Internal Medicine and Medical Investigation Journal
E-ISSN: 2474-7750
Homepage: www.imminv.com

ORIGINAL ARTICLE

Survey On Methanol Poisoning Epidemic in Rafsanjan City in Year 2013

Vahid Mirzaee[1], Zahra Riahi[2], Zahra Sharifzadeh[1], Moein Kardoust Parizi[2]*, Amir Adineh Pour[1]
[1]*Department of Internal Medicine, Faculty of Medicine Rafsanjan University of Medical Sciences, Rafsanjan, Iran*
[2]*Student Research Committee, Rafsanjan University of Medical Sciences, Rafsanjan, Iran*
Corresponding Author: Moein Kardoust Parizi, E-mail: moeinkardost@yahoo.com

ARTICLE INFO

Article history
Received: Feb 20, 2017
Accepted: Mar 9, 2017
Published: Aug 4, 2017
Volume: 2
Issue: 3

Conflicts of interest: None
Funding: None

Key words
Rafsanjan,
Poising,
Methanol,
Epidemic

ABSTRACT

Background: Examination and early detection of the methanol toxicity epidemic are very important, so identification and initiation of appropriate therapy can significantly reduce morbidity and mortality. Therefore, this study was aimed to investigation methanol poisoning epidemic in Rafsanjan city. **Methods:** This case series study was conducted in 252 patients with methanol poisoning in 2013 in the Ali-ibn-Abi-Talib hospital of Rafsanjan. Data were through interviews and records that were collected at hospital admission. Due to the large number of patients and the possible lack of ability of rapid measurement of serum levels of methanol and need of rapid intervention, treatment to reduce any further complications, early diagnosis and treatment were carried out by clinical history and interpretation of arterial blood gas test results. Data record on provided checklists and then analyzed using SPSS version 19. **Results:** The mean pH was 0.13±7.27. The most frequent clinical features were visual disturbances (39.7%), dyspnea (1.2%), and gastrointestinal symptoms (7.1%). There was a trend towards decreasing PCO2 with decreasing pH amongst the patients surviving. The opposite trend was demonstrated in the dying; the difference was highly significant by linear regression analyses (P< 0.001). **Conclusions:** Methanol poisoning still has a high morbidity and mortality, mainly because of late diagnosis and treatment. Respiratory arrest, coma and severe metabolic acidosis upon admission were strong predictors of poor outcome. Early admission and ability of respiratory compensation of metabolic acidosis were associated with survival.

INTRODUCTION

Methyl alcohol (methanol) is a toxic and inexpensive substance among illicit drinks (1). There is a slight level of methanol in commercially available alcoholic drinks while these drinks contain sufficient amounts of ethanol. In contrast, handmade alcoholic drinks contain high levels of methanol, which can lead to poisoning. Most of the patients survive, but some cases result in death, which cannot be even prevented using intensive care, dialysis, and treatment with antidotes (2).

Poisoning by counterfeit alcoholic drinks is one of the most hazardous poisonings that sometimes leads to death (3-5). Since the sale, production, and consumption of alcoholic beverages are legally prohibited in Iran, there is a high possibility of profiteering and fraud in their production. There is not any detailed report available on the amount of alcohol consumption in Iran, but the increase in alcohol poisoning and even death indicates that substandard and counterfeit alcoholic beverages have targeted the young population's health (5). Alcoholic beverages are among the preparations that have taken the lives of many people to date and sometimes lead to their intoxication. One of the hazardous pesticides is wood alcohol or methanol (5,6). Due to reported cases of mass epidemics of methanol poisoning, familiarity with the principles of diagnosis and treatment of them are of paramount importance in some cities of the country (5,7,8).

World Health Organization (WHO) reports that 7.5% of people in a public communication attempt alcohol abuse on average (9). Although statistics in our country is about 0.1%, which is much lower than this amount (10), the remarkable thing is that most cases of alcohol abuse and its related data are reported in the country (11). Most of the people who consume alcohol in our country involve adolescents and youth aged from 18 to 20 years old who turn to it for curiosity or experience of new substance; although no information is available on the epidemiology, management, and treatment of alcohol poisoning (12).

