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Methanol mass poisoning in Iran: role of case finding in outbreak management

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ABSTRACT

Background There are no guidelines addressing the public health aspects of methanol poisoning during larger outbreaks. The current study was done to discuss the role of active case finding and a national guideline that organizes all available resources according to a triage strategy in the successful management of a methanol mass poisoning in Rafsanjan, Iran, in May 2013.

Methods A retrospective cross-sectional study was performed reviewing the outbreak Emergency Operation Center files. The objectives were to describe the characteristics, management and outcome of a methanol outbreak using Active Case Finding to trace the victims.

Results A total of 694 patients presented to emergency departments in Rafsanjan after public announcement of the outbreak between 29th May and 3rd June 2013. The announcement was mainly performed via short message service (SMS) and local radio broadcasting. A total of 361 cases were observed and managed in Rafsanjan and 333 were transferred to other cities. Seventy-five and 100 patients underwent hemodialysis (HD), retrospectively. The main indication for HD was refractory metabolic acidosis. Eight patients expired due to the intoxication. Except for the deceased cases, no serum methanol level was available.

Conclusion In developing countries, where diagnostic resources are limited, use of active case finding and developing national guidelines can help in the management of large outbreaks of methanol poisonings.

Keywords methanol, poisoning, outbreak, epidemics, mortality, intoxication

Introduction

Disaster Health Management (DHM), a systematic process of using administrative decisions, organizations, operational skills and capacities to meet the challenge of planning for, responding to, and recovering from health consequences of disasters has substantially improved in Iran during the recent years, especially after the Bam earthquake in 2003.[1,2] The Emergency Management Center (EMC) under the Deputy of Health in Iran's Ministry of Health and Medical Education (MOH& ME) is the highest center of planning for and supervising DHM programs. This center consists of the Emergency Medical Services (EMS) and national Emergency Operation Centers (EOCs).[2,3]

Mass poisoning of methanol happens sporadically and typically occurs in developing countries or in countries with high taxes on alcohol. The illegal spirits can contain pure

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methanol, it can be diluted with water or it can be mixed with ethanol.[4,5] In Islamic countries with legal prohibitions on distribution and sale of alcohol, methanol poisoning is largely due to the consumption of underground handmade alcoholic beverages. In Iran, methanol poisoning is becoming a serious and growing healthcare problem mostly involving young males.[6,7] Recognizing this potential threat, a national clinical guideline for treatment of methanol poisoning was developed by reviewing all outbreaks and recruiting principal medical directors in Iran from all around the country.[8] An executive summary is available at online Supplementary data. This guideline has become the centerpiece of DHM's recommendations for controlling methanol outbreaks and is followed by all EOCs in Iran in response to such events.

We defined active case finding as looking systematically for cases in groups known or thought to be at higher risk of the disease rather than waiting for people to develop symptoms/signs of active disease and present themselves for medical attention (also known as passive case finding).[9]

The objectives of this study were to discuss the characteristics, management and outcome in a large methanol outbreak where Active Case Finding was used.

Methods

This is a retrospective descriptive cross-sectional study of the methanol poisoning outbreak in Rafsanjan -Iran, in May 2013. Every patient presenting to one of the Rafsanjan EDs with a history of handmade alcoholic beverage consumption with or without signs and symptoms of methanol poisoning was considered as a potential victim. Although we had access to the medical files of 177 patients transported to Kerman (the center of the province and the main referral city during the outbreak), we decided to evaluate this event from a public health standpoint for two reasons: first, we did not have access to the patients' records in Rafsanjan (where the greatest number of the patients were located); second, some available records did not include complete data because a huge number of patients were collected in various centers in a short time frame. The mortality rate and the occurrence of visual disturbance persisting to discharge time were considered as outcomes. Using the data reported by the EOC and EMS, all cases presenting to hospitals with relevant history were included in the calculation of the mortality rate: in lack of confirmatory tests, we therefore do not know how many patients were 'worried well', and thus not poisoned by methanol *per se*. By law, all suspect fatalities are examined by local forensic institutions, making us able to cross-check all fatalities from the hospital.

