

CASE REPORT

A Case of Successful Prolonged Resuscitation of a Patient with General Hypothermia

Albina A. Ivanova¹, PhD, ScD; Alexander F. Potapov¹, PhD, ScD; Dmitriy V. Bosikov², PhD; Ivan I. Protodiakonov²; Tatiana A. Androsova²; Elena M. Klimova²

¹*M. K. Ammosov North-Eastern Federal University*

²*Center for Emergency Medical Care of Yakutsk
Yakutsk, the Republic of Sakha (Yakutia), Russia*

Abstract

This article presents a case of a successful prolonged cardiopulmonary resuscitation (CPR) performed by the emergency medical services on a patient with general hypothermia (GH) and frostbite in the extremities. The resuscitation activities continued for more than 3.5 hours and resulted in a successful restoration of spontaneous BC. An extended CPR was performed while the patient was being warmed up (wrapping in a blanket and insulating pads, infusion of warmed fluids, gastric lavage and urinary bladder lavage with water heated to +45°C). After the restoration of BC, the patient was hospitalized and subsequently discharged without any neurological deficit. (**International Journal of Biomedicine. 2021;11(2):224-227.**)

Key Words: general hypothermia • clinical death • cardiopulmonary resuscitation

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Abbreviations

AV, artificial ventilation; BC, blood circulation; CPR, cardiopulmonary resuscitation; ECM, external cardiac massage; GH, general hypothermia; HR, heart rate; PEA, pulseless electrical activity; RR, respiratory rate; VF, ventricular fibrillation.

Introduction

The injuries caused by the effect of cold natural temperatures on the human body are one of the serious challenges for emergency medicine. This problem is particularly urgent in northern latitudes and characterized by low and ultra-low natural temperatures.

Along with a severe clinical course and frequently developed complications in the respiratory and excretory systems, a distinctive feature of cold injury is a high mortality

rate and disability of the patients due to amputations of various segments of extremities. The outcomes of treatment are determined both by the degree of hypothermia and the depth of local tissue damage, as well as by the tactics of treating the patients, especially the adequacy of resuscitation activities during the pre-thaw phase (from the onset of injury to the start of tissue rewarming and restoration of circulation) and the early post-thaw phase (from the start of tissue warming and restoration of circulation to the end of Day 1).

The complex of resuscitation activities in the event of death from hypothermia has certain peculiarities, taking into account the need for warming the patients. In an event of death from hypothermia, a number of countries apply the “no one is dead until warm and dead” approach, which was recommended by the European Resuscitation Council.⁽¹⁾

**Corresponding author: Prof. Albina A. Ivanova, PhD, ScD. M.K. Ammosov North-Eastern Federal University, Yakutsk, the Republic of Sakha (Yakutia), Russia. E-mail: iaa_60@mail.ru*

To this end, modern high-tech treatment methods are used, including extracorporeal core warming and irrigation of body cavities with warmed fluids.⁽²⁾

The primary tasks of intensive care in hypothermia include ensuring adequate oxygenation of the body, maintaining hemodynamics and preventing fatal heart rhythm disorders along with achieving the general warming of the patient.⁽³⁾ At present, the basic approach to treating patients with frostbite of extremities is to ensure slow and gradual rewarming of the damaged tissues through internal heat production, which helps to prevent tissue necrosis, or reduce its area.^(3,4)

The aim of our research was to present a clinical case of a successful, prolonged resuscitation of a patient having experienced clinical death due to GH.

Case Presentation

An anesthesiology-intensive care team arrived at the site where a man was found in the street 14 minutes after the call had been received. According to the official data of the Meteorological Office, on the day of the accident, the air temperature in the area where the patient was found was -41°C . At the initial examination, the patient was in extremely grave condition. He was unconscious, with the Glasgow Coma Scale score of 6. The pupils were wide, with no photoreaction. One could smell alcohol from his mouth. There were traces of vomit on the skin. The skin was pale cyanotic and cold. There were signs of frostbite in the lumbar area of the hands, shins, and feet up to degree 3. He could breathe, with RR of 20 per minute. The heart sounds were muffled, with HR of 69 bpm, blood pressure could not be measured. The glucometer reading was 7.1 mmol/L. It was impossible to determine the blood oxygen level due to the absence of peripheral pulsation. Continuous cardiac monitoring was started. The cardiac monitor showed an irregular idioventricular rhythm with a frequency of 53 per minute, with the ventricular complex deformed due to the Osborne wave.

