Case Report

Sudden Death from Toluene Intoxication: A Case Report and Review of Literature

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Toluene is an aromatic hydrocarbon (C7H8) found in gasoline, acrylic paints, varnishes, lacquers, paint thinners, adhesives, and shoe polish. Toluene toxicity can occur from unintentional or deliberate inhalation of fumes, ingestion, or transdermal absorption. Unintentional exposure to high concentrations of toluene results in severe toluene intoxication. This is a report of toluene poisoning in a middle-age man found dead at home after varnish application by spray. There was no obvious external and internal cause of death. The blood test revealed the presence of toluene. The cause of death was diagnosed as cardiopulmonary failure caused by toluene, which is a rare case report in Thailand.

Keywords: *Toluene, Volatile agent, Sudden death, Non-occupational intoxication*

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Toluene is a colorless, flammable liquid with a sweet pungent odor. Toluene has numerous commercial and industrial applications. It is a solvent in paints, lacquers, thinners, glues, collection fluids and is used in the printing and leather tanning processes. Acute and chronic accidental exposure to toluene can occur, particularly in occupational exposure[1]. More than 3 million tons per year of toluene are produced in the United Stated alone[2]. Toluene is rapidly absorbed and is detectable in arterial blood within about 10 seconds of exposure by inhalation. More severe intoxication can lead to arrhythmias, respiratory depression, convulsions severe organ damage, coma, and death[1].

Fatal intoxication by toluene is not common in Asia. Between 1983 and 1991, four deaths have been attributed to occupational exposures in Singapore[3]. We report here a case of fatal toluene intoxication using information available from police investigation. This incident appeared to result from toluene intoxication as determined by the autopsy that detected toluene in the blood. This is a rare case report of fatal non-occupational acute toluene intoxication in Thailand.

Case Report

A man aged in his forties (168 cm tall and weighing 66 kg) was transferred to our Forensic Medicine Department. The history at the crime scene investigation from police was described as follows. Around 4 pm, the man sprayed a compound of Beger™ Thinner M-44 and Beger™ Unithane U-202 (Wood Coating varnish) in a sealed-off room, sized 4x3x3 m on the second floor of his house. He ran down to the first floor around 4.20 pm with chest pain and difficulty in breathing. He suddenly collapsed. He was declared dead at around 4.30 pm at the local hospital near his house in Phichit.

The corpse was stored in cold before being sent to our department in Phitsanulok. Postmortem interval between death and autopsy was estimated to be approximately 42 hours. The body was intact and well preserved without postmortem decomposition. Small contusions of dorsal part of both hands were present at autopsy. No petechial hemorrhage was observed on the conjunctivae of the eyes. The heart weighed 320 g containing a large volume of liquid blood and no endocardial hemorrhage was observed. The left and right lungs weighed 500 and 420 g, respectively, with moderate congestion and edema. The stomach was empty. Other organs were unremarkable. By histological examination, moderate pulmonary edema and congestion were observed bilaterally. Focal and minimal steatosis of the hepatic cells was found.

Toxicological analyses and results

Sample collection and analysis

Blood samples (5 ml) were collected using disposable clean syringes, placed in sodium fluoride tube, and sealed with Parafilm®. Sample was

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immediately stored at 4°C and then analyzed for volatile agents in blood at the Regional Medical Sciences Center 9 in Phitsanulok province. The volatile agents were determined by Chrompack CP-9000 gas chromatograph with flame ionization detector (FID) using the standard procedures.

Results

The toxicological analyses identified toluene in the blood sample. Neither ethyl nor methyl alcohols were found in the blood sample. The quantitative analysis of toluene in the blood was not available in this Center and nearby Centers. The cause of death was diagnosed as acute toluene intoxication.