The data were gathered by an emergency medicine technician by reviewing local EMS and EOC records. In addition to

Table 1 A collection of methanol outbreaks the recent decades published in medical literature

Year	*Location*	*Affected people*	*Reported deaths*	*Reference*
1998	Phnom Penh, Cambodia	>400	60	10
2000	Nairobi, Kenya	661	140	10
2000	San Salvador, El Salvador	>200	117	10
2000	Feni, Bangladesh	>100	56	10
2001	Pärnu, Estonia	154	68	4
2002	Antananarivo, Madagascar	40	11	10
2002–2004	Norway	59	17	5
2004	Shiraz, Iran	62	17	11
2011	Khartoum, Sudan	>137	71	12
2012	Czech Republic	73	13	13
2013	Rafsanjan, Iran	694	8	—

Table 2 A collection of methanol outbreaks the recent decades published in the news (adapted from Zhang *et al.*, 2012)[14]

Year	*Location*	*Affected people*	*Reported deaths*
1998	Nis, Serbia	>90	43
1998	Shanxi Province, China	>200	27
2000	San Salvador, El Salvador	>200	117
2001	Pärnu, Estonia	154	68
2001	Bombay, India	>120	27
2003	Botswana	>45	9
2005	Kenya	174	49
2006	Nicaragua	801	48
2006	Urals, Russia	60	3
2008	Karnataka & Tamil Nadu, India	285	150
2009	Central Uganda	77	27
2009	Gujarat/Ahmedabad, India	>275	136
2009	Bali/Lombok, Indonesia	45	25
2009	Kampala, Uganda	189	89
2011	Los Rios, Ecuador	>770	51
2011	West Bengal, India	>370	170
2011	Haiti	40	18
2011	Kolkata, India	>167	143
2012	Orissa, India	100	31
2012	Cambodia	367	49
2012	Tegucigalpa, Honduras	48	24
2012	Czech Republic and Slovakia	>105	33
2013	Libya/Tripoli	>800	>90

its EMS reports regarding the number of the patients and transports, the EOC received data directly from all hospitals. All of the regions involved in the management of the outbreak were located in one district with respect to EOC and EMS systems. Tables 1 and 2 present a brief overview of some recent epidemics.

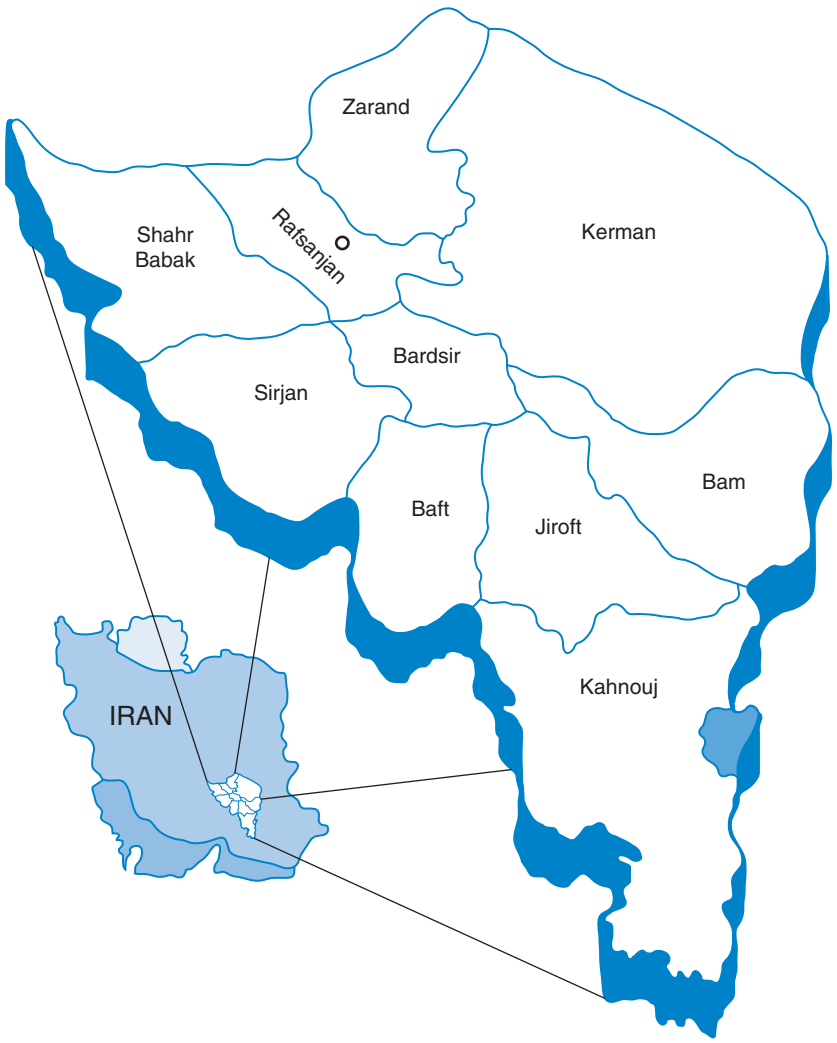
This study is in accordance with the principles of the World Medical Association Declaration of Helsinki and further revisions.

