

Case Report

Takotsubo cardiomyopathy developed during rewarming of accidental hypothermia with extracorporeal membrane oxygenation

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Background: We here present the first case report of takotsubo cardiomyopathy that developed during rewarming of a patient with severe accidental hypothermia with extracorporeal membrane oxygenation.

Case: A 74-year-old woman was found unresponsive outdoors and suffered cardiopulmonary arrest during transfer to our hospital. On arrival, she was still in cardiopulmonary arrest. Veno-arterial extracorporeal membrane oxygenation was initiated for resuscitation and rewarming. After admission to the intensive care unit, her blood pressure suddenly dropped, and coronary angiography on day 2 indicated intact coronary arteries. Left ventriculography showed typical takotsubo-like dysfunction in the end-systolic phase, which led to the diagnosis of takotsubo cardiomyopathy. Left ventricular wall motion gradually improved, and echocardiography on day 6 revealed that abnormalities in the left ventricular wall motion had almost disappeared.

Conclusion: Takotsubo cardiomyopathy might arise during rewarming of patients with severe accidental hypothermia.

Key words: Accidental hypothermia, cardiopulmonary arrest, extracorporeal membrane oxygenation, rewarming, takotsubo cardiomyopathy

BACKGROUND

TAKOTSUBO CARDIOMYOPATHY IS defined as a transient cardiac dysfunction that is commonly triggered by physical or emotional stress.¹ Wall-motion abnormalities of takotsubo cardiomyopathy are typically characterized by apical systolic dysfunction and hyperdynamic basal contraction; therefore, it can be complicated by heart failure. The underlying pathophysiology remains uncertain; however, excess catecholamine release is considered as a trigger for takotsubo cardiomyopathy.¹

Accidental hypothermia is defined as an unintentional drop of the core body temperature below 35°C.² The risk of cardiac arrest substantially increases when the core

temperature drops below 28°C.² Rewarming of patients with severe accidental hypothermia is associated with complications, such as cardiovascular collapse, often termed as rewarming shock. This condition is defined as a decline in the cardiac output that results in a sudden drop in the arterial blood pressure.³ Here, we report the first case of a patient who developed takotsubo cardiomyopathy during rewarming for severe accidental hypothermia with extracorporeal membrane oxygenation (ECMO).

CASE PRESENTATION

A 74-YEAR-OLD WOMAN was found unresponsive outdoors, and the ambient temperature on the arrival of emergency medical services to the scene was −1.7°C. At that time, she was in shock, with a body temperature of 24.6°C. During her transfer to our hospital, she suffered cardiopulmonary arrest (CPA). On arrival, she was still in CPA, and her cardiac rhythm was ventricular fibrillation. Veno-arterial ECMO was initiated for resuscitation and rewarming, and she became responsive to commands after a few minutes. Rewarming was aimed at increasing her body

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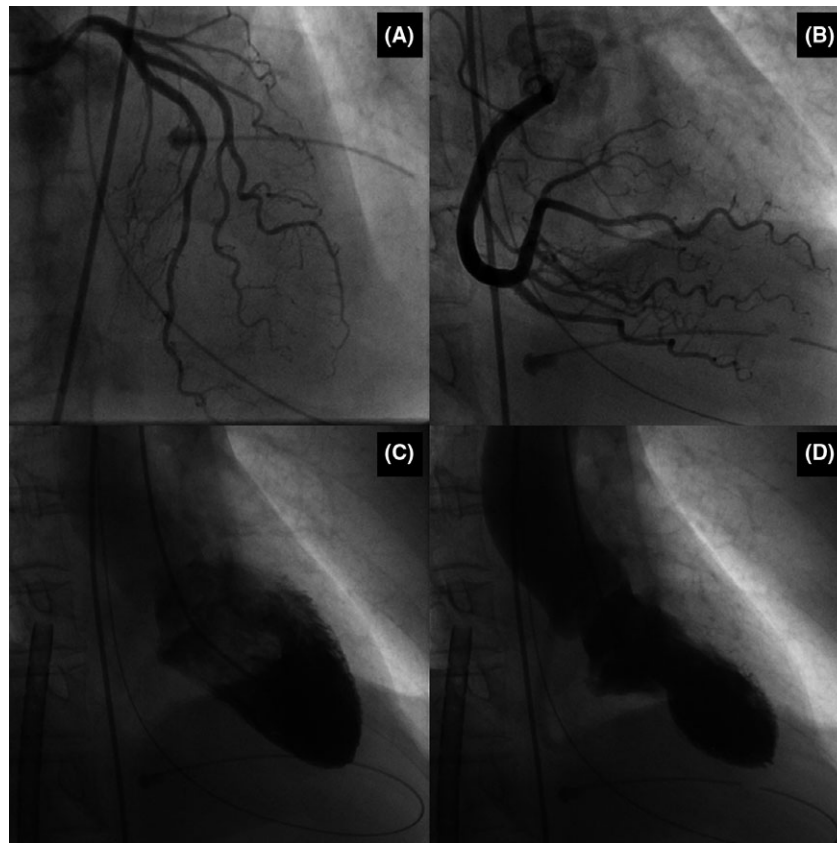


