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CASE REPORT

Successful Nonextracorporeal Life Support Resuscitation and Rewarming of a Patient with Hypothermia in Cardiac Arrest

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We report full recovery of a patient with hypothermia in cardiac arrest following continuous and prolonged cardiopulmonary resuscitation (CPR) and conventional, nonextracorporeal life support (non-ECLS) methods. A 57-y-old man presented with unwitnessed cardiac arrest and a core temperature of 23°C (73°F). The presenting cardiac rhythm was ventricular fibrillation. The team administered epinephrine and performed defibrillation and CPR. Because ECLS was unavailable at the facility, the medical team externally and internally rewarmed the patient using heated blankets, forced warmed air, thoracic lavage, and warmed IV fluids. The patient achieved return of spontaneous circulation after 4 h 56 min of continuous CPR and rewarming. The medical team admitted the patient to the intensive care unit. He achieved full neurologic recovery the following day. When ECLS is not available and transfer is not appropriate because of patient instability or hospital location, conventional rewarming methods and continuous, prolonged CPR can lead to successful outcomes in patients with hypothermia in cardiac arrest. This case demonstrates that CPR in patients with hypothermia-associated cardiac arrest can lead to full recovery.

Keywords: cardiopulmonary resuscitation, extracorporeal membrane oxygenation, resource availability

Introduction

Cardiac arrest is a potential consequence of severe hypothermia. Extracorporeal life support (ECLS) is considered the optimal method of resuscitation for patients with hypothermia in cardiac arrest. Extracorporeal life support has been shown to increase the odds of survival and return to normal neurologic function.[1-5] However, this treatment is not offered by all hospitals. If ECLS is not available, an alternative approach is the use of conventional rewarming techniques with continuous cardiopulmonary resuscitation (CPR).[5]

We report the case of a patient with hypothermia in cardiac arrest, in which rewarming techniques and CPR were successfully used because ECLS was not available.

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Case Presentation

At 2048 (elapsed time, 0) on a midwinter Wisconsin night, emergency medical services (EMS) brought a 57-y-old man with ventricular fibrillation and cardiac arrest to the emergency department. The EMS had found the patient outside in freezing conditions with an unwitnessed arrest. En route to the hospital, the EMS performed continuous CPR, attempted defibrillation, and administered 3 doses of epinephrine. There was no note of core temperature during EMS handoff to the emergency medicine team. After arrival, the medical team administered 4 additional rounds of epinephrine along with continued attempts of manual CPR and defibrillation. They used classic pad positioning for the majority of defibrillation attempts. However, they attempted anterior/posterior positioning for the last 2 rounds. Additionally, they administered IV amiodarone (300+150 mg), 2 doses

of calcium chloride (1 g × 2), and sodium bicarbonate ampules (50 mEq × 2) while the patient was briefly in pulseless electrical activity. At 30 min, the physician performed point-of-care ultrasound (POCUS) echocardiography, which showed no cardiac activity. The physician performing POCUS noticed that the patient felt cool to the touch. The team then measured the patient's rectal temperature. This was 22.8°C, indicating that the patient was severely hypothermic. Because CPR should not be terminated until asystole persists with a core temperature of >32°C, the physician immediately started rewarming the patient using conventional methods.[2] These included placing a forced air blanket, placing heated blankets on the patient's upper torso, and administering warmed Ringer lactate solution through 2 antecubital 16-gauge IV lines. The team continued manual CPR because ECLS was not available. The team attempted to transfer the patient to an ECLS-capable hospital 30 min away. This hospital refused the transfer because they had no protocol to receive patients with hypothermia in cardiac arrest.

The core temperature, monitored using an indwelling urinary catheter, rose slowly. At 1 h 45 min, the physician successfully inserted 2 chest tubes into the patient's right hemithorax. The right side of the chest was continuously irrigated with warmed normal saline using the 2-tube technique. The team did not irrigate the left hemithorax to avoid the risk of cardiac irritation.[6] They continuously irrigated the patient's bladder with warmed saline through the indwelling urinary catheter.

The complete blood count, basic metabolic panel, serum lactate level, and venous blood gases levels were normal. The potassium level was 4.0 $mmol{\cdot}L^{-1}$. The termination of CPR based on potassium level should not be considered unless the serum potassium level is >12.0 $mmol{\cdot}L^{-1}$.[7]

At 2 h 12 min, the emergency medicine physician intubated the patient to protect his airway. Because the patient was in cardiac arrest, no sedative or paralytic was necessary. Because there was possible active movement of the larynx during intubation, the team repeated POCUS echocardiography and again observed no cardiac activity. At this point, the physician placed the patient on a mechanical chest compression device, which was set at 100 $beats{\cdot}min^{-1}$. The team continued active internal and external rewarming while the patient underwent mechanical chest compressions and ventilation. At 4 h 56 min, the monitor showed ventricular tachycardia. The team then successfully defibrillated the patient (at 200 J), converting the heart rhythm into normal sinus rhythm. The patient began to open his eyes and attempted to extubate himself. The physician started a propofol infusion for sedation and admitted the patient to the intensive care unit. The intensive care unit team extubated the patient the following day, with complete neurologic recovery. The patient discharged himself against medical advice roughly 24 h after admission to the intensive care unit.

Discussion

Cardiac arrest can be a consequence of severe hypothermia. While ECLS is the optimal method for resuscitation, it may not always be an option.[2,7,8] Clinicians should be aware of other methods for treating patients with severe hypothermia.

This case demonstrates that the use of conventional rewarming methods and non-ECLS techniques can lead to a successful outcome. Non-ECLS techniques may be the only option at hospitals without ECLS capabilities.

This is an example of prolonged CPR being used to successfully achieve return of spontaneous circulation in a patient with severe hypothermia in cardiac arrest. There are other reported cases of patients with hypothermia with cardiac arrest, with successful recovery after prolonged CPR.[9-12] A patient with hypothermia in cardiac arrest with a reasonable chance of recovery being treated at a hospital without ECLS capability should be transferred to an ECLS-capable center if the transfer can be accomplished within 6 h of the start of resuscitation. The chance of recovery if placed on ECLS can be assessed using guidelines such as the hypothermia outcome prediction after extracorporeal life support (HOPE) score.[2] In the case we described, the HOPE score would have indicated a survival probability of 80% after 30 min of CPR.[13,14]

For some patients with severe hypothermia in cardiac arrest at hospitals without ECLS capabilities, when transfer to an ECLS center is not possible, the use of CPR and conventional rewarming may lead to successful outcomes, with full neurologic recovery.

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