Treatment Of Severe Hypothermia Utilizing A Veno-venous Continuous Renal Replacement System With A Counter Current Blood Warmer.

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Abstract

Patients suffering severe hypothermia secondary to exposure offer numerous challenges. A major problem is maintaining hemodynamic and cardiac stability during the re-warming. Therapeutic options are invasive internal re-warming and cardiac bypass, both methods are risky and fraught with complications. We describe two patients with severe accidental hypothermia treated with continuous renal replacement therapy. This method of re-warming appears to be effective and safe.

CASE 1

A 27 y/o BM with history of bipolar disorder on lithium therapy was found face down outside his house in mid-December. The patient had been binge drinking the day prior along with illicit drug use. Upon admission to the Emergency Department, the patient's mean arterial pressure (MAP) was 55, rectal temperature of 27.7oC. Electrocardiogram revealed sinus bradycardia without Osbourne waves. An endotrachial tube was placed for airway protection. The patient received volume expansion and dopamine for BP support. A dual lumen dialysis catheter was inserted into the femoral vein.

The patient was placed on a Prisma® (Gambro; Littleton, CO) CRRT machine with the return line placed through a Hotline® (Level 1; Rockland, Maine) set at 40 degrees centigrade. The blood pump was set to circulate 125ml/min through the system. Warmed Normosol® (Abbott Labs; North Chicago, Ill) was used as a replacement solution set at 1000ml/hour.

The graph below describes the patient's clinical course and rate of re-warming. The patient maintained hemodynamic and cardiac stability throughout this re-warming process.

After 4 hours of veno-venous re-warming the patient's mental status improved and the dopamine was discontinued. Once the patient's rectal temperature researched 37oC, the veno-venous system was discontinued. The patient was able to maintain normal temperature and was extubated one hour later. The patient was completely alert and oriented. After 10 hours in the ICU, the patient was transferred to a regular floor.

CASE 2

An 82 y/o female was found unresponsive in her apartment. She had not been seen for several days and her neighbors called the police and EMS. Upon their arrival, the patient was cold to touch, hypotensive with a systolic BP of 82 mmHg and a heart rate of 54. The patient was transferred to
At time of admission to the ER, the patient remained unresponsive. The patient had an endotrachial tube placed in transit by EMS. The patient's rectal temperature was 28°C rectally. She was noted to be in slow atrial fibrillation with “classic” Osbourne waves. The patient received fluid resuscitation with improvement in her MAP.

A double lumen dialysis catheter was inserted into her right femoral vein. The veno-venous system was initiated as described above and at identical settings. Below is a graph demonstrating the patient's temperature after starting veno-venous re-warming.

**Figure 2**
Figure 2: Graph illustrating the initial re-warming process.

The patient had steady and consistent re-warming. The patient converted to sinus rhythm when her temperature rose to above 33 degrees. However, the patient's mental status never improved and was found to have a pontine CVA. The patient was hemodynamically and cardiovasculary stable and able to maintain physiologic temperature. However, she later succumbed to her neurologic process.

**DISCUSSION**
As illustrated by these two cases, there were excellent results using this system. The patients had a re-warming rate of 1.7°C/hr without adverse cardiovascular or hemodynamic complications. Similar experiences have been reported using this system of active re-warming [7,8].

With the increased availability of CRRT machines and circuits, applying this technology to extra corporal re-warming appears both effective and safer than other invasive methods if re-warming. Most concerns with this system are the risk of anticoagulation. Neither of these patients received neither systemic nor regional anticoagulation. It has been our experience that filter life and patency of the access catheter can be maintained without anticoagulation in patients at high risk of bleeding complications. In patients with underlying coagulopathy, such that is induced by hypothermia, we maintain the filter and catheter by adjustments in blood flow rate and reduction in hemofiltration rates.

**CONCLUSION**
These two cases show that veno-venous re-warming is an effective method of core re-warming in patients suffering accidental hypothermia. This method can be performed with the use of anticoagulation in patients with high risk of bleeding complications.

**References**
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