Shimane J. Med. Sci., Vol.31 pp.25-28, 2014

Fatal Hypothermia in Summer

Kaori KIMURA-KATAOKA[1)], Junko FUJIHARA[1)], Toshihiro YASUDA[2)] and Haruo TAKESHITA[1)]

[1)]Department of Legal Medicine, Shimane University Faculty of Medicine, 89-1 Enya-cho, Izumo, Shimane 693-8501, Japan

[2)]Division of Medical Genetics and Biochemistry, Faculty of Medical Sciences, University of Fukui, 23-3 Matsuokashimoaizuki, Eiheiji-cho, Yoshida-gun, Fukui 910-1193, Japan

（Received October 31, 2014; Accepted November 11, 2014）

An elderly woman in her late 80s was living with her husband and her son in his mid-60s. The woman had urinary incontinence. Her son took her to the bathroom, showered her in the bathtub with her clothes on, and then left her inside the bathtub. Five days after on a hot summer day, the woman was found dead inside the waterless bathtub. A forensic autopsy was performed 2 days after the discovery of her death on suspicion of the son's negligence as a guardian. The woman was underweight, and the low BMI value in addition to the lack of sufficient subcutaneous fat and musculature, had an effect on the woman's vulnerability to hypothermia. Furthermore, the woman's clothes were drenched. We believe that these factors contributed greatly to her susceptibility to hypothermia. Examining all of the environmental factors and autopsy results, the cause of death was concluded to be hypothermia.

Keywords: Hypothermia, Summer, Bathtub, Elderly

INTRODUCTION

It is difficult to demonstrate that hypothermia is the cause of death since there are no diagnostic criteria or definite autopsy findings. Many reports have described both the macroscopic and microscopic findings in cases of hypothermia; however, these findings appear to be nonspecific. Accordingly, forensic pathologists need to incorporate environmental factors and any autopsy findings, keeping in mind the importance of exclusion diagnosis, in order to determine fatal hypothermia.

Death from hypothermia occurs as a consequence of exposure to extremely low temperatures but can also occur in temperate climates. Here, we describe a case of death from hypothermia in a bathtub, with an average ambient temperature of 20.9°C. Such a case report seems to merit publication.

CASE HISTORY

A woman in her late 80s was living with her husband, who was in his late 90s and bedridden from a lumbar fracture, and her son, who was in his mid-60s and taking care of his parents. The woman had a history of hypertension, chronic heart failure, and dementia. Five days before her death in August, she had urinary incontinence in bed, but she refused her son's advice to take a bath. Shortly after, her son took her to the bathroom, showered her in the bathtub with her clothes on, and then left her in the bathtub. Because he could not get her to undress, he showered her in the bathtub with her clothes on. She stayed inside the bathtub even after the shower, so her son put a blanket over her body. The woman remained in the bathtub hereafter. According to her son, he did not bring her any food but she was drinking water.

Four days after this incident, a public health nurse visited the house and tried to persuade the woman to come out of the bathtub. However, the woman ignored the recommendation by both her son and the nurse. They tried to take her out of the bathtub, but she again refused and continued to lie down in the bathtub.

One day later, on a hot summer day, the woman was found dead inside the waterless bathtub. She was lying face up with her knees bent, her head on

Corresponding author: Haruo Takeshita, MD, PhD
Department of Legal Medicine, Shimane University Faculty of Medicine, 89-1 Enya-cho, Izumo, Shimane 693-8501, Japan
Tel: +81-853-20-2156
Fax: +81-853-20-2155
E-mail: htakeshi@med.shimane-u.ac.jp

top of a pillow, and a blanket up to her shoulders (Fig. 1a). She was wearing a long-sleeved undershirt, a long-sleeved polo shirt, and long underpants rolled up to her thighs (Fig. 1b). A forensic autopsy was performed 2 days after the discovery of her death on suspicion of the son's negligence as a guardian.

