

The Effects of a Warming Blanket on the Maintenance of Body Temperatures in Anesthetized Infants and Children

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Body temperature tends to decrease during anesthesia in a modern air-conditioned operating room; the smaller the patient, the greater the decrease.¹ Exposure to a cold environment and preparation of the skin with cold and volatile solutions are very important causes of heat loss in infants and children, because their surface areas are large in relation to total body mass.

Berring and Matson² used an electric blanket to maintain the temperatures of infants undergoing neurosurgical procedures. Stephen *et al.*³ described use of a water-circulating blanket connected to a heating unit to stabilize body temperature. Calvert⁴ used another modification of such a unit during neurosurgical procedures in infants, and it appeared to be more effective with the smallest-sized infants. However, the usefulness of the warming blanket in forestalling or correcting hypothermia has been questioned.⁴ Morris⁵ reported recently that heating blankets were not effective in paralyzed adult patients.

This study was conducted to determine the relationship between the size of the patient and the effectiveness of the heating blanket in maintaining body temperature.

METHODS

Twenty-five infants and children undergoing general surgery were studied. Premedication for children above 18 months of age consisted of only secobarbital or pentobarbital, 4 mg/kg.

No premedication was given to younger children. Anesthesia was achieved with halothane, nitrous oxide, and oxygen via an Ayre's T-piece. No humidification was used.

A warming blanket covered by two layers of a cotton blanket was placed beneath each patient. Randomization was achieved by using the unit number of the patient. The temperature of the heating blanket was set at 40°C.

The following temperatures were measured with either mercury thermometers or calibrated thermistors and telethermometers: 1) Preoperative oral or rectal. 2) Lower esophageal, correct distance from the incisors being calculated from the chart of Jackson and Jackson.¹⁰ 3) Upper surface of the cotton blanket covering the thermal blanket. 4) Skin in contact with the blanket. 5) Skin on the anterior surface of the patient. 6) Operating room.

Unwarmed intravenous fluids were given at the rate of 4 ml/kg/hour. In addition, fluid deficits (calculated by multiplying the fluid requirement by the number of fasting hours) were replaced in the first two hours. Procedures requiring blood transfusions were excluded from the study. The first temperature reading was made about 15 minutes after the start of anesthesia, before or during the prepping of the patient, and thereafter temperatures were recorded every 15 minutes. All patients were prepped with a room-temperature soap solution, followed by an alcoholic dye solution (Anylin) and ether.

The surface area was calculated from the Dubois formula of weight and height using the Hannon nomogram.⁷ For small babies, whose heights were difficult to measure, the formula $[S.A. = 5.188 \times (\text{weight in kg}^{0.75})]$ provided by Boyd *et al.*⁸ was used.

For statistical analysis the standard deviations and *t* values for the differences between two means were used.

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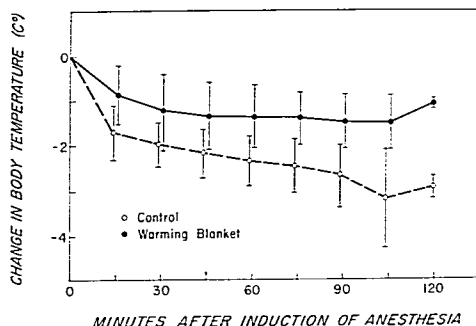


FIG. 1. Changes in body temperature (mean \pm SD) in infants with less than 0.5 a sq m of body surface area.

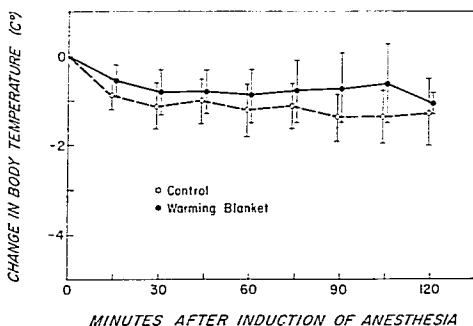


FIG. 2. Changes in body temperature (mean \pm SD) in infants with more than 0.5 sq m of body surface area.

RESULTS

When our results were plotted on a scatter diagram it was obvious that children with surface areas of less than 0.5 sq m behaved differently from larger children. Hence, we divided the results into two groups:

Group I. 13 infants whose surface areas were less than 0.5 sq m, seven of whom were placed on warming blankets; six were controls.

Group II. 12 children whose surface areas were more than 0.5 sq m, six of whom were placed on warming blankets; six were controls.

There was no statistical difference in room temperature or surface area between study subjects and controls in either group.

Also, differences between the preoperative body temperatures of study subjects and their controls were not significant in either group.

Changes in Body Temperatures during the Procedure

Group I (fig. 1). Body temperatures decreased in both warmed patients and controls. The greatest decrease occurred in the first 15 minutes of anesthesia. The decreases were more marked in the control group. The mean temperature of infants on the warming blanket stabilized after 30 minutes, whereas the mean temperature of the controls continued to drift down. After one hour of anesthesia, the mean

temperature of the control infants had dropped by 2.35 ± 0.56 C, while that for infants on a warming blanket had decreased 1.34 ± 0.69 C. The difference between the two means became statistically significant one hour after induction of anesthesia and remained significant through the second hour of anesthesia ($t = 2.73-9.8$, $P < 0.05-0.005$).

Group II (fig. 2). Again, body temperatures decreased, with the greatest decreases occurring in the first 15 minutes of anesthesia, but the heat losses were much smaller than in Group I (0.85 ± 0.62 C for those on a blanket and 1.21 ± 0.63 C for controls after one hour of anesthesia). Differences between the two means during the two-hour period were not significant.

DISCUSSION

The principal finding of this study is that a single warming blanket set at 40 C and covered with two layers of cotton blanket effectively conserves heat in pediatric patients with surface areas of less than 0.5 sq m during halothane, nitrous oxide, and oxygen anesthesia for general surgical procedures in an operating room environment of 23 C (73 F). Children with surface areas of 0.5 sq m usually weigh about 10 kg and are about 14 months old. The warming blanket had no significant effect on older children with surface areas of more than 0.5 sq m.

All children become hypothermic after the start of anesthesia. The smaller the child, the greater the decrease in temperature. As Harrison, Bull, and Schmidt⁹ have shown, children weighing less than 10 kg cool significantly more than heavier children because their surface areas are relatively large compared with body mass. Thus heat exchange with the en-

vironment is greater and more heat is lost than in larger children. However, they also have proportionately larger surfaces in contact with a warming blanket, and hence the blanket is more effective in this group.

Therefore, we strongly recommend the continued use of the warming blanket for infants weighing less than 10 kg. However, we do not advocate its routine use for larger children because of its lack of effectiveness and its potential hazards.¹⁰

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