The present knowledge about human poisoning with methanol largely pertains to the studies conducted on laboratory animals due to the existing restrictions. The examination and early diagnosis of epidemic poisonings with

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http://dx.doi.org/10.24200/imminv.v2i3.47

methanol are of great importance for the identification and initiation of appropriate treatment can significantly reduce morbidity and mortality. Therefore, in this study, the methanol poisoning epidemic had been investigated a scientific perspective in Rafsanjan city in June 2013. In this way, the problems and barriers in the future similar incidents can be tackled in addition to the provision of detailed information on the management of the current crisis.

METHODS

In this case series study, 252 patients referring to Ali Ibn Abi Talib Hospital in Rafsanjan in June 2013 because of injury by the methanol poisoning incident were evaluated. The patients were admitted based on their history of alcohol use. After it had been found that the number of patients suffering from poisoning symptoms would be on the rise, it was predicted that a methanol poisoning epidemic was occurring. Accordingly, a new treatment protocol was designed for the condition at play.

In collaboration with medical students and interns, patients were given arterial blood gas tests (ABG), and the test results were interpreted in the presence of the Internal Medicine Department experts. A group of patients was referred for dialysis due to renal failures arising from methanol poisoning as well as acidosis. It is noteworthy that surgical specialists embedded Shaldon for these patients before their transition to dialysis ward. To carry out this study, the data about patients were collected by their consent through a variety of methods, including interviews, the information contained in patients' hospital admission records. Then, these data were inserted into the checklists developed by Internal Medicine Department experts. The subjects were re-examined to determine the side effects of Shaldon. Large numbers of patients have been concurrently admitted, and it was not feasible to quickly gauge the methanol level in serum. On the other hand, it was required to conduct quick interventions to reduce health complications as much as possible. Therefore, early diagnosis and treatment were fulfilled based on the clinical history and interpretation of arterial blood gas test results as per the clinical approach designed by the Internal Medicine Department experts of the hospital (Figure 1). Patients were interviewed in person in accordance with the information contained in their medical records so that the patients' status could be examined. Then, the data were inserted into SPSS version 19 and were analyzed after data coding.

RESULTS

The number of 252 patients referring to Ali Ibn Abi Talib Hospital in June 2013 participated in this study. The mean value of participants' age was equal to 23.7 ± 5.5 years where the minimum and maximum ages of the participants belonged to a 15-year-old man and a 48-year-old man, respectively. Most of the patients suffering methanol poisoning were aged between 17 and 28 years old. Regarding gender, the majority of the patients were male, and only 0.8% of them (n=2) were female, both of whom were 19-years-old. In terms of marital status, 43(17.1%) patients were single, 13 (5.2%) patients were married, and 77.8% of the patients had not determined their marital status. Among all the patients, 2.4% had primary school education degrees, 0.4% had secondary school education degrees, and 0.4% had academic degrees while 92.5% of the patients had not answered the question about their education level (Table 1).

The mean value of the duration that patients had used methanol until the incidence of poisoning symptoms was reported to 24.32±2.517 hours, which has a range of 1 to 120 hours. It took 16.4±11.69 hours since the occurrence of poisoning symptoms up to the referred of the patients to the hospital for treatment. These individuals had referred to the hospital minimum 1 hour and maximum 48 hours after the occurrence of poisoning symptoms. Some of the patients referring to the hospital initially had acute symptoms in a way that 36.1% of them (n=91) suffered neurological disorder symptoms, 7.1% (n=18) suffered gastrointestinal disorders, and 1.2% suffered respiratory disorders. Forty-two (16.7%) patients had mydriasis, and 100 (39.7%) patients suffered symptoms of visual impairment, 6 (2.4%) patients underwent tachypnea, and 15 (6%) patients were involved in respiratory distress. Furthermore, 66 (26.2%) patients did not suffer any dizziness while 78(31%) patients experienced dizziness; (38.1%) patients had no headaches, but 46(18.3%) patients had a headache. Similarly, 3 (1.2%) patients suffered from seizure, 0.4% (n =1) of them had no balance, and 0.4% (n =1) of them suffered stupor. The mean PH were 7.27 ± 0.13 among the patients upon their admission. In this regard, the lowest and the highest values were 6.69 and 7.47, respectively. The number of 114 patients (45.2%) had acidosis, 2 patients (0.8%) had alkalosis, and 54 patients enjoyed normal PH (Table 2).

