Role of Polyethylene Plastic Bags for Prevention of Hypothermia in Preterm and Low Birth Weight Infants in a Tertiary Level Hospital in Bangladesh

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Abstract

Background: *Preterm and low birth weight infants have difficulty in maintaining body temperature specially after birth and contributes to a major cause of neonatal mortality and morbidity. Polyethylene plastic bags covering the trunk and extremities reduces hypothermia without causing hyperthermia.The objective was to determine if placing preterm and low birth weight infants inside plastic bags at birth maintains normothermia.*

Methods: *A total 108 infants with gestational age 28 weeks to before 37 weeks and/or with birth weight of 1000 to 2499 grams, born at Labour and Gynae Ward (LGW) of Rajshahi Medical College Hospital during the study period were randomly selected. 54 newborns received standard thermal care and the other 54 were placed under polyethylene plastic wraps.Axillary temperature was measured in the World Health Organization defined normal range (97.7°-99.5°F), or mild, moderate or severe hypothermiaat 1 day after admission and final outcome as discharged healthy or death was documented.*

Result: *Among infants randomized to polyethylene plastic bags,35(64.81%) maintained normothermia, 7(12.96%) developed mild hypothermia, 10(18.52%) moderate and 2 (3.70%) severe hypothermia. In control group, 42(77.78%) infants maintained normothermia, 4(7.40%) developed mild, 5(9.26%) moderate and 3(5.56%) severe hypothermia.Regarding clinical outcome, 47 (87.04%) infants in intervention group were discharged healthy and 7(12.96%) died(p>0.05).In control group, 45 (83.33%) infants were discharged healthy, 1(1.85%) was referred to Paediatric Surgery Department and 8(14.81%) died (p>0.05). None developed hyperthermia.*

Conclusion: *Placing preterm LBW infants inside polyethylene plastic bags soon after birth reduces hypothermia and hypothermia related complications without causing hyperthermia.It is a low-cost and promising intervention in limited resource setting with limited availability of radiant warmers and incubators. Polyethylene plastic bags are not superior tostandard care but can be an alternative in our resource-poor setting.*

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Introduction

Temperature control immediately after birth, especially during resuscitation is particularly important in reducing neonatal mortality & morbidity[1]. In preterm & low birth weight infants, there will be a drop in body temperature unless measures are taken to prevent this heat loss. Current resuscitation guidelines recommend placing the infants under a radiant warmer, drying the skin, removing wet linen & placing on a dry prewarmed blanket to reduce heat loss[2]. Despite these measures preterm very low birth infants are at high risk for cold stress. The EPICURE study showed that with decreasing gestational age, there was a very high incidence of cold stress.[3]Extended period of cold stress can lead to harmful side effects, which include

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hypoglycemia, respiratory distress, hypoxia, metabolic acidosis, coagulation defects, delayed readjustment from fetal to neonatal circulation, acute renal failure, necrotizing enterocolitis, failure to increase weight or weight loss and in extreme cases death[1,4] Rapid postnatal fall on body temperature is attributable to a combination of the physical characteristics of the infant (e.g. large body surface & thin layer of insulating fat) & environmental factors in the delivery suite. Extent of heat loss & the four modes of heat exchange (conduction, convection, radiation & evaporation) are influenced by the ambient air, temperature, pressure and relative humidity and temperature of surrounding surface.[5] Increased rate of heat loss is mainly caused by evaporation of amniotic fluid from the skin surface when the wet newborn moves from the warm environment of uterus into a cool, dry delivery suite.[6]In attempt to maintain core body temperature within normal range, the term infants respond mainly by production of heat from breakdown of brown fat & peripheral vasoconstriction.[7] When skin temperature falls to 35-36°C, non-shivering thermogenesis is initiated. The preterm infant has the combined disadvantages of decreased fat for heat production and insulation, decreased glycogen stores, immature skin which increases water loss & poor vascular control. They experience even higher evaporative heat losses than term infants in the first day especially at low ambient relative humidity.[8]

It is thought that the plastic bags reduce evaporative & convective heat loss, insensible water loss & the need for metabolic heat production.[9,10] The International Liaison Committee on Resuscitation consensus statement recommends the use of a plastic bag in the delivery room for very low birth weight infants[11] So in our poor country it is possible that the addition of the plastic bag to standard WHO thermoregulation care may be an effective intervention to decrease the rate of hypothermia in preterm LBW infants where others facilities like incubator, radiant warmers are not so available. There are not so many studies done in Bangladesh in this perspective. So this study was done to determine if placing preterm low birth weight infants in polyethylene plastic bags after birth reduces hypothermia and thus reduces hypothermia related mortality and morbidities.