Results

Events and efforts

A total of 694 patients were recorded, of which 361 were managed in Rafsanjan and 333 were transported to the other cities by 22 ambulances and 3 ambulance buses from the EMS (Fig. 1).

The first patient presented severely ill to a local ED in Rafsanjan at 7:45 PM on 29th May. He died after a few hours



Kerman	Zarand	Shahr Babak	Sirjan	Bardsir	Baft	Yazd	Total
P = 800,000	*P* = 120,000	*P* = 100,000	*P* = 240,000	*P* = 90,000	*P* = 138,000	*P* = 484,000	
D = 110(SE)	*D* = 197(N)	*D* = 144(W)	*D* = 143(SW)	*D* = 133(S)	*D* = 215(S)	*D* = 246(N)	
N = 177	*N* = 54	*N* = 19	*N* = 40	*N* = 19	*N* = 5	*N* = 19	*N* = 333

Fig. 1 Map and number of transported patients to other cities in the Kerman province and north (Yazd). *P*: Population of the city, *D*: distance of the city from Rafsanjanin kilometers, *N* = number of patients transported to that city, SE: Southeast, N: North, W: West, SW: Southwest, S: South.

of critical care. As the number of patients increased to 5 at 12:10 PM on 30th May, the EOC of the province was activated. According to the EOC announcement, all on-call prehospital and hospital resources and personnel were recruited to their positions and possible dispositions from emergency and critical care units were initiated. The Bahonar Academic Hospital—a trauma and toxicology center in Kerman—was assigned as the collection point for transported patients with severe metabolic acidosis. From this center, patients needing hemodialysis (HD) were transported to five different centers with dialysis facilities in Kerman after catheter placement. Case-finding protocol was activated in Rafsanjan by encouraging patients to find their drinking partners, sending warning messages via short message service (SMS) to Rafsanjan cell phones and repeated announcements by Rafsanjan broadcasting (Fig. 2). Some local healthcare facilities encouraged people by using loudspeakers to inform others regarding possible toxic alcohol contamination in distributed alcoholic beverages. After initiation of the case-finding protocol, the number of patients presenting to EDs of Rafsanjan increased even with