AUTOPSY FINDINGS

The body was 142.0 cm in height and weighed 26.2 kg. Discolorations of the skin on the back of the head, measured 5.0 cm×3.5 cm and 4.5 cm×4.0 cm. A pale, purplish-red livor mortis was present on the back. There were abrasions, presumably pressure

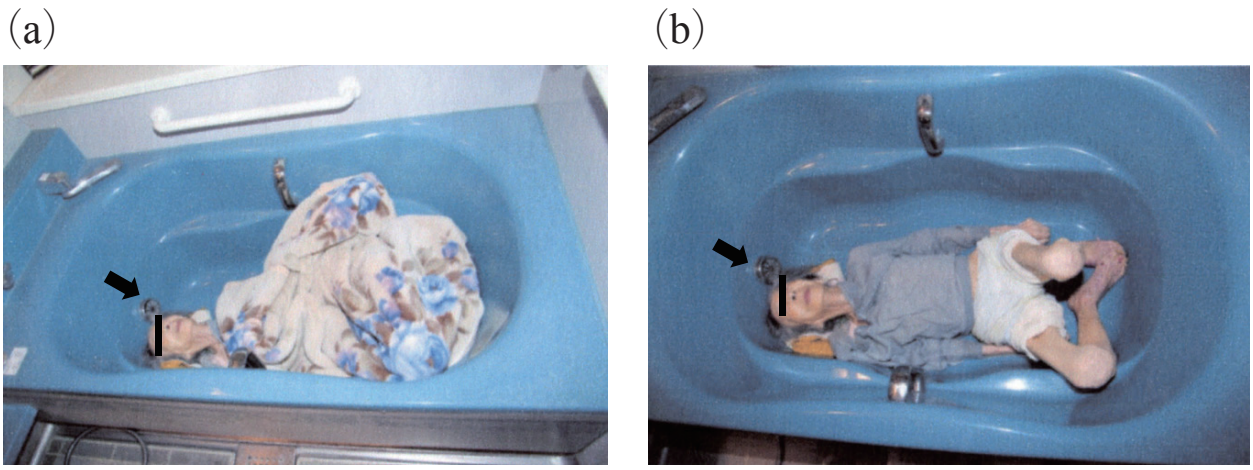

Fig. 1. Pictures of how the deceased was discovered in the bathtub; (a) with the blanket and (b) without the blanket. ➡ Water spout.

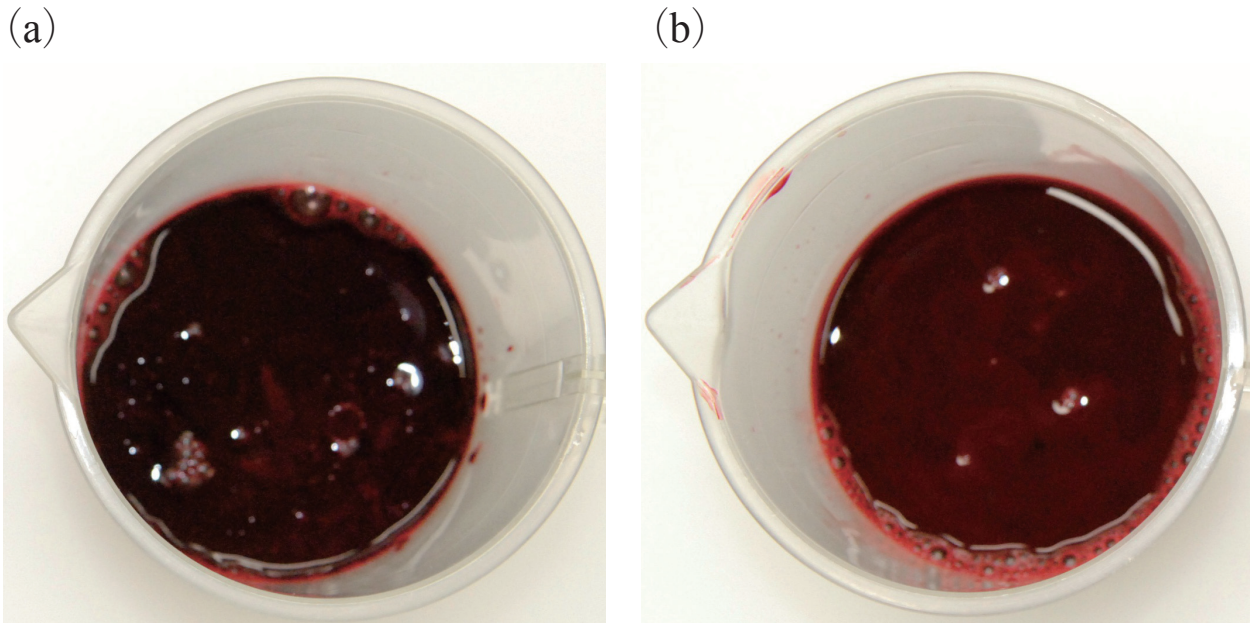

Fig. 2. Difference in the color of cardiac blood, (a) right and (b) left

ulcers, on the back measuring 11.5 cm×3.5 cm, 3.0 cm×2.0 cm, and 3.5 cm×2.5 cm. Additionally, there were minute abrasions and subcutaneous hemorrhages on the head, face, and extremities.

