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Hypothermia at Birth and its Associated Complications in Newborns: a Follow up Study

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Abstract

Hypothermia is one of the main causes of neonatal mortality in developing countries. The aim of this prospective study was to determine the relationship between hypothermia at birth and the risk of mortality or morbidity among neonates born in Imam Hospital in Tehran, Iran. During a one-year period, body temperature was taken from all newborns using a low-reading rectal thermometer, immediately after their admission into the Neonatal ward of the above hospital. A temperature less than 36.5°C was considered as hypothermia. A questionnaire was filled for each subject. Using logistic regression the risk of development of respiratory distress in the first six hours of birth, hypoglycemia, metabolic acidosis, hyperbilirubinemia, scleroderma, pulmonary hemorrhage, Disseminated Intravascular Coagulopathy (DIC) in the first three days of birth were assessed and compared with the hypothermic and normothermic newborn infants. Nine hundred and forty neonates were enrolled into the study. A significant relationship was found between hypothermia and respiratory distress in the first six hours of birth and death, as well as with jaundice, hypoglycemia and metabolic acidosis in the first three days of birth (P=0.0001). Logistic regression showed that, regardless of weight and gestational age, hypothermia at birth alone could increase the risk of neonatal death (OR=3.64, CI=1.85-7.18), Respiratory distress (OR=2.12, CI=1.53-2.93), metabolic acidosis (OR=2.83, CI=1.74-4.59) and jaundice (OR=2.01, CI=1.45-2.79). Neonatal hypothermia at birth increases mortality as well as significant morbidity and hospitalization period.

Keywords: *Newborn, Hypothermia, Infant, Mortality, Iran*

Introduction

In 1958, (1) and 1964 (2) the adverse effects of hypothermia on the viability and survival in premature and low birth weight neonates was reported. Low body temperature in newborns, can lead to an increased rate of basal metabolism, peripheral vasoconstriction, decreased peripheral perfusion, tissue ischemia and finally metabolic acidosis (3). Vascular changes in the lungs may result in decreased ventilation, increased demand for oxygen and worsening of respiratory distress (4). Meanwhile, acidosis and hypoxia can predispose to pulmonary hemorrhage and disseminated intravascular coagulation (DIC) (3). Hepatocyte ischemia effects liver function and may cause indirect hyperbilirubinemia. In addition, the high metabolic rate leads to higher glucose consumption and hypoglycemia (4). Considering the high prevalence of hypothermia experienced by neonates born in developing countries, including full-term infants, and regarding that the information related to this topic is scattered and the associated complications have been reassessed inadequately in the past few years, we decided to study the complications of hypothermia in these infants.

The aim of this study was to determine the effect of hypothermia at the time of birth on development of respiratory distress within the first six hours of life as well as in developing hypoglycemia, metabolic acidosis, hyperbilirubine-

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mia, scleroderma, DIC, and pulmonary hemorrhage in the first three days of life. Moreover, the effect of hypothermia on mortality was assessed in respect to weight and gestational age.

Materials and Methods

This prospective cohort study was performed from (February 1st 2002- January 1st 2003) on 940 neonates who were born in Imam Khomeini Hospital (a teaching hospital) in Tehran- Iran. The average time that elapsed for the infants to be admitted into the neonatal unit (levels I, II, III neonatal care), was twenty min after birth. Rectal temperature was taken using a low-reading rectal thermometer for at least three min.

Body temperature less than 36.5 ºC was considered as hypothermia (5). Routine cares were done for babies after birth in the delivery room. Concerning newborns body temperature; they were divided to into two groups of hypothermia and no hypothermic infants. They were the entire same race, and received the same kind of care after birth.

In order to minimize the effect of environmental temperature on our results,the study was performed in all four seasons (environmental temperature changed between -3 ºC to 40 ºC).

A questionnaire containing information about birth weight, gestational age, and body temperature on admission, and outcome (discharge or death) was completed for each infant. Development of respiratory distress within the first six h of birth, pulmonary hemorrhage, metabolic acidosis (pH<7.25 and HCO_3^- <20), Jaundice (to the degree requiring intervention, in terms of the values of jaundice in American Academy of Pediatrics guideline) (6), hypoglycemia in terms of the values of surger and hypoglycemia in World Health Organization guideline (7). DIC, scleroderma or death occurring in the first three days of birth were also recorded. Laboratory tests were performed only for infants in whom a clinical sign necessitated laboratory tests to be done. This study was approved by the Medical Ethics Committee of the Reproductive Health Research Center, and was conducted under the supervision of the same center.

