A Servo-Assisted Gel-Pack Cooling Method for Newborn Infants with Hypoxic-Ischemic Encephalopathy

Introduction
Consensus recommendations on the use of therapeutic hypothermia for infants born at or near term with moderate to severe hypoxic-ischemic encephalopathy (HIE), state that treatment should be consistent with protocols used in randomized clinical trials [1]. The recently published Infant Cooling Evaluation (ICE) trial [2], provides a pragmatic protocol using manually applied refrigerated gel-packs to induce and maintain cooling. The method used in the ICE trial required manual manipulation of the radiant warmer every 15–30 min. We have previously published a similar method of cooling with gel-packs which differed from the method used in the ICE trial by using a heat-shield over the head and a servo-controlled radiant warmer with a target temperature of 34°C [3]. The core temperatures achieved in this study and also in the ICE trial were in the upper end of the desired range.

The use of a warmer that is able to servo-control core temperature to 33.5°C during gel-pack cooling should result in more appropriate temperature control. We now report on a cohort of infants whom were cooled with this method, but using a radiant warmer to servo-control the target core temperature to 33.5°C.

Methods
From March 2010, the details of in-born infants admitted to the tertiary neonatal intensive care unit at Groote Schuur Hospital whom received therapeutic hypothermia for evolving moderate to severe HIE were entered into a register. The register was approved by the University of Cape Town Health Sciences Faculty Human Research Ethics Committee. We reviewed the register from March 2010 until the end of March 2011. Data were analyzed of all 14 infants with moderate-severe HIE defined by Shankaran [4], who were cooled to a target core temperature of 33.5°C. Statistica 10 was used for statistical analysis.

Hypothermia was achieved by applying refrigerated gel-bags around the head, placing a reflective heat shield over the head and measuring core temperature using a temperature probe between the infant and the mattress. Infants were sedated with intravenous morphine unless they were already adequately sedated by anticonvulsants. This cooling method has been described and validated in more detail previously [3]. Core body temperature was controlled with a servo-control radiant warmer (Servocrib, Servocare Medical Industries cc, Cape Town, South Africa) set at a target temperature of 33.5°C. Re-warming was achieved by increasing the target temperature on the radiant warmer by 0.2°C/h.

Results
The median (range) birth weight and gestational age of the infants was 3078 g (2140–3570 g) and 38 weeks (36–42 weeks) respectively. Before age 24 h the amplitude integrated electro-encephalogram (aEEG) background was suppressed in 7 of the 14 infants and was moderately abnormal in 6 infants. aEEG data were incomplete in one infant. Three of the seven infants with the severely abnormal background died.

References
before discharge. All six of the infants with the moderately abnormal background in the first 24 h had a normal voltage aEEG by 48 h.

Hourly temperature during cooling and rewarming is shown in Figure 1. Mean (SD/95% confidence intervals) core temperature during cooling from 1–72 h after cooling commenced was 33.6°C (0.3°C/33.5°C–33.6°C). One infant was cooled for 79 h. The cooling data of this infant was truncated at 72 h.

Discussion

Our data show that if infants with HIE have their core temperature servo-controlled with a radiant warmer to a core temperature of 33.5°C during gel-pack cooling, the mean core temperatures are closer to 33.5°C than has been recorded using other gel-pack cooling methods. For comparison, the mean (SD) core temperature in the ICE study was 33.8°C (0.4°C). The temperature control achieved with our servo-assisted method was comparable to that reported with more complicated hypothermia equipment [5], and it eliminated the need for manual temperature adjustments.

Acknowledgements

We thank the staff in the Groote Schuur Hospital neonatal unit for their role in the management of these infants

Correspondence: Alan R. Horn, Neonatal Medicine, H46 OMB, Groote Schuur Hospital, Observatory, 7925, Cape Town, South Africa. Tel: +27 21 4046025. Fax: +27 21 7619472. E-mail: <alan.horn@uct.ac.za>.

Predictors of Mortality, Length of Stay and Co-Morbid Hypothermia in Hospitalized Neonates with Pneumonia in Eritrea, Africa

Pneumonia is the third leading cause of neonatal death in Sub-Saharan Africa, however systematic reviews of newborn mortality in this region are lacking [1–6]. The majority of cases occur in developing world countries, which have no formal reporting system for these deaths, many of which occur at home [7, 8]. We sought to determine the predictors of mortality in a hospitalized cohort of infants with pneumonia in Asmara, Eritrea, conducting a retrospective review of all 2006 admissions to the Orotta Pediatric Hospital Neonatal Intensive Care Unit, the nation’s only tertiary newborn centre. Independent for less than three decades, the country introduced a ‘Specialized Neonatal Care Unit’ (SNCU) in 2003. The SNCU was attended to by two physicians and provided a centralized oxygen supply, infusion pumps and incubators, three radiant warmers and phototherapy equipment. Bubble Continuous Positive Airway Pressure was the primary means of assisted ventilation [9].

Data on age, birth weight, gender, mode of delivery, Apgar score, maternal age, birth location, admission diagnosis, admission comorbidities and outcome was collected. Multivariate analysis determined predictors of mortality and length of stay. Bivariate analysis determined the impact of admission hypothermia (temperature <36.5°C rectally at the time of first medical presentation, including rural medical facilities prior to admission. Hypothermia complicated 25.8% (79/306) of cases with pneumonia (Fig. 2). Hypothermia was inversely related to birthweight, occurring in 50% of patients ≤2 kgs.

For infants with a birthweight of ≤2 kgs with pneumonia, mortality was higher in infants with co-morbid hypothermia (p < 0.05, Fig. 3). No mortality was seen in hypothermia patients >2.5 kgs. No significant differences in mortality were seen in normothermic infants across weight classes >2.0 kgs.

Multivariate regression modeling was performed to determine association with length of stay. Decreased gestational age and birthweight ≤2 kgs were associated with increased length of hospitalization (p < 0.05 and p < 0.0001, respectively, Table 2).

This work is the first major report on neonatal pneumonia from this region. Focus on thermal care may reduce mortality in neonates with pneumonia < 2 kgs. Efforts to prevent hypothermia can focus on support for skin-to-skin contact and maintenance of the ‘warm chain’ [12–14]. Given the discrepancy in mortality rates from pneumonia between low birthweight, hypothermic and normothermic newborns, modest improvements could result in substantial mortality reductions. Improvements

Fig. 1. Morality rates for hospitalized neonates in Eritrea during 2006. Overall mortality was 8.2% (87/1035). Cause-specific mortality for pneumonia was more than double that of ‘Non-Pneumonia’ Diagnoses (13.7% vs. 6.0%, *p < 0.02, Fisher’s exact test, Confirmed by Mantel-Haenszel χ²test). No difference between overall mortality and pneumonia-specific mortality rates was observed.