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Examination of patients admitted to a university hospital with methanol intoxication

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ABSTRACT

Objective: The aim of this study is to evaluate the demographic data, clinical features and laboratory findings of patients followed up with methanol poisoning in our internal medicine clinic. In addition, to examine the data of the patients followed in our intensive care unit and to contribute to the literature in this direction.

Material and Method: In this study, 21 patients diagnosed with methanol intoxication who were hospitalized in the internal medicine clinic of our hospital between 01.01.2019 and 01.04.2022 were included. Demographic information of the patients, initial complaints, accompanying symptoms, laboratory results, blood gas values, intensive care unit requirements, mechanical ventilation needs, length of hospital stay and whether they received hemodialysis treatment were recorded from the hospital automation system.

Results: 21 patients were included in the study. The mean time for patients to apply to the hospital after drinking alcohol was calculated as 31.42±4.27 hours. The mean hospital stay was 3.0±1.02 days. While 12 patients were followed up in the intensive care unit, it was found that 6 patients needed mechanical ventilation and 9 patients needed hemodialysis. Glucose, creatinine, acetyl aminotransferase (AST), partial carbon dioxide pressure ($PaCO_2$), lactate, anion gap and base gap were found to be statistically significantly higher in the group treated in the intensive care unit ($p<0.05$). When the blood gas parameters at the time of admission were compared between the groups who received and did not receive hemodialysis treatment of the patients who presented with methanol intoxication, pH, lactate, anion gap and base deficit were found to be statistically significantly higher ($p=0.001$).

Conclusion: Hyperglycemia, increased serum creatinine value and metabolic acidosis were found to be significantly different in patients hospitalized in the intensive care unit

Keywords: Methanol, intensive care unit, hemodialysis

INTRODUCTION

Methanol, CH_3OH, is a clear, colorless, volatile liquid with a distinct odor that tastes the same as ethanol. Methanol intoxication may result from accidental exposure, overconsumption of compounds containing methanol with suicidal intent, or following consumption of distilled and contaminated alcoholic beverages(1). Toxicity of methanol is related to the production of toxic metabolites by the enzyme alcohol dehydrogenase (ADH), which can lead to metabolic acidosis, blindness (in methanol poisoning) and death(2). The initial acidic metabolites lead to metabolic acidosis, whereas the end metabolites mediate organ damage. Methanol is metabolized to formic acid, which produces acidosis as well as retinal and optic nerve damage leading to blindness observed in methanol poisoning (3). Although methanol poisoning can occur as an isolated ingestion, it is infamous for being involved in numerous epidemics. In outbreaks, methanol poisoning usually results from consumption of alcoholic beverages that have been spiked with methanol due to its low cost. These epidemics occur world-wide, often with high mortality rates(4-9).

Management of intoxicated patients starts with decontamination and supportive measurements besides the corrective metabolic therapy. Antidotal therapy with fomepizole or ethanol is a cornerstone, as it helps to inhibit toxic metabolites formation. Hemodialysis is an essential treatment for enhancing toxic metabolite removal. The time interval between methanol exposure and receiving treatment is closely related to the outcomes.

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The identification of at-risk patients requiring admission to the intensive care unit (ICU) and prompt treatment may prevent complications and long-term deaths(10,11).

The aim of this study is to evaluate the demographic data, clinical features and laboratory findings of patients followed up with methanol poisoning in our internal medicine clinic. In addition, to examine the data of the patients followed in our intensive care unit and to contribute to the literature in this direction.

MATERIAL AND METHOD

This study was planned retrospectively. The study was carried out with the permission of Hitit University Faculty of Medicine Non-Interventional Clinical Researches Ethics Committee (Date: 30.03.2022, Decision No: 2022-07). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

In this study, 21 patients diagnosed with methanol intoxication who were hospitalized in the internal medicine clinic of our hospital between 01.01.2019 and 01.04.2022 were included. Our study was planned retrospectively. Since methanol level was not measured in our hospital, patients whose ethyl alcohol level was measured in the hospital file system (<10 mg/dl) and who had a history/clinic of suspected alcohol intake were included in our study. Fifteen patients with an ethyl alcohol level below 10 mg/dl and 6 patients with an ethyl alcohol level above 10 mg/dl who consumed unlabeled and homemade alcohol in their anamnesis, had visual impairment, changes in consciousness, and had a high anion gap in blood gas analysis were also included. Demographic information of the patients, initial complaints, accompanying symptoms, laboratory results, blood gas values, intensive care unit requirements, mechanical ventilation needs, length of hospital stay and whether they received hemodialysis treatment were recorded from the hospital automation system.

Statistical Analysis

SPSS (version 26.0) software was used for statistical analysis. Frequency and percentage values were used for categorical data, and mean±standard deviation values were used for continuous variables. If the continuous variables in our study were in a normal distribution, the "t-test in independent groups" was used when comparing independent groups, and the "Mann Whitney U" test was used when comparing continuous variables that did not fit the normal distribution in two groups. In the evaluation of categorical variables, "Pearson chi-square" and "Fisher's exact probability" tests were used. Statistically significant value was accepted as $p<0.05$.

