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ACUTE METHANOL INTOXICATIONS – A CHALLENGE FOR CLINICAL TOXICOLOGY

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ABSTRACT

Purpose: Methanol (CH_3OH) is a monohydric alcohol, vastly used both in housekeeping and industry. Although the acute methanol intoxications are rare, they may include life-threatening symptoms, substantial lethality and negative consequences such as neurological disorders and vision damage. Aim of the work is to conduct a retrospective study on the acute methanol intoxications within Varna region for a 10-year period (2006-2015).

Material/Methods: This study covers 39 patients of the Clinic for Intensive Treatment of Acute Intoxications and Toxicoallergies at Naval Hospital – Varna, all of which had their diagnosis confirmed, including gas chromatography methods.

Results: Methanol intoxication prevalence showed male/female ratio close to 2.9:1. The major part of the cases concerned economically active population, the age group of 25-60 being the most affected. In all instances an oral methanol intake has been involved. Death occurred in 14 cases (35.9%).

Key words: methanol, acute intoxications, alcohol dehydrogenase, formaldehyde, formic acid,

INTRODUCTION

Methanol intoxications occur due to accidental or intentional intake of household products or home-distilled spirits. There are plenty of methanol-containing industrial products on the market, e.g. windshield washer fluid, solvents, cleaning agents and denatured alcohol. Methyl alcohol has a narcotic effect on central nervous system (CNS); however it is a substance of low toxicity by itself [1, 2]. After an oral ingestion it is readily absorbed by gastrointestinal tract (GIT). Up to 90-95% of ingested methanol is metabolized in the liver via alcohol dehydrogenase (ADH) aldehyde dehydrogenase (ALDH) systems in the process as known as "lethal synthesis". Products of this metabolism pathway – formaldehyde and formic acid are those, responsible for the acute toxicity, as they cause grave metabolic acidosis, lead to eye and CNS damage and are responsible for the death of poisoned persons. Although methanol intoxications are relatively rare, they are of high lethality and disability risk [3, 4], representing a challenge for clinical toxicology. This is why we set up our aim on conducting a retrospective study of acute methanol intoxications in Varna region for a 10-year period (2006-2015).

MATERIALS AND METHODS

Study includes 39 patients with acute methanol intoxication, hospitalized in the Clinic for Intensive Treatment of Acute Intoxications and Toxicoallergies at Naval Hospital – Varna. Study is a retrospective one; it covers 10-year period (2006-2015). Every single diagnosis was established using information collected by examining the medical history and physical examination; clinical laboratory tests for metabolite acidosis as well as analytical toxicology confirmation were always performed. A validated method for methanol and other volatile compounds determination was used, exploiting gas chromatography units GS 5890-series II Hewlett Packard + FID Headspace sampler19395A and HP 3396 Series II Integrator, and Agilent Technologies 7890B GC System + 7697A Headspace Sampler. All available medical records, personal documentations and legal expertise (in case of death) were thoroughly examined in all cases.

