

CASE REPORT

An uncommon case of severe accidental hypothermia in an urban setting

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Abstract

Accidental hypothermia is an uncommon presentation in urban settings. Here we present a patient admitted with a core temperature of 26.6°C (80°F) and a serum potassium of 8.5 mmol/l who subsequently went into cardiac arrest. After > 90 min of active cardiopulmonary resuscitation and peak serum potassium of >12 mmol/l, the patient had a spontaneous return of circulation. The patient's hospital course was complicated by compartment syndrome of his forearm; however, he was discharged home without any lasting neurological damage.

INTRODUCTION

Accidental hypothermia is defined as a condition in which core body temperature drops involuntarily to <35°C (<95°F) and is associated with high morbidity and mortality [1]. It can be either a primary process in a patient with no impairment of the thermoregulatory system or a secondary process to underlying disease. There are a substantial number of deaths from this condition each year, with the majority occurring in patients older than 65 [2]. This presentation is relatively uncommon in urban settings, yet it is important to be aware of the condition.

CASE REPORT

Our patient is a 33-year-old male who presented to our trauma center as a Level 1 activation after being found unresponsive by EMS. He was discovered with no coat early in the morning after a frigid night where temperatures dropped below -9°C (15°F). On primary survey, trismus was noted, airway was patent, breath sounds were auscultated bilaterally, and distal pulses were palpable. The patient had a Glasgow Coma Scale score of 3. On

secondary survey, the patient was cold to the touch and no rectal temperature could be measured. The lone traumatic finding was a 2 cm laceration above his left eyebrow. The remainder of the physical exam was within normal limits.

The patient underwent rapid sequence intubation (induced with 14 mg etomidate and 80 mg succinylcholine) for airway protection, bilateral large bore IVs were placed, and fluids warmed to 40°C were started. Additional warm fluid was instilled through both a Foley catheter and a nasogastric tube, and an external warming blanket was applied. Subsequently, the first rectal temperature was measured at 26.6°C (80°F). Initial laboratory studies were significant for an elevated K at 8.5 mmol/l, pH of 7.14 with a base deficit of 10.5, and a lactic acid of 6.2 mmol/l (Table 1). Additionally, his EtOH level was 250 mg/dl. The patient was transported to CT scan with stable vital signs to screen for traumatic injuries.

In the CT scanner, the patient became unstable and progressed to ventricular fibrillation with loss of pulse. ACLS protocol was initiated; he was given a total of 23 rounds of epinephrine, 22 shocks, 300 mg of Amiodarone, 1 g magnesium, 40 units of vasopressin, 2 g of calcium gluconate and 250 mEq of bicarbonate. A peritoneal

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catheter was inserted and 2 l of fluid warmed to 40°C was instilled into his abdominal cavity. After >90 min of CPR performed in the CT scan room, the patient regained vital signs.

He was then admitted to the medical ICU to continue re-warming at an intended rate of 2–4°C/h, and was extubated on hospital Day 3 with a GCS of 15. The patient developed renal insufficiency that plateaued 3 days post arrest with a peak creatinine of 2.2 mg/dl, as well as elevated creatine kinase and myoglobin, likely

from trauma during the resuscitation efforts. This subsequently resolved and returned to baseline of 0.8 mg/dl. After extubation, the patient developed right arm swelling caused by an acute right axillary deep vein thrombosis, likely secondary to reperfusion injury. Despite full dose anticoagulation, he developed signs of compartment syndrome on hospital Day 6. He was taken to the

Table 1: Temperature, pH, lactic acid, potassium, base deficit with time *due to limitations of our laboratory, values >12 are not reported

Hours after admission	Temperature	pH	Lactic acid (mmol/l)	Potassium (mmol/l)	Base deficit
0	26.6°C (80°F)	7.14	6.2	8.5	10.5
6	28.5°C (83.3°F)	6.93	12	>12*	20.7
12	36.5°C (97.8°F)	7.15	12.8	5.7	6.2
18	36.7°C (99.7°F)	7.27	11.1	3.9	7.0
24	38°C (100.5°F)	7.60	2.2	3.8	
48	36.9°C (98.5°F)	7.44	3.2	4.1	

Table 2: The Swiss staging system of hypothermia classification [3]

