



Novel Feedback Controlled Circular Water Warming System (Allon 2001) Is Superior to Forced Warmed Air Device in Maintaining Normothermia in Infants Undergoing Major Surgery

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Abstract

Hypothermia caused by anesthesia and cold environment are especially difficult to compensate in infants due to their relatively large body surface and limited thermogenesis. Although normothermia is usually attained by the end of surgery, the deleterious effects of intraoperative hypothermia remain remarkable. In this prospective study we compared the Allon 2001 system with the forced warmed air device in infants undergoing major abdominal surgery.

Methods

The Allon 2001 system is designed to keep preset body temperature. It has central and peripheral temperature sensors and a central heating/cooling unit that circulates warm/cold water to the flexible water channeled (ThermoWrap™) garment. Thirty-three infants scheduled for elective major abdominal surgery were randomly allocated into two groups. In the Allon group (n=20) patient temperature was controlled using the Allon system with infant garment while in the Warmed Air Device (WAD) group (n=13) patients were warmed using Bair Hugger with the original U-shaped tubular cover. After inhalational anesthesia induction with halothane in nitrous oxide/oxygen plus I.V. midazolam and atracurium followed by intubation, epidural catheter was inserted and loading dose of ropivacaine 2mg/kg was given. Anesthesia was maintained with nitrous oxide/oxygen and isoflurane along with continuous epidural infusion of bupivacaine 0.125% with fentanyl 1-2 mcg/ml. We kept operating room temperature at 21°C. Unpaired t-test was used for statistical analysis with significance of p<0.05.

Results

There was no significant difference between the two groups in terms of demographic data, surgery and starting temperature. Although core temperature dropped in both groups during the first 30 min. of anesthesia reaching 35.8°C in the Allon group and 35.1°C in the WAD group, it started to rise in the Allon group and reached 36.7°C within 90 min. while continued to fall in the WAD group. Infants in the WAD group had decreasing body temperature until 60 min. of anesthesia and started increasing afterward, reaching 36.4°C at 150 min. The temperature difference between the two groups became statistically significant after 30 min. of anesthesia. Hypothermia lasted for 75 min. in the Allon group and for 180 min. in the WAD group. We did not encounter any complications related to the use of the Allon 2001 system.

Conclusions

Our study proved that Allon 2001 system is more effective than warmed air device in maintaining normothermia in infants during major surgery. This safe, reliable and easy to use device keeps patient temperature within previously unattainable narrow range.



1. **ThermoWrap**, a disposable active heat exchange garment covering the patient during operation/treatment.
2. **Allon 2001 Controller**, an algorithm driven heat pump that supplies water at desired temperature into the ThermoWrap.
3. **Body Temperature Sensors**, which provide continuous feedback to enable closed loop temperature management.

Demographic data

	Allon Group N=20	WAD Group N=13	p
Age (months)	11.89 (8.74)	14.20 (10.47)	*NS
Weight (kg)	8.34 (2.92)	8.69 (2.97)	*NS
Anesthesia duration (minutes)	185.00 (75.12)	169.37 (54.32)	*NS
Surgery duration (minutes)	158.14 (70.01)	141.25 (53.35)	*NS
Initial Core Temperature (°C)	36.80 (0.64)	36.63 (0.63)	*NS

The values are Mean and Standard Deviation (SD)
p<0.05 values are considered significant *NS = Non Significant

Conclusions

1. The Allon 2001 system is more effective than forced air warming system in maintaining normothermia in infants during major surgery.
2. Core temperature increased faster with the Allon system and the total duration of normothermia was significantly longer in the Allon group than in the WAD group.
3. The use of the device was simple and safe. After activation of the system, the anesthesiology team did not have to take any action in connection with thermoregulation.
4. Due to closed loop feedback mechanism, it is capable of keeping patient temperature within narrow range, thus preventing intraoperative hypothermia.