The heart weighed 245 g; the coronary arteries contained mild arteriosclerosis. The color of the right cardiac blood was dark red, and that of the left cardiac blood was bright red (Figs. 2a and 2b). Coagulation was present in both the right and left cardiac blood. There were small, old myocardial infarctions on the left posterior wall. The thickness of subcutaneous adipose tissue near the umbilical region was measured to be 0.3 cm. Thyroid atrophy, numerous small renal cysts, a left ovarian cyst, and severe arteriosclerosis of the abdominal aorta were observed. The stomach contained 120 ml of brownish-red viscous fluid. No apparent fracture was present on the skull. The brain measured 18.0 cm×15.0 cm×6.5 cm and weighed 1,120 g. A mild degree of cerebral atrophy was present in the regions between the frontal and temporal lobes; however, there was no subarachnoid hemorrhage or any other intracranial hemorrhages. Wischnewski ulcers were not present on the gastric mucosa. The blood alcohol concentration was 0.11 mg/g, and the acetone concentration was 0.05 mg/g.

PATHOLOGICAL FINDINGS

Severe congestion and mild-to-moderate postmortem changes were evident in most of the organs. Moderate fat deposition, mild adipose infiltration, and old myocardial infarctions on the left posterior wall were observed in the heart. Abnormalities of the cardiac conduction system were not present. Sinusoidal dilation of the liver, renal cysts, ectopic pancreas on the duodenum, and neuronal degeneration were observed. There was no apparent evidence of an infectious spleen.

DISCUSSION

The environmental temperature does not need to be lower than 0°C for death from hypothermia to occur. According to Turk [1], low environmental temperatures, damp conditions, and the wind are environmental risk factors for hypothermia. Damp clothing would facilitate the heat loss due to evaporation [2]. Thin individuals are at a higher risk, as their insulation through body fat is worse than that of obese individuals. Low muscle mass results in decreased muscular heat production as well as in reduced mobility. Hypothyroidism causes a low metabolic rate, impairing the body's heat production. Consequently, elderly people are at high risk for developing hypothermia, since they often have a combination of these risk factors. Accidental hypothermia and deaths from hypothermia have been reported in temperate climates as well as in cool or cold temperatures [3,4].

Meanwhile, the color of the right cardiac blood was identified as dark red, and that of the left cardiac blood as bright red. In general, death from hypothermia is said to exhibit color differences in the right and left cardiac blood. The bright red color of the left cardiac blood is due to oxyhemoglobin. In low-temperature conditions, oxygen binds easily to hemoglobin; moreover, it is harder to be dissociated. Therefore, the brightness of the left cardiac blood indicates that the deceased was inhaling cold air before death, and the blood's color difference between the right and left sides of the heart is considered to have a high diagnostic significance [5].

In this case, the BMI of the woman, who was measured to be 142.0 cm in height and weighed 26.2 kg, was calculated to be 13.0; BMI lower than 18.0 is considered to be underweight. Moreover, the thickness of the abdominal subcutaneous adipose tissue was only 0.3 cm. The low BMI value of 13.0, in addition to the lack of sufficient subcutaneous fat and musculature, had an effect on her vulnerability to hypothermia. The temperature inside the bathroom was not verified; however, the recorded ambient temperature at the nearest monitoring point was between 19.8 and 23.3°C (Fig. 3). The fact that the woman's town was surrounded by mountains and the bathroom window was facing north implies the possibility that the actual bathroom temperature was lower than the outside temperature, even though the incident occurred in August. Furthermore, the woman was showered periodically, keeping her clothing drenched. We believe these factors contributed greatly to her susceptibility to hypothermia.