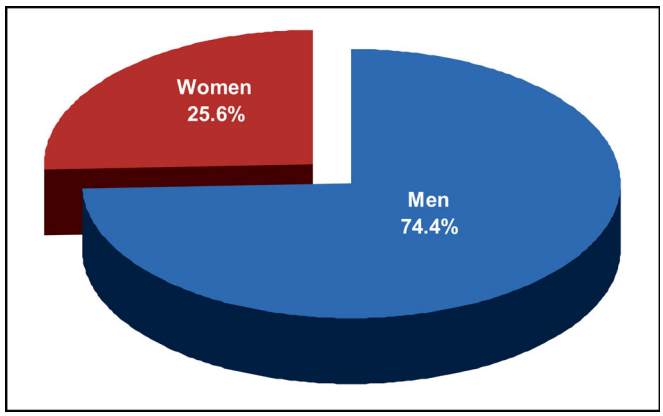
RESULTS AND DISSCUSSION

During the period described (2009-2015) a total number of 6356 patients with acute intoxications were accepted for treatment in the Clinic. Acute methanol intoxication was recognised in 39 (0.6%) of those patients. Therefore we confirm a low frequency of methanol poisoning that has been already reported elsewhere [5, 6]. All of the methanol poisoning cases occurred due to oral ingestion. Suicide attempts were described in only 3 (7.7%) individuals. The rest of the patients – 36 (92.3%) are victims of accidental methanol intake. Such a high prevalence of unintended poisoning origin could be easily explained by methanol physical properties; that is, its colour, taste and odour are very close to those of ethanol. As a consequence one could hardly distinguish between the two alcohols and methanol is often misused. One of the most important origins of methanol poisoning is the denatured alcohol used

as a solvent and as fuel for alcohol burners. Many manufacturers use in its production methanol, which is substantially cheaper than ethanol [7].

It has been already reported that methanol poisoning is more frequent within man [8, 9]. Our study leads to the conclusion that male patients outnumber female approximately by 2.9:1 (Fig. 1). This could be explained by the social pattern of alcohol consumption.

Fig. 1. Gender distribution of acute methanol poisoning



The major part of the cases concerned economically active population – 35 (89.7%) cases, the age group of 45-60 being the most affected (Tabl. 1). Our results well corresponds to data from other authors [10, 11].

Tabl. 1. Age distribution of acute methanol poisoning

Age, years of cases	Number abundance, %	Relative
up to 24	1	2,6
25 - 44	14	35,9
45 - 60	20	51,3
over 60	4	10,2
Total	39	100

First real set of symptoms arises some time after the initial exposure; this latent period in our study proves to have a mean value of 13 hours, but in separate occasions it could be as long as 24-28 hours [12]. These symptoms usually include blurring (up to complete loss of vision), acidosis, convulsions, consciousness disorders, and coma. Physical examination may show tachypnea; hemodynamic instability is not rare. In most cases establishing diagnosis is not a difficult task, key elements being medical history and data for ingestion of alcohol beverages with suspicious origin or denatured alcohol, mydriasis, vision disorders, and grave metabolite acidosis. Results from analytical toxicology department, especially gas chromatography analysis are required as a final confirmatory step. Blood methanol level determined dictates ongoing therapeutic approach.

A common therapeutic approach includes gastric lavage, acidosis correction, antidote therapy by intravenous infusion of ethanol, and haemodialysis. Immediate measures administered right after diagnosis clarification may substantially improve prognosis [13]. Haemodialysis is proven to be an essential component of the treatment due to its ability to eliminate methanol as well as its toxic metabolites from the body [1, 14, 15]. We have never applied *Fomepizole*, rather popular nowadays in many countries. Instead, our choice for antidote has always been ethanol (by intravenous infusion); in order to increase the effectiveness of the procedure both methanol and ethanol blood levels have been continuously monitored. It is already reported that antidote choice does not correspond to procedure's outcome [16, 17, 18].

Death occurred in 14 (35.9%) cases, thus we confirm a high lethality in methanol poisoning [19, 20, 21]. Prognosis is being usually correlated with blood methanol level, degree of metabolite acidosis, presence of hyperglycaemia, coma, and absence of ethanol in blood at the moment of hospitalization [17, 19, 22]. Vision damage as a result of the intoxication was registered in 4 (16.0%) cases, half of which progressed to total blindness. Undergoing 2 to 3 courses (10 rounds each) of hyperbaric oxygen therapy (HBOT) during recovery period showed partial vision regeneration, however some kinds of eye damage appeared irreversible [2]. There were 3 (12.0%) patients classified as in a persistent vegetative state (PVS).

CONCLUSION

Acute methanol intoxications are rare, but they represent a serious therapeutic problem. Serious health consequences may often occur including neurological disorders and vision damage (some of which – irreversible). Typically, the oral route of administration is reported. In most cases an accidental poisoning take place. Suicide attempts involving methanol are few. The age group of 45-60 appeared to be the most affected one. Methanol intoxication prevalence shows male-to-female ratio close to 2.9:1. Notwithstanding measures taken, lethality is very high, greater than 1/3.

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