

Deaths associated with Methanol Poisoning in Şanlıurfa

Şanlıurfa'da Metanol Zehirlenmesine Bağlı Ölümler

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ÖZ

Amaç: Metanol, odunun destrüktif distilasyonundan elde edilen berrak, renksiz ve yüksek derecede toksik bir maddedir. COVID-19 pandemi döneminde özellik kronik alkol kullanıcılarının ucuz alkollü içecek ve kolonya gibi alternatif içecekler tükettiği ve toksikolojik analizlerde alkollü sıvılarda etanolün yerine daha ucuz olan metanol kullanılmasına bağlı metanol intoksikasyonlarında artış olmuştur. Bu çalışmada, Şanlıurfa Adli Tıp Şube Müdürlüğü'nde otopsi yapılan ve ölüm nedeni metanol zehirlenmesi olarak belirlenen olguların değerlendirilmesi amaçlanmıştır.

Araçlar ve Yöntem: 1 Ocak 2016- 1 Kasım 2022 yılları arasındaki Şanlıurfa Adli Tıp Şube Müdürlüğü'nde ölüm nedeni metil alkol intoksikasyonu olarak belirlenen 15 olgu incelenmiştir. Olguların sosyodemografik verileri, olay yeri bilgileri, klinik bulgular ve hastane yatış verileri ile, olayların yıllara göre dağılımı, alınan içecek türü ve toksikolojik & patolojik veriler değerlendirilmiştir.

Bulgular: Olguların tümü erkekti. Yaş ortalaması 52.1 olarak hesaplandı. Tüketilen içeceklerin 8'inde kolonya, 4'ünde sahte rakı, viski ve votka olduğu belirlenirken, 3'ünde içeceğin türü belirlenemedi.

Sonuç: Alkollü sıvı tüketiminin arttığı dönemlerde sıvılara etanol yerine metanol karıştırılabileceği unutulmamalı ve intoksikasyonlara karşı halkı bilinçlendirici çalışmalar yapılmalıdır. Metanol intoksikasyonuna karşı alkollü içecek ve kolonya gibi alkollü antiseptiklerin üretim ve satış aşamasında kontroller artırılarak gerekli yaptırımlar uygulanmalıdır.

Anahtar Kelimeler: adli tıp; otopsi; ölüm; metanol zehirlenmesi

ABSTRACT

Purpose: Methanol, is a clear, colourless, highly toxic substance obtained from the destructive distillation of wood. During the COVID-19 pandemic, chronic alcohol users consumed alternatives such as cologne and cheap alcohol, the toxicology analyses showed that there was an increase in methanol poisoning due to the use of cheaper methanol instead of ethanol in alcoholic liquids. The aim of this study was to evaluate autopsy cases in the Şanlıurfa Forensic Medicine Branch Directorate that were recorded as cause of death from methanol poisoning.

Materials and Methods: 15 cases whose cause of death was determined to be methyl alcohol intoxication were examined at Şanlıurfa Forensic Medicine Branch Directorate between 1 January 2016 and 1 November 2022. Sociodemographic data of the cases, crime scene information, clinical findings and hospitalization data, distribution of events according to years, type of beverage consumed toxicological and pathological data were evaluated.

Results: All of the cases were male. The mean age was calculated as 52.1. The drinks consumed were determined to be cologne in 8 cases, fake rakı, whisky and vodka in 4, and the type of drink could not be determined in 3 cases.

Conclusion: It should not be forgotten that in times of increased alcohol consumption, methanol can be mixed with liquids in place of ethanol, and programs should be implemented to inform the public about intoxications. The necessary precautions against methanol intoxication should be taken by increasing control at the production and sales stages of alcoholic drinks and antiseptics containing alcohol, such as cologne.

