

Neonatal hypothermia among hospitalized high risk newborns in a developing country

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ABSTRACT

Objective: To estimate the frequency of neonatal hypothermia and to identify the risk factors associated with it.

Methodology: This cross sectional survey study was conducted from March 2008 to November 2008 in the Neonatal Intensive Care Unit, Department of Women and Child Health, Aga Khan University Hospital, Karachi, Pakistan. Data was collected with a pre tested data collection tool. Three hundred neonates were included in the study. SPSS v17.0 was used for descriptive analysis.

Results: Of the 300 neonates admitted to the neonatal unit, 144 (49.5%) developed hypothermia. The frequency of hypothermia was found to be significantly higher in low birth weight (LBW) 58.1% and preterm 64.2 % babies.

Conclusion: There is a high frequency of neonatal hypothermia in our setup which is on the higher side of the range reported in comparable regions. LBW and prematurity were independent risk factors as was the external environment at the time of delivery.

KEY WORDS: Hypothermia, Neonates.

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INTRODUCTION

Neonatal hypothermia is a worldwide issue but especially a common problem in the developing nations¹ with poor monetary sources.^{2,3} High prevalence of hypothermia has been reported widely from warmer regions of Africa and South Asia. Progress toward thermal care of newborns in

developed countries is still far behind in knowledge and practice. High prevalence of hypothermia has been reported from countries with the highest burden of neonatal mortality¹, where hypothermia is increasingly gaining attention and significance as a critical intervention for newborn survival.

Hypothermia is described by the World Health Organization (WHO) as "axillary temperature less than 36.5°C".³ It has been defined differently by various researchers using dissimilar cutoffs and the body temperature being measured at various sites^{4,5}, which could possibly account for the variability in reporting the incidence in different areas⁴. However, WHO definition has universal acceptance and credibility.³

In 2003-2004, an estimated 10.8 million children under 5 years of age died globally due to various reasons, of which 3.9 million (36%) were neonates (in the first 28 days of birth).^{6,7} South Asia essentially has had a major contributing role in the overall number of neonatal deaths worldwide due to

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multiple factors, with Pakistan standing third in line after India and China.⁷ South Asia also reports an increased incidence of hypothermia particularly within a day of the newborn's delivery.^{8,9}

Hypothermia on admission in babies raises the possibility of increased morbidity and death^{10,11} specifically in the course of the first 28 days of life.¹² A neonate becomes hypothermic when exposed to the outside environment after being delivered especially if the baby is born before term, is low weight at birth, has low apgars, has had the need for cardiopulmonary resuscitation, is ailing or born in winters.¹³⁻¹⁵

Significant metabolic and physiological changes take place in the first few days of life as normal response to acclimatize to the surroundings.¹⁰ Pre-term infants in particular are vulnerable to temperature^{10,16} and water loss¹⁰, more so in the early period. WHO recommends that measures should be taken to prevent the body temperature of neonates from falling as part of basic routine practice.¹⁷

Neonatal hypothermia needs to be immediately identified and effectively managed since it can lead to a wide range of complications including "seizures, infection, hypoglycaemia, cardiac dysrhythmias, gastrointestinal bleeding, sclerema, hypovolaemia, metabolic acidosis, jaundice, respiratory distress, pulmonary hemorrhage and death."¹⁸ Curtailing heat losses improves the long term outcome and longevity in preterm and low birth weight babies.¹⁰

Although literature on neonatal hypothermia is extensive, it is limited to the western countries. Regrettably, there is a dearth of data on such issues in Pakistan with an increased frequency of hypothermia in Pakistani neonates. The aim of this study was to calculate the frequency and identify the risk factors associated with neonatal hypothermia so that appropriate management techniques can then be devised and instituted to reduce its incidence.

METHODOLOGY

This cross sectional survey study was conducted in the Neonatal Intensive Care Unit, Department of Women and Child Health, Aga Khan University Hospital, Karachi, Pakistan. The study was carried out from March 2008 to November 2008. All babies born in Aga Khan University Hospital, who are admitted to the neonatal intensive care unit, were included in the study. Out born babies admitted to NICU were excluded from the study. Hypothermia was defined as skin (Axillary) temperature of less than 36.5°Cⁿ.

Axillary temperature for all inborn consecutive admissions was measured on admission and then two hours after admission in the neonatal unit with a mercury thermometer (Shanghai medicine and health products[®]) which could measure from 32°C to 42°C. Babies found to be hypothermic (Axillary temperature < 36.5°C) at birth were kept under radiant warmer/incubator. Using the WHO classification, axillary temperature less than 36.5°C was recorded as hypothermic. Hypothermia was further classified into two group's i.e. Hypothermia: (35°C to 36.4°C) and severe Hypothermia (32°C to 34.9°C). Other data obtained from the subjects included the clinical diagnoses, age in hours, sex, body weight, estimated gestational age (EGA), urine output, PH, PO₂, CPR, BP {Systolic & Diastolic}, signs of respiratory distress and APGAR score.

