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Case Report

Iatrogenic third-degree burn caused by off-label use of an infrared radiant heat lamp in a patient with accidental hypothermia

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ABSTRACT

We report a case of third-degree burn involving 5% of the total body surface area caused by off-label use of Hanautherm®, an infrared radiant heat lamp for bed-warming, in a patient with severe accidental hypothermia. This iatrogenic burn required repeated surgical interventions and long-term hospitalization and caused subsequent cosmetic disfigurement and functional disability. To our knowledge, this is the first reported adult case of iatrogenic burn occurring during treatment for hypothermia. Radiant heat lamps should never be used for rewarming of patients with hypothermia without careful observation.

1. Introduction

Accidental hypothermia is defined as an unintended drop in core temperature below 35 °C [1]. Severe hypothermia (<28 °C) has high mortality and is associated with cardiac arrest [2]. Standard treatment strategies for severe hypothermia have not been established. Here we report a case of iatrogenic burn from the use of a radiant heat lamp for the treatment of hypothermia in order to highlight the potential risk.

2. Case report

A 74-year-old man was found lying unconscious on the floor in his house at 6p.m. in March on a day when the high and low temperatures were 2 °C and 0 °C, respectively. He was transported by ambulance to the emergency department of our hospital. On arrival, his temperature was 27.3 °C, heart rate was 46 beats/min, and blood pressure was 73/26 mmHg. He was rewarmed by intravenous administration of warmed fluids, half-body immersion in warm water, and use of an infrared radiant heat lamp (Hanautherm®; Heraeus MED GmbH, Hanau, Germany) set more than 1 m above the body surface. After the lamp had been used for about 1 h, third-degree burn involving 5% of the total body surface area was seen on the surface of the chest and abdomen, and the use of the lamp was stopped. Within 2 h of arrival at hospital, he had been rewarmed to 34 °C, and computed tomography revealed acute peritonitis secondary to perforated appendicitis. Emergency surgery was then performed for intra-abdominal drainage by general surgeons. He was referred to us the next day (Fig. 1A).

On post-burn day (PBD) 11, we performed debridement of the burn wound eschar including part of the anterior sheath of the rectus abdominis (Fig. 1B, C). On PBD 18, debridement of the necrotic anterior sheath of the rectus abdominis and an abscess on the abdominal wall of the left flank was performed (Fig. 2A). On PBD 53, after debridement of necrotic tissue, a meshed split-thickness skin graft was applied to the wound (Fig. 2B, C), with negative-pressure wound therapy for graft fixation. On PBD 111, we performed local flap and meshed split-thickness skin grafting to cover the exposed left rib and the remaining wound area (Fig. 3A, B). On PBD 180, he was transferred to another hospital for rehabilitation. On PBD 295, he was discharged from the hospital.

At 1 year after the burn incident, a cutaneous fistula was seen on the left hypochondriac region, suggestive of osteomyelitis of the underlying rib with an abdominal hernia seen in the region where the anterior rectus abdominis sheath had been resected (Fig. 3C). By the 3-year follow-up, the cutaneous fistula had healed with conservative treatment provided through home nursing care once a week.

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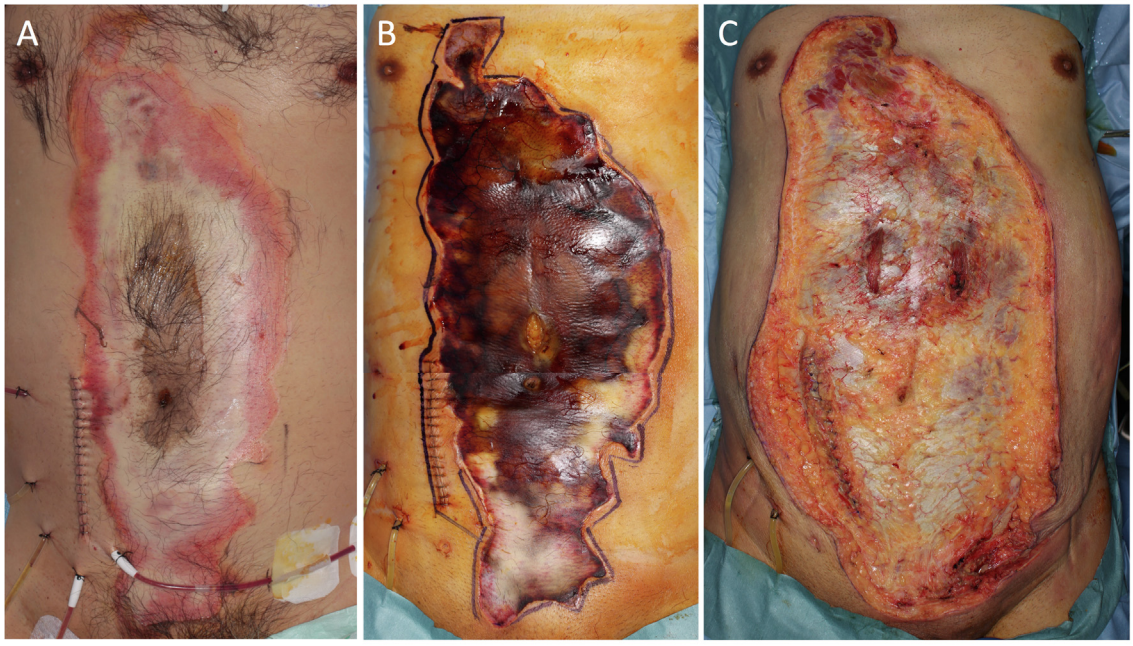