The mean blood HCO3 in the patients upon their admission equaled 13.52 ± 6.45 in such a way that the amount of HCO3 in blood was lower than normal in 148 patients and was normal in 21 patients. Moreover, it was revealed that the mean PCO2 in patients' blood equaled 28.12 ± 10.31. This index took up the values of 9.5 and 70.5 in its minimum and maximum values in the patients. The classification of this index in patients based on three modes of low, normal, and high showed that there was a low level of PCO2 in 131 (52%)

Table 1. Demographic values of patients enrolled in this study

Variable	N (%)
Gender	
Male	250 (92.2)
Female	2 (0.8)
Marital status	
Single	43 9 (17.1)
Married	13 (5.2)
Not mentioned	196 (77.8)
Education	
Primary school	6 (2.4)
The Junior school	6 (2.4)
High school	6 (2.4)
University	1 (0.4)
Not mentioned	233 (92.5)

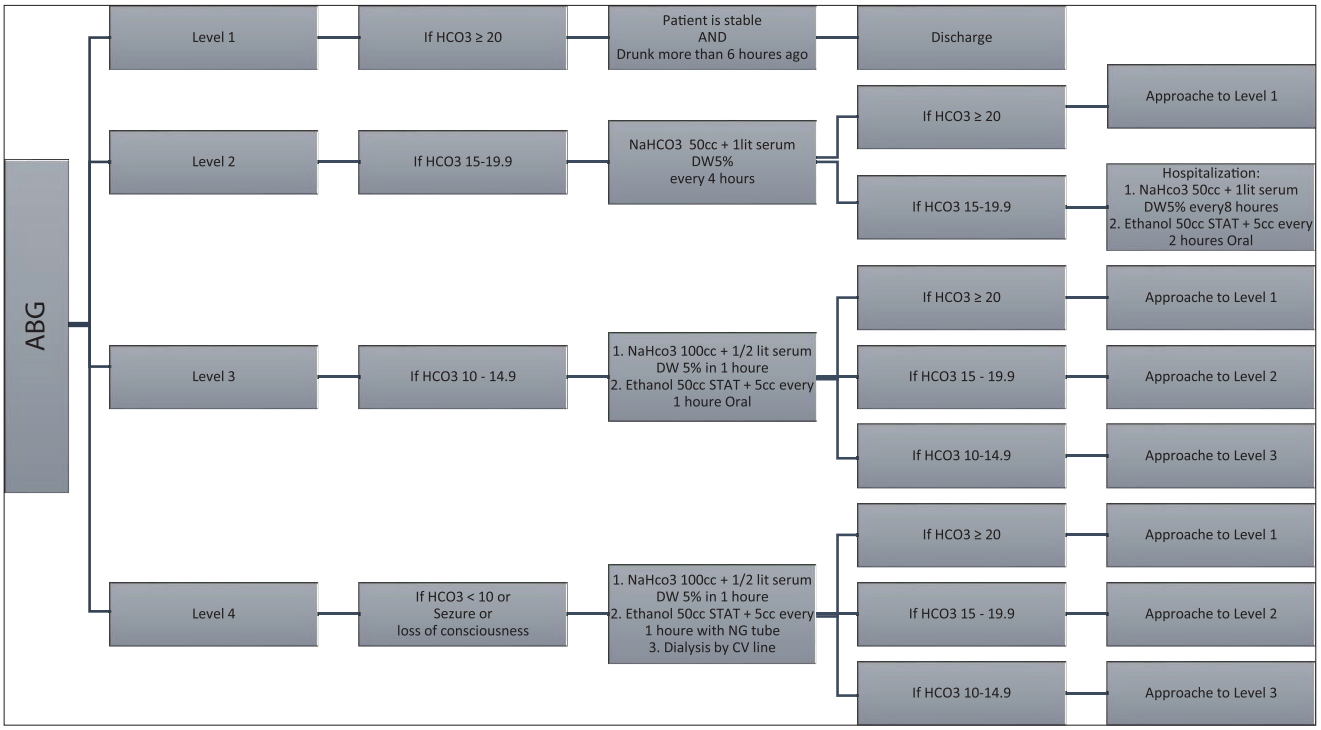

Figure 1. The clinical approach designed by the internal department experts

Table 2. Frequency distribution of pH, HCO_3, PCO_2, Na, Ca, K values, and level of blood sugar in the patients

