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Neonatal Temperature and Surgery

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There are still many difficulties in the maintenance of normothermia during operations on the newborn.[1,2] Modern newborn intensive care succeeds in keeping alive very ill newborns who come to surgery for increasingly complex procedures requiring longer surgical times. Measures to counteract loss of body heat in the operating room increase in importance, and this report examines operating room temperature control as a means of achieving thermic stability.

METHODS

For the past two years in this institution, ambient operating room temperature has been increased for operations on the newborn (as much as 28 days old) and used as the primary method of temperature control. During this period the basic anesthetic technique has not changed: premedication is with atropine, 0.1 mg, and then the infant is transported to the operating room in an incubator. The trachea is intubated with the newborn awake, and a nondepolarizing muscle relaxant given iv into a small vein on the volar aspect of the wrist. Anesthesia is maintained with oxygen–nitrous oxide and ventilation controlled with a T-piece circuit. An iv route and appropriate monitors, including a tympanic temperature probe, are secured before positioning and preparation of the operative site. Draping includes the use of Vi-drape®, and a warming mattress is placed under the baby. Overhead heating devices are not used, anesthetic gases are not heated, and iv solutions (except blood) are not warmed.

RESULTS

All procedures were either abdominal or thoracic. The cases are summarized in table 1. The mean operative time was 125 minutes. Prematures consisted of 70 per cent of the cases.

TABLE 1. Summary of Cases

Number of babies:	33
Number premature:	23 (less than 2.5 kg)
Ages:	newborn to 28 days (mean 9 days)
Weights:	mean 1.9 kg (range 780 g–4.0 kg)
Operative times:	125 min (ranges 35–250 min)

In figure 1 mean change in body temperature during the procedure is plotted against ambient operating room temperature. Only five specific ambient temperatures were employed, and the mean changes in body temperature at each ambient temperature are shown separately for mature and premature newborns. In almost all the babies (81 per cent) temperatures increased during the surgical procedures. In most instances this was an attempt to regain normothermia, as they cooled down to an average of 1 C below normal prior to operation. Only 12 per cent had normal (37 C) body temperatures initially.

A more meaningful presentation of the results is shown in table 2. The percentage of newborns who at the end of operation had either normal body temperatures or rising subnormal temperatures (we presumed that normothermia would have been achieved) is given for each operating room temperature. The range of ambient temperatures needed for achievement of thermal stability was found. In 36 per cent of these neonates, ambient temperature control was the only method of heat control employed.

DISCUSSION

The newborn is not poikilothermic[3]; rather, temperature is maintained by the balance between heat production and heat loss. Metabolism is usually equated with body weight or surface area. Oxygen consumption, hydrogen ion production, and water turnover, all indices of heat production, are two to four times those in the adult.[4] Heat loss by conduction, convection, and radiation is greater in

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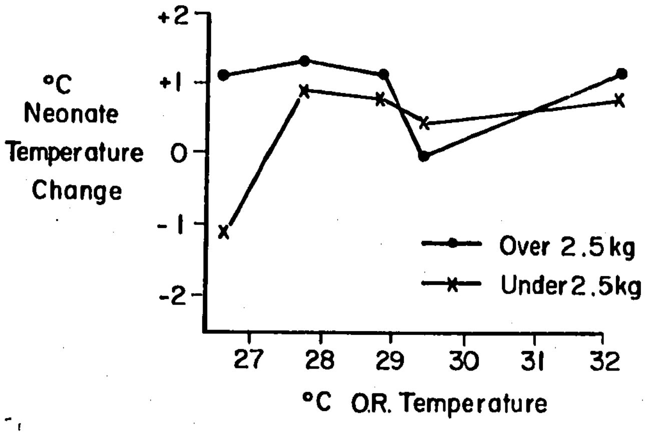

FIG. 1. Relation of ambient temperature to change in neonate's body temperature.

the newborn. Factors contributing to this are the infant's large surface area, the convexity of the abdomen, and the lack of body depth. The newborn's innate ability to maintain body temperature is limited, and although the newborn can increase muscle tone, the evidence is against shivering as a primary heat-generating mechanism.[4] Infants possess brown fat, richly supplied with vascular and mitochrondial elements, which can be metabolized to increase heat production. It is suggested that catecholamines, which are present in the newborn, are the major control mechanism.[4,5] However, the effects of illness and drugs, including anesthetic agents, on these mechanisms are not known.

Hypothermia does have deleterious effects.[1,2] Delayed awakening, immobility, increased reflex activity, abnormal reaction to drugs, diminished enzymatic activity, sclerema, cardiac irritability, sympathetic paralysis, and acidosis, both respiratory and metabolic, are well recognized. When discussing transport of newborns, Hackel[6] has stated that core temperature (less than 35.5 C) and pH (less than 7.2) are the most discriminating factors in survival, the method and distance of travel being of no significance.

Elimination of temperature loss by the newborn during operation requires insulation combined with heat supply. The insulating effects of blankets, surgical drapes, and plastic drapes (such as Vi-drape®) are well recognized. Suggested methods of heating include: warming the preparation and intravenous solutions, warming blankets and mattresses, warming and humidifying anesthetic gases, overhead infrared lamps,[7] and high ambient temperature. There are limitations to each of these proposals. The temperatures of many operating rooms can be regulated, and this simple expedient can control a newborn's temperature. Of course, there will be differences in the proper ambient temperatures according to the babies' conditions, and personnel may complain about the high temperatures, which may not be pleasant. But this is a small price to pay to remove the deleterious effects of hypothermia in the newborn.

TABLE 2. Results

Ambient Temperature (C)	Tympanic Temperature (Normal or Low but Rising at End of Anesthesia)
26	50 per cent
27.5	87 per cent
29	75 per cent
30.5	66 per cent
32	60 per cent

The ideal operating room temperature will depend to a great extent upon individual judgement. As a general rule, the less active the newborn, the higher should be the ambient temperature. Small obtunded premature babies require operating room temperatures near 32 C. Large active babies do quite well at an ambient temperature of 26 C. The operative time did not appear to be a factor. In attaining these temperatures, doors should be kept closed and transit kept to a minimum. Dire emergencies, *e.g.*, diaphragmatic hernia, may not allow time for the proper temperature to be obtained. Thus, operating room temperature control does not preclude the principles of warming iv solutions, especially blood. It would appear that the most suitable ambient temperature for newborns, in general, is 29 C.

Control of ambient operating room temperature is very effective in regulating the temperature of the newborn during anesthesia. It offers many advantages other than simplicity. It acts from the moment the newborn enters the operating room: this includes induction of anesthesia, acquisition of iv route, and monitoring installation when full access to the baby is necessary. During the surgical procedures it clears the operative site of fixed heat sources, which can be cumbersome and have a tendency to stray from the site of their original applications.

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