Materials and Methods

This study was conducted at Special Care Neonatal Unit (SCaNU) of Department of Paediatrics, Rajshahi Medical College Hospital (RMCH),Rajshahi, Bangladesh from 01 February 2014 through 31 July 2014. A total of 108 babies born before 37 completed weeks of gestation, in LGW with birth weight between 1000 to 2499 grams, age less than 24 hours and whose parents gave informed written consent for the study, were selected for the study. After admission, the infants were randomized into control (n=54) and intervention group (n=54) by simple random sampling.

All infants were weighed first and axillary temperature was recorded by clinical thermometer and thorough clinical examination was done. Then the infants of control groupreceived standard hospital care that is providing warm room, immediate drying and resuscitation under radiant warmers or placing inside incubators. Infants of the intervention group, after immediate drying and resuscitation, were placed inside a plastic bag (nonmedical polyethylene plastic bags measuring about 400×250×1mm costing about taka 20 (US$ 0.20) per piece) covering trunk and extremities up to neck. A woolen linen was provided beneath the plastic bags to prevent skin excoriation; head and hands and feet were covered with woolen cap and socks respectively. Auscultation was done over the bag and had umbilical access been required, a hole was made in the bag to provide access.

For recording axillary temperature, the clinical thermometer was placed high in the axilla and the arm then held against the side of the baby for 2 minutes.Then the recorded temperaturewas categorized as normothermia (97.7°-99.5° F), mild (96.8°-97.52° F), moderate (89.6°-96.6° F) and severe hypothermia (<89.6° F)[12].

Axillary temperature and other vital parameters were recorded every day 4 hourly at 6 am, 10 am, 2 pm, 6 pm, 10 pm and any time when sign of hypothermia and other features of complications like brady- or tachycardia, apnoea or tachypnea, prolong CRT (capillary refill time), convulsion, vomiting or abdominal distension developed and were managed accordingly. Infants in the intervention group received with hypothermia were first tried with using table lamp with 200-watt bulb to maintain normothermia and then wrapped in plastic bags. This technique was also applied anytime whenever they developed hypothermia after wrapping in.

Blood samples (Hb%, TC, DC, CRP) were sent on 2nd day of admission and CBG (capillary blood glucose) was done immediately after admission. Other investigations like serum bilirubin, blood grouping and blood C/S and plain X-ray abdomen were done according to patient's clinical condition. All serological investigations were done from the Department of Pathology, RMC and X-ray from the Department of Radiology, RMCH. Babies' weight was

recorded daily and OFC weekly. Gestational age was assessed by the last menstrual period or from early ultrasound scans in the 1st trimester and clinically by new Ballard score. Maternal information like age, antenatal care, and complications during pregnancy was ascertained by history and pathology records.

The numerical data obtained from the study were analyzed by computer using Statistical Programs for Social Science (SPSS, Version 15.0) and the results were presented in tables, graphs & charts.

The protocol was approved by the Ethical Committee of Rajshahi Medical College, Rajshahi, Bangladesh and informed written consent was taken from the guardians of the patients before collection of their samples.

Results

A total of 108 infants were enrolled in this study. The baseline characteristics of neonates randomized to the intervention and control groups were almost similar. 8(14.81%) neonates in intervention group had gestational age within 28-30 weeks, 18 (33.33%) within 31-33 weeks and 28 (51.85%) within 34-37 weeks.

Table I. Baseline characteristics of study population

Characteristics	Intervention group (n=54)	Control group (n=54)	Probability
Gestational age (weeks)	33.2±2.1	33.1±1.7	p>0.05
Birth weight (grams)	1800±415	1740±402	p>0.05
Sex (M/F)	(24:30)	(24:30)	
Mode of delivery	36 (66.67%)	32 (59.26%)	p>0.05
Multiple birth (twin)	9 (16.67%)	8 (14.81%)	p>0.05
Maternal age	23±4.8	23.9±5.2	p>0.05
Antenatal care	39 (72.22%)	33 (61.11%)	p>0.05
Admission age in hour	6.3±5.8	4.7±3.4	p>0.05
Axillary temperature on admission	95.3±1.5	95±1.3	p>0.05

After 1 day of admission, among 8 neonates in 28-30 weeks of gestational age group, 1 (12.5%) developed mild, 4 (50%) developed moderate and 2 (25%) developed severe hypothermia. In 31-33 weeks of gestational age group, among 18 neonates, 3 (16.6%) developed mild and 6 (33.33%) developed moderate hypothermia; in 34-<37 weeks of gestational age group, among 28 neonates, 3 (10.71%) developed mild hypothermia.