Variables	Mean±SD	Low	Normal	High	Not registered
pH	7.27±0.13	45.2	21.5	0.8	22.5
HCO3	13.52±6.45	58.7	8.4	0	22.9
PCO2	28.12±10.31	52.0	10.3	3.6	24.1
Na	144.68±7.85	6.0	14.7	5.2	74.1
Ca	9.60±1.38	0	5.6	4.4	90.0
K	3.99±1.11	6.3	21.4	2.8	69.5
Blood sugar	7.27±0.13	2.8	12.5	1.2	82.5

patients, a normal level of PCO2 in 26(10.3%) patients, and a high level of PCO2 in 9 (3.6%) patients. Table 3 shows the correlation of pH, HCO3, and PCO2 values with the number of dialyzes, dialysis duration, and the duration of hospitalization in 252 the patients who had referred to the hospital. As these results show, although the relationship between pH, HCO3, and PCO2 was significant in some cases, what was of importance to us was the correlation of these variables with the number of dialyses, dialysis duration, and the duration of hospitalization that the results suggest that these correlations are not statistically significant ($P<0.05$). However, a direct and significant relationship was eventually found between the number of hospitalization days, the number of dialyzes, and also duration of dialysis ($P>0.05$). This relationship suggests that duration of dialysis in patients has witnessed an increase with increasing the number of dialyzes and also the duration of dialysis (Table 4).

The relationship between variables, such as age, duration of methanol use until the incidence of poisoning symptoms, the duration of the incidence of poisoning symptoms until hospital admission, pH and the like have been shown in Table 4. The results of this table show that the mean age of the individuals remaining alive was higher, but the difference was not statistically significant.

The duration of methanol consumption until the onset of symptoms was longer in healthy people. This finding suggests that poisoning symptoms have emerged at much higher speeds in the dead persons. This finding was not statistically significant.

In this study, it was also found that the pH value in dead persons is lower than that in the individuals remaining alive. This finding was statistically significant ($P<0.001$).

DISCUSSION

Confrontation with active cases of diseases and their evaluation may be feasible only when that disease has low mortality rates. This experience is achieved when the disease outbreak is detected in the initial phase of development; and the time from start to hospitalization; from start to hospitalization; and from hospitalization to diagnosis and treatment is high (13,14). On the contrary, diagnosis in this study was made in a short time, and the disease outbreak was immediately relieved in this study.

In all the studies examining the prevalence of methanol poisoning (5,15,16), experience has shown that methanol poisoning still causes a wide range of side effects (17). This issue is vital due to the delays in hospitalization and diagnosis.

The slow recovery clearly reflects the availability of the relationship between the metabolic acidosis (for example resulting from formic acid and then lactic acid) originating from methanol metabolites and control of mitochondrial cellular respiration (16). As with other diseases, early diag-

Table 3. Pearson correlation coefficient (rs) between the quantitative variables in the study patients

	pH	HCO3	PCO2	Number of dialysis	Duration of dialysis	Hospitalization days
pH						
rs	1					
P-value	---					
HCO3						
rs	**0.684	1				
P-value	0	---				
PCO2						
rs	*0.190	**0.775	1			
P-value	0.014	0	---			
The number of dialyses						
rs	–0.108	–0.239	–0.223	1		
P-value	0.405	0.062	0.081	---		
Duration of dialysis						
rs	–0.227	–0.259	–0.225	**0.892	1	
P-value	0.102	0.061	0.104	0	---	
Hospitalization days						
rs	–0.18	–0.21	–0.085	**0.432	*0.333	1
P-value	0.187	0.124	0.526	0.001	0.018	---

**Correlation is significant at the level of 0.01, *Correlation is significant at the level of 0.05

Table 4. The relationship between the living and the dead in terms of the study variables

Variable	Alive	Dead	P-value
Age	24.95±6.96	25.00±1.73	0.990
Consumption duration until the onset of symptoms	24.41±26.14	12.00±0.00	0.643
Duration of incidence of symptoms until referring to the emergency	16.39±11.96	6.00±0.00	0.398
pH	7.22±0.12	6.86±0.21	<0.001
HCO3	11.27±6.29	6.40±1.73	0.189
PCO2	26.02±10.60	41.40±26.54	0.421
P	6.01±5.81	10.63±6.16	0.266
Hospitalization days	2.60±0.74	3.50±0.71	0.099
Duration until Shaldon placement	114.00±87.79	120.00±0.00	0.948
The number of dialyses	1.08±0.43	0.67±0.58	0.108
Duration of dialysis	3.07±1.13	2.50±0.71	0.483

nosis and timely treatment are of utmost importance. The diagnosis of disease in the present patients was postponed due to lack of proper training to physicians about the possibility of the occurrence of such accidents. However, we could analyze the level of methanol in the first 24 hours of the occurrence.

