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Detection of kerosene in stomach contents – useful indicator of vital reaction

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Abstract: Detection of kerosene or other flammable substances from post-mortem samples provides useful information for forensic practice. Such substances can be detected from not only blood and intratracheal gas/contents, but also from stomach contents. The present results show that the existence of kerosene in stomach contents indicates findings of vital reactions.
Key Words: kerosene, GC-MS, stomach contents.

Analysis of volatile hydrocarbons in post-mortem blood samples from fire-related cases provides useful information for forensic diagnosis [1-3]. We have previously described the utility of intratracheal contents for forensic examinations [4]. Those results revealed exposure to flammable substances prior to death. The head-space solid-phase microextraction (HS-SPME) method is a simple, reliable procedure for analysing volatile substances [5]. The combination of HS-SPME with gas chromatography/mass spectrometry (HS-SPME/GC-MS) has been applied to determine the presence of ignitable substances in forensic practice [5-7]. This study describes a burn death case with detection of kerosene from stomach contents by HS-SPME/GC-MS, and discusses the utility in forensic diagnosis as a vital reaction.

CASE HISTORY

A male in his fifties (height, 155 cm; weight, 60.5 kg) was found dead after a room fire in his house. Kerosene was detected from the debris in a subsequent police investigation.

Autopsy findings indicated no evidence of external injury other than a broad third-degree burn with carbonized skin on the anterior surface of his body. The heart weighed 372 g and contained 190 ml of dark-red blood without coagulation. The left and right lungs weighed 404 g and 462 g, respectively, and were slightly congested. A small amount of soot was present in the trachea and bronchus. Marked congestion was observed in each organ. Stomach contents comprised approximately 120 g of brown, muddy substances containing foodstuffs without any oily smell. A drug screening test using a Triage® panel (Biosite Diagnostic, San Diego, CA) and ethanol examination by routine HS-GC were performed. Carboxyhemoglobin saturation was measured using an AVOX 4000 oximeter (International Technidyne Corporation, Piscataway Township, NJ) [8, 9]. Post-mortem samples were collected for toxicological examination, including femoral blood and stomach contents.

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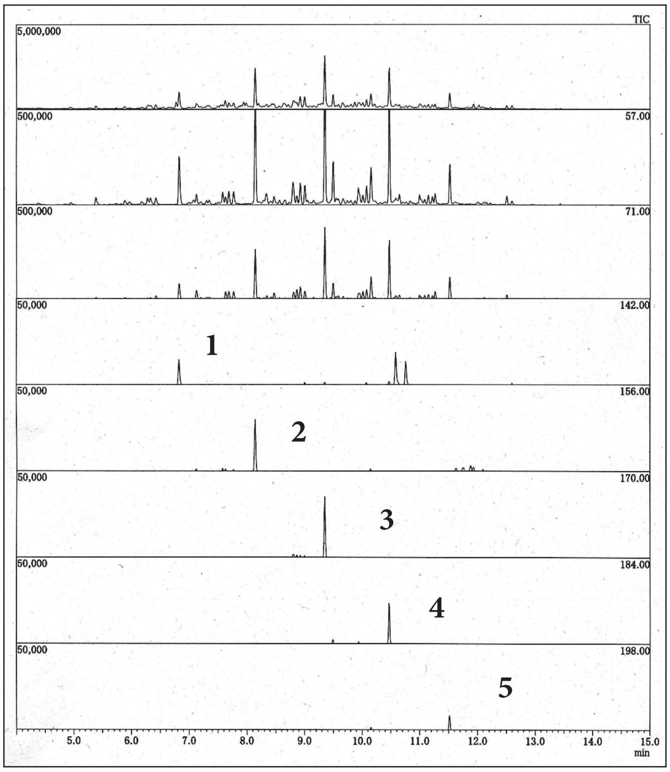

Figure 1. Total ion and mass chromatogram for each ion in stomach contents (1: n-decane; 2: n-undecane; 3: n-dodecane; 4: n-tridecane; 5: n-tetradecane).

Equipment

Analysis of volatile hydrocarbons was carried out in accordance with previous reports [4,10]. In brief, a GC-MS model QP-2010 Plus (Shimadzu, Kyoto, Japan) was used. The GC was fitted with a DB-5MS column (30-m×0.25-mm I.D., 0.25-µm film thickness; Agilent Technologies, Santa Clara, CA). Helium was used as the carrier gas (1.78 ml/min). The operating conditions for GC-MS system were in accordance with previous reports [4,10]. Identification of each compound was determined by retention times and the confirmation ion [4].

Sample preparation

The procedure for HS-SPME was carried out according to a previous report with slight modification [11]. In brief, 0.5 ml of post-mortem sample with 0.5 ml of distilled water was placed into a 20-ml glass vial, and sealed with a silicone-rubber septum and aluminium cap. The SPME fibre assembly (polydimethylsiloxane, 100 µm thickness; Sigma-Aldrich Japan, Tokyo, Japan) was inserted into the HS of the glass vial, through a silicone-rubber septum. The vial was heated to 60°C on a heating block, and the fibre was exposed to the HS for 15 min.

RESULTS AND DISCUSSION

Total ion chromatograms and mass chromatogram for the stomach contents of the deceased (Fig. 1) identified peaks of saturated aliphatic hydrocarbons, such as n-decane, n-undecane, n-dodecane, n-tridecane, and n-tetradecane. Since those compounds were also identified from femoral blood, the deceased was considered to have been exposed to kerosene or light oil prior to death [1-4]. The Triage® panel yielded negative results and no ethanol was detected. Carboxyhemoglobin saturation was 3.9% in left heart blood and 5.9% in right heart blood. From the autopsy findings, the results of subsequent toxicological examinations, and the police investigation, we concluded that the cause of death was burning, and speculated that the deceased had been exposed to kerosene prior to death.

Detection of kerosene from stomach contents has been reported in some burn cases [12-14]. In our case, saturated aliphatic hydrocarbons were detected in stomach contents. This may have originated from unwittingly swallowing and/or ingesting vapour or liquid [15]. Although the component of kerosene is not always detectable in cases of burn death using kerosene [16], its presence in stomach contents suggests the patient was alive at the time of ingestion or ignition, along with soot in the oesophagus or stomach, as an indicator of respiration during the smoky phase of a fire [17].

Sampling of stomach contents at autopsy is not time-consuming. Identification of volatile substances in the stomach offers valuable information for forensic diagnosis. Samples of stomach contents should be analysed in cases where fire-related death with involvement of a flammable substance is suspected.

Conflict of interest. There is no conflicts of interest related to the study.

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