Original Research Article

Temperature instability during medical procedures in neonates admitted in the neonatal intensive care unit

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Abstract

Objectives: To determine the temperature instability during medical procedures in neonates admitted in the NICU **Methods:** This prospective observational study was carried out in the Neonatal Intensive Care Unit at Ramaiah Medical College Hospital on neonates requiring procedures such as PICC insertion, ECHO, surfactant therapy, umbilical vein catheterisation, venous cut down and lumbar puncture. Neonates with cardiovascular instability and neurological disorders were excluded. Procedures were carried out under radiant warmers in air mode and axillary temperature was measured before the procedure, immediately after, 15 and 30 minutes after the procedure. Quantitative parameters were expressed as mean ± standard deviation. Qualitative parameters were expressed as frequency and percentage. **Results:** The mean difference in temperature ± SD (in °F) before and after the procedure was found to be 0.228±0.53 overall. In neonates with basal hypothermia the increase was found to be 0.775±0.89. In neonates in normal range of baseline temperature was found to be 0.091±0.26. **Conclusion:** Variation in temperature occurs during common procedures in the NICU leading to an increase in temperature. This increase in temperature may cause overheating and its consequences.

Key Words: Procedure, temperature, hypothermia, hyperthermia.

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INTRODUCTION

There is a narrow range of ambient temperature within which the metabolic rate and oxygen demand of neonates are minimal[1]. This neutral thermal environment varies with an infant's body weight, age, and amount of clothing,[2,3] and is important because babies managed at environmental temperatures outside this range may grow less adequately,[4] and be at risk of increased mortality and morbidity. Neonates admitted in NICU are subjected various medical procedures, like PICC insertion, umbilical vein catheterisation, lumbar puncture, ECHO, venous cut down and surfactant therapy. During the procedures, neonates are kept in air mode/skin mode in radiant warmers. Due to covering of probe, draping, temperature variations can occur in the neonate. Provision of a neutral thermal environment with incubators and overhead heaters is an important feature of neonatal intensive care. Without outside help, neonates behave like classic poikilothermies, its temperature reflecting that of its surroundings. This neutral thermal environment is breached during medical procedures. In full term infants, hypothermia leads to an increase in the metabolic rate as the infant attempts to generate heat to regain normal temperatures.[4]In preterm infants with respiratory problems this may result in increased oxygen demand in a neonate whose oxygen requirements are already raised. This increased metabolic rate can cause acidosis, hypoglycaemia, and poor weight gain,[4] and if the neonates already has respiratory difficulties, it may contribute to respiratory failure. In this study, the aim was to determine the variation of temperature during various procedures. Thereby, preventing temperature instability and its potential consequences.

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MATERIALS AND METHODS

This prospective observational study was conducted at Ramaiah Medical College Hospital. It was approved by the institutional ethical committee and informed consent was taken. Neonates admitted in the NICU requiring the following procedures: PICC line insertion, Lumbar Puncture, Umbilical Line, Surfactant therapy, ECHO, venous cut down were included. Neonates with cardiovascular instability and neurological disorders were excluded. Sample size was calculated based on a pilot study. According to the data, mean temperature before procedure was 98.15 ± 0.77(in °F) and after procedure was 98.38 ±1.03 (in °F). Using these measures, n-master version 2.1 was employed to calculate the sample size with an assured precision of 0.3 and desired confidence interval of 95%. The required sample size worked out to be 71.80 neonates satisfying the inclusion criteria were included. Demographic details, birth weight, current weight, gestation and postnatal age were recorded in a pro forma. When the neonate was due for the above mentioned medical procedures temperature before the procedure was recorded. Procedures were carried out following standard protocol under a radiant warmer in air mode. Time required for the procedure was recorded. Axillary temperature of all neonates was recorded immediately after procedure and at 15, 30 minutes after the procedure using a digital thermometer. Data was entered in Microsoft excel and analysed using SPSS version 18.0.Quantitative parameters were expressed as mean ± standard deviation. Qualitative parameters were expressed as frequency and percentage. During the analysis of the data, the neonates were classified into groups: Group 1- with baseline temperature <97.7°F that is with neonatal hypothermia (n=16) and Group 2- with baseline temperature >97.7°F (n=64), that is in the normal range. The mean difference in temperature between before procedure and immediately after the procedure, immediately after the procedure and 15 mins after the procedure, 15 mins after and 30 mins after the procedure and before the procedure and 30 minutes after the procedure was calculated.