Newborns with various anomalies were excluded from the study. Data were analyzed using X^2, 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 including death, respiratory distress, hypoglycemia, jaundice, metabolic acidosis, DIC, pulmonary hemorrhage and scleroderma were assessed with the dependent variable of body temperature, thereby eliminating their confounding effects on each other. Finally, 42 cases were excluded from the study due to anomalies or inadequate data recorded in the questionnaire.

Results

Among the studied newborns, 478 (53.3%) had a body temperature below 36.5 °C. 53 infants (6%) died. Hypothermia was responsible for death to a significant degree (P= 0.0001); hypothermic newborns were 3.64 times more at risk of death as compared to normothermic newborns (CI= 1.85-7.18) (Table 1).

A significant statistical relationship was showed between hypothermia and development of conditions such as metabolic acidosis, jaundice and respiratory distress. In addition, odds ratio showed that hypothermia increased the risk of these complications (Table 2). During the study period, 190(21.2%), 8(0.9%), 4(0.4%) and 2(0.2%) of infants developed hypoglycemia, pulmonary hemorrhage, DIC, and scleroderma, respectively. However, regarding the inadequate number of our cases, we failed to find a significant relationship between hypothermia and these complications. We found the most common complications associated with hypothermia to be first, respiratory distress within the first six hours of birth and second, jaundice and metabolic acidosis.

Table 1: Characteristics of newborns under study by weight and gestational age

GA/W / Temperature	Gestational age (weeks)		Weight (gr)		
	≤37 (n)	**>37 (n)**	**<1500 (n)**	**1501-2500 (n)**	**>2500 (n)**
Hypothermic	252	224	74	132	272
Normothermic	150	269	17	74	328
Total	402	496	91	206	600

Table 2: Comparison between logistic regression of complications in two groups by body temperature

Complications / Body Temperature	Hypothermic Infant	Normothermic Infant	*P*- value	EXP(ß)	CI
Death (n)	42	11	0.0001	3.65	1.85-8.18
Metabolic Acidosis (n)	70	24	0.0001	2.83	1.75-4.59
Jaundice (n)	134	68	0.0001	2.02	1.45-2.80
Respiratory distress (n)	141	69	0.0001	2.12	1.53-2.94
Hypoglycemia (n)	113	77	0.052	1.38	1.00-1.91
Pulmonary hemorrhage (n)	6	2	0.19	2.66	0.53-13.23
DIC (n)	4	0	0.12	1.88	1.77-2.006
Scleroderma (n)	1	1	0.72	0.88	0.06-14.08

Discussion

This study shows that hypothermia alone is one of the important risk factors in causing death in newborns of all weight and gestational age groups. Regarding the complications associated with hypothermia, most previous studies focused on the effect of hypothermia in causing mortality in premature and low birth weight neonates (1-5). However, the risk of mortality may be increased in all newborns, regardless of their weight or gestational age. Our results are in accordance with those of the studies performed in India (8) and Brazil (9). In addition, our study shows the effect of hypothermia in causing metabolic acidosis in all newborns, regardless of weight and gestational age, whereas before this finding was shown to occur only in case of infants with very low birth weight (VLBW) (4). Furthermore, it is clear that hypothermia at the time of birth is a risk factor for respiratory distress and jaundice. Literature review did not reveal any other studies in which hypothermia increased the risk of jaundice. Therefore, we may consider hypothermia as one of the chief risk factors in causing morbidity and prolonged hospitalization of newborns. The increased rate of respiratory distress in hypothermic newborns may be explained by their increased metabolic demand, which results in metabolic acidosis and compensatory hyperventilation. This finding is in contrary to that of another study (4), in which oxygen demand was not increased in VLBW infants. However, this may be because their study population consisted only of VLBW infants referred to the NICU ward. Naturally, in these newborns, other factors may also intervene in increasing the demand for oxygen and causing respiratory distress. Due to the small number of newborns with DIC, pulmonary hemorrhage, hypoglycemia and scleroderma, we did not find a significant relationship between these conditions and hypothermia. However, a study performed in China on a large group of newborns, showed that there is a close relationship between scleroderma and hypothermia (10).

It was concluded that hypothermia could increase the incidence of respiratory distress, metabolic acidosis, jaundice, and death of neonates, regardless of weight and gestational age. We suggest that thermal care of newborns in delivery room and during transport to be evaluated and qualified and its difficulties to be improved.

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