Use of Continuous Venovenous Haemodialysis to Reverse Acute Hypothermia After Multiple Trauma

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Hypothermia is an independent risk factor for mortality in trauma patients. We describe the use of continuous venovenous haemodialysis (CVVHD) as a rewarming method in a hypothermic, multiply injured patient. CVVHD achieved rapid rewarming and holds advantages over established rewarming methods in the trauma setting. [Asian J Surg 2008;31(3):151–3]

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Introduction
Hypothermia in trauma patients can lead to decreased cardiac output, arrhythmia, central nervous system depression and coagulopathy, and is thus a risk factor for mortality independent of the anatomic degree of injury or extent of physiological derangement.1–3

Methods for reversal of acute hypothermia include external active and passive techniques (warming blankets, water baths), active core rewarming (heated intravenous fluids, warm air inhalation, body cavity lavage), and extracorporeal blood rewarming (arteriovenous or venovenous rewarming circuits, cardiopulmonary bypass). Continuous venovenous haemodialysis (CVVHD) holds theoretical advantages over established rewarming methods in injured patients. We describe a multiply injured patient in whom CVVHD was used to rapidly reverse acute hypothermia.

Case report
Our patient, a 39-year-old male, was rescued after jumping from a bridge approximately 130 feet into the East River in New York City. On arrival to the emergency room, he had shallow breath sounds, tachycardia (100 bpm), hypotension (67/37 mmHg), Glasgow Coma Scale Score of 12, and equal reactive pupils. Bilateral thoracostomy tubes were placed, initially returning 200 mL of blood from the left chest. An abdominal ultrasound exam was negative for intra-abdominal haemorrhage. Warm IV fluids were administered, with resolution of hypotension. The arterial blood pH was 6.91 and peripheral blood bicarbonate was 11 mmol/L. The rectal temperature was 31°C. Secondary survey and subsequent imaging revealed bilateral pulmonary contusions, a left humeral fracture, and multiple rib and spine fractures.

The patient was taken to the surgical intensive care unit, where he required mechanical ventilation. Despite external rewarming and warmed IV fluid resuscitation, he remained profoundly hypothermic (32°C by oesophageal probe) and developed supraventricular tachyarrhythmia. His arrhythmia twice degenerated into cardiac arrest that was treated successfully with cardiopulmonary resuscitation and antiarrhythmic medication. We proceeded with CVVHD as a method of rapid rewarming. A dialysis catheter
was placed in the femoral vein and clearance dialysis was carried out using an Exeltra 210 dialyser (Baxter Healthcare Corp., Deerfield, IL, USA) for 155 minutes at a pump speed of 200–300 mL per minute. The patient tolerated dialysis well and was rewarmed from 32°C to 35°C after 90 minutes and to 37°C after 155 minutes. Additional resuscitation efforts continued in parallel with dialysis, including mechanical ventilation and blood product replacement for ongoing blood losses from the chest tubes. During the course of dialysis, the patient’s metabolic status improved, with normalization of pH and bicarbonate levels. Blood urea nitrogen levels were normal at presentation and remained so during dialysis. Haemodynamic parameters including heart rate and blood pressure improved, and the post-dialysis cardiac output was 7.2 L/min.

The post-injury course was marked by multifactorial respiratory failure, tracheostomy, gastrostomy, open reduction/internal fixation of the fractured humerus, and refractory tachyarrhythmia requiring antiarrhythmic medication. The patient was ultimately transferred to inpatient psychiatric care on post-injury day 54.

Discussion

Rewarming methods vary in their degree of invasiveness and speed of warming. External rewarming methods have the advantage of being noninvasive, but they are relatively slow in reversing hypothermia and are limited by vasoconstriction in patients with shock. Active core rewarming methods are effective in reversing hypothermia, but are more invasive. In particular, body cavity lavage has serious limitations in the trauma patient, in that thoracic lavage may impair oxygenation or exacerbate intrathoracic injury, and abdominal lavage is contraindicated in the setting of intra-abdominal injury or previous laparotomy. Warm IV fluid infusion is a simple and effective means of rewarming, but is limited by the degree of fluid requirement and, as in patients like ours with pulmonary contusion, situations in which judicious fluid resuscitation is desirable.

Extracorporeal circulatory rewarming achieves faster rewarming times than external methods, which in one prospective randomized trial was associated with reduced early mortality and resuscitation fluid requirement in severely injured patients. However, each method has significant limitations. Cardiopulmonary bypass is highly invasive, time-consuming and requires systemic anticoagulation, which is usually contraindicated in injured patients. Continuous arteriovenous rewarming is limited by the risks inherent in large bore arterial cannulation, as well as its dependence on the patient’s own arteriovenous blood pressure gradient, which may be compromised in unstable trauma victims. Venovenous bypass does not require systemic anticoagulation or an intrinsic blood pressure gradient, but does require central venous access in two different sites.

CVVHD as a rewarming technique has been described in the uninjured patient. However, its use has not been described in acute trauma, a setting in which it holds theoretical advantages over the established methods described above, while achieving a rewarming time in our patient comparable to other extracorporeal bypass techniques. CVVHD avoids trauma-related contraindications to body cavity lavage, and can be used in settings where judicious fluid resuscitation is desirable. Unlike cardiopulmonary bypass, CVVHD does not require systemic anticoagulation; and unlike arteriovenous bypass, CVVHD does not require arterial catheterization and does not rely on a pressure gradient that may be unreliable in the unstable trauma patient. CVVHD is similar in principle to venovenous bypass, but is advantageous in that it requires only a single central venous access site and utilizes equipment familiar and readily available to ICU staff. Moreover, dialysis allows for rapid correction of complex mixed acid–base and other metabolic abnormalities often seen in the trauma setting.

In summary, CVVHD was used effectively to rapidly rewarm a profoundly hypothermic, multiply injured patient who had contraindications to established rewarming methods. This particular patient exhibited complex respiratory and metabolic abnormalities and undoubtedly benefited from other simultaneous interventions; thus, the contribution of rapid rewarming alone to the patient’s improvement cannot be determined. Further studies will be necessary to directly compare the efficacy and applicability of CVVHD with other rewarming methods in hypothermic trauma patients.

References