During the examination, the BC stopped, the monitor showed VF. Electrical defibrillation was performed with a biphasic rectangular pulse with the energy of 150J, which led to the restoration of sinus rhythm and return of the pulse in the carotid artery. The oral cavity was sanitized, and the infusion of warmed saline started. Then, premedication with Atropine solution (1 mg), induction with Ketamine solution (100 mg), and muscle relaxation with Rocuronium bromide solution (50 mg) were followed by trachea intubation, and artificial ventilation was started. At the same time, the team used a special warming blanket and insulating pads on the limbs.

In 5 minutes, the monitor recorded a recurrence of VF, which was stopped by a double electrical shock of 150-200J with an interval of 2 minutes. Between the shocks, continuous external cardiac massage and artificial ventilation with an Ambu bag were performed. After the resuscitation, the patient was connected to a mechanical ventilator.

For 35 minutes, spontaneous circulation was maintained, respiration was provided by mechanical ventilation, HR was 50 bpm, blood pressure – 70/40 mmHg, saturation – 94%. The team doctor made a decision to start medical evacuation of the

patient to the Republican Hospital #2 - Center for Emergency Medical Aid (RH No.2–CEMA). On the way there, the monitor registered VF again. A double electrical shock of 200J with an interval of 2 minutes in combination with continuous external cardiac massage, mechanical ventilation, and intravenous administration of an Adrenaline solution (2.0) did not restore the HR. The doctor decided to use the AutoPulse Zoll automatic compression device and began intensive warming of the patient during continuing automated compressions.

It should be noted that gastric lavage and urinary bladder lavage are mandatory in the resuscitation of patients with GH. However, ambulance teams usually have to provide their services to patients with cold injuries outdoors, where it is not possible to perform the lavage with warmed water. Meeting this condition is something to work out during the pre-hospital stage, since it prolongs the time of transporting patients to the hospital.

Further, the resuscitation activities continued for 3 hours 5 minutes from the last circulatory arrest and included chest compressions with the AutoPulse device, mechanical ventilation with an Ambu bag, continuous infusion of warmed saline, gastric lavage and urinary bladder lavage with water heated to 45°C . The patient's body was warmed to a temperature of 35.5°C in the armpit. During that period, the type of circulatory arrest underwent a transformation from VF into the pulseless electrical activity and back; the resuscitation tactics of applying electrical shocks changed accordingly. As a result of the activities applied, spontaneous BC was restored. When the CPR was complete, the patient's HR and pulse were 49 per minute, blood pressure – 30/00 mmHg, saturation – 74%, core temperature – 35.8°C , and the monitor showed sinus bradycardia. The further diagnosis was as follows: General hypothermia, severe. Frostbite in both hands, lumbar area, both shins and feet. Clinical death was declared at 08:10. CPR. Resuscitation at 08:12. Recurrence of clinical death at 08:17. CPR. Resuscitation at 08:21. Recurrence of clinical death at 08:54. CPR. Resuscitation at 11:50. The patient reached the RH No.2-CEMA in the early post-resuscitation period.

Table 1 presents the course of the resuscitation activities that were carried out.

The long-term outcome of treatment is favorable: the patient came out of a coma without any neurological deficit, the frostbitten limbs were preserved, amputation avoided.

In conclusion, the presented case signals the urgency of the problem with cold injury in the region. The injury is characterized by severe frostbite of extremities with tissue necrosis combined with hypothermia, which significantly complicates the treatment of the injury. It should be emphasized that today there are no national standards or clinical guidelines for the treatment of patients with hypothermia, including the use of active warming methods, a unified technique for reliable diagnosis of the severity of tissue damage and a degree of hypothermia, without which timely and adequate treatment of patients is impossible. Given these circumstances, the institution previously developed an algorithm for CPR in patients with hypothermia and implemented it in the activities of ambulance teams. Following the algorithm resulted in a successful rescue of the patient in the case described.