A large number of patients were symptomatic at the beginning, and 39.7% of them were reported with vision problems, which are considered as the most common symptom. This study confirms the other studies that have reported the rate of vision problems in the range of 29 to 64% of the population (14,18-21). In parallel studies, the emerging disease symptoms have been reported to be from1 8% to 67% in the gastrointestinal tract (14,20-22) and to be 8% to 25% in dyspnea (14,20,22).

The prognosis of methanol poisoning is contingent upon the amount of metabolic acidosis (23,24), which has been shown in Table 3. Blood pH levels of less than 6.86 ±0.21 is the desired indicator to measure the mortality rate among patients. Similar to the results of the study done by Hassanian-Moghaddam et al., the pH level below 7 is the determinant of mortality in these results (25).

In the present study, the mortality rate among the admitted patients was equal to 11 (4.36%) cases. The mortality rate of patients in other studies indicates that different factors such as the time interval from alcohol consumption to hospital visit, simultaneous consumption of ethanol, and the degrees of metabolic acidosis are effective in mortality rate. According to this research and the consistent study (20,26,27), better documentations can be found to discuss the severity of poisoning.

Except for two pieces of research carried out in Norway and Estonia (13,14), research findings are similar to the results of the present study. Although various sources lay emphasis on the measurement of osmolality and anion gap for diagnosis (16), laboratory measures are not mostly available during a widespread outbreak of the disease. Hence, physicians usually use clinical symptoms and blood gas analyzers for disease diagnosis in such circumstances (28).

In a case-series study, conducted by UK School of Medicine in Afghanistan, the researchers used osmolality gap and breath alcohol analyzers and managed to diagnose methanol poisoning cases (29). In addition, the degrees of metabolic acidosis caused by formic acid and level of consciousness in the presence or absence of hyperventilation can predict the consequences and side effects of methanol poisoning (25,30).

In America, national poison data system is a data-monitoring unit that is released by the Centers for Disease Control and Prevention (CDC), which is responsible for the dissemination of information on confrontation with chemicals and the resultant poisoning. In this case, such coordination arises that creates an opportunity for the progress of public health response to chemical and toxic substances; finally, the morbidity and mortality caused by them decrease and, thereby, the correlation between technology and health increases (31). However, there is not such a system in Iran, and this is fulfilled by emergency operation centers (EOCs), which obtains each of its information centers from emergency medical services (32) (EOC has obtained the information in this study in Rafsanjan).

Experience has shown that methanol poisoning still may cause a wide range of side effects (17). This issue is very important due to the delays in hospitalization and diagnosis. A slow recovery vividly represents the relationship between metabolic acidosis (for example resulting from formic acid and then lactic acid) originating from methanol metabolites and control of mitochondrial cellular respiration (16). As with other diseases, early diagnosis and timely treatment are of utmost importance. The diagnosis of disease in the present patients was postponed due to lack of proper training to physicians about the possibility of the occurrence of such accidents. However, we could analyze the level of methanol in the first 24 hours of the occurrence.

The prevalence of such incidents, including the present study and its published results plays an important role in giving information and even warnings to those at risk and also physicians. Methanol poisoning still causes a considerable mortality rate due to the delay in referring to hospital and delayed diagnosis. The use of buffers, antidotes, and hemodialysis can be useful provided that it is used quickly at the very beginning. For this reason, methanol poisoning should be considered in metabolic acidosis with unknown etiology so that the timely treatment can be practiced.

CONCLUSION

Visual disturbances, dyspnea, and gastrointestinal symptoms are among the variable symptoms, while severe metabolic acidosis, coma, and increased pCO2 are associated with inappropriate and poor treatment outcomes. Many patients who were symptomatic were discharged after treatment without any complication and side effects. This study is the summary report of the innovative treatment and its outcome that specialists made use of for the early diagnosis and treatment of patients in the event of 2013.

ACKNOWLEDGMENTS

We have to thank all the patient who contributes in this study.

AUTHORS CONTRIBUTION

All the authors contribute in this study equally.

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