OBSERVATIONS AND RESULTS

Table 1: Baseline parameters

Parameter	Value
Total neonates	80
Male neonates	48
Female neonates	32
Average Gestational Age (In weeks)	32.61±4.138
Average Birth Weight(In grams)	1772.75±887.35
Average Current Weight (In grams)	1758±917.95
Average Procedure Time(In minutes)	17.40±5

Table 2: Mean difference in temperature and standard deviation

Mean difference in temperature (In °F)	Group 1	Group 2	Mean
Before and Immediately after procedure	0.775±0.89	0.091±0.26	0.228±0.53
Immediately after and 15 mins after procedure	0.068±0.57	-0.077±0.24	-0.048±0.34
15 mins after and 30 mins after procedure	0.2313±0.65	0.020±0.23	0.062±0.36
Before and 30 mins after the procedure	1.07±1.27	0.034±0.221	0.242±0.72

The analysis of mean difference in temperatures at various time periods showed an initial rise in the temperature of 0.775±0.89and 0.091±0.26 in group 1 and group 2 respectively (Mean difference in temperature before and immediately after the procedure ± Standard deviation [in °F]).The mean difference in temperature between immediately after and 15 minutes after the procedure was found to be 0.068±0.57 and -0.077±0.24in group 1 and group 2 respectively (Mean ± SD [in °F]).The mean difference in temperature between 15 and 30 minutes after the procedure was found to be 0.2313±0.65 and 0.020±0.23 in group 1 and 2 respectively (Mean ± SD [in °F]).The mean difference between before the procedure and 30 minutes after the procedure was found to be 1.07±1.27 and 0.034±0.221 in group 1 and group 2 respectively (Mean ± SD [in °F]). The overall variation in mean difference in temperature before and immediately after the procedure, immediately after the procedure and 15 minutes after the procedure, 30 minutes and 15 minutes after the procedure and before the procedure and 30 minutes after the procedure was found to be 0.228±0.53, -0.048±0.34, 0.062±0.36, 0.242±0.72 respectively. (Mean difference in temperature± Standard deviation [in °F]).

DISCUSSION

The aim of the current study was to measure the variation in temperature during procedures. In the current study, it is seen that in group 1, that is, neonates that were hypothermic at the start of the procedure showed a rise in temperature through the half hour period. In group 2, where in, the baseline temperature was in the normal range showed an initial rise of temperature followed by a fall in temperature and consequent rise. However, the overall difference in temperature is that of an increase by around 0.03°F. In a study conducted by Mok Q *et al.*[5] total care procedures were carried out under skin mode, central temperature fall of mean of 0.7°C (range 0-1.7), peripheral temperature fall by 1.3°C (range 0.2-3.0)and a widened temperature gap by an average of 0-6°C (range

0.0-2.7) were observed. A study conducted by Ducker *et al.*[6] shows better thermal stability in the incubator on air mode. Hence, air mode was used in our study. Most neonates admitted in the Neonatal Intensive Care Unit require many procedures as part of their care in the NICU. These procedures are performed following the standard of care. As per protocol, neonates are shifted to the warmer from the incubator and the procedure is performed under air control mode. The working principle of the air control mode is based on a sensor which is also placed under the warmer. This sensor detects the temperature of the area under the warmer and maintains the set temperature. The blocking of this sensor by multiple health care workers and draping during the procedure leads to incorrect transmission and thereby altered thermoregulation. This could lead to the rise in temperature seen in both groups of neonates. The above mentioned, combined with a hypothermic neonate trying to achieve normal range of core temperature can lead to the sustained raise in the temperature noted in the study in group 1. Exposure to excess heat or insulation can lead to a rise in the core body temperature rapidly due to their inadequate heat dissipation mechanisms which occurs in uncontrolled incubators and warmers. This can be likened to a warmer functioning with a covered probe leading to a rise in the core body temperature of the neonate[7]. Hyperpyrexia of newborn is defined as core body temperature >37.4°C by Craig[8]. Although it is uncommon, mostly occurs due to failure of a warming device. Mild overheating has been associated with an increase in apnea of prematurity[9-10]. The following are the consequences of hyperpyrexia due to overheating: shock, protracted fits, diarrhoea, disseminated vascular coagulation, renal failure, hepatic failure[11]. Sudden death also has been associated with overheating[12]. Apart from the direct consequences of hyperpyrexia, a mistaken diagnosis of fever may lead to a series of unnecessary and painful investigations for the cause of fever. Considering the possibility of hyperpyrexia following procedures, this can be avoided. In our study, the mean time required for procedures was 17 minutes (Range 12-22 minutes) which showed an increase in temperature. This rise in temperature may cause hyperthermia in neonates. Studies including procedures that require longer periods of time have to be conducted to study temperature instability over longer periods of time.

CONCLUSION

Procedures in the NICU result in disturbance of thermoneutrality leading to increase in core temperature of neonates.

Hyperpyrexia is a potential consequence of this temperature instability. Further studies are warranted to study the occurrence and effects of this increase in temperature. There is a need to explore methods to reduce the alteration of thermoneutrality during procedures.

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