Keywords: autopsy; death; forensic medicine; methanol poisoning

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INTRODUCTION

Methanol is a clear, colourless, volatile, light, combustible, aliphatic alcohol with a specific smell, which is obtained from the destructive distillation of wood, and is a highly toxic substance.¹ In addition to use as a solvent in industry, there are synthetic organic components in its structure. As methanol is cheap, it is used in the production of fake alcohol, and as poisoning and death can result from the consumption of readily available solutions such as cologne, it is important in respect of forensic medicine.^{1,2}

Methanol can cause severe metabolic disorders, blindness, permanent neurological dysfunctions and death.³ Methanol manifests toxic effects with formic acid metabolites and formaldehyde that are released when broken down.⁴ The toxic effects of methanol are seen in the body through the digestive system, and it can also be spread and have an effect on the body by absorption from the skin and via the respiratory system.⁵ Methanol poisoning causes high morbidity and mortality even at low doses. A lethal dose of methanol can show individual differences according to age, gender, and metabolic rate. It is estimated that a lethal dose of methanol that can be taken orally is 30 – 240 mL, and the minimum toxic dose is 100 mg/kg. There are data in literature that even a methanol level of <20 mg/dL is dangerous.^{6,7}

The majority of cases of methanol intoxication are accidental, and only occasionally of suicide origin. Adults with chronic alcoholism may consume solutions containing methanol either knowingly or accidentally, and accidental deaths of children, although rare, can also be seen.^{2,8} Many cases of poisoning and death can be seen associated with an increase in illegal alcohol production. In Turkey, many deaths have been reported following the consumption of illegally produced alcohol.² Reports have shown that the majority of methanol intoxications in Tunisia, Turkey, and India are related to the drinking of cologne and perfume.⁹

The illegal production of alcoholic drinks and their consumption is a significant problem in Turkey and around the world. The consumption of illegally produced alcohol varies from region to region and constitutes approximately 30% of all alcohol consumption worldwide.

The highest levels of consumption of illegal alcohol are in Eastern Europe, South America, and Africa. It has been reported that 50% of the alcohol consumed in Ukraine in 2005 was unrecorded or illegal.¹⁰ According to the 2010 World Health Organisation Global Information System of Alcohol and Health (WHO-GISAH), approximately 30% of the alcohol consumed in Turkey was illegally produced.¹¹

Alcohol is the most frequently encountered psychoactive substance in forensic toxicology. It is known that alcohol abuse can lead to alcohol-related diseases, and trigger alcohol consumption at a younger age and violent behaviours.¹² Individuals with high blood alcohol concentrations are likely to injure themselves through accidental falls or experience blunt trauma.¹³ Alcohol abuse can cause death. According to WHO reports, 3.3 million people per year worldwide die because of alcohol consumption, and this constituted 5.9% of all deaths in 2012.^{12,13}

The aim of the study is to evaluate the socio-demographic, clinical and autopsy findings of the phenomena of methanol poisoning, which were autopsied at the Sanliurfa Division of Forensic Medicine and identified as the cause of death.

MATERIALS and METHODS

The study was approved by the Ministry of Justice Forensic Medicine Institute Education and Scientific Research Commission (Date: 22/02/2023 and number 2023/102). A total of 4,650 cases of autopsy carried out between 1 January 2016 and 1 November 2022 were examined by the Directorate of Forensic Medicine in Sanliurfa. From these, 15 (0.32%) cases were determined which were recorded as death resulting from methanol intoxication. For each of these cases a retrospective examination was made of the hospital records, autopsy reports, histopathology reports, autopsy photographs, scene of incident reports prepared by the police or armed forces, witness statements, and expert opinion reports. The cases were evaluated in respect of sociodemographic data, findings from the environment of the incident, information related to the incident, the content of the drink consumed,

cause of death, clinical findings, and toxicology and histopathology examination results.

The samples were analyzed using a GC/MS system (Hewlette Packard (Palo Alto, CA)) consisting of HP-6890 gas chromatograph, HP-5972 mass selective detector (MSD), and HP-6890 automatic liquid sampler. Separations of compounds as methanol, ethanol, formic acid, formamide, acetaldehyde, methyl amine, methyl formate, acetic acid, iso-amyl alcohol, trans-anethole, propionic acid, 1-butanol, 1-propanol, ethyl acetate, 2-propanol and trioxan were performed using HP-FFAP (25 m, 0.2 mm i.d., with 0.33 mm film thicknesses) cross-

linked capillary column (Hewlette Packard, Palo Alto, CA).