Transportation of hypothermic babies from obstetrical unit at Aga Khan University Hospital to NICU was done by the neonatal staff and accompanied by resident. The ambient temperature of operation theatre, labour room during the study period remained between 23°C-25°C. The temperature of the newborn nursery where the hypothermic babies were managed was maintained between 24°C-26°C.

Investigations done in all the hypothermic babies were blood culture, sepsis screen, serum electrolytes, blood sugar and X-ray chest. Ultrasound of head was done only in those babies who were suspected to have intracranial bleed. Infants with positive blood culture were excluded from the study.

The data were analyzed with SPSS 17.0 version using the chi-square test, odds Ratio and the 95% Confidence Interval (CI). Statistical significance was established when p values were less than 0.05 or the 95% CI did not include unity.

RESULTS

During study period, there were over 300 live births admitted to the neonatal unit, 144 (49.5%) of these developed hypothermia. Hypothermia was found to be significantly higher amongst LBW 58.1% and preterm 64.2 % as compared to full term and appropriate for gestational age babies (Table-I). Ninety five (64.2%) of the preterm babies had any degree of hypothermia compared with forty six (33.1%) of term babies which is statistically significant (OR = 3.62; CI =2.23-5.90).

The average time taken for correction of hypothermia in those babies was 2hrs. Out of all hypothermic babies (49.5%), 14.8% remained hypothermic at 2 hours of age.

Table-I: Comparison between logistic regression of risk factors in two groups by body temperature.

<i>Gestation</i>	32 - 36.49 °C <i>Hypothermic</i>	≥36.5 °C <i>Normothermic</i>	<i>P-value</i>	<i>EXP(β)</i>	<i>95% CI</i>
Preterm (<37 weeks)	95(64.2)	53(35.8)	< 0.01	3.62	2.23 - 5.90
Term (≥37 weeks)	46(33.1)	93(66.9)			Reference
<i>n</i>	141	146			
<i>Birth weight</i>	32 - 36.49 °C <i>Hypothermic</i>	≥36.5 °C <i>Normothermic</i>	<i>P-value</i>	<i>EXP(β)</i>	<i>95% CI</i>
< 2.5 kg	97(58.1)	70(41.9)	< 0.01	2.27	1.41 - 3.65
≥ 2.5 kg	47(37.9)	77(62.1)			Reference
<i>n</i>	144	147			

There were 206(68.7%) males and 94(31.3%) females. The estimated gestational age ranged from 23 to 40 weeks with the mean of 35.1 ± 3.6 weeks while the body weight varied between 0.58 kg and 4.5 kg with the mean of 2.3 ± 0.7 kg. Babies with hypothermia had significantly lower mean body weight compared with babies with normal body temperature (2.1 ± 0.8 kg *vs.* 2.6 ± 0.7 kg, $p < 0.01$). The incidence of hypothermia decreased steadily with increasing body weight; it was 75.5% for babies < 1.5 kg, 49.1% for babies weighing between 1.5 and 2.49 kg and 37.9% for babies who weighed 2.5 kg or more.

The first two hours of life were observed to be critical for maintaining the body temperature as the maximum cases of hypothermia ($n=144$) were seen within this period. Babies requiring active resuscitation and CPR was associated with 27 % ($n = 81$) cases of hypothermia.

Data Analysis: Data were analyzed using Chi Square, logistic regression, odds ratio, and confidence interval and incidence rates were calculated. $P < 0.05$ was considered as significant. Using logistic regression, the relationship between independent variables (Table-II) including gestation, birth weight and Urine output were assessed with the dependent variable of body temperature. The data analysis was performed using SPSS®, Version 17.0 (SPSS Inc; Chicago, IL).

DISCUSSION

The relevance of our study is vindicated by the high incidence of neonatal (49.5%) hypothermia revealed in our setup which is alarming and needs to be taken care of. The incidence in this study measured using a mercury thermometer is less than 85% and 62% reported in the Zimbabwean¹⁴ and Nigerian¹⁹ neonates respectively but more than 33% in Iranian¹⁸ newborns. Moreover, a research in Shimla established that only 2.9% of the newborn babies under study were found to be hypothermic

of which an estimated 81% were low birthweight.¹⁹ These studies along with WHO guidelines reported to have frequent occurrence of neonatal hypothermia were from countries with a warm climate like Pakistan's.

