

Hyperthermia due to heat retention in chronic spinal cord injury: A case report

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Abstract

An 80-year-old male with past history of cervical spinal cord injury visited our hospital owing to perforation in the digestive tract. Upon admission to the general ward, he presented with a sustained fever that was unresponsive to acetaminophen and antibiotics. Based on the dry skin and underlying disease, he was diagnosed with hyperthermia due to heat retention. After controlling the room temperature to cool his body and performing evaporative and convective cooling, his symptoms completely resolved. This case highlights that primary physicians should be aware of thermoregulatory dysfunction in patients with cervical spinal cord injury.

KEYWORDS

heat retention, hyperthermia, spinal cord injury

1 | INTRODUCTION

Thermoregulatory dysfunction is an unusual complication after cervical spinal cord injury (SCI), which most primary physicians are unfamiliar with. Here, we report the case of an 80-year-old man with hyperthermia due to heat retention during hospitalization.

2 | CASE REPORT

An 80-year-old man presented at the Department of General Medicine of our hospital with fever of unknown origin. His past history comprised cervical SCI due to trauma and cerebral hemorrhage at age 46 and 73 years, respectively. Before this hospitalization, he had fever several times, which was thought to be due to urinary tract infection. He had been living in a long-term care facility because of his bedridden condition. Sixteen days before the evaluation, he was referred to the intensive care unit (ICU) of our hospital for digestive tract perforation. Despite undergoing conservative management for the perforation, he underwent mechanical ventilation via

an endotracheal tube for 3 days because of carbon dioxide narcosis. Five days before the evaluation, his condition improved. He was then transferred to the general ward. One day later, he developed fever (38°C) that did not resolve despite acetaminophen administration. Despite the fever, he did not feel hot. For 5 days, he was intravenously administered with piperacillin/tazobactam for suspected aspiration pneumonia; however, his symptoms worsened. Despite discontinuing all drugs following the suspicion of drug fever, his symptoms worsened, and his body temperature increased to 41°C.

Upon examination, he was found to be unconscious with a body temperature of 41.2°C, pulse of 70 beats/min, blood pressure of 100/50 mm Hg, and respiratory rate of 36 breaths/min. The oxygen saturation was 95%; however, he was breathing oxygen via a nasal cannula at a rate of 2 L/min. His skin was significantly dry with no sweat, and a mild coarse crackle was audible in both lungs. However, the remaining examinations were normal. Laboratory data revealed hyponatremia (150 mEq/L) due to poor intake and dehydration; however, complete blood counts, C-reactive protein level, and liver, renal, and thyroid functions were normal. Cultures of sputum, urine, and blood exhibited no growth. Furthermore, chest X-ray revealed

no abnormal findings, and contrast-enhanced chest and abdominal computed tomography imaging revealed no evidence of infectious lesions. The room temperatures of the ICU and general ward were 25 and 29°C, respectively. Hence, on the basis of the past history of cervical SCI and dry skin, we attributed his condition to heat retention and hyperthermia. After controlling the room temperature at 25°C and performing evaporative and convective cooling, the patient's hyperthermia significantly decreased, and his unconscious state resolved (Figure 1). Thus, we diagnosed the patient with heat retention and hyperthermia. Gradually, the symptom completely resolved, and he was discharged on day 30. As a discharge instruction, the facility staff was instructed about room temperature control and cooling at the time of fever.

3 | DISCUSSION

Spinal cord injury is a common event, and the incidence of traumatic SCI is estimated to be 50 per million people per year in both Japan and the United States.^{1,2} SCI is accountable for several chronic complications and neurological deficits, which are often fatal despite being common. Respiratory and cardiovascular complications, including autonomic dysreflexia or coronary artery disease, are the most common causes of fatalities.³

We herein presented the case of a patient with cervical SCI complicated with hyperthermia due to heat retention during hospitalization. A medical history of SCI, normal laboratory data, specific physical findings including lack of sweating, and good response to cooling can lead to the diagnosis of hyperthermia. Although thermoregulatory dysfunction is one of the most unusual complications after SCI,⁴ primary physicians, except for some experts, are unfamiliar with this condition. Core body temperature is regulated within a narrow range by hypothalamus via several mechanisms including heat production and release. However, SCI above the T6 level interrupts the ability to thermoregulate, and stability of the core body temperature is compromised, which can lead to hyperthermia even at mild, ambient temperature, as reported in patients with SCI who

developed accidental hyperthermia.⁵ To date, hyperthermia due to heat retention has been reported in not only SCI but also multiple system atrophy.⁶