RESULTS

In 15 cases on which autopsy was performed in the Şanlıurfa Forensic Medicine Branch Directorate in a 6-year period, the cause of death was determined to be methanol intoxication. All the cases were male with a mean age of 52.1 years (range, 32-68 years). The deaths occurred in the city centre in 11 cases and in a rural location in 4 cases. All the locations of the incident were the home. The cases comprised 13 Turks and 2 Syrians. Distribution of the cases by year is shown in Table 1.

Table-1 Sociodemographic Data.

| Case | Gender | Age (years) | Location of incident | Year | Month | Season | Place of residence |
|------|--------|-------------|----------------------|------|-------|--------|--------------------|
| 1. | Male | 50 | Home | 2016 | 11 | Autumn | City centre |
| 2. | Male | 51 | Home | 2016 | 10 | Autumn | City centre |
| 3. | Male | 59 | Home | 2016 | 11 | Autumn | Rural |
| 4. | Male | 41 | Home | 2017 | 2 | Winter | City centre |
| 5. | Male | 32 | Home | 2017 | 2 | Winter | City centre |
| 6. | Male | 42 | Home | 2017 | 1 | Winter | City centre |
| 7. | Male | 53 | Home | 2020 | 6 | Summer | City centre |
| 8. | Male | 49 | Home | 2020 | 5 | Spring | Rural |
| 9. | Male | 68 | Home | 2020 | 11 | Autumn | City centre |
| 10. | Male | 53 | Home | 2020 | 12 | Winter | Rural |
| 11. | Male | 52 | Home | 2021 | 5 | Spring | City centre |
| 12. | Male | 57 | Home | 2021 | 6 | Summer | City centre |
| 13. | Male | 58 | Home | 2021 | 12 | Winter | City centre |
| 14. | Male | 62 | Home | 2021 | 12 | Winter | Rural |
| 15. | Male | 55 | Home | 2022 | 8 | Summer | City centre |

The most common clinical findings were clouded consciousness with respiratory problems, and there were visual impairment and coma symptoms in few cases. The drink causing the intoxication was most often cologne (n: 8), and these cases were seen to be within the last 3 years (2020-2022). In the post-poisoning trial, the other drinks consumed were raki, whiskey and vodka, while in three cases the type of the drink could not be determined. (Table 2). No methyl alcohol was detected in the toxicology analysis of body fluids taken from long-lasting events (n:2) in the hospital, while in all other phenomena, methyl alcohol was found. (Table 2). No traces of trauma were determined in any case in the external examination of the medicolegal autopsies performed. The histopathological and toxicology findings of the body samples taken in the medicolegal autopsies are shown in Table 2.

From the anamneses taken from close relatives it was learned that some cases (#7, 8, 10, 12, 14, 15) had chronic alcohol dependence and drank cologne when they could not obtain alcohol for economic reasons. The man, registered as case number seven in the hospital records, died in a hospital from drinking two glasses of cologne. Case no. 10 felt ill after drinking cologne and died after presenting at hospital. The person with case number 12 have been drinking cologne for the past two weeks after previously drinking only alcohol. Case no. 14 was stated to have drunk cologne regularly for the last 6 months with no previous history of drinking cologne. Case no.15 was reported to have chronic alcohol and cologne dependency.

Table 2. Type of Drink, Toxicological and Histopathological Data of the Cases.