Discussion

Direct evidence for toluene intoxication was not done because a measurement of blood toluene concentration, which is commonly determined by gas chromatography/mass spectrometry, was unavailable in this case. The cause of death was suggested as acute toluene intoxication. The history from the crime scene investigated by the police showed that the deceased was working in sealed-off room, 4x3x3 m. This working environment might increase a risk of unintentional exposure to high concentration of toluene. The Occupational Safety and Health Administration (OSHA) have determined the occupational exposure to toluene as the Permissible Exposure Limit (PEL) for people in the workplace. 200 ppm is considered an acceptable level of exposure as a time-weighted average for an 8-hour workday. Toluene levels of 500 ppm are considered immediately dangerous to life and health[4]. Exposure to concentrations ranging from 10,000 to 30,000 ppm can result in narcosis and death[5]. The lowest lethal concentration has also been reported is 2,000 ppm with a 30 minutes exposure[6].

The acute toluene intoxication in this case was diagnosed by history of toluene exposure and detection of toluene in blood with anatomical and histological findings of acute cardiopulmonary failure. The clinical signs and symptoms after exposure to toluene including chest discomfort, difficulty in breathing, and sudden collapse, were compatible with cardiopulmonary failure. The anatomical and histological pathology finding revealed evidence of cardiopulmonary failure. Detection of toluene in the blood suggested that toluene might be the cause of sudden cardiac death. Although it is the most common cause of death in toluene intoxication, the mechanism remains unknown. Certainly, toluene causes reduced neural function and that may inhibit coughing, respiratory drive, and cardiovascular reflexes. Therefore, the depression of cardiac function compounded with hypoxia, and central and peripheral neural function may have all compounded the cause of death.

An earlier theory has simply postulated that exposure to toluene sensitizes the myocardium to effects of catecholamines via some unknown mechanism[7]. Some toluene deaths may be attributed to its ability to reversibly inhibit cardiac voltage-activated sodium channels, which is required for the initial phase of cardiac action potential[8]. The current theory is that inhalation of toluene results in QT interval prolongation and QT dispersion, favoring the occurrence of torsade de pointes[9]. Another possible mechanism for toluene-induced arrhythmias may involve decreased intracytosolic calcium concentrations in cardiomyocytes and decrease force of contraction[10]. Another possibility is fatal respiratory depression because of high brain toluene concentrations[11] and occupational asthma due to genetic polymorphisms causing high sensitivity to toluene[12].

However, the concentrations of toluene in brain or blood might not necessarily be useful determinants for the cause of death because no studies have correlated these with toxicity[11,13].

Conclusion

In conclusion, the author reports a rare case of fatal toluene intoxication in Thailand. Although definite diagnosis of intoxication is lethal level of blood toluene, a clinical history of toluene exposure and toxicological test revealing the presence of toluene in the blood were helpful in this case.

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What is already known on this topic?

Fatal toluene intoxication was reported in occupational exposure by inhalation, glue sniffers, and accidental ingestion. It is uncommonly found in Thailand.

What this study adds?

A rare case report of fatal non-occupational acute toluene intoxication in Thailand.

Potential conflicts of interest

None.

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การเสียชีวิตอย่างกะทันหันจากพิษของโทลูอีน

วีระพงษ์ ประยูรเสถียร

โทลูอีนเป็นสารอโรมาติกไฮโดรคาร์บอน (C7H8) ที่พบได้ในน้ำมันเชื้อเพลิง สีทาบ้าน น้ำยาขัดเงา แล็กเกอร์ ทินเนอร์ กาว และน้ำยาขัดรองเท้า การได้รับพิษของโทลูอีนโดยไม่ตั้งใจเกิดได้จากการหายใจ การกิน และทางผิวหนัง การได้รับโทลูอีนความเข้มข้นสูงส่งผลให้เกิดพิษจากโทลูอีนอย่างรุนแรงได้ ในรายงานนี้เป็นการศึกษาการเสียชีวิตจากพิษของโทลูอีนของชายไทยวัยกลางคนหลังจากทำการฉีดพ่นสเปรย์สารเคลือบขัดเงาภายในบ้าน จากการตรวจศพภายนอกและผ่าตรวจศพไม่พบพยาธิสภาพที่เป็นเหตุตาย ผลการตรวจทางพิษวิทยาพบสารโทลูอีนในเลือด ในรายนี้จึงวินิจฉัยสาเหตุการตายเป็นภาวะหัวใจและการหายใจล้มเหลวจากโทลูอีน ซึ่งเป็นกรณีศึกษาที่พบได้ยากมากในประเทศไทย