RESULTS

The mean age of the patients was 35.52±11.22. The mean time for patients to apply to the hospital after drinking alcohol was calculated as 31.42±4.27 hours. The mean hospital stay was 3.0±1.02 days. When evaluated according to the symptoms of admission; It was determined that 6 patients had blurred vision, 6 patients had nausea, 6 patients lost consciousness, 1 patient had loss of vision, and 2 patients had no complaints, but the patients who had taken alcohol together had symptoms. Among the accompanying spmtoms; There were fatigue in 17 patients, nausea in 15 patients, vomiting in 12 patients, dizziness in 13 patients, and blurred vision in 15 patients. While 12 patients were followed up in the intensive care unit, it was found that 6 patients needed mechanical ventilation and 9 patients needed hemodialysis (**Table 1**).

Table 1. Demographic and clinical data of patients

Sex (n)	20 male / 1 Female
Age (Mean±SD)	35.52±11.22
Time to Admission to the Hospital (Mean±SD)	31.42±4.27 hours
Length of Stay in Hospital (Mean±SD)	3.0±1.02 days
Follow-up in the Intensive Care Unit (n)	12
Hemodialysis Treatment (n)	9
Mechanical Ventilation Requirement (n)	6
Presenting symptom (n)	
Blurred vision	6
Nausea	6
Vision loss	1
Loss of consciousness	6
No symptoms	2

The hemogram, biochemistry and blood gas analysis results of the patients who received and did not receive treatment in the intensive care unit are given in **Table 2**. Glucose, creatinine, acetyl aminotransferase (AST), pH, partial pressure of carbon dioxide ($PaCO_2$), bicarbonate (HCO_3), lactate, anion gap and base deficit were found to be statistically different in the group receiving treatment in the intensive care unit ($p<0.05$).

When the blood gas parameters at the time of admission were compared between the groups who received and did not receive hemodialysis treatment of the patients who presented with methanol intoxication, pH, $PaCO_2$, HCO_3, lactate, anion gap and base deficit were found to be statistically significantly different ($p=0.001$) (**Table 3**).

Table 2. Comparison of hemogram, biochemistry and blood gas parameters of patients treated and no treated in the intensive care unit

	Treated in the intensive care unit group	No treated in the intensive care unit group	p value
White blood cell (10^9/L)	10.12±4.74	8.96±3.63	0.072
Hemoglobin (g/dL)	17.09±2.1	17.01±3.02	0.896
MPV(fL)	9.98±1.67	9.96±1.76	0.671
Platelet(10^9/L)	247.45±90.72	227.06±91.72	0.328
Neutrophil leumphocyte ratio	5.34±4.37	4.46±2.63	0.186
Glucose (mg/dL)	199.43±74.95	138.33±52.76	0.013
Urea	26.07±9.75	27.19±10.83	0.234
Creatinine	1.09±0.41	0.96±026	0.041
Sodium	133.07±5.26	133.58±6.34	0.532
Chlorine	101.46±4.27	101.23±4.39	0.841
Potassium	4.76±0.92	4.52±0.87	0.547
Acetyl aminotransferase	82.90±61.06	65.23±27.41	0.001
Alanine aminotransferase	47.38±25.43	42.67±24.12	0.253
pH	6.91±0.13	7.31±0.19	0.001
$PaCO_2$	58.02±13.15	32.78±11.62	0.001
HCO_3	7.14±3.93	10.07±3.45	0.002
Lactate	8.02±3.96	4.63±2.73	0.019
Anion gap	29.09±4.78	21.23±6.43	0.043
Base deficit	-25.69±4.96	-16.45±5.32	0.001

Table 3. Comparison of initial blood gas values of patients receiving and not receiving hemodialysis treatment

	Hemodialysis group	Non-hemodialysis group	P value
pH	6.95±0.11	7.34±0.21	0.001
$PaCO_2$	65.73±11.93	28.85±10.34	0.001
HCO_3	6.34±2.45	11.85±3.42	0.001
Lactate	12.83±3.75	3.63±1.86	0.001
Anion gap	28.55±3.96	19.36±4.61	0.001
Base deficit	-24.05±4.13	-15.31±5.8	0.001

DISCUSSION

The current study established male predominance over females (20 male, 1 female), which was thoroughly reported (12,13). The mean age of patients involved in the current study was 35.52±11.22 years, which is consistent with multiple case reports in various settings (14,15). On the other hand, Ahmed et al. (13) reported slightly higher age (mean 36.2±8.6 years) (12). Furthermore, Kurtas et al. indicated that individuals aged 41–50 years are more exposed. Rulisek et al. (16) reported an increased incidence of methanol intoxication in the elderly aged 50.9±2.6 years. The noticed age variation indicates the prevalence of methanol exposure in all age groups, especially during outbreaks.