Fig. 1. (A) Third-degree burn on the anterior chest and abdominal wall on post-burn day (PBD) 1. Burn eschar (B) before debridement and (C) after debridement including part of the anterior sheath of the rectus abdominis on PBD 11.

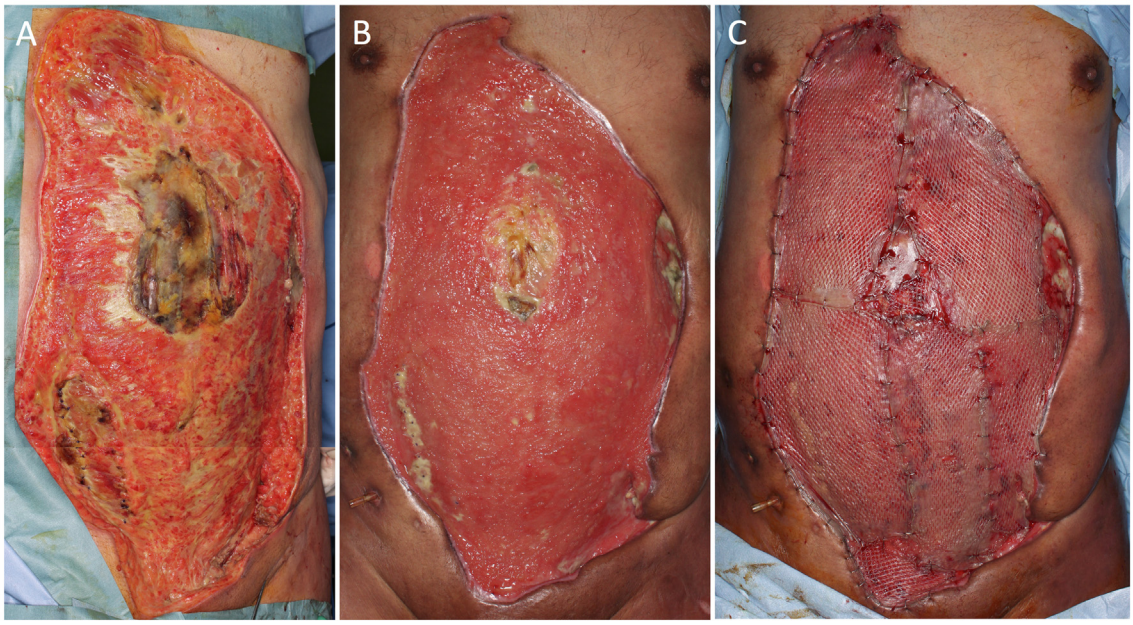

Fig. 2. (A) Necrosis of the remaining anterior sheath of the rectus abdominis and abdominal wall abscess on the left flank on post-burn day (PBD) 18. Wound (B) before debridement and (C) after meshed split-thickness skin grafting on PBD 53.

3. Discussion

Iatrogenic burns have rarely been reported in the literature. Such burns have been attributed to the use of several operative instruments [3,4], a transilluminator [5], a defibrillator [6], an external cardiac pacing device [7], a catheter during MRI [8], a heated dental instrument [9], accidental breakage of an alcohol lamp [10], operating microscopes [11,12], a topical hemostatic agent [13], warm water immersion [14], hot water bottles [15,16], and a radiant warmer for neonates [17,18]. To our knowledge, this is the first reported adult case on iatrogenic burn resulting from treatment for hypothermia and is the most severe case of iatrogenic burn in the literature to date.

