 50-99 mL/dL methanol group, followed by 100-149 mL/dL (n = 11, 23.4%) and 150-199 mL/dL (n = 8, 17%). The mean potential of hydrogen (pH) value was 7.17 ± 0.7 and the mean hydrogen carbonate (HCO_3) was 10.55 ± 7.02 mmol/L. All patients who had methanol of ≥ 200 mL/dL had metabolic acidosis. Table 3 presents the laboratory findings of patients at the time of admission.

Gastric lavage was administered to 11 (23.4%) patients who were admitted within 2 hours after methanol ingestion. Activated charcoal was used in 15 (31.9%)

patients. 37 (78.7%) patients received ethanol treatment. Hemodialysis was performed once in 29 (61.7%) patients and twice in 17 (36.1%) patients. The mean time from methanol ingestion to hemodialysis was 10 ± 10 hours (range, 3-48 hours).

Table 3. Laboratory findings of patients at the time of admission

Methanol level, mL/dL	
<50	4 (8.5)
50-99	17 (36.1)
100-149	11 (23.4)
150-199	8 (17)
≥200	7 (14.8)
pH	7.17 ± 0.7
PCO ₂ , mmHg	23.55 ± 11.04
HCO ₃ , mmol/L	10.55 ± 7.02
O ₂ saturation	94.62 ± 2.1
PaO ₂ , mmHg	99.2 ± 16.45
Presence of metabolic acidosis based on methanol level	
<50	2 (50)
50-99	6 (35.2)
100-149	10 (90.9)
150-199	7 (87.5)
≥200	7 (100)
Glucose, mg/dL	156 ± 118
Sodium, mmol/L	133.75 ± 21.25
Potassium, mmol/L	3.97 ± 1.12
BUN	15.02 ± 6.85
Creatinine, mg/dL	1.07 ± 0.25
INR	1.27 ± 0.75
WBC, 10 ⁹ /L	11.2 ± 4.8

Data were presented as mean \pm SD except methanol level groups (n, %). BUN, blood urea nitrogen; INR, international normalization ratio; WBC, white blood cell count

The mortality rate of methanol poisonings was 12.7% (n = 6). 28 (59.5%) patients survived without complications, whereas, 13 (27.6%) patients survived with a neurological sequel. The clinical outcome rates according to the methanol level were shown in Table 4.

Table 4. The clinical outcome rates according to the methanol level at the admission

Methanol level, mL/dL	Survived without complications	Survived with complications	Death
<50	3 (75)	1 (25)	0 (0)
50-100	14 (82.3)	2 (11.7)	1 (5.8)
100-149	8 (72.7)	2 (18.1)	1 (9)
150-200	3 (37.5)	4 (50)	1 (12.5)
>200	0 (0)	4 (57.1)	3 (42.9)

Data were presented as n (%)

DISCUSSION

In this descriptive study, we evaluated the epidemiological features and clinical signs of methanol poisonings in our region. To the best of our knowledge, this is the first study reported from our region about methanol poisonings and its sample size is similar to the literature from Turkey (8,9).

The mortality rates of methanol poisoning vary between countries. A study conducted in Tehran, by Hassanian et al. included 25 patients during a 9-month follow-up and the mortality rate was 48% (10). Davis et al. reported a 0.5% of mortality in the United States (11). In Poland, the incidence of methanol poisonings decreased from 0.7% to 0.4% over a 10-year period, the reported mortality rate was 20.4%, and the most related agents with death were methanol and ethylene glycol (6). In countries where alcohol consumption is legal, the most common etiology of methanol poisoning is suicide attempts (12). However, in Turkey, legal alcohol is relatively more expensive compared to high-income countries and the methanol poisonings are often related to accidental ingestion or effort to access cheap alcohol (8). Our results also support this thought. The vast majority of the patients poisoned accidentally and the mortality rate was 12.7%.

The symptoms of patients with methanol poisoning were ranging from common complaints such as headache, nausea, vomiting, to coma. Blurred vision is one of the important symptoms of methanol poisoning, however, life-threatening findings are known to be associated with metabolic acidosis with a high anion gap (10). Paasma et al reported that metabolic acidosis with an anion gap is correlated with high serum methanol levels (6). In this study, while the presence of metabolic acidosis rate is 35.2% between 50-99 mL / dL methanol, it is 87.5% between 150-199 mL / dL, and 100% over 200 mL / dL. 21 patients had an ophthalmic symptom. Optic disc examination was normal in 15 (71.4%) of them, but 2 (9.5%) patients developed an irreversible vision defect. On the other hand, as a result of metabolic acidosis with an anion gap; 4 (8.5%) patients admitted to the ED in a coma, 13 (27.6%) patients had neurologic sequelae on discharge, and 5 (10.6%) patients died in the hospital. It was observed that as the serum methanol level increased, the rates of neurological sequelae and mortality increased. Furthermore, the time to hemodialysis from ingestion is relatively higher which could be responsible for the high neurologic sequelae and mortality rates compared to the literature (13).

Potential weaknesses of this study include its retrospective nature and low study sample. Due to the low study sample, serum methanol levels and poor prognosis could not be correlated. Likewise, the statistical relationship between time to hemodialysis and poor prognosis is unknown. In addition, the long-term effects of methanol poisoning could not be evaluated because of the lack of medical data after discharge. There is a need for a prospective multicenter study to a larger study sample, more comprehensive data collection, and healthier data analysis.

CONCLUSION

In conclusion, methanol poisoning is a serious problem among developing countries, where alcohol is not legal and cheap. High serum methanol levels are associated with a

poor prognosis. Time spent from ingestion to treatment is critical to avoid complications and mortality, therefore clinicians should keep in mind methanol poisoning during differential diagnosis in such patients.

Competing Interests: The authors declare that they have no competing interest.

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Ethical Approval: All procedures performed in this study were in accordance with the ethical standards of local ethical committee of Aksaray University (IRB Number: 2021/01-53).

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