In this study reported in presentation to the hospital (mean 31.42±4.27 hours) and hospital stay of 3 days. These results are in line with a previous study conducted in the USA, in which patients intoxicated with methanol spent approximately 4.0±6.1 days. Prolonged hospitalization places a noticeable burden on health care providing services (17). In a study by Md Noor et al. (10). reported the time to hospital admission as 24-96 hours

The current research revealed that nausea, blurred vision, vision loss and loss of consciousness were the most common presentations. Similarly, Ahmed et al. (12). reported that about half of the presented patients suffered from blurred vision Md Noor et al. (10). reported in a study that approximately one-third of patients presented with vomiting, blurred vision, and altered consciousness level

While 12 of the patients included in our study were admitted to the intensive care unit, it was determined that 9 of these patients received hemodialysis treatment and 6 patients needed mechanical ventilation. In the study of Sharif et al. (18), it was reported that 9 out of 37 patients admitted with methanol intoxication were admitted to the intensive care unit. 51.4% of the included patients treated with supportive measures without requiring hemodialysis or antidotal therapy, 21.6% received fomepizole, 13.5% underwent hemodialysis, 10.8% underwent hemodialysis, and received fomepizole, while 2.7% only received ethanol

In our study, no significant difference was found in hemoglobin, white blood cells, NLR and platelet parameters between the patients who were followed up and those who were not followed up in the intensive care unit. These findings corroborate those of other studies (18,19).

Hyperglycemia and serum creatinine has been shown to be a poor prognostic factor in methanol intoxications in studies (10,11,20). In our current study, glucose and serum creatinine levels were found to be significantly higher in patients followed in the intensive care unit, which supports the studies in the literature.

In our study, pH and HCO_3 levels were found to be low in the blood gas analysis results of the patients followed in the intensive care unit, while lactate, $PaCO_2$ and anion gap were found to be high. There was no death due to methanol intoxication among our patients. In 1998, Liu et al. (21). reported that 18 of 50 (36%) patients at the Toronto Hospital died of methanol poisoning. Coma or seizure on presentation and severe metabolic acidosis (pH <7) were indicators of poor prognosisIn the study by Meyer et al. (22) the strongest predictor of death was a blood pH of <7.0. An analysis by Hovda et al. (4). of a methanol outbreak in Norway between 2002 and 2004 revealed that respiratory arrest, coma, and severe metabolic acidosis (pH<6.9 and base deficit >28 mmol/L) were strong predictors of poor outcome

Coulter et al. (23). analyzed the literature data of 119 patients with methanol poisoning and concluded that large osmolal gap, anion gap, and low pH (pH <7.22) were associated with increased mortality and that pH has the highest predictive value. Another study reported the significant function for the anion gap as an unfavorable outcome predictor, which agrees with other studies. The association between methanol toxicity and high anion gap metabolic acidosis is due to formic acid formation. The parallel decrease in HCO_3 and elevated serum formic acid in patients with unfavorable outcomes supports the crucial role of formic acid in methanol-induced acidosis. Acidosis accelerates the toxicity by enhancing more formic acid diffusion into the cells (18). Finally, it was suggested in a multicenter study that low pH (pH <7), coma (GCS score <8), and inadequate hyperventilation (pCO_2 ≥3.1 kilopascal (kPa) in spite of a pH <7) on admission were the strongest predictors of poor outcome after methanol poisoning (5).

Hemodialysis is a commonly used reliable management procedure. Hemodialysis removes methanol and its toxic metabolite formic acid from the blood. Indications for hemodialysis include a serum methanol concentration of 50 mg/dL (15.6 mmol/L) or more, the presence of metabolic acidosis, and visual disturbances(24,25). In our study, the pH value of the patients who received hemodialysis was 6.95±0.11 and this value was found to be significantly lower than the group that did not receive hemodialysis.

Study limitations: This study has some limitations. Retrospective planning, the small number of patients, and the fact that we do not know how much and what type of methanol alcohol the patients consume are among these limitations.

CONCLUSION

In summary, hyperglycemia, increased serum creatinine value and metabolic acidosis were found to be significantly different in patients hospitalized in the intensive care unit. However, the retrospective nature of the study, lack of control of a retrospective cohort, small patient population and absence of methanol, formic acid or ALDH2 measurements limit the certainty of our conclusions. In addition, since our study is planned retrospectively, post-discharge sequelae could not be evaluated in patients.

Ensuring high quality-controlled production and distribution of alcoholic beverages. Establishing a tracking system to limit illegal alcohol production. Increasing orientation of populations about hazards of industrial alcohol and illegal alcoholic beverages.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Hitit University Faculty of Medicine Non-Interventional Clinical Researches Ethics Committee (Date: 30.03.2022, Decision No: 2022-07).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version.

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