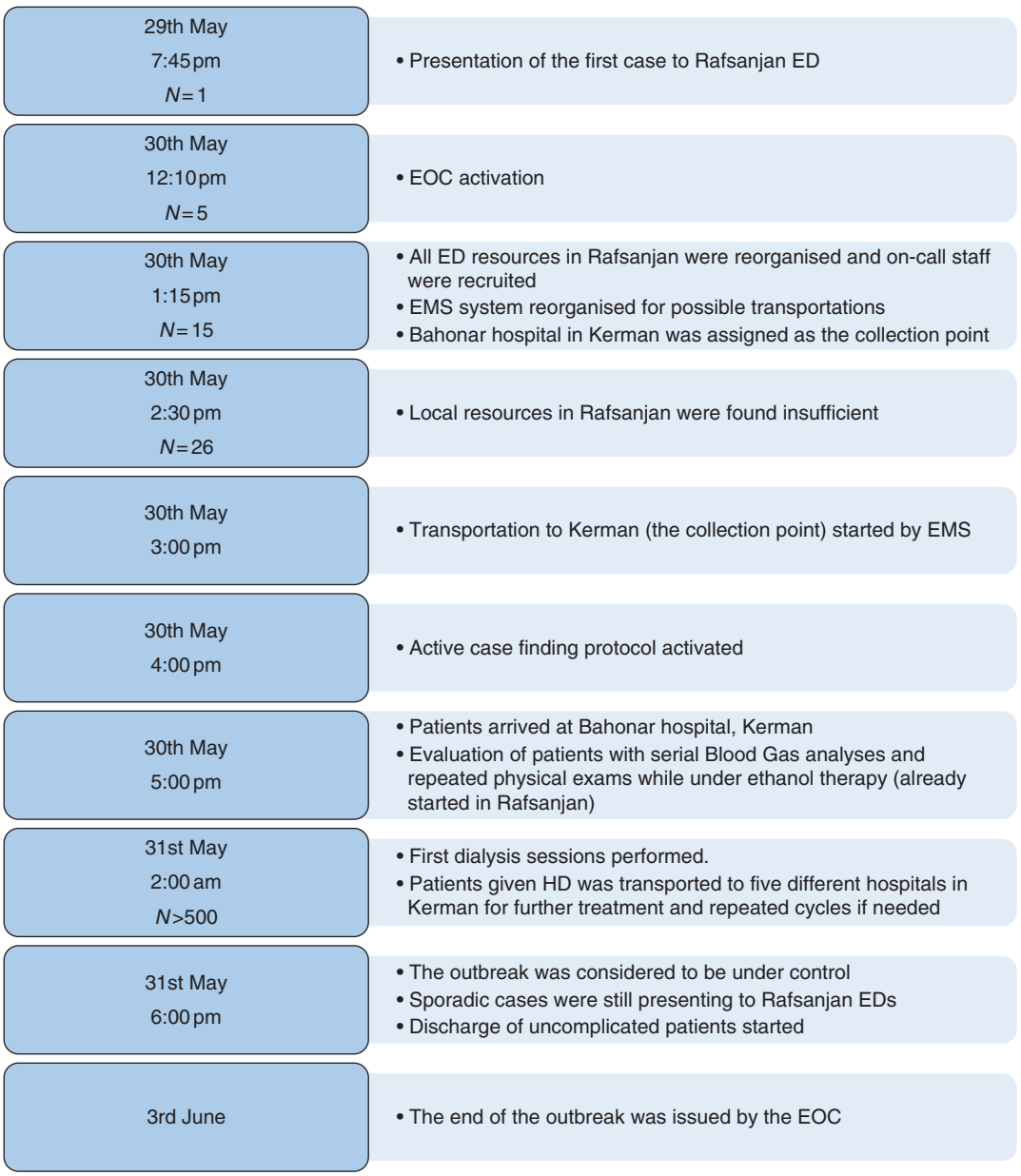


Fig. 2 Sequence of events during outbreak from the beginning to the end. Abbreviations: ED = Emergency Department, *N* = number of patients presenting to Rafsanjan EDs. EOC = Emergency Operation Center. EMS = Emergency Medical Service.

initial minor symptoms (Fig. 2), but fortunately, there was no report of any serious problem or breakdown in ED services, including screening for metabolic acidosis by serial blood gas analyses and looking for symptoms or signs of poisoning by collecting prior history and serial physical examinations.

After collecting the suspicious beverages from multiple sources, the analysis revealed a methanol concentration of >60%. The contaminated beverages were exclusively home-made alcoholic drinks. Whether all these sources originated from a single person or not was subject to local police investigations, but no official report by police or EMC is available to date.