Table 1.**The sequence of the extended cardiopulmonary resuscitation**

Time	Data from the cardiac monitor, hemodynamics, core temperature	Activities
08:03	Irregular idioventricular rhythm with a frequency of 53 per minute, the ventricular complex deformed due to the Osborne wave	Preliminary examination; infusion of warmed NaCl; insulating pads
08:10	VF	150 J shock
08:10-08:12		ECM, AV with an Ambu bag
08:12	Organized rhythm, pulse over the carotid arteries	Infusion of warmed NaCl, oral cavity sanitation, trachea intubation, AV
08:17	Recurrence of VF	Adrenalin 1.0 IV, 150 J electrical shock
08:17-08:19		ECM, AV with an Ambu bag, infusion of warmed NaCl
08:19	VF	Adrenalin 1.0 IV, 200 J electrical shock
08:19-08:21		ECM, AV with an Ambu bag, infusion of warmed NaCl
08:21	Organized rhythm, pulse over the carotid arteries	Mechanical ventilation
08:21-08:54	Organized rhythm on the monitor. Spontaneous blood circulation, breathing – mechanical ventilation, HR – 50 per minute, pulse – 50 per minute, blood pressure – 70/40 mm/Hg, saturation – 94%.	Continued infusion of warmed NaCl
08:54 -08:58	VF	Double 200 J electrical shock with 2-minute interval, Adrenalin 1.0 IV as per scheme, ECM, AV with an Ambu bag between the shocks, infusion of warmed NaCl
08:58 – 10:01	VF Core temperature < 35.0°C	Automatic compressor Autopulse Zoll applied; AV with an Ambu bag, continued infusion of warmed NaCl; gastric lavage and urinary bladder lavage with water heated to 45°C; Adrenalin 1.0 IV with 10-minute interval, 200 J defibrillation with 2-minute interval
10:01 – 10:03	PEA of the heart	Automatic compressor Autopulse Zoll; AV with an Ambu bag, infusion of warmed NaCl; gastric lavage and urinary bladder lavage with water heated to 45°C
10:03	VF	Adrenalin 1.0 IV; 200 J electrical shock
10:03-10:05		Automatic compressor Autopulse Zoll; AV with an Ambu bag, infusion of warmed NaCl; gastric lavage and urinary bladder lavage with water heated to 45°C
10:05	VF	Automatic compressor Autopulse Zoll; AV with an Ambu bag, infusion of warmed NaCl; gastric lavage and urinary bladder lavage with water heated to 45°C
10:05-10:19	VF	Automatic compressor Autopulse Zoll; AV with an Ambu bag, infusion of warmed NaCl; gastric lavage and urinary bladder lavage with water heated to 45°C; Adrenalin 1,0 IV with 10-minute interval
10:19	VF	200 J electrical shock
10:19-10:21	VF	Automatic compressor Autopulse Zoll; AV with an Ambu bag, infusion of warmed NaCl; gastric lavage and urinary bladder lavage with water heated to 45°C
10:21-10:39	VF	Automatic compressor Autopulse Zoll; AV with an Ambu bag, infusion of warmed NaCl; gastric lavage and urinary bladder lavage with water heated to 45°C; Adrenalin 1,0 IV with 10-minute interval
10:39	VF, core temperature 35.5°C	200 J electrical shock
10:39-10:57	VF	Automatic compressor Autopulse Zoll; infusion of warmed NaCl; AV with an Ambu bag, gastric lavage and urinary bladder lavage with water heated to 45°C; Adrenalin 1,0 IV with 10-minute interval, 200 J defibrillation
10:57 – 11:50	PEA of the heart	Automatic compressor Autopulse Zoll; AV with an Ambu bag, infusion of warmed NaCl; gastric lavage and urinary bladder lavage with water heated to 45°C; Adrenalin 1.0 IV with 10-minute interval

Table 1 (continued).**The sequence of the extended cardiopulmonary resuscitation**

Time	Data from the cardiac monitor, hemodynamics, core temperature	Activities
11:50	Organized rhythm, sinus bradycardia; pulse over the carotid artery	Mechanical ventilation, saline infusion
11:50-12:26	Organized rhythm, sinus bradycardia; pulse over the carotid artery. Blood pressure – 30/00 mmHg, HR – 49 per minute, core temperature – 35.8°C, saturation – 71%	Mechanical ventilation, saline infusion; Dopamine infusion at rate 15 mcg/kg/min

Competing Interests

The authors declare that they have no competing interests.

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