| Case | Clinical findings | Drink consumed | Methyl alcohol level blood/intra-ocular (mg/dL) | Ethyl alcohol level blood/intra-ocular (mg/dL) | Histopathological findings |
|------|--|-------------------------------------|---|--|--|
| 1. | Visual impairment | Raki | 238/263 | - | Liver: diffuse macrovesicular fattiness in parenchyma cells and cirrhosis Heart: calcified atheroma plaque narrowing the lumen by 50% in coronary artery samples |
| 2. | Visual impairment | Illegal drink of indeterminate type | 159/256 | - | Liver: advanced stage macro and micro vesicular fattiness, Heart: widespread scar areas, advanced degree of perivascular and interstitial fibrosis, advanced degree of obstruction in coronary vessels |
| 3. | Clouded consciousness and respiratory problems | Illegal drink of indeterminate type | 0 | - | Liver: advanced stage macro and micro vesicular fattiness and cirrhosis, Lungs: bronchopneumonia Heart: Mild fibrosis in the heart, advanced degree of obstruction in coronary vessels and ischaemia consistent with 3-7 days |
| 4. | Clouded consciousness and respiratory problems | Whisky and vodka | 46/62 | 64/28 | Liver: advanced stage macro and micro vesicular fattiness Heart: mild fibrosis, moderate obstruction in coronary vessels |
| 5. | Visual impairment | Illegal drink of indeterminate type | 520/624 | - | Liver: advanced stage macro and micro vesicular fattiness, hepatosteatosi, Eyes: severe congestion and bleeding below the retina |
| 6. | Clouded consciousness and respiratory problems | Vodka | 128/154 | 173/171 | Liver: Steatosis, Lungs: pneumonia, |
| 7. | Clouded consciousness and respiratory problems | Cologne | 119/166 | - | Liver: Cirrhosis, |
| 8. | Clouded consciousness and respiratory problems | Cologne | 342/477 | - | Liver: mild macro and micro vesicular fattiness, Heart: mild obstruction in coronary vessels |
| 9. | Clouded consciousness and respiratory problems | Whisky | 239 | - | Liver: advanced stage macro and micro vesicular fattiness and cirrhosis, Lungs: interstitial fibrosis, oedema, congestion, Heart: mild fibrosis |
| 10. | Visual impairment | Cologne | - | - | Liver: mild macro and micro vesicular fattiness, Lungs: lobular pneumonia, purulent bronchitis, Heart: mild fibrosis |
| 11. | Clouded consciousness and respiratory problems | Cologne | 386/505 | - | Liver: cirrhosis, Heart: scarring and almost complete obstruction in coronary vessels |
| 12. | Coma | Cologne | 274/360 | - | Liver: advanced stage macrovesicular fattiness and cirrhosis, Kidneys: Acute tubular necrosis, Heart: mild fibrosis |
| 13. | No information | Cologne | 216/314 | - | Liver: moderate macrovesicular steatosis in hepatocytes, congestion, Heart: mild obstruction in coronary vessels |
| 14. | Clouded consciousness and respiratory problems | Cologne | 143/202 | 25/15 | Liver: an increase in connective tissue in portal areas with expansion, widespread macrovesicular and microvesicular steatosis, Heart: scarring and advanced degree of obstruction in coronary vessels |
| 15. | Clouded consciousness and respiratory problems | Cologne | 98/143 | - | Heart: mild obstruction in coronary vessels |

DISCUSSION

Excessive alcohol consumption can cause death by drowning, traffic accidents, or violence. Previous studies have shown that deaths related to acute alcohol poisoning (AAP) constitute a significant proportion of all alcohol-related deaths.¹² There was reported to be a significant increase in morbidity and mortality due to methanol in Iran during the COVID-19 pandemic. As methanol is cheaper and can be found more easily than ethanol, some fraudsters in Iran used methanol instead of ethanol in home-produced alcohol and a serious increase in deaths has been reported in recent times.^{9,14} Similarly in the current study, 60% (n:9) of the victims were determined to have died during the COVID-19 pandemic, all died at home as a result of methanol poisoning, and no traumatic findings were determined in the autopsies. This suggests that as a result of the economic problems that emerged during the pandemic, chronic alcoholics in particular voluntarily searched for cheap alcohol and turned to alternatives such as cologne.

Previous studies have shown that the majority of cases of methanol toxicity in Tunisia, Turkey, and India were related to drinking cologne and perfume.⁹ Research in Turkey has shown that the majority of deaths related to methanol poisoning originate from the drinking of illegally and home-produced alcohol. Pectolytic enzymes in many fermentation products such as in fruit (grapes, plums)-based alcoholic drinks and apple wine can increase the methanol levels in illegal home-produced drinks. In addition, methanol can be used instead of ethyl alcohol during the illegal production of alcohol. As a result of this, sporadic outbreaks are encountered with cases of death related to methanol poisoning.^{15,16} In the present study, the majority of the victims (8/15) were determined to have died after drinking cologne. All of the deaths from cologne consumption occurred during the outbreak of COVID-19. This suggests that this is due to the use of cheaper methanol instead of ethanol in illegal production, which is linked to the large antiseptic increase of cologne production.