Under high temperatures, heat is released by increased skin blood flow and heat of vaporization due to sweating. However, in patients with SCI above the T6 level, heat release is rendered impossible because of decreased sweating response and compromised cutaneous blood flow, causing difficulty in maintaining a healthy core temperature with respect to environmental temperature changes.⁷ In hot rooms, patients with cervical SCI cannot sweat, thus causing a rapid elevation in their body temperature compared with healthy subjects.⁸ The range of optimum room temperature for cervical SCI is narrow (23-25°C).⁹ Moreover, patients with SCI have impaired thermal sensation in ambient temperature: Their thermal sensation has a narrower range between room temperature and most pleasant temperature, compared with that of subjects without SCI.⁴ In the current patient, the difference in room temperature (ICU, 25°C; general ward, 29°C) combined with impaired thermal sensation was considered as the underlying cause of hyperthermia.

Thermoregulatory dysfunction can occur regardless of length of cervical SCI.⁹ The thermoregulatory dysfunction in the current case manifested 34 years after the injury. Large cysts or spinal cord atrophy, a characteristic finding in patients with chronic SCI, showed no tendency to neurological improvement.¹⁰ In the current case, magnetic resonance imaging and nerve conduction test to evaluate the injured spinal cord were not performed. Factors for exteriorization include routine cooling for fever in the facility where he lived and the omission of cooling due to the lack of symptoms during this hospitalization.

In hospitalized cases, the differential diagnoses of hyperthermia include diseases that cause temperature elevation—infectious and noninfectious diseases. Infectious diseases during hospitalization are limited and include catheter-related urinary tract infection, intravascular catheter-related infection, aspiration pneumonia, *Clostridium difficile* infection, or skin infection. In the present case, the most likely differential infectious disease was urinary tract infection; however, laboratory and microbiology studies revealed no evidence of such an infection.

By contrast, noninfectious diseases, such as drug fever, deep vein thrombosis, or thyroid storm, which cause temperature elevation during hospitalization, can lead to a potential differential diagnosis of heat retention.¹¹ In the present case, the patient's thyroid function was normal, and drug fever was unlikely because his symptoms did not resolve after discontinuation of all drugs. However, as we did not perform leg compression ultrasonography, we could not completely eliminate deep vein thrombosis.

Heat retention due to cervical SCI is often clinically diagnosed after excluding the abovementioned differential diseases. Useful findings in the discrimination include lack of sweat despite fever and poor response to antipyretics. Sweat function tests, including sympathetic skin response, thermoregulatory sweating test, silastic imprint test, and quantitative sudomotor axon reflex test, are useful for

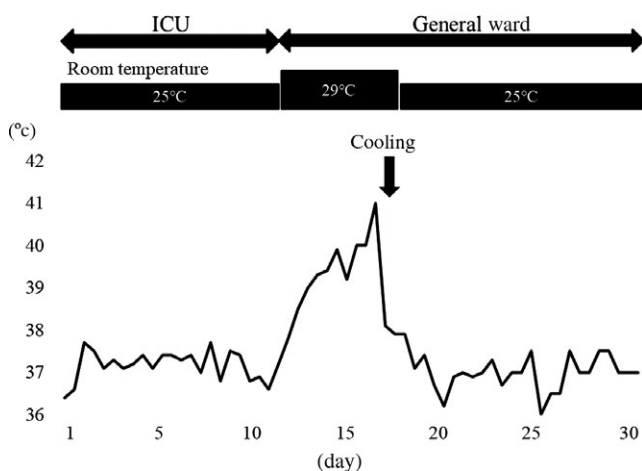


FIGURE 1 Clinical course of the patient

the diagnosis of anhidrosis¹²; however, this test was not performed because of obvious SCI.

In conclusion, we encountered a case of hyperthermia caused by heat retention in a patient with cervical SCI. Primary care physicians should consider heat retention as a differential diagnosis for patients with cervical SCI with persistent fever. Furthermore, physicians should control the room temperature.

CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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