Fig. 1. Coronary angiogram and left ventriculogram of a 74-year-old woman who suffered cardiopulmonary arrest due to severe accidental hypothermia. Left (A) and right (B) coronary arteries show the absence of coronary artery disease. The left ventriculogram shows hyperdynamic basal contraction in the presence of akinesis of the apical segments (C, D).

temperature to 36°C as rapidly as possible with the inclusion of a heater-cooler device with ECMO. Whole-body computed tomography scan with contrast enhancement showed no abnormalities that could explain the cause of CPA. She was admitted to the intensive care unit (ICU), and the return of spontaneous circulation was achieved at the time of admission without adrenaline and defibrillation. The left ventricular (LV) ejection fraction was approximately 60% estimated visually.

Her blood pressure suddenly dropped 1 h after the ICU admission, and echocardiography showed severe diffuse hypokinesia of the LV wall and apical akinesia. Coronary angiography undertaken on day 2 indicated that coronary arteries were intact (Fig. 1A,B). Left ventriculography showed typical takotsubo-like dysfunction in the end-systolic phase and hyperdynamic basal contraction, and apical akinesia (Fig. 1C,D) as well as a T-wave inversion in multiple leads on the electrocardiogram (Fig. 2). Based on these findings, she was diagnosed with takotsubo cardiomyopathy. Left ventricular wall motion gradually improved, and she

was taken off ECMO on day 3 (Fig. 3) and extubated on day 5. Echocardiography on day 6 showed that abnormalities in the LV wall motion had almost disappeared.

She was discharged from the ICU on day 8. She confessed having ingested several sleeping pills. Therefore, she was moved to the psychiatric ward to receive psychological treatment on day 12 and was discharged on day 43 without neurological deficits.

DISCUSSION

THE PRESENT CASE highlights two important clinical issues: (i) takotsubo cardiomyopathy can develop during rewarming of patients with severe accidental hypothermia, (ii) ECMO is an effective life-saving approach for severe LV dysfunction from takotsubo cardiomyopathy that might develop during rewarming. Hypothermia-induced takotsubo cardiomyopathy has been previously reported, but diabetic ketoacidosis was a coexisting condition in those patients.^{4,5}