Previous studies reported that methanol poisoning is generally seen in males, usually in the 4th -5th decades of life.^{14,15} It has also been stated that hospital presentations

may be delayed in places where alcohol consumption is not acceptable to society or for religious reasons.¹⁴ Consistent with the literature, all the cases in the current study were male with a mean age of 52.1 years. This was thought to be due to alcohol consumption just being among males because of the traditional cultural characteristics of Şanlıurfa.

The clinical symptoms of methanol intoxication resemble the symptoms of normal alcohol intake, such as sleepiness, headache, nausea and vomiting. However, it can subsequently cause much more serious symptoms such as kidney failure, respiratory failure, convulsions, and central nervous system depression extending to coma. Visual impairments occur in approximately 50% of patients, and these may develop as diplopia, blurred vision, decreased visual acuity, photophobia, decreased visual field, and blindness.^{3,17} In the current study, clouded consciousness and respiratory problems were observed in 9 cases, and 4 presented at the Emergency Department with visual disorders and 1 in a state of coma.

Varying ranges of blood concentration at a toxic level in methanol poisoning have been reported in literature. The widest range reported is 15-500 mg/dl.¹⁸ The morbidity and mortality limits for methanol have been seen to be in extremely broad ranges in studies in literature.^{19,20} The lethal dose of alcohol is related to age, gender, and genetic factors, and the rate of alcohol consumption, the type of drink, and drinking habits may also have an effect.¹² In the current study, the blood toxicology levels showed variability of 46-520 mg/dl, and the intra-ocular fluid toxicology levels of 62-624 mg/dl. In the toxicology examinations of the bodily fluids of 2 cases, no methanol or metabolites were determined as they were hospitalised or a long time. Therefore, in cases of intoxication, sending the first blood sample taken in hospital to a centre that can analyze methanol and metabolites would make a significant contribution to the autopsy procedure.

Alcohol can inhibit the central nervous system, can cause respiratory depression, and ultimately can lead to death because of asphyxia.¹³ Pulmonary oedema, pulmonary congestion, alveolar spaces filled with hemorrhagic oedema, gastric mucosal damage, cardiac findings, obstructions related to foreign bodies in the trachea,

bronchi or bronchioles associated with vomiting, and changes in organs and tissues due to chronic alcohol use can be seen in the autopsies of deaths related to alcohol intoxication.¹² Acute and chronic changes were determined in the tissues of all the present study cases, which was supportive of methanol intoxication and consistent with the literature (Table 2). When performing an autopsy, other causes of suspicious death must be discounted and non-specific autopsy findings must be supported by forensic investigation data.

From 4650 medicolegal autopsies performed in our centre in the last 7 years, 0.32% (n:15) were determined to have died as a result of methanol intoxication. There was seen to be an increase in methanol poisonings as a result of consuming alternative drinks such as drinks with cheap alcohol or cologne, especially by those with chronic alcohol use during the COVID-19 pandemic. Toxicology analyses determined that cheaper methanol had been used in alcoholic liquids instead of ethanol. All the victims were male, and the majority were chronic alcoholics in the 5th and 6th decades of life who died at home. In the autopsies, there were seen to be non-specific histopathological findings and no signs of trauma. In the toxicology analysis, the methanol level in the intra-ocular fluid was higher, and analysis of the first blood samples taken at the hospital, especially for those treated for a long period provided significant support in clarification of the event. In conclusion, there is a need for programs to be implemented to inform the public about intoxications developing after the consumption of liquids containing methanol, and early treatment should be started. In addition, there is a need to take precautions against methanol intoxication by increasing control at the production and sales stages of alcoholic drinks and antiseptics containing alcohol, such as cologne.

Conflict of Interest

The authors declare that there is not any conflict of interest regarding the publication of this manuscript.

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Ethics Committee Permission

The study was approved by the Ministry of Justice Forensic Medicine Institute Education and Scientific Research Commission (Date: 22/02/2023 and number 2023/102).

Authors' Contributions

Concept/Design: ASD, İA. Data Collection and/or Processing: ASD, İA. Data analysis and interpretation ASD, İA. Literature Search: ASD, İA. Drafting manuscript: ASD, İA.

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