The forensic autopsy revealed some injuries and

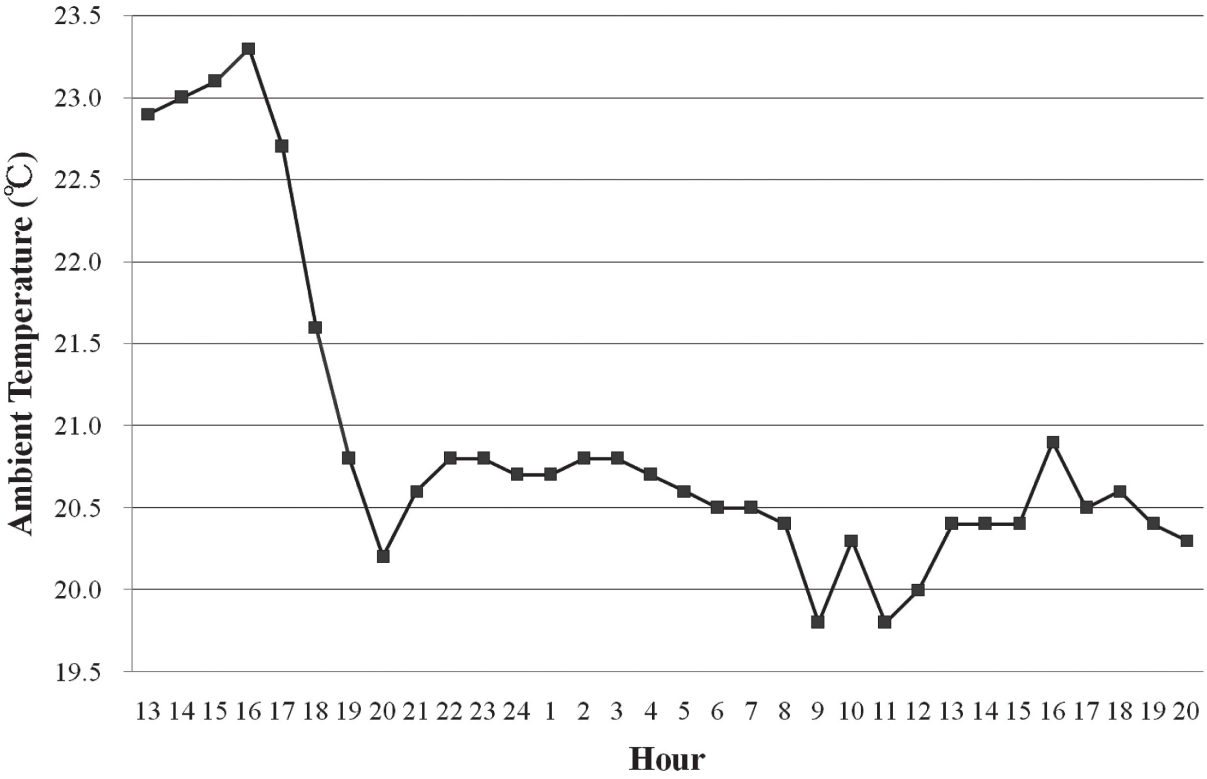

Fig. 3. The ambient temperature between the time the woman was last witnessed to be alive and the time she was found dead

pathological lesions. Since there were no skull fractures or intracranial hemorrhages, the discolorations on the scalp were probably caused by the water spout (Figs. 1a and 1b). Old myocardial infarctions were observed both macro- and microscopically; however, there were no apparent acute myocardial infarctions that could lead to death. Thyroid atrophy was observed upon autopsy, which might have led to hypothyroidism. After examining all of the environmental factors and autopsy results, the cause of death was concluded to be hypothermia.

It has been recognized that hypothermia not only occurs in individuals exposed to extreme environmental temperatures, but in more temperate climates as well. Only a limited number of reports have been made regarding hypothermia fatalities in moderate climates. The facts that this woman was underweight and that her clothes were drenched from periodical showers, in addition to the possibility of comparatively low temperatures in the bathroom and the autopsy findings, allowed us to conclude that her death was due to hypothermia. This case illustrates that the combination of environmental and physical conditions could facilitate death from hypothermia even in warm midsummer weather.

REFERENCES

1) Turk E (2010) Hypothermia. F*orensic Sci Med Pathol* 6: 106-115.

2) Saukko P and Knight B (2004) Neglect, starvation and hypothermia. In:Knight's forensic pathology, 3rd ed. pp.412-420, Hodder Arnold, London.

3) Udy AA, Ziegenfuss MD and Fraser JF (2007) Deep accidental hypothermia during the Queensland summer. *Crit Care Resusc* 9: 341-343.

4) Lim A and Duflou J (2008) Hypothermia fatalities in a temperate climate: Sydney, Australia. *Pathology* 40: 46-51.

5) Mizukami H, Shimizu K, Shiono H, Uezono T and Masahiro S (1999) Forensic diagnosis of death from cold. *Leg Med* 1: 204-209.