Intravascular Temperature Management During Burn Surgery

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Introduction

Burn patients with greater than 20% total body surface area [TBSA] burn often encounter the perils of perioperative hypothermia. Far-reaching and deleterious effects of hypothermia include depressed immune function [more surgical wound infections], decreased cutaneous blood flow [decreased graft take], prolonged hospitalization [resource utilization and costs], decreased platelet function [coagulopathic blood loss], increased likelihood of blood transfusions [greater transfusion risks and limited resource utilization] and decreased metabolism [prolonged drug effect]. Prevention of these sequelae is complicated since the etiology of intraoperative hypothermia during burn surgery is multifactorial. Intravascular temperature management [IVTM] has been used to treat patients with acute stroke, traumatic brain injury and cardiopulmonary arrest; however, only in the context of deliberate hypothermia. The historical goal has always been to cool the patient. Recently this technology is being applied to burn surgery in efforts to maintain normothermia. Core body temperature is maintained as blood circulates over a special catheter placed in the central venous system [See Fig. 1]. Preliminary results obtained from using this system are encouraging.

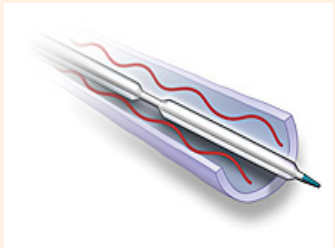

Figure 1. Illustration of endovascular warming via circulation of warm saline in a closed-loop circuit through balloons surrounding the catheter.

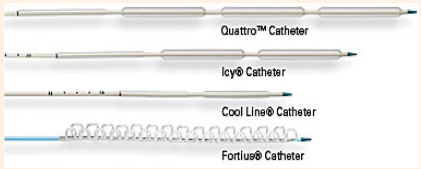

Figure 2. A catheter-based intravascular temperature management products that address an unmet clinical need for effective, accurate, easy-to-use and cost-effective control of body temperature in critical care patients

History [HPI]

A 21 year old male polytrauma and burn victim presented to the Burn Operating Room for initial excision and grafting of 77% total body surface area [TBSA] burn injury. Prior to the traumatic events surrounding his injury, he had no significant medical history, no surgical history and no chronic medications. On arrival to the OR, he was classified an ASA IVE in accordance with his trauma history which included:

- 77% TBSA thermal burn
- Bilateral pneumothoraces
- Left tib-fib compound fracture and bilateral calcaneal fractures
- Right brachial artery repair with saphenous vein grafting
- Hypotensive shock requiring vasoactive drips to maintain mean arterial pressures > 60 mmHg
- Anemia to a hematocrit of 22%
- Thrombocytopenia to platelet count of 55,000 cells/mL
- Acute renal failure with creatinine 1.5 mg/dL

Intraoperative Results

In the first two hours in the OR, core temperature fell from 98.2 °F to 96.6 °F despite aggressive warming measures [coverage of surface area as available, use of a heat/moisture exchanger in the anesthesia circuit, IV fluid warmer, and increase in OR ambient temperature setting up to 102 °F]. After discussion with the surgical team, an Cool Line CL2® 22 cm 8.5 French central venous catheter (Alsius Corporation, Irvine, CA) was placed in the right internal jugular vein with aseptic technique. This catheter was then connected to the Thermogard™ system (Alsius Corporation, Irvine, CA), which was set for intravascular warming with maximum flow rate and a target temperature of 100.4 °F. Within one hour, core temperature had returned to 97.7 °F, and the OR temperature setting had been decreased to 95 °F. By the end of the second hour, the patient's core temperature was 98.1 °F, and the OR temperature setting was then reduced to 85 °F. Of note, the surgeons noted with pleasant surprise that it was appreciably cooler in the OR within the first hour after initiation of IVTM.

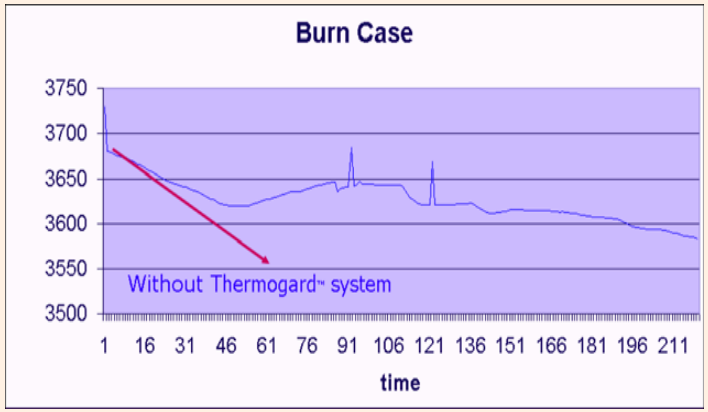

Figure 3. An example of intraoperative IVTM during burn surgery. Red arrow is indicative of the typical or expected temperature trend during burn excision and grafting procedures. Target temperature was set at 36.5 °C.

Postoperative Results

At completion of the case, the Thermogard™ warming unit was disconnected from the patient and transported to the ICU. Intraoperative fluids administered in total were 4.5 liters crystalloid, 4 units packed red blood cells, 2 units fresh frozen plasma and 1 six-pack of platelets. Fluid losses for the case were estimated to be 3000 cc blood loss and 150 cc urine output. The first documented core temperature postop in the ICU was 97.7 °F, and the patient was reconnected to the Thermogard™ warming unit when core temperature fell to 96.8 °F.

Summary

Perioperative maintenance of normothermia has been an extremely elusive goal during burn surgery. The increase in morbidity and mortality associated with unintentional perioperative hypothermia warrants further investigation into warming strategies for burn patients. Future perioperative studies in burn patients are needed to detect the clinical dividends of IVTM regarding decreased surgical wound infections, improved graft take, decreased hospitalization costs, decreased blood loss, decreased transfusion risks and improved metabolism. Utilization of the Thermogard™ intravascular warming system and Cool Line CL2® catheter for intravascular temperature management prevented intraoperative hypothermia during this very large burn excision. We expect that IVTM will help to demonstrate the benefits of avoiding perioperative hypothermia during burn surgery.

Literature cited

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