Stage	Core temperature °C (°F)	Clinical symptoms
HT I	35–32° (95–89.6°)	Conscious, shivering
HT II	32–28° (89.6–82.4°)	Impaired consciousness, no shivering
HT III	28–24° (82.4–75.2°)	Unconscious, no shivering, vital signs present
HT IV	24–13.7° (<75.2–56.7°)	Unconscious, no vital signs, apparent death, possible ventricular fibrillation
HT V	<13.7° (<56.7°)	Death due to irreversible hypothermia, no vital signs, asystole

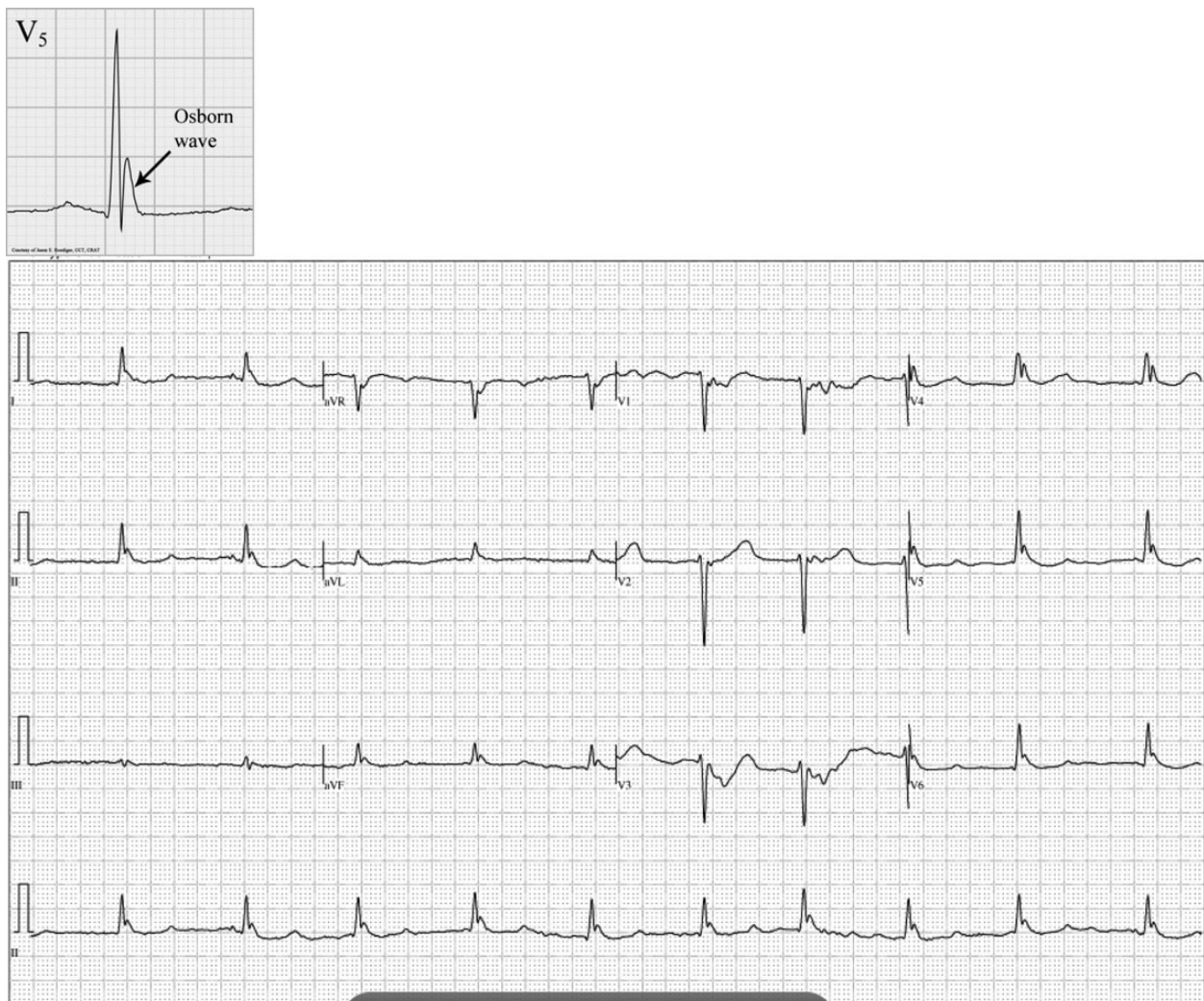


Figure 1: Osborn waves on our patient's electrocardiogram.

operating room (OR) for a decompressive fasciotomy and regained motor and sensory function. He was taken back to the OR later in his hospital course for a split thickness skin graft closure. The patient remained neurologically stable and was discharged home with a GCS of 15 on hospital Day 26.

