Usefulness of intratracheal gas analysis in an autopsy case of helium inhalation

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Abstract: A case of fatal asphyxia by helium inhalation from inside a plastic bag closed around the neck with tape is presented. Helium was identified by headspace gas chromatography in the intratracheal gas, lung tissue and blood. Severe congestion of the organs was also observed. We concluded that the cause of death was asphyxia due to inhalation of helium, and identification of helium from intratracheal gas was useful for making this diagnosis.

Key Words: helium, inert gas, asphyxia, headspace gas chromatography, intratracheal gas.

It is important during a forensic examination of victims of asphyxia by inert gas to identify the gas components involved [1]. Identification of the inert gas from biological samples such as blood or tissues has usually been performed by gas chromatography (GC) or gas chromatography-mass spectrometry (GC/MS) using the headspace method [1-5]. The headspace method is a simple, rapid and widely used procedure for the detection of gas or volatile compounds that requires no special preparation [6, 7]. It has been reported that intratracheal gas sampling is useful for identification, after death, of volatile substance exposure while alive [8]. Here we report a case of death caused by inhalation of helium gas inside a plastic bag closed around the neck with tape, and identification of the helium using headspace gas chromatography (HSGC).

CASE HISTORY

A male in his thirties (height 171 cm, weight 76 kg) was found dead outside of his house and leaning on a fence. His head was covered with a plastic bag, and it was connected to two helium cylinders by a vinyl tube. The plastic bag was tied by vinyl tape around the neck.

Autopsy findings indicated no evidence of external injury. The heart weighed 362 g and contained 680 ml of dark red blood with coagulation. The brain weighed 1535 g and was slightly edematous. The left and right lungs weighed 379 and 440 g, respectively, and were moderately congested. The trachea contained small amounts of clear frothy fluid. Marked congestion was observed in each organ. A drug screening test using a TriageTM (Biosite Diagnostic Inc, San Diego, CA, USA) panel was negative. No ethanol was detected by HSGC. Postmortem samples, including femoral blood, lung and liver tissues, were collected and stored in glass vials with screw caps, and kept at 4°C until analysis.

Equipment

Analysis of the helium was carried out according to previous reports with a slight modification [1]. In brief, a model GC-14A gas chromatograph (Shimadzu, Kyoto, Japan) with a thermal conductivity detector was used. The column material used was Molecular Sieve 5A (60-80 mesh). The identification of each component was determined by its retention time as compared to gas standards.

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Helium, an inert gas with atomic weight 4, is a colorless, odorless and nonflammable gas used as a carrier gas for party balloons or cryogenic liquids [9, 10]. It acts as a simple asphyxic agent, and when a closed space is filled by helium, oxygen depletion occurs [9, 10].

As shown in Fig. 1a, the gas chromatogram of the tracheal contents identified two peaks equivalent to helium and oxygen, respectively, and the helium content of the intratracheal gas sample was about 83.5%.

Helium was clearly detected from lung tissue (160 µl/g tissue at 25°C, 1 atm) (Fig. 1b), faintly detected in blood (Fig. 1c), but was not seen in the liver (Fig. 1d). As the normal concentration of helium in room air is very low, at 0.00052% (v/v) [11], it was not detected by our HSGC system (Fig. 1e). Detection of helium in the blood, lung and intratracheal gas proved that the deceased was exposed to a high concentration of helium while alive. These results played an important role in evaluating the circumstances of the scene of death, and provided valuable information for making the forensic diagnosis.

It has been reported that lung tissue is a suitable matrix for analysis of the presence of helium [3, 4]. From the viewpoint of forensic toxicology, intratracheal gas is useful, as its sampling is easy and the relatively high concentration of target gas present after inhalation is detectable. The present result indicates that the victim was exposed to a high concentration of helium gas in the antemortem period.

In the present case, a faint peak of helium was detected in blood, and helium was not detected in liver tissue. Since helium has highly diffusive properties, diffusion from samples to their surroundings during the postmortem interval needs to be considered [5]. Samples must be collected and analyzed as soon as possible.

From the autopsy findings and the results of the toxicological examination, we concluded that the cause of death in this case was asphyxia due to oxygen depletion. In the present case, we used HSGC to analyze intratracheal gas, and identified helium. Analysis of intratracheal gas is useful for identification of inhaled gas components. More use in the future of HSGC can be expected for forensic analysis of cases of suspected inert gas inhalation.

### RESULTS AND DISCUSSION

Helium, an inert gas with atomic weight 4, is a colorless, odorless and nonflammable gas used as a carrier gas for party balloons or cryogenic liquids [9, 10]. It acts as a simple asphyxic agent, and when a closed space is filled by helium, oxygen depletion occurs [9, 10].

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