



Case Report

Contribution of forensic autopsy to scene reconstruction in mass fire casualties: A case of alleged arson on a floor consisting of small compartments in a building



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ABSTRACT

A fire is an important cause of mass disasters, involving various forensic issues. Before dawn on an early morning, 16 male visitors in their twenties to sixties were killed in a possibly incendiary fire at a 'private video parlor' consisting of small compartments in a building. The main causes of death as determined by forensic autopsy were acute carbon monoxide (CO) intoxication for all of the 15 found-dead victims, and hypoxic-ischemic encephalopathy following acute CO intoxication for a victim who died in hospital. Burns were mild (<20% of body surface) in most victims, except for three victims found between the entrance and the estimated fire-outbreak site; thus, identification was completed without difficulty, supported by DNA analysis. Blood carboxyhemoglobin saturation (COHb) was higher for victims found dead in the inner area. Blood cyanide levels were sublethal, moderately correlated to COHb, but were higher in victims found around the estimated fire-outbreak site. There was no evidence of thinner, alcohol or drug abuse, or an attack of disease as a possible cause of an accidental fire outbreak. These observations contribute to evidence-based reconstruction of the fire disaster, and suggest how deaths could have been prevented by appropriate disaster measures.

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1. Introduction

A fire is an important cause of mass disasters, involving a spectrum of forensic issues, including victim identification, determination of lethal factors, and reconstruction of the scene to investigate the outbreak site and cause of the fire as well as possible survival. In addition to natural, industrial and traffic disasters [1–14], there are potential dangers of mass fire disaster in densely populated areas, as well as in amusement and hotel facilities [1–11,14]. Lethal factors in indoor fires involve flames, hot gases or fumes, toxic gases including carbon monoxide (CO) and cyanide, smoke or soot, and oxygen deficiency due to combustion [14–24]. In addition, an attack of disease, or abuse of alcohol, inflammables, including thinner and gasoline, or drugs may accidentally cause a fire, and secondary traumas in a fire may

be fatal [25–29]. Thus, forensic case study of tragic mass fire casualties is important for disaster prevention [8,11].

Here we report the forensic autopsy findings of 16 fire victims in an alleged arson case involving a floor consisting of small compartments in a building and discuss the casualties from the viewpoint of evidence-based reconstruction of the scene.

2. Case report

2.1. Case history

At approximately 3:00 a.m., a fire broke out in the middle of a 'private video parlor' on the ground floor of a multi-use building, having 32 small private compartments occupied by 23 visitors; 16 men in their twenties to sixties were killed, although other people in the area near the entrance escaped by themselves or were rescued. The fire was alleged arson. The compartments around the estimated fire-outbreak site and the passage to the entrance/exit were badly burned and destroyed, surrounded by superficially damaged compartments, indicating that the fire

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spread along the passage, while hot gasses with smoke filled the floor. The parlor had only one entrance/exit, without an emergency exit or window, smoke extraction system or a sprinkler system. Fifteen victims were found dead in the passage ($n = 4$) and in the compartments ($n = 11$), as shown in Fig. 1. A victim who was found unconscious in a compartment near the entrance was resuscitated at an emergency hospital unit, underwent oxygen therapy under the diagnosis of CO intoxication, but died on the 14th hospital day. All victims underwent forensic autopsy (about 6–22 h postmortem).

2.2. Autopsy findings

Burns were localized (<20% of body surface) in most victims, except for in 3 victims found dead between the entrance and the estimated fire-outbreak site (Table 1 and Fig. 1): Two victims (Victims 2 and 4) found dead in the compartments between the entrance and estimated fire-outbreak site had 2nd to 3rd degree burns over about 30% and 75% of the body surface with partial charring. One victim (Victim 3) found dead at the passage to the entrance sustained 3rd to 4th degree whole-body burns with charring and airway burns, accompanied by hemorrhages in the root of the tongue. Seven victims (Victims 5–11) found dead at the passage or in the compartments around the possible fire-outbreak site had minor 2nd to 3rd degree burns over about 5–20% of the body surface and/or mild airway burns without charring. The other victims found dead in inner compartments (Victims 12–16) did not show any significant burns or charring. These found-dead victims had substantial amounts of soot in the airway, without any other pathology except for general congestion and edema. The hospital death case (Victim 1) had minor 2nd to 3rd degree burns over about 10% of the body surface, whole-body edema, advanced pulmonary congestion and edema, and encephalomalacia, without

any other pathology. Otherwise there was no significant injury or pathology related to a sudden onset of disease in each victim.

Since most bodies were intact, except that one victim had severe body charring, and two victims sustained severe burns of >30%, identification was completed by police investigation without difficulty, supported by DNA analysis.

2.3. Toxicological findings

Blood carboxyhemoglobin saturation (COHb), as measured using a CO-oximeter (Hemoximeter OSM3, Radiometer, Copenhagen) immediately after blood sampling, was 50–85% for the found-dead victims (Table 1 and Fig. 1), and an extremely high level (>70%) was detected in the victims found dead around the estimated fire-outbreak site and in the inner area. Peripheral iliac venous COHb levels were similar to heart blood levels. Blood methemoglobin was not increased in any of the cases (<2.1%).

Screening results of volatile substances, including ethanol, acetone, toluene and cyanide, using an automated head-space gas chromatography-mass spectrometry (GC-MS; GCMS-QP 5000, Shimadzu, Kyoto, Japan) [30–32] were as follow: In found-dead victims, blood cyanide levels, as measured within 24 h after sampling (storage at 4 °C), were sublethal and moderately correlated to COHb for right heart blood ($r = 0.66$, $p < 0.01$) (Fig. 2); however, a distinctly higher left heart blood level (>0.5 µg/mL) was detected for four victims found around the estimated fire-outbreak site independent of COHb (Table 1 and Fig. 1). Peripheral iliac venous cyanide levels were similar to or lower than right heart blood levels. Blood ethanol was positive in two cases (<1.0 mg/mL; Victims 6 and 8). A trace of toluene (0.05–0.11 µg/mL) was detected in the blood of 13 cases; however, metabolites of organic solvent chemicals (hippuric acid, methyl hippuric acid and mandelic acid) in urine, using high performance liquid chromatography

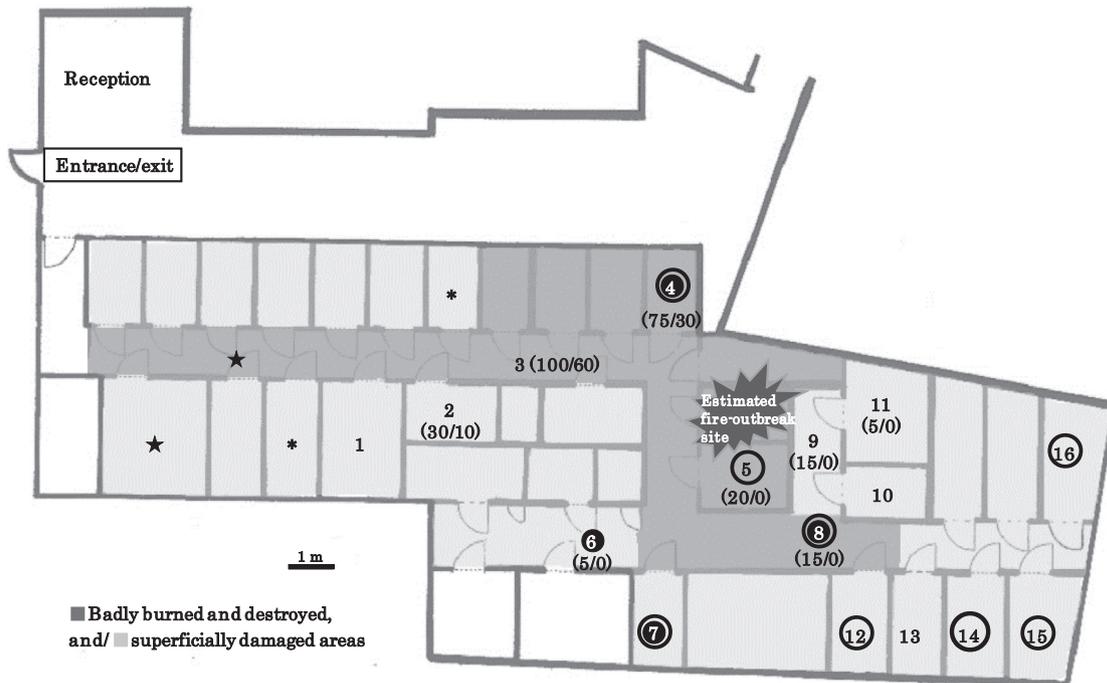


Fig. 1. Distribution of sites where victims were found in the 'private video parlor' with regard to burn/charring area, blood carboxyhemoglobin saturation (COHb), and cyanide levels. Most bodies were intact, except for three victims found in the rooms and passage between the entrance and estimated fire-outbreak site. There was a tendency for higher COHb in victims found around the estimated fire-outbreak site and in the inner area. Blood cyanide levels were higher for victims found around the estimated fire-outbreak site. ★ Ambulance transportation, alive; * self-escape; Victim 1, a victim who died on the 14th hospital day after resuscitation; victims 2–16, victims found dead at the site; (burns/charring, % body surface area); ○ COHb > 70% and ● cyanide > 0.5 µg/mL in left heart blood. ■ Badly burned and destroyed, and ■ superficially damaged areas.

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