A-588

October 14, 2002
2:00:00 PM - 3:30:00 PM
Orange County Convention Center, Room 224 A

Evaluation of a New Automatic Body Temperature Control System

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Introduction: Hypothermia is a serious complication of anesthesia and surgery. Many warming therapies have been developed over the past ten years. However, even active intraoperative warming cannot prevent hypothermia in all cases. Furthermore peripheral vasoconstriction during hypothermia makes it difficult to rewarm patients.[1] Convective warming with forced-air is currently considered to be the most effective ***active warming*** system. However, it is likely that heat transfer via conduction is more effective than convective warming. Recently a new warming blanket, Allon®, Thermoregulation System (MTRE advanced technology ltd., Israel), has been developed. This blanket is wrapped around the patient's body and transfers heat via conduction. We studied the effectiveness of the new warming device and compared it to forced-air warming. Additionally we evaluated actual heat transfer and heat balance.
Method: With IRB approval, we studied four volunteers, aged 23 ± 1yr. Each subject was evaluated on two randomly ordered study days. Anesthesia was induced with propofol and maintained with desflurane. Vecuronium, 0.15mg/kg, was administered iv. An endotracheal tube was inserted and ventilation controlled to maintain end-tidal PCO_2 near 40mmHg. Muscle relaxation was subsequently maintained with an infusion of vecuronium adjusted to maintain 0-1 twitches in response to supra-maximal train-of-four electrical stimulation of the ulnar nerve at the wrist. The subjects were cooled with forced-air to core temperature of 34°C and active peripheral arterio-venous shunt vasoconstriction was established and maintained for 30 minutes. Subsequently, subjects were warmed on each day for three hours using one of two randomly assigned methods: 1. Allon®, 2. Forced-air (Bair Hugger®, Augustine Medical, Inc). Core temperature was recorded at the esophagus and tympanic membrane, area-weighted skin temperature and thermal flux from 15 skin-surface sites were measured using thermal flux transducers. A forearm-fingertip temperature gradient exceeding 4°C indicated intense vasoconstriction. Oxygen consumption was measured using a metabolic monitor. The data was analyzed with paired t-test. $P<0.05$ was considered statistically significant different. Data are presented as means ± standard deviations.
Results: During the treatment period the core temperature increased 1.2 ± 0.2 °C/h with the Allon® device and 0.8 ± 0.2°C/h with Forced-air ($p=0.05$). Heat transfer was 41 ± 16 kcal/h during ***active warming*** with the Allon device and 25 ± 5 kcal/h during forced-air warming ($p=0.3$).
Conclusion: Core temperature increased faster with the Allon system as compared to forced-air warming. This suggests that convective warming is more effective in hypothermic and vasoconstricted subjects.
Reference:(1) Kurz A; Anesthesiology 83:491-9, 1995

Anesthesiology 2002; 96: A588