EMERGENCY CASEBOOK

A novel method of intravascular temperature modulation to treat severe hypothermia

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Intravascular rewarming may provide an efficient and reliable method of restoring normal body core temperature in patients, while avoiding after-drop. The system provides continuous temperature monitoring and automatically adjusts warm saline delivery until the desired temperature is reached.

An 81-year-old man with a history of hypertension, urosepsis, congestive heart failure and chronic renal insufficiency was noted by his family to be short of breath and unresponsive. Emergency medical service was called, and the patient was found to have a blood pressure of 70/palpitation, heart rate of 49 beats/min, respiratory rate 14 breaths/min. Oxygen saturation was 98%. The patient was treated with atropine for bradycardia and intravenous fluids for hypotension, and was transported to the local tertiary care hospital. On admission to the emergency department, the patient was found to have a rectal temperature of 27.9°C, pulse 52, blood pressure 104/69 mm Hg and an oxygen saturation of 100%. A Foley catheter was placed and bladder irrigation was carried out with warm saline. The patient was orally intubated. Pan-cultures were obtained, and empiric antibiotics were started as per sepsis protocol. The patient was treated for evidence of hyperkalaemia by a serum potassium level of 7.6 mmol/l with intravenous calcium chloride and a Kayexaleta enema. Laboratory values on admission showed acute renal failure with a creatinine concentration of 7.2 mg/dl and blood urea nitrogen concentration of 95 mg/dl. Electrocardiogram at the time of

admission did not show the classic Osborne waves often seen with hypothermia, but a marked first-degree atrioventricular block was present with an initial pr interval of 0.41 ms and a right axis deviation. Owing to the severity of the hypothermia and the availability of an intravascular temperature modulation catheter, it was decided to attempt to rewarm the patient with a device normally used to maintain normothermia or hypothermia in patients with neurological disorders or cardiac arrest. An Icy[®] catheter was placed via the femoral vein, and intravascular warming was initiated with the goal temperature set at 37.5°C. The patient was warmed to the desired temperature at a steady rate within 12 h after admission, at a rate of 0.74°C/h. The patient did not experience cardiovascular after-drop, and normal sinus rhythm resumed 90 min after rewarming was initiated (fig 1). The patient was transferred to the medical intensive care unit and subsequently dialysed. The patient was successfully extubated 2 days after admission, but was made a do-not-resuscitate/do not intubate case 3 days after admission by the healthcare power of attorney, after taking into consideration the patient's pre-existing mental condition and comorbidities.

BACKGROUND

Hypothermia can be either primary or secondary. Primary hypothermia is seen in otherwise healthy people who are inadequately clothed and exposed to severe cold, whereas in secondary hypothermia another illness predisposes the person to accidental hypothermia. Elderly and infirm people are at increased risk for secondary hypothermia, and several medical conditions and drugs can also impair a patient's

Figure 1 Effect of intravascular rewarming on heart rate and mean arterial pressure (MAP). BPM, beats per minute; NSR, normal sinus rhythm.

ability to maintain an adequate body temperature in a cold environment. Rewarming a patient with hypothermia is not a casual endeavour, as too rapid rewarming can precipitate a condition known as after-drop. After-drop is defined as the precipitous reduction in core temperature resulting from redistribution of body heat to improperly warmed peripheral tissues, and the rapid shunt of cold blood from the periphery to the core as the direct result of vasodilatation. After-drop can cause a further drop in core temperature, even after a patient is removed from the cold. Shock and metabolic derangements can also be precipitated by too rapid rewarming or by warming the periphery before core warming. Rewarming the core at a prescribed rate is important, as hypothermia alone may not be fatal above 25°C.

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

INTRAVASCULAR REWARMING

Intravascular rewarming via a closed-loop indwelling catheter is a novel approach to rewarming that was successfully used at our medical centre. The Icy® catheter used to rewarm the severely hypothermic patient described in the preceding case study was originally developed to provide core temperature cooling in patients who had undergone neurosurgery and in patients post-cardiac arrest. The catheter is part of the

CoolGard system developed by Alsius Corporation (Irvine, California, USA), which consists of a temperature monitor, a temperature control unit, a heat exchange unit and a roller pump. Feedback from a bladder thermister regulates the temperature of sterile saline that is circulated through the closed catheter membranes to facilitate steady achievement and maintenance of the desired body temperature. The catheter has the further advantage of providing an extra infusion port to allow for central infusions.

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