Case report

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# Targeted temperature management after out-of-hospital cardiac arrest in three young patients

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**Key words:** Targeted temperature management ▪ Out-of-hospital cardiac arrest.

**Objective.** We present the use of targeted temperature management in a tertiary-level intensive care unit, in three patients who experienced an out-of-hospital cardiac arrest. **Case report**. Three young patients experienced an out-of-hospital non-coronary cardiac arrest. The causes of the cardiac arrest were: Wolf-Parkinson-White syndrome, drug overdose and long-QT syndrome. All patients were resuscitated according to the advanced cardiac life support guidelines, and treated with targeted temperature management, with a target temperature of 33°C for 24 hours. After completion of targeted temperature management, all the patients regained full consciousness and were discharged from hospital without any neurological sequelae. **Conclusion.** Targeted temperature management may improve survival and neurological outcome in patients after out-of-hospital cardiac arrest.

## Introduction

The introduction of targeted temperature management (TTM) in patients after out-of-hospital cardiac arrest (OHCA) is one of the most important clinical advancements in the field of resuscitation. The American Heart Association issued a Guidelines update in 2015 for cardiopulmonary resuscitation and emergency cardiovascular care, recommending that all comatose adult patients with return of spontaneous circulation (ROSC) after cardiac arrest should be treated with TTM, and the target temperature of 32°-36°C maintained constantly for at least 24 hours (1). Although this practice is now widely used in the developed world, the developing countries have lagged behind in use of this practice, including Bosnia and Herzegovina.

We present three young patients who experienced OHCA and who were managed with TTM with a target temperature of 33°C in a tertiary-level intensive care unit.

## Case report I

A 24-year-old man collapsed during a university lecture and his friends immediately

started bystander resuscitation. He was unconscious, pulseless, and ventricular fibrillation (VF) was established by the emergency medical services, which arrived 6 minutes later. The advanced cardiac life support guidelines were followed, with cardiopulmonary resuscitation (CPR) continuously performed and two defibrillations, followed by IV adrenaline and amiodarone, which resulted in ROSC after 25 minutes. The patient was hospitalized at the Medical Intensive Care Unit (MICU). Physical examination showed coma with a Glasgow coma scale (GCS) score of 6/15 (e1, v1, m3), and blood pressure (BP) 113/54 mmHg. Electrocardiogram (ECG) showed a sinus rhythm with a ventricular rate of 92 bpm, short PR interval and delta wave, without signs of acute ischemia or myocardial lesion. He was sedated and placed on mechanical ventilation. He was treated with cold IV saline, proton pump inhibitor and anticoagulant. Two hours after the OHCA, TTM was started using the Arctic Sun® Temperature Management System (Model 2000, Medivance Inc., USA) with a target temperature of 33oC achieved 4 hours after ROSC. Analgosedation was achieved by IV midazolam and fentanyl infusion, and vecuronium was used for neuromuscular blockade. Laboratory data revealed elevated creatinine kinase 675 U/L, aspartate aminotransferase 66 U/L, alanine aminotransferase 84 U/L, troponin 0.243 ng/mL and D- dimer 4.0 mg/L. Twelve hours after admission, the serum troponin level increased to 1.590 ng/ml. On the second day following admission, after completion of TTM and cessation of sedatives, he regained consciousness and was successfully extubated. Heart ultrasound showed a morphologically and functionally normal heart. He was transferred to the Clinic of Heart Disease for further evaluation of suspected Wolff–Parkinson–White syndrome. He was released from the hospital fully recovered. At a recent follow-up, he was completing his Master's degree in History.

## Case report II

A 26-year-old man was found unconscious in his bedroom on the morning after a party. He was taken by car to the nearest medical practice. He was unconscious and pulseless, without spontaneous respiration. ECG showed VF. Cardiopulmonary resuscitation was immediately commenced with chest-compressions, intubation, IV adrenaline, amiodarone, naloxone and four defibrillations, which resulted in ROSC after 35 minutes. He was hospitalized at the MICU. Physical examination showed deep coma with GCS 3/15 (e1, v1, m1). ECG showed sinus rhythm with a ventricular rate of 80 bpm, and no signs of acute myocardial ischemia. Thoracic CT scan showed signs of aspiration pneumonia. Toxicology results were positive for amphetamines and cannabinoids, making a drug overdose the most probable cause of cardiac arrest. After admission he was sedated and placed on mechanical ventilation. He was treated with cold IV saline, antibiotics, proton pump inhibitor and anticoagulant. Three hours after cardiac arrest, TTM was started using the Arctic Sun® Temperature Management System (Model 2000, Medivance Inc., USA) with a target temperature of 33°C which was achieved 6 hours after ROSC. On the second day, after completion of TTM and cessation of sedatives, he regained full consciousness. Aspiration pneumonia was treated with antibiotics. After conservative treatment, he recovered fully and was released from hospital. At a recent follow-up, his sister reported that he was in good health, but she suspected that he was still abusing drugs, and he was therefore referred to the Drug and Alcoholism Rehabilitation Center.