DISCUSSION

Initial recognition and classification of hypothermic patients upon their arrival in the emergency department should be the first step taken toward treatment. It can guide the methods used to return to normal body temperature and alert the team of possible complications (Table 2). Extreme care should be taken with trauma patients as there is a 3-fold increase in mortality for patients presenting with both trauma and hypothermia [4]. Early rewarming measures may contribute to reducing mortality in this cohort.

Patients with accidental hypothermia have increased risk of developing arrhythmias, namely atrial fibrillation, as temperatures decrease $<32^{\circ}\text{C}$ (90°F) [5]. Furthermore, the risk of cardiac arrest increases substantially once the patient reaches 28°C . Rescue collapse, cardiac arrest precipitated by transport of severely hypothermic patients, is a major risk. Irritation to the cardiac membrane can precipitate ventricular fibrillation and cardiac arrest. Patient movement should be held to a minimum and invasive monitoring utilized only if absolutely necessary [4]. ECG should be obtained early and assessed for Osborn (J) waves, which has been correlated with degree of hypothermia. Our patient's ECG contained this finding as shown in the figure (Fig. 1).

Neurological outcomes in hypothermic patients with witnessed cardiac arrest are generally positive and have favorable long-term neurological outcomes [6]. The duration of cardiac resuscitation is an important issue. Current guidelines suggest that until the patient is warmed to $>30^{\circ}\text{C}$, no >3 shocks should be given and epinephrine and all drugs should be held [7]. Serum potassium should be measured and it is recommended that CPR be discontinued if the serum potassium is >12 mmol/l due to cardiac membrane instability. However, in our patient, the serum potassium was >12 mmol/l, and resuscitation was successful despite these guidelines. We suggest that in cases similar to ours, when arrest is witnessed and CPR started immediately, it might be beneficial to continue resuscitation until the patient is adequately rewarmed despite serum potassium [8].

The treatments are aimed at rewarming the patient to restore normal homeostasis. For patients in Stage I hypothermia, passive external rewarming with warmed blankets is appropriate. In Stage II, active external methods like immersion in a warm water bath should be utilized. These patients can also be started on intravenous fluids warmed to 38 – 42°C .

Patients in Stage III/IV hypothermia are more acutely ill and should be treated with invasive measures. Cardiopulmonary bypass methods, like Extracorporeal Membrane Oxygenation, are preferred because of rapid rewarming rate of 7 – $10^{\circ}\text{C}/\text{h}$ plus providing full circulatory support. If this is not available, pleural and peritoneal lavage with warmed or hemodialysis are appropriate [9].

Due to the uncommon nature of this presentation, our treatment of this patient progressed without direct knowledge of the published guidelines. We aimed to stabilize and rewarm using less invasive rewarming methods when the patient first presented. Due to our inexperience with rescue collapse, the patient transported to the CT scanner where he subsequently

decompensated. At that point, following a witnessed arrest, we turned to more invasive rewarming methods while focusing on resuscitative efforts. Our patient was not transferred to an ECMO capable center since he was unstable and by the time he had regained vitals, he was being warmed sufficiently. However, ECMO should be considered early on in the management of similar patients especially if the admitting hospital has the capability or transport is deemed safe. In the event of future cases, our institution has identified certain ECMO capable centers in the area to which patients can be transferred depending on the safety and stability of the patient.

In urban settings, accidental hypothermia is a relatively rare and under-diagnosed condition. Early appropriate management of these patients will improve resuscitation, restore normothermia and help reduce unwanted complications.

ETHICAL APPROVAL

Approved by NYU Lutheran IRB.

CONSENT

Patient signed consent was obtained.

GUARANTOR

Vadim Meytes, DO.

CONFLICT OF INTEREST STATEMENT

None declared.

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