We present a case of profound accidental hypothermia in a previously fit and well 56-year-old male. He presented critically unwell, though spontaneously perfusing, with an admission rectal temperature of 21.7°C. Cardiac output is almost globally absent below 24°C – indeed an extensive search of the literature has not found any reported case of spontaneous perfusion at any temperature lower than in this case.

CASE SUMMARY:
A 56-year-old man was admitted to the Emergency Department after being found semi-conscious in a rural location. Pre-hospital he was spontaneously ventilating and had perfusing cardiac output. Rectal temperature was 21.7°C.

He had been reported missing from his home 14 days previously, and an extensive Search & Rescue operation had been ongoing since that time. Nocturnal atmospheric temperatures throughout this period were consistently below 0°C. He was found by rescue dogs on day 14 of the operation.

He was previously fit and well and did not drink alcohol.

On arrival at the Emergency Department he was markedly bradycardic (25 bpm), hypotensive (77/60 mmHg) and bradypnoeic (8 breaths / minute). He had strong central pulses, and was self-ventilating with oxygen saturations of 99%. He had a Glasgow Coma Score of 10/15; (E4,V1,M5), and his pupils were equal and sluggishly reactive to light. He was globally areflectic.

INVESTIGATIONS:
Initial venous blood results revealed a profound hyperkalaemia (>10mmol/L) in a non-haemolysed venous sample. There was rhabdomyolysis (CK=192U/L), associated acute kidney injury, and a hypothermic coagulopathy (INR=1.4). Other results were unremarkable. Paracetamol, salicylate and alcohol levels were all 0mmol/L.

Arterial blood sampling demonstrated a lactic acidosis (pH=7.19, lactate=6.6) and again confirmed the hyperkalaemia (7.8mmol/L following initial treatment).

Initial electrocardiogram rhythm strip revealed an irregular bradycardia at a rate of 26 beats per minute, profound QRS broadening (275ms), QT prolongation (QTc=556ms), Osborn waves, ST depression and T-wave inversion.

REWARMING:
Non-invasive warming was immediately commenced with forced-air warming blankets. Intravenous fluids were warmed to approximately 43°C and infused rapidly via two wide-bore intravenous canulae. A urethral catheter was inserted and warmed bladder lavage was performed.

Hyperkalaemia was treated with 30mL of 10% calcium gluconate and with an insulin-dextrose infusion. Broad spectrum antibiotics were given empirically and anti-tennis antitoxin administered.

Fluid-resistant hypotension necessitated cautious use of bolus-dose vasopressors.

The gentleman was transferred to the critical care unit where emergent continuous veno-venous haemofiltration (CVVHF) was commenced to allow electrolytic clearance and for rewarming at approximately 2°C/hour.

OUTCOME:
The patient had a turbulent post-resuscitative period.

Five hours following admission, the patient suffered a prolonged generalized tonic-clonic seizure requiring emergent intubation and ventilation. Furthermore, in the initial 12 hours following admission to the intensive care unit, the patient developed rewarming shock with hypotension resistant to rapid fluid replacement. Focused intensive care echocardiography demonstrated a hyperdynamic left ventricular function and evidence of hypovolaemia. Thus, further intravenous fluids were given and dual inotropic therapy with noradrenaline and vasopressin infusions commenced.

The patient also suffered a range of delayed complications related to the hypothermic episode: On day 2, he developed an aspiration pneumonitis which improved with intravenous antimicrobial therapy. On day 6, the patient experienced an episode of large-volume melena requiring transfusion of 4 units of packed red cells. Urgent oesophago-gastro-duodenoscopy (OGD) revealed an actively bleeding gastric stress ulcer which was injected with adrenaline. On day 10, the patient developed a hyperactive delirium requiring re-intubation. A full septic screen and lumbar puncture confirmed a hospital-acquired pneumonia managed with a further course of broad-spectrum antimicrobials. Additional complications included an ischaemic hepatitis, ischaemic colitis and a widespread postulovesicular rash, all of which were managed conservatively.

Following two weeks of intensive care treatment and a four week total hospital admission, he was discharged to a rehabilitation community hospital, and has since made a complete recovery.

DISCUSSION:
The human thermoregulatory system provides homeostatic mechanisms by which the body maintains homeostasis in response to changes in environmental temperature. Hypothermia can be defined as a state in which these homeostatic mechanisms are overwhelmed in the presence of a cold stressor. Hypothermia produces a multi-system pathophysiological response affecting myocardial contractility, neuronal excitation and immune function amongst others.

Despite hypothermia being a condition associated with significant mortality and morbidity, no consensus exists for its management, either with respect to rewarming speed or method used for rewarming. Rapid rewarming (>0.5°C per hour) is associated with increased risk of seizures and rewarming shock (both of which our patient experienced) compared to a slower rewarming protocol, but exposes the patient to a longer period of cardiac instability and there is cautious consensus that at least an initial phase of rapid rewarming in profound hypothermia is probably justified.

The consensus gold-standard treatment for cardiovascularly unstable hypothermia is regarded to be veno-arterial extracorporeal membrane oxygenation (VA ECMO) or cardiopulmonary bypass (CPB). These permit the most rapid rewarming rate, and are recognised to reduce mortality. Veno-venous ECMO and CVVHF are alternative options for rewarming, though provide an inferior rewarming speed. However, as with our patient, we would propose that a relative indication for CVVHF over VA ECMO/CPB would be patients with cardiovascularly unstable hypothermia in combination with life-threatening electrolytic derangement.

References: