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Case Report

Rewarming After Severe Accidental Hypothermia

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Abstract: Although accidental hypothermia is considered a totally preventable cause of death, severe hypothermia (<28°C) carries a mortality rate about 21%. That's why conventional rewarming techniques such as using a warming blanket, warm intravenous saline, nasogastric lavage, continuous bladder irrigation and thoracic lavage via chest tubes are often considered inefficient and extracorporeal circulation is the therapy of choice. We report a case of severe hypothermia (24.1°C) successfully resuscitated without using extracorporeal circulation observed in an urban hospital in Northern Greece.
Keywords: Severe hypothermia, Rewarming.

INTRODUCTION

Accidental hypothermia is defined as an unintentional fall in core temperature to -35 8C, and is classified into mild, moderate, and severe in different ways, mild usually being 33–35 8C, 32–35 8C, or 32.2–35 8C, and severe usually being defined as -28 8C, -27 8C, or -26.7 8C [1]. Moderate hypothermia carries a mortality rate around 21% and the mortality rate for severe hypothermia increases to around 40% [1, 2]. Managing hypothermic patients can be a challenge because of the absence of a reliable history in most cases. We report a case of severe hypothermia successfully resuscitated without using extracorporeal circulation.

CASE REPORT

A 55 year old caucasian male with an unknown past medical history was transported to the Emergency Department (ED) of a tertiary hospital in Thessaloniki, Northern Greece, in early January. The average outside temperature that night was 0-4°C. The patient was initially found by local police officers lying unconscious in a deep ditch. When Emergency Medical Services arrived on scene the patient was cold, unresponsive, Glasgow Coma Scale (GCS) 3, covered with mud and without any other obvious signs of skeletal or traumatic injury. Yet, he looked neglected and had an amputated right lower limb. The patient was fully immobilized in a cervical collar and on a backboard prior to transport to the ED and was intubated secondary to his low GCS. The patient's vitals at the time showed sinus bradycardia at a rate of 41 bpm, palpable carotid pulse but an unobtainable peripheral blood pressure on multiple attempts, fixed unresponsive pupils and hypoglycemia (blood glucose 47 mg/dl). First recorded temperature was 24.1°C (75.38°F). The patient was treated with atropine for bradycardia and intravenous fluids for hypotension, and was transported to the local tertiary care hospital.

Upon arrival at ED the patient was being given warm intravenous (IV) fluids (including 50 ml $D_{35}W$), warm humidified air via mechanical ventilation and broad spectrum antibiotics. Norepinephrine infusion was also initiated. He underwent a scan of his head, neck, abdomen, and pelvis which showed a fracture of 1st right rib with ipsilateral pneumothorax. A chest tube was inserted. Forty min after ED arrival, the patient's temperature was recorded to be 25.2°C (77.36°F). Supplemental active re-warming interventions including warm water lavage via gastric tube and Foley catheter were started at that time.

Subsequently, the patient was transported to Intensive Care Unit (ICU) where she remained 6 days. Clinical and laboratory examination upon ICU admission, revealed GCS 3 with fixed 2 mm unresponsive pupils, supraventricular tachycardia (125 bpm), premature ventricular beats (PVCs) with presence of Osborn waves in ECG and blood pressure 100/52 mmHg (under 0.25 $\mu g.kgr^{-1}.min^{-1}$ norepinephrine infusion). Core temperature was 26.9°C (80.42°F) and arterial blood gases: pH 7.061, $PaCO_2$ 27.05 mmHg, PaO_2 677 mmHg (FiO_2 100%), HCO_3^- 7.5 mEq/lt, Basis Excess -20.6 , Na^+ 154 mEq/lt, K^+ 3.1 mEq/l, anion gap 30 mEq/lt, delta gap 17.95mEq/lt,

delta ratio -5.89 mEq/lt. Further laboratory results were: serum creatinine 1.57, urea 134, serum glutamic oxaloacetic transaminase (SGOT) 280 IU/lt, serum glutamic-pyruvic transaminase (SGPT) 85 IU/lt, Creatine phosphokinase (*CPK*) 12850 mgr/lt, Creatine phosphokinase-MB (CK-MB) 322 mgr/lt, Troponin T 35 mcg/lt, white blood count 10.02 k/dl, hemoglobin 9.1 gr/dl, platelets 232 k /dl, partial prothromboplastin time 33.5 sec, prothrombin time 11.5 sec.

During the next 7 hours the temperature raised to normal, and 8 hours later metabolic and laboratory abnormalities were corrected (Graph 1 and Table 1). ECG returned to sinus rhythm, without any PVCs. The days after patients' relatives were found and his medical history was retrieved. The man was under drug regime for arterial hypertension, diabetes mellitus type 2 and depression; yet, with bad compliance to medical direction and often alcohol abuse. Family history was non-contributory.