Clinical toxicology aspects

The patients who died had their methanol confirmed qualitatively in serum or vitreous fluids. Other than that, no methanol or ethanol levels were available, nor was osmolality or chloride ions for calculating the osmolal and anion gaps, respectively. However, for non-emergency matters, these were available in private laboratories. As a result and according to the national guideline, all patients with relevant history and serum pH of <7.3 with parallel serum bicarbonate levels of <20 mEq/l (20 mmol/l) were given oral or intra-gastric ethanol for metabolic blockade followed by repeated blood gas analyses. We did not have access to fomepizole for metabolic blockade. Hemodialysis was in most cases provided in the metabolic acidotic patients (pH < 7.25 and/or base deficit > 15 mmol/l) refractory to antidote or patients having visual disturbances. Metabolic acidosis was present in all 177 patients transferred to Kerman and in many cases in Rafsanjan. We, however, did not have access to the details of cases in Rafsanjan except that according to the EOC reports, from 138 patients treated in Rafsanjan, 65 (47%) had visual disturbances. The number of patients undergoing HD was 75 in Rafsanjan and 100 in Kerman. By the end of the outbreak on 3rd June, eight (1.1%) deaths were reported: seven in Rafsanjan and one in Zarand. There were a high number reported to have visual disturbances on admission, but no permanent blindness were accounted for.

Discussion

Main findings of this study

Active case finding may have resulted in a lower morbidity and mortality. This is based on experiences from earlier outbreaks where the initial phase usually is characterized by a long time from intake to admission and admission to diagnosis/initiation of treatment.[4,5] The present outbreak represented the opposite with a very high number of patients being identified and treated within a short time frame, and the outbreak ending very abruptly.

What is already known on this topic

Except for a few studies on outbreaks in Estonia and Norway,[4,5] large outbreaks of methanol poisoning with determination of serum levels are scarce.[6,15,16] Although literature supports the use of osmolar and anion gaps in the diagnosis of methanol poisoning,[16] such laboratory measurements are often not available during large outbreaks. Clinicians may, therefore, have to manage methanol poisoning using only clinical symptoms and blood gas analyses.[17] In a case series reported from a British medical treatment facility in Afghanistan, the authors reported that the use of osmolar gap and a breath alcohol analyzer can assist in the diagnosis of toxic alcohol poisoning in resource-limited areas.[18] Moreover, the degree of metabolic acidosis from formic acid, consciousness level at presentation and presence or absence of hyperventilation can predict the outcome in methanol poisonings.[7,19]

In the USA, the National Poison Data System is a surveillance system providing the data used by the Centers for Disease Control and Prevention to rapidly identify chemical and poison exposures. This integration provides the opportunity to improve the public health response to chemical and poison exposures, it can reduce morbidity and mortality and it serves as an important step forward in surveillance technology and integration.[20] In Iran, there is no similar data system, and this task is done by EOCs of each district by receiving data from EMS (contacts of exposed patients), healthcare professionals working in the hospitals and EOC sub-centers located in each middle-sized city (in this case, the Rafsanjan EOC).[2]

What this study adds

Following the national guideline, practitioners in Rafsanjan with no academic experience in clinical toxicology were able to manage a considerable number of the patients. This was because a national surveillance for foodborne outbreaks had been established in Iran 6 years earlier and had facilitated finding outbreaks including those involving methanol poisoning. This study adds Active Case Finding as a relevant aspect of methanol poisonings for the first time. Although the case finding program may contribute to ED overcrowding, it will shorten the time from ingestion to presentation and thus increase the likelihood of the simple treatments to be effective. Third, the role of the EOC in the distribution of victims, as well as coordinating the availability of HD in Rafsanjan and Kerman, may have likely lowered the observed morbidity and mortality rates. Using fomepizole and having serum levels of methanol, formic acid and ethanol available might have

reduced the number of dialysis sessions, the need for ICU and simplified the logistics. However, given the already low mortality, it would not necessarily have saved more lives in the present situation.

A well-designed national guideline adopted to the locally available resources, active case finding programs and systematic use of all resources available is likely to improve the outcome in large-scale methanol outbreaks. This is in particular true for countries with limited resources but is otherwise generalizable.[11,13,21]

Limitations of this study

The data suffer from lack of laboratory confirmation (methanol) and clinical status on admission based on laboratory results and clinical features. Metabolic acidosis may also have resulted from other toxicants, although the history of drinking alcoholic beverages accompanying metabolic acidosis in an otherwise healthy young male strongly suggests intoxication with a toxic alcohol.

No direct comparison between this and other studies can be done, but the estimated number and low mortality suggest a positive impact of the current approach.

Supplementary data

Supplementary data are available at the *Journal of Public Health online*.

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