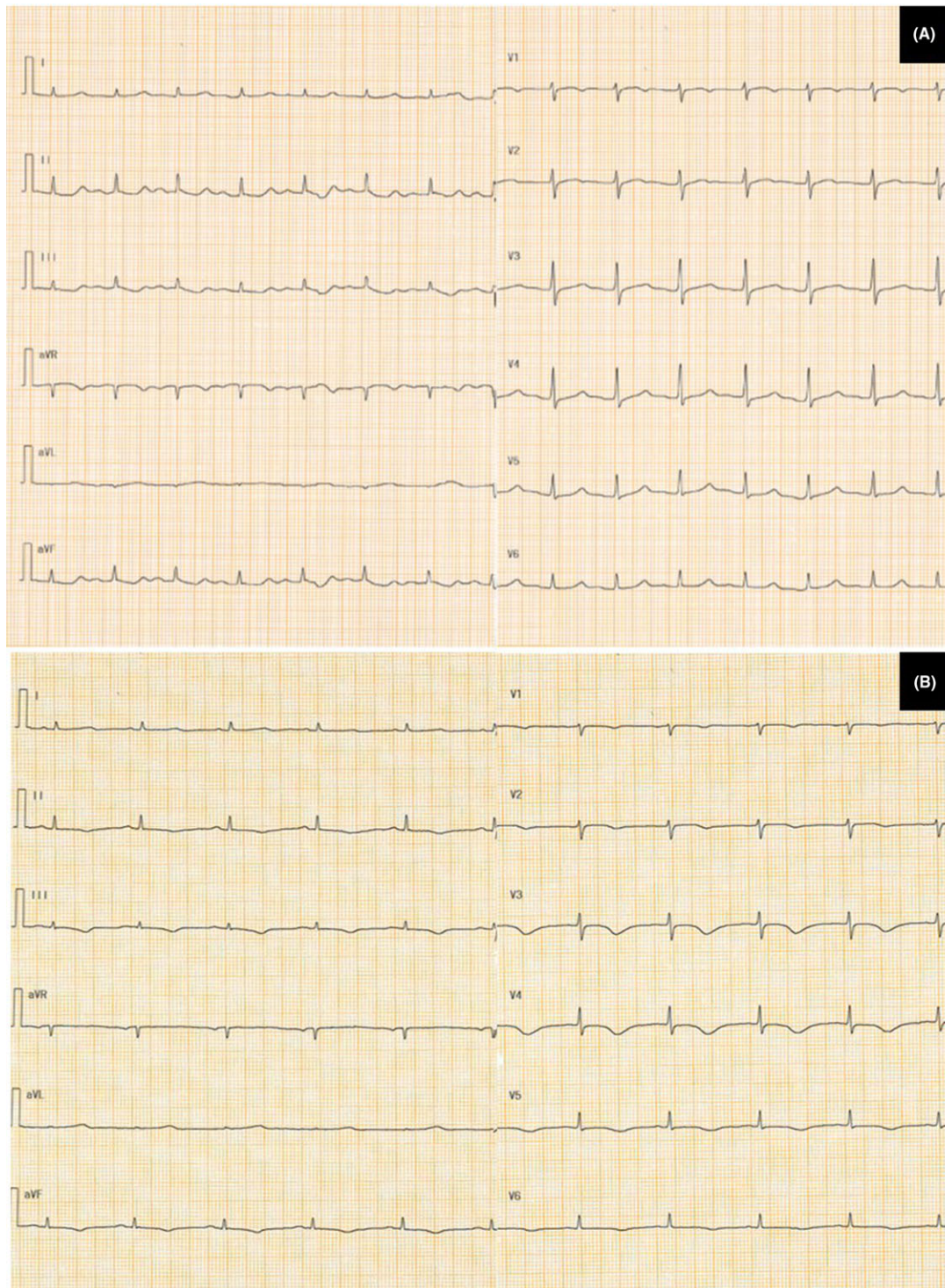


Fig. 2. Electrocardiogram on admission (A) and day 2 (B) of a 74-year-old woman who suffered cardiopulmonary arrest due to severe accidental hypothermia. A new T-wave inversion in multiple leads appears on day 2.