During the next four days, norepinephrine infusion stopped, neurological status of the patient improved and chest drain tube was removed after X-Ray control. Weaning from mechanical ventilation was also uneventful. The patient was finally discharged from ICU fully alert and oriented (Glasgow Outcome Coma Scale Extended (GOSE) score 8).

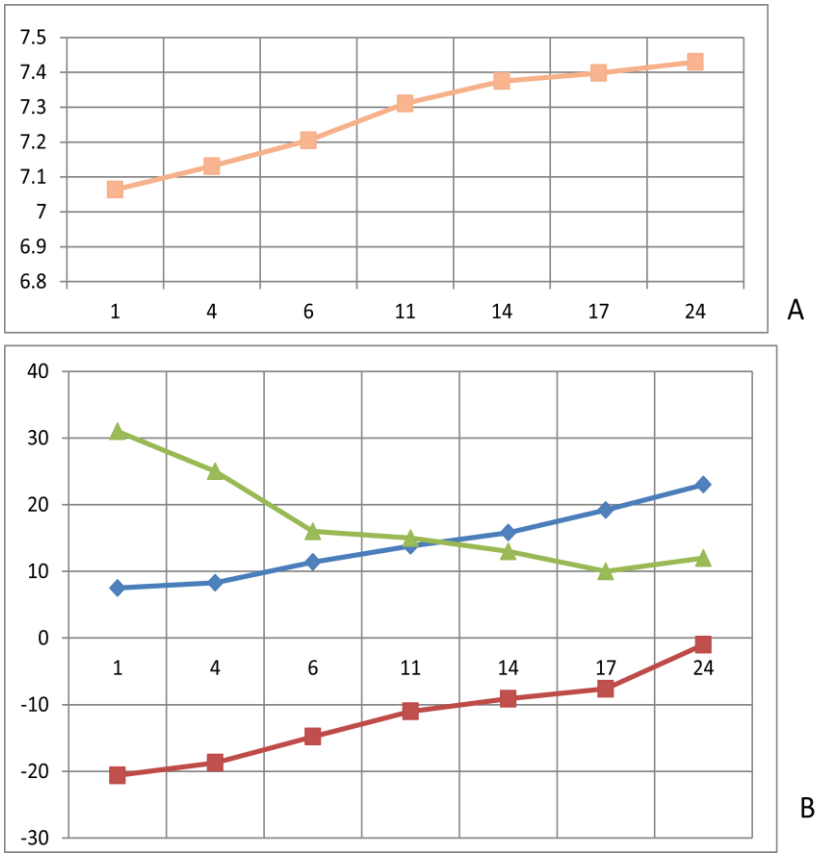

Fig.1: Time course of (A) pH (B) Basis Excess (red), Lactate (green) and HCO3-(blue) from ICU admittance

Table 1: Time course of temperature and rate of rewarming per hour

t^o	24.9	25.6	26.9	27.9	28.6	29.8	32.5	35,4	36.3	36.6
Δt^o	0	1.6	1.9	1.0	0.8	1.2	2.7	2.9	0.9	0.3
Diuresis	0	50	70	500	600	600	300	100	100	100

DISCUSSION

Usually, deep accidental hypothermia in an urban environment is related with alcohol or drug abuse and serious illness in elderly [1]. In some series of fatal hypothermia cases, enthanol is detected to up to 43%[2]. Yet, simultaneous ethyl alcohol intoxication can be considered a protective factor as it reduces the threshold for lethal arrhythmias by about 2–5°C [3]. Clinical manifestations are temperature related, usually in a uniform manner. Various cardiac arrhythmias have been reported: presence of Osborn waves (in 80% of cases with t^o<30°C), sinus bradycardia, atrial ectopic activity, atrial fibrillation, ST depression, supraventricular and ventricular tachycardia [4, 5].

Managing of these cases is often challenging. Rewarming should be careful, as side effects like rebound acidosis, cold dieresis, electrolyte disorders, after-drop phenomenon, paralytic ileus, bladder atony and rhabdomyolysis can occur [6]. A review of the

literature shows that patients have been successfully rewarmed and discharged from the hospital without permanent organ damage at rates ranging from 1 to 2.95°C/h [1]. In fact, rewarming rate greater than 1.67^{o} C/h (3^{o}F) in patients with hypothermia that is associated with an urban environment is associated with a low risk of underlying infection [7]. In our case a medium to high rewarming rate was applied. Extracorporeal circulation remains the treatment of choice for deep hypothermic patients with cardiac arrest, even though successful recovery has been reported without it [8]. On the rest of the cases, other more "noninvasive" strategies could be used.

CONCLUSION

Accidental hypothermia is an uncommon problem that affects people of all ages. Older people are particularly susceptible to it because thermoregulatory ability is progressively impaired with age. Despite uniform manner of temperature-related clinical symptoms, therapy options should be chosen often on an individual basis, considering the usually unknown medical history. Rewarming should be delicate, as balancing the protective effects of hypothermia, limiting its injuries and avoiding side effects of rewarming is difficult

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