A study conducted in a tropical country demonstrated greater chances of mortality in newborns regardless of their weight at birth¹. However, another one¹⁴ outlined that very low birth weight babies were indeed a risk factor to the development of hypothermia which was in agreement with our finding. Our study showed that there was an increased incidence of hypothermia in neonates with low Apgar, low birth weight and those born prematurely. Our findings also correlate with various other studies.^{13,19} This could possibly be attributed to lack of subcutaneous tissue, underdeveloped temperature regulating mechanisms,^{19,20} diminished brown adipose tissue, quick loss of water via the skin surface²¹ and the greater surface area to mass ratios in the these babies.²

Our observations that most babies in our study are hypothermic within the first two hours of birth have been reported previously¹⁹ where the frequency was highest within the first hour. Those who had CPR or birth asphyxia were also found to be at increased risk in our study which has previously been established as well.¹⁹ Hypothermic babies had augmented urine output and mean arterial pressures. We believe this observation of increased quantitative urine output and mean arterial pressure is due to the direct effect of hypothermia on myocardial function.²² As a normal physiological response, a rise in the blood pressure and urine output precede an eventual decline in the heart rate due to hypothermia.²² The rise in mean arterial pressure and hence the blood pressure could be due to peripheral vasoconstriction caused by hypothermia.²² Consequently an increase in peripheral vascular resistance will ultimately

Table-II: Characteristics of study population.

Characteristics	n (%)
Gender	
Male	206(68.7)
Female	94(31.3)
Birth Weight	
Mean±SD	2.3±0.8 kg
<2.5kg	170(56.7)
>2.5kg	130(43.3)
Mean Gestational Age	
Mean±SD	34.9±3.7
Term >37 weeks	143(48.5)
Preterm <37 weeks	152(51.5)
Temperature on admission	
32 - 35 °C (Severe Hypothermic)	10(3.4)
> 35 - 36.49 °C (Hypothermic)	134(46.0)
≥ 36.5 °C (Normothermic)	147(50.5)
Urine output	
Mean±SD	2.6±1.3
< 1 cc/kg/hr	16(5.8)
≥ 1 cc/kg/hr	261(94.2)
PH	
Mean±SD	7.4±0.1
< 7.35	69(33)
≥ 7.35	140(67)
PO2	
Mean±SD	105±80.7
< 85 mmHg	117(56)
> 105 mmHg	69(33)
85mmHg - 105mmHg	23(11)
BP Systolic	
Mean±SD	69.0±12.8
< 48 mmHg	8(2.9)
48-60 mmHg	66(23.7)
> 60 mmHg	205(73.5)
BP Diastolic	
Mean±SD	43.4±10.5
< 24 mmHg	5(1.8)
24-38 mmHg	89(32.0)
> 38 mmHg	184(66.2)
Apgar score at 1 minute*	
8-10 (Excellent Condition)	85(39.2)
4-7 (Mild risk of mortality and morbidity)	108(49.8)
0-3 (High risk of mortality and morbidity)	24(11.1)
Apgar score at 5 minute*	
8-10 (Excellent Condition)	164(75.6)
4-7 (Mild risk of mortality and morbidity)	51(23.5)
0-3 (High risk of mortality and morbidity)	2(0.9%)
CPR	
Not Given	219(73)
Given	81(27)

* APGAR scores Cutoff based on Article:

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increase the glomerular filtration rate in the kidneys increasing the formation of urine.

Also, the temperature of the labour room during our study period remained between 23°C-25°C. The

temperature of the newborn nursery where the hypothermic babies were managed was maintained between 24°C-26°C. It is recommended by WHO that at places where body contact between the neonate and the mother is maintained, the temperature of the delivery room should be 25 degree Celsius at the lowest and between 28-30 degree Celsius otherwise.²³ Therefore, increasing the room temperature in our setup will improve outcomes and decrease the incidence of hypothermia in our babies.

Studies have attributed the most frequent reason contributing to neonatal hypothermia to the absence of awareness amongst the caretakers as well as the mother regarding easy and uncomplicated ways to keep the baby's body temperature under control.²⁴ Simple and cost effective precautions such as a warm surrounding, avoiding an immediate bath, wrapping the baby to preclude a drop in the body temperature, establishing close contact with the mother and early breast feeding, and warm handling of the baby subsequently will all help to reduce the chances of hypothermia in the newborns.^{24,25} Quick drying of the baby after delivery has been debated upon with some encouraging^{24,25} and others discouraging the practice. This aspect needs to be researched further. We need awareness programs and hands on experiences for the caretakers to understand the local risk factors and the correct handling and prevention of hypothermia by simple measures and early recognition. Also, further audits in the country should be conducted to determine any improvement or further deterioration in the current pattern.

Limitation of the study: This study has been an audit on the measures in the NICU taken to avert the development of hypothermia in neonates. Our study was not without limitations. This was a single centre study and hence our results may not be generalized. Also, our study was conducted in a private hospital and these results do not extend to the public health care setup where the results are expected to be worse. We would like to expand our research in future by involving multiple public and private sector setups to give a more indiscriminate statement.

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Authors Contribution:

All Authors worked collaboratively and equally on each stage of the study.