## Case report III

A 23-year-old woman collapsed during a dinner with friends. She was unconscious, with no pulse or respiration. Her friends immediately started resuscitation and called the EMS, which arrived 10 minutes later. ECG showed VF. The advanced cardiac life support recommendations were followed, with continuous CPR and one defibrillation, adrenaline and amiodarone, which resulted in ROSC after 15 minutes. She was admitted to the MICU. Physical examination showed coma with GCS 4/15 (e2, v1, m1). ECG showed sinus rhythm with HR 93 bpm, prolonged QT interval and ventricular extra-systoles (bigeminy). Immediately after admission, she was sedated and placed on mechanical ventilation. She was treated with cold IV saline, antibiotics, continuous antiarrhythmic and anticoagulant. Two hours after ROSC, TTM was started using the Arctic Sun® Temperature Management System and the target temperature of 33°C was achieved 6 hours after ROSC. Analgo-sedation was achieved by continuous IV midazolam and fentanyl infusion. Laboratory data revealed elevated lactate, 7.4 mmol/L, leucocyte count 18.5 x $10^9$/L, CK 220 U/L, LDH 387 U/L, AST 51 U/L, ALT 51 U/L, and decreased potassium, 2.8 mmol/L On the second day she regained consciousness. She had no neurological deficit and was transferred to the Clinic for Heart Disease, where the diagnosis of long-QT syndrome was established. She was referred for implantation of an internal cardioverter defibrillator. At a recent follow up, her brother reported that she was on a trip overseas, fully recovered.

## Discussion

Sudden cardiac arrest occurs in 250,000-300,000 people in Europe every year (2). Survival in patients with out-of-hospital cardiac arrest is less than 15%, while survival with in-hospital cardiac arrest is approximately 22% (3, 4). Only 5-35% of them leave the hospital alive, with some degree of neurological impairment (5). Seventy percent of all OHCA are due to coronary heart disease. A further 10% are caused by structural heart disease (e.g. hypertrophic cardiomyopathy) (6), and 5% to 10% are due to arrhythmic causes, in the absence of structural heart disease. In the absence of structural or electrophysiological abnormality, these entities are termed as primary electrical disease (7). Fifteen to 25% of OHCA are non-cardiac in origin (8).

The benefits of TTM have been summarized in a systematic review and meta-analysis of six randomized trials (9). According to this review, patients treated with TTM were more likely to survive than patients whose temperature was not managed with TTM.

However, TTM is is associated with a number of adverse effects and complications. The main adverse effects reported are: shivering, seizures, bradycardia, tachyarrhythmia, pneumonia, sepsis, coagulopathy, electrolyte and metabolic disturbances (10). All three of our patients experienced bradycardia with heart rate as low as 40 bpm. Recently, bradycardia during the cooling phase of TTM has been suggested to be a predictor of favorable outcome (11). Also, two patients in our case study experienced hyperglycemia during the cooling phase. Hypothermia leads to metabolic rate decline, reduces endogenous insulin secretion, induces insulin resistance and alters blood glucose homeostasis (12). Hyperglycemia is a part of the natural response to hypothermia and is regarded as being safer than the occurrence of hypoglycemia. Our patients experienced transient hypokalemia, which was appropriately treated. Hypokalemia during TTM was not associated with poor outcome, as reported in previous studies (13). Shivering was observed in one patient and was managed by the use of neuromus-

cular blockade. The lack of major adverse effects of TTM may be explained by the fact that our patients were young individuals without comorbidities, and this may be a limitation of our study.

Only a decade ago, a minority of resuscitated patients were treated with TTM in both American and European intensive care units (14). Ten years ago, TTM was utilized in only 38% of departments treating patients after OHCA in Germany (15). Although in recent years there have been major improvements in the use of TTM, this practice is still not widely used in developing countries due to limited financial resources and a lack of awareness of this treatment method. A previous study showed that 15% of health care professionals in developing countries have used TTM in comatose survivors after cardiac arrrest (16).

Before our MICU was equipped with the proper cooling system, alternative cooling methods (cold IV fluids and surface cooling with ice packs, wet blankets and a cooling fan) were utilized, which should encourage other health care professionals in intensive care units with limited resources in Bosnia and Herzegovina and further afield to start using this treatment option.

## Conclusion

Sudden cardiac arrest is one of the most unexpected, dramatic, and life-threatening events in medicine. In this paper, we have presented three young patients experiencing non-coronary OHCA. The causes of cardiac arrest were: Wolf-Parkinson-White syndrome, drug overdose and long-QT syndrome. All patients were resuscitated according to the advanced cardiac life support guidelines. They were admitted to the medical intensive care unit, and treated with TTM, with a target temperature between 32°C and 36°C, which was maintained constantly for 24 hours. After completion of TTM all patients regained full consciousness and were discharged from hospital without any neurological sequelae. This report further demonstrates the feasibility of TTM in limited resource settings, and should encourage other intensive care units in Bosnia and Herzegovina and further afield to use TTM in adult patients after OHCA, because it is technically feasible in developing countries.

**What is already known on this topic**

*Targeted temperature management is one of the most important clinical advancements in the field of resuscitation. The incidence of a neurologically good outcome is remarkably improved with this method in selected patients, after out-of-hospital cardiac arrest.*

**What this study adds**

*Although targeted temperature management is widely used in medical and coronary intensive care units in developed countries, this practice is still not widely used in developing countries. This is the first case report describing the use of targeted temperature management in patients after cardiac arrest in Bosnia and Herzegovina. When OHCA occurs in younger patients, we must diligently search for less frequent causes of cardiac arrest in the absence of structural heart disease.*

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**Conflict of interest**: The authors declare that they have no conflict of interest.

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