ACCIDENTAL DEEP HYPOTHERMIA WITH CARDIAC ARREST. PROMPT COMPLETE RECOVERY AFTER REWARMING BY EXTRACORPOREAL CIRCULATION. CASE REPORT

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Background: Deep accidental hypothermia (core temperature < 28 °C) is an uncommon medical emergency requiring rapid active core rewarming. Extracorporeal circulation has become the treatment of choice for deep hypothermic patients with cardiac arrest.

Case report: We report on a 30-year-old patient who suffered from deep accidental hypothermia (core temperature 24.8 °C) and cardiac arrest by prolonged exposure to a cold urban environment as a consequence of severe ethylalcohol intoxication. The rewarming with the aid of extracorporeal circulation was initiated shortly after his arrival at the hospital. External cardiac massage was maintained until full ECC flow was established. The patient was weaned from extracorporeal circulation after 157 min, awaked 4 hours later and consequently extubated within 16 hours after rewarming with no neurological impairment. At 3-week follow-up, the patient was fully re-integrated in his work and personal life.

Conclusion: This case demonstrates the excellent prognosis of a young victim in the case of deep accidental hypothermia with cardiac arrest, provided that deep hypothermia precedes the cardiac arrest and rewarming by extracorporeal circulation is immediately applied. Simultaneous ethyl alcohol intoxication can be considered a protective factor improving the patient's outcome. Complete recovery was achieved within 24 hours after the accident.

INTRODUCTION

Deep accidental hypothermia (core temperature < 28 °C) in urban environment is usually associated with drug, alcohol abuse or serious illness in the elderly¹. Despite improvement in pre-hospital rescue care, in-hospital intensive care and rewarming techniques, the mortality rate remains high². Since its introduction, rewarming by extracorporeal circulation (ECC) has become the treatment of choice for deeply hypothermic patients with cardiac arrest³. Clinical experience has demonstrated that mostly young and healthy people survive deep hypothermia with cardiac arrest with no or minimal cerebral impairment, regardless how prolonged the circulatory arrest⁴.

CASE REPORT

A 30-year old man was found lying on the street in the early morning, while the urban environmental tempera-

ture during the night had dropped to - 3.0 °C. According to the medical rescue service record, he was unconscious, hypothermic, had sinus a rhythm with systolic blood pressure up to 50 mm Hg. Upon arrival at the emergency room (ER), ventricular fibrillation immediately occurred. The patient was unsuccessfully biphasically defibrillated three times (150J, LifepakTM 20, Medtronic Physio-Control Inc., USA). Cardiopulmonary resuscitation (CPR) was commenced including rapid orotracheal intubation, artificial ventilation and external cardiac massage. The patient had widely dilated pupils with no response to light and a rectal temperature probe recorded 24.8 °C initially. When deep hypothermia with cardiac arrest was confirmed, no further external defibrillation was carried out. Serum-ethyl alcohol concentration was measured up to 3.5 g/kg blood. The cardiosurgical team was called immediately and the patient was transferred to the operating theatre 45 min after admission to the ER. Meanwhile, continuous CPR kept the systolic blood pressure at 50 mm Hg. Heparin 3 mg/kg body weight was applied and activated clotting time was monitored and maintained above 400 s. ECC

was established 85 min after commencement of CPR via the left femoral artery and vein, using a heparin-coated system (Capiiox RX™, Terumo Inc., USA). ECC flow started at 0.5 and increased to 3.0 l/min depending on venous return. The blood arterial acid base and electrolytes variables at the start of ECC were: pH 7.0; PaO₂ 23.5 kPa; PaCO₂ 4.64 kPa; BE -17.2; lactate 14.1 mmol/l; potassium 4.52 mmol/l; glucose 6.3 mmol/l. External cardiac massage was continued until full ECC flow was established, overall time reached 98 min. A maximum temperature gradient of 5–6 °C was maintained between heat exchanger and actual core temperature. Ventricular fibrillation was electrically converted to sinus rhythm at 32 °C of core temperature. The patient was weaned from ECC after 157 min, when the core temperature achieved 37 °C. He was transferred to the intensive care unit and required low-dose vasopresoric support. Four hours later, he was awake and then extubated with no neurological sequelae, 16 hours after rewarming. The postoperative course was uneventful. The presence of an arrhythmia heart substrate was ruled out by echocardiography, magnetic resonance imaging and electrophysiology. The ventricular fibrillation was thus caused purely by deep hypothermia. The patient was discharged on the 12th day from the hospital and had no neurological impairment at 3-week follow-up, when he was already fully re-integrated in his work and personal life.

DISCUSSION

The mortality rate of deep accidental hypothermia with cardiac arrest varies between 20 to 80 % from one study to another^{2, 5, 6}. This variability can be explained by differences in accident mechanisms, patient population, pre-hospital handling as well as determination of the rewarming strategy. The therapeutic approach is basically determined by the question of whether cardiac arrest has to be considered as a direct consequence of hypothermia or is attributed to the sequela of asphyxia². If asphyxia precedes cardiac arrest, even in a deeply hypothermic patient, the chances of survival are very small. Hyperkalemia is known as a marker of poor prognosis in patients with accidental hypothermia and its correlation with patient's outcome is more precise than other biochemical variables such as central venous pH, pCO₂ or activated clotting time^{1, 2, 7, 8}. Asphyxia as well as trauma, crush trauma especially, are associated with significant hyperkalemia^{7, 8}. A serum potassium concentration exceeding 10 mmol/l has been considered to justify the termination of resuscitation effort^{7, 8}. On the other hand, if cardiac arrest is only a consequence of deep hypothermia and no further factors such as polytrauma or brain injury are presented, the survival rate reaches 60 to 70 %^{3, 6}. Hypothermia reduces metabolic activity and oxygen demand in parallel with temperature. If cardiac arrest occurs, patients with ventricular fibrillation or lower degree of deep hypothermia have better prognosis, moreover, no linear correlation between duration of circulatory arrest and the mortality

has been determined^{3, 9}. Ethyl alcohol has been shown to reduce the threshold for lethal arrhythmias by about 2–5 °C¹⁰. Thus, an adequate circulation can be maintained at lower temperature within ethyl alcohol intoxication¹¹. Similarly, carbamazepine intoxication can improve the neurological outcome in deeply hypothermic patients due to their brain protective effects¹². ECC is the rewarming modality of choice for accidental deep hypothermia with cardiac arrest, since it is the fastest method of rewarming, it provides adequate and immediate circulatory support, and it may improve tissue perfusion by hemodilution. Furthermore, metabolic disturbances can be corrected rapidly and the body core is rewarmed before the rest of the body, thus preventing shock due to peripheral vasodilatation^{3, 4, 10}. The long-term neurological outcome of survivors favours ECC for rewarming in deeply hypothermic patients in comparison with other rewarming modalities^{4, 13, 14}.

CONCLUSION

This case demonstrates excellent prognosis of a young victim who suffered from deep accidental hypothermia with cardiac arrest provided that: (1) deep hypothermia preceded the cardiac arrest; (2) ECC rewarming was immediately applied and (3) external cardiac massage was not interrupted as long as full ECC flow was established. Simultaneous ethyl alcohol intoxication can be considered a protective factor improving the patient's outcome as well. Complete recovery including no neurological and mental sequelae was achieved within 24 hours after the accident.

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