Hypothermia can be staged clinically based on vital signs using the Swiss staging model for hypothermia. The proposed core temperature range is 35–32 °C for stage I, 32–28 °C for stage II, 28–24 °C for stage III, and below 24 °C for stage IV [19]. In patients with mild hypothermia (stage I), passive external rewarming with provision of basic or advanced life support is indicated, including provision of a warm environment, warm clothing, and warm sweet

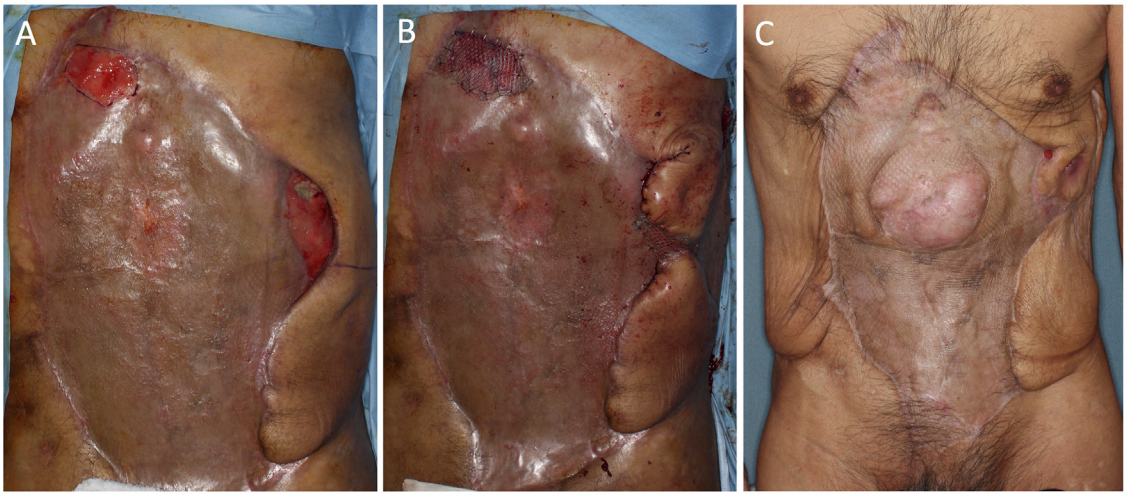

Fig. 3. Wound with (A) the exposed left rib and (B) after local flap and meshed split-thickness skin graft on post-burn day (PBD) 111. (C) Cutaneous fistula in the left hypochondriac region and abdominal hernia in the region where the anterior rectus abdominis sheath was resected on PBD 355.

drinks; and, if possible, active movement. In patients with moderate to severe hypothermia (stage II or III) and stable circulation, active external and minimally invasive rewarming is indicated, including provision of a warm environment; use of chemical, electrical, or forced-air warming packs or blankets; and administration of warm parenteral fluids. Patients with severe hypothermia (stage III or IV) and cardiac instability require rewarming with extracorporeal membrane oxygenation or cardiopulmonary bypass [2].

However, rewarming methods for patients with severe hypothermia remain controversial. Active external rewarming involves the direct exposure of the patient's skin to an exogenous heat source, which has the potential for thermal injury [1]. Forced-air rewarming blankets (Bair Hugger™) have been shown to be effective for the treatment of accidental hypothermia without causing thermal injury [20–22] and for maintenance of core temperature during surgery [23]. Whole-body immersion in hot water, which causes massive vasodilatation and hypotension, is contraindicated as a rewarming method in hypothermic patients [24].

The use of radiant heat lamps had been recommended for active external rewarming since the 1990s [1,25,26], though it has not been advocated for the treatment of severe hypothermia [2,24]. The use of radiant heat lamps for the care of sick neonates has become widespread, but the potential risk of iatrogenic burns has been reported [17,18]. Radiant energy causes thermal injury when the skin temperature exceeds 44 °C [27]. Factors increasing the risk of thermal injuries by radiant heat lamps are poor blood circulation, dark skin color, high room temperature, and lack of air movement [27].

The Hanautherm® bed-warming unit is designed for postoperative use and is contraindicated for use in warming humans according to the instruction manual. However, the off-label use of Hanautherm® to warm the body surface was reported to show efficacy for the prevention of hypothermia during skin grafting for patients with severe burn [28]. Our patient had severe hypothermia and acute peritonitis, and off-label use of Hanautherm® resulted in third-degree burn on the anterior abdominal wall. This required repeated surgical interventions and long-term hospitalization and caused subsequent cosmetic disfigurement and functional disability. Our case suggests that radiant heat lamps should never be used for rewarming in patients with hypothermia without careful observation.

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Consent statement

The authors confirm that consent for publication was obtained from the patient.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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