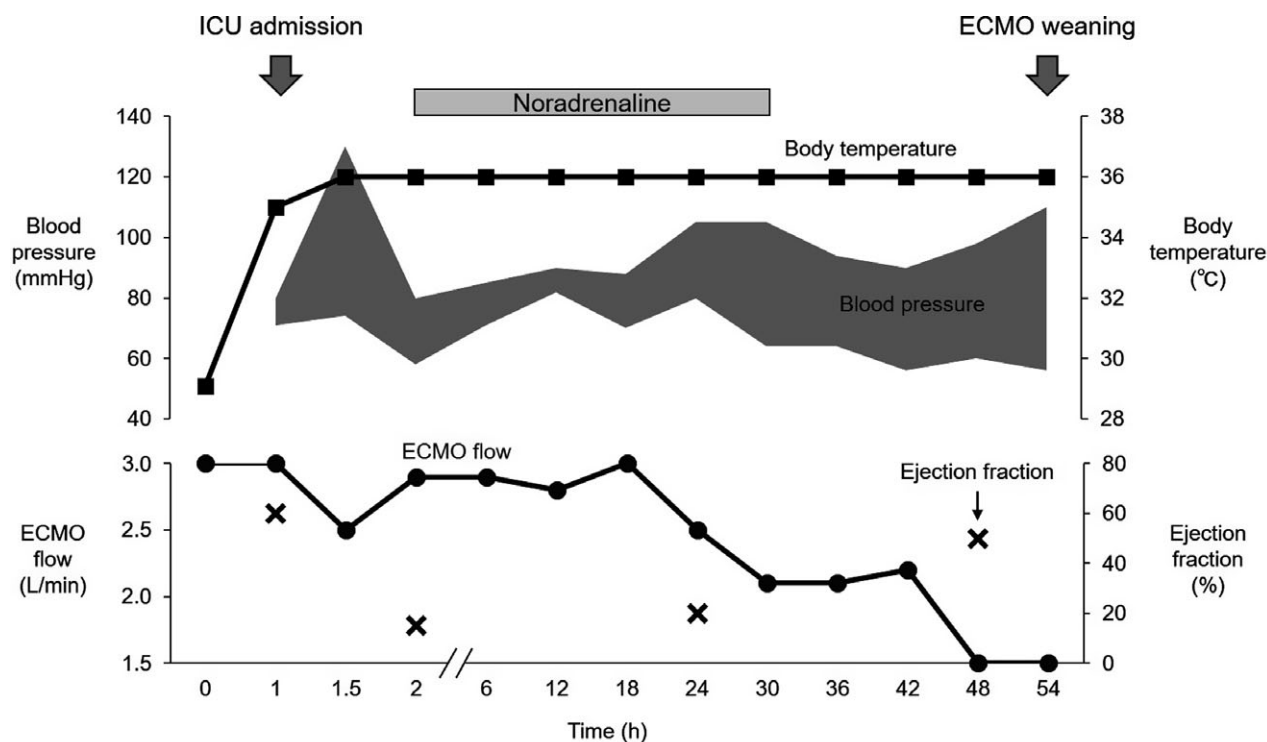


Fig. 3. Clinical course from admission to extracorporeal membrane oxygenation (ECMO) weaning of a 74-year-old woman who suffered cardiopulmonary arrest due to severe accidental hypothermia. ICU, intensive care unit.

Hypotension, or rewarming shock, can occur during or after rewarming in patients with severe accidental hypothermia.⁶ The pathophysiology of rewarming shock is poorly understood; however, studies have shown that peripheral vasodilation and severe cardiac dysfunction are causes of rewarming shock.^{7,8} Our experience in the present case raises the possibility that cardiac dysfunction, which was previously attributed to rewarming shock, is associated with takotsubo cardiomyopathy.

In a cold environment, catecholamines are released from the adrenal medulla and reach peripheral sympathetic nerve endings.⁹ Catecholamine secretion from the sympathoadrenal medullary system is associated with metabolic and cardiovascular responses that are critical for heat production and heat loss prevention.¹⁰ Urinary catecholamine levels have been reported to be significantly increased in fatalities due to hypothermia compared with those due to other causes.⁹ Although the exact factors involved in the pathogenic mechanism underlying takotsubo cardiomyopathy remain unclear, excessive catecholamine secretion and sympathetic hyperexcitation have been proposed as the most likely factors. In the present case, the patient's circulation rapidly

improved with ECMO, suggesting that takotsubo cardiomyopathy was induced by the rapid dissemination of increased catecholamines released during hypothermia.

Extracorporeal membrane oxygenation is a safe and efficient rewarming strategy in patients with severe hypothermia¹¹ and is also useful for circulatory support for refractory CPA or severe cardiogenic shock, such as takotsubo cardiomyopathy.¹² Therefore, it can be an effective life-saving treatment approach for takotsubo cardiomyopathy during rewarming of patients suffering from severe hypothermia, as shown in the present patient.

CONCLUSION

IN SEVERE ACCIDENTAL hypothermia, takotsubo cardiomyopathy could occur during rewarming because of the rapid dissemination of increased catecholamines during hypothermia, and ECMO should be considered as an effective life-saving rewarming strategy in such patients.

DISCLOSURE

Approval of the research protocol: N/A.

Informed consent: The patient provided informed consent for publication of this case report.

Registry and the registration no. of the study/trial: N/A.

Animal studies: N/A.

Conflicts of interest: None.

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