

Detection of toluene, methanol and formic acid in the autopsy case of a solvent abuser

Hiroshi Kinoshita¹, Naoko Tanaka¹, Ayaka Takakura¹, Mitsuru Kumihashi¹, Mostofa Jamal¹, Asuka Ito¹, Kunihiko Tsutsui², Shoji Kimura¹, Shuji Matsubara³ and Kiyoshi Ameno¹

¹ Department of Forensic Medicine, Faculty of Medicine, Kagawa University, Kagawa Japan

² Health Sciences, Faculty of Medicine, Kagawa University, Kagawa, Japan

³ Community Health Care Education Support Center and Postgraduate Clinical Education Center, Kagawa University Hospital, Kagawa, Japan

SUMMARY

A fatal case of abuse of solvent containing mixture of toluene and methanol is presented. Concentrations of toluene, methanol and formic acid in a femoral venous blood sample were 20.1 mg/L, 210 mg/L and 25.2 mg/L, respectively. From the autopsy findings and toxicological examination, we concluded that the cause of death was poisoning by toluene and methanol.

Keywords: solvent – methanol – toluene – formic acid – abuse – fatal intoxication

Detekce toluenu, metanolu a kyseliny mravenčí při pitvě pacienta závislého na rozpouštědlech

SOUHRN

V tomto článku je prezentován smrtelný případ zneužití rozpouštědla. Čtyřicetiletý muž byl nalezen mrtvý ve svém domě s mnoha prázdnými vinylovými sáčky a lahvemi obsahujícími směs toluenu a metanolu v okolí. Pitva neprokázala žádné známky vnějšího poranění a vyloučila i fyzická onemocnění. Následné šetření odhalilo, že oběť dlouhodobě zneužívala toluen. V krvi ze stehenní žíly byla zjištěna koncentrace toluenu 20,1 mg/l, metanolu 210 mg/l a kyseliny mravenčí 25,2 mg/l. Nebyl detekován žádný etanol a screening léků pomocí Triage™ (Biosite Diagnostic, San Diego, CA) byl rovněž negativní. Koncentrace toluenu ve femorální krvi byla na letální úrovni a koncentrace metanolu byla v toxickém rozmezí. Těžká, relativně dlouhodobá expozice toluenu vyplývala z vysoké koncentrace kyseliny hippurové v moči (12,91 g/l). Z pitevních nálezů, výsledků toxikologického vyšetření a vyšetřování ze strany úřadů vyplývalo, že příčina smrti byla otrava toluenem a metanolem.

Klíčová slova: rozpouštědlo – methanol – toluen – kyselina mravenčí – abusus – fatální intoxikace

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Various cases of sudden death due to solvent abuse have been reported (1-3). Toluene is used in industrial and household articles, paints, paint thinners and glues (4), and is one of the most abused solvents in Japan (5). Toluene poisoning is caused not only by accidental exposure, but also by solvent abuse, and fatalities have been reported (6-10). Methanol is likewise widely used in paints, varnishes and other industrial products (11). Various types of fatal methanol poisoning have also been reported, with outbreaks occurring frequently worldwide (12-16). In addition, relatively high concentrations of methanol can be detected in cases of poisoning by methanol-containing pesticides (17). Here we report a fatal case of solvent abuse in which toluene, methanol and formic acid were detected in blood.

CASE REPORT

A 40 year-old Japanese man (height, 165 cm; weight, 65.5 kg) was found dead in his house with numerous empty vinyl bags

✉ Correspondence address:

Dr. Hiroshi Kinoshita,
Department of Forensic Medicine,
Faculty of Medicine, Kagawa University,
1750-1, Miki, Kita, Kagawa 761-0793, Japan
tel: +81-87-891-2140 fax: +81-87-891-2141
e-mail: kinochin@med.kagawa-u.ac.jp

and filled bottles nearby. The liquid in the bottles was identified as toluene (ca. 70% by volume) and methanol (ca. 30 % by volume). Subsequent investigation by the authorities showed the victim had been abusing toluene for a long period. Autopsy showed no evidence of external injury. The heart weighed 315 g and contained 70 mL of blood without coagulum. The brain weighed 1259 g without any evident injury. Pleural effusion was observed in the thoracic cavity. The left and right lungs weighed 693 g and 692 g, respectively, and appeared edematous and congested. The stomach contained approximately 10 mL of brownish liquid. Approximately 150 mL of urine was collected in the bladder. Internal examination revealed no diseases. Signs of congestion were noted in other organs. Urine drug screening using the Triage™ test panel (Biosite Diagnostic, San Diego, CA) yielded negative results. Postmortem samples of femoral venous blood, urine, bile, tissues (brain, liver and fat) and stomach contents were collected for toxicological investigations.

Determinations of toluene, ethanol and methanol concentrations were performed using headspace gas chromatography-mass spectrometry (GC/MS) and headspace gas chromatography, slightly modified from previous reports (9, 16). Determination of formic acid concentration was performed using headspace gas chromatography following methylation with sulfuric acid (18).

In brief, toluene analysis was performed by GCMS-QP2010 (Shimadzu, Kyoto, Japan). Chromatographic separation was performed with a fused-silica capillary column DB-5MS (30 m × 0.25 mm I.D., 0.25 µm film thickness; Agilent, Santa Clara, CA,