Table II. Distribution of temperature Maintenance according to gestational age after 1 day of admission in intervention group

Gestational age	Frequency	Normothermia	Mild hypothermia	Moderate hypothermia	Severe hypothermia
28-30 weeks	8	1 (12.5%)	1 (12.5%)	4 (50%)	2 (25%)
31-33 weeks	18	9 (50%)	3 (16.6%)	6 (33.33%)	0
34- <37 weeks	28	25 (89.29%)	3 (10.71%)	0	0
Total	54	35 (64.81%)	7 (12.96%)	10(18.52%)	2 (3.70%)

Table III. *Distribution of temperature maintenance according to gestational age after 1 day of admission in control group*

Gestational age	Frequency	Normothermia	Mild hypothermia	Moderate hypothermia	Severe hypothermia
28-30 weeks	4	1 (25%)	1 (25%)	1 (25%)	1 (25%)
31-33 weeks	25	17 (68%)	2 (8%)	4 (16%)	2 (8%)
34-<37 weeks	25	24 (96%)	1 (4%)	0	0
Total	54	42 (77.78%)	4 (7.40%)	5 (9.26%)	3 (5.56%)

Figure 1. *Temperature maintenance after 1 day of admission in both study groups*

The development of complications after hospital admission is higher in control than intervention group (Table IV). 15 (27.78%) infants in intervention & 20 (37.04%) in control group developed septicemia. 2 (3.70%) babies in polyethylene bag group and 7 (12.96%) in control group developed NEC. Development of NEC is higher in control than intervention group & 1 infant in control group developed perforation following NEC. 2 infants of intervention group developed neonatal convulsion.

Apnoea of prematurity was one of the common causes of death of the sample population. 7 (12.96%) infants in intervention and 13 (24.07%) in control group developed apnoea which is also higher (almost double) in control population. The rate of development of apnoea was decreasing with increasing gestational age. 15 (27.78%) infants in intervention and 11 (20.37%) in control group developed hypoglycemia after admission.

The most common complication of the infants of both group is neonatal jaundice, the incidence is also higher in control 33 (61.11%) than in intervention 24 (44.44%) group. Development of neonatal jaundice is a limitation of the study as after development due to phototherapy infants were kept exposed & polyethylene bags could not be introduced. In that condition, infants were warmed with table lamp with 200-watt bulb. 1 infant in both group & 1 infant in control group developed umbilical sepsis & IVH respectively.

Table-IV. *Comparison of clinical outcome between intervention & control group*

Variables	Intervention group (n=54)	Control group (n=54)	Probability
Mean birth weight	1800 ± 415	1740 ± 402	p > 0.05
Gestational age	33.2 ± 2.1	33.1 ± 1.71	p > 0.05
Admission age in hour	6.3 ± 5.8	4.7 ± 3.4	p > 0.05
Maternal age	23 ± 4.8	23.9 ± 5.2	p > 0.05
Temperature on admission	95.3 ± 1.5	95 ± 1.3	p > 0.05
Hypothermia after 1 day	19 (35.19%)	12 (22.22%)	p > 0.05
Temperature on discharge	98.9 ± 0.4	99 ± 0.6	p > 0.05
Hypoglycaemia	15 (27.78%)	11 (20.37%)	p > 0.05
Septicemia	15 (27.78%)	20 (37.04%)	p > 0.05
NEC	2 (3.70%)	7 (12.96%)	p < 0.05
Neonatal convulsion	2 (3.70%)	0	p > 0.05
Apnoea	7 (12.96%)	13 (24.07%)	p > 0.05
Neonatal jaundice	24 (44.44%)	33 (61.11%)	p > 0.05
Umbilical sepsis	1 (1.85%)	1 (1.85%)	p > 0.05
Intraventricularhaemorrhage	0	1 (1.85%)	p > 0.05
Perforation	0	1 (1.85%)	p > 0.05
Skin problem	0	0	
No. of discharge	47 (87.04%)	45 (83.33%)	p > 0.05
No. of death	7 (12.96%)	8 (14.81%)	p > 0.05
No. of referral	0	1 (1.85%)	p > 0.05

Table V. *Clinical outcome of study groups*

Study group	No. of discharge	No. of death	No. of referral	Total	Probability
Intervention	47 (87.04%)	7 (12.96%)	0	54	p >0.05 (NS)
Control	45 (83.33%)	8 (14.81%)	1 (1.85%)	54	
Total	92	15	1	108	

NS : Non-significant in chi-square (χ^2) test of significance

Discussion

Keeping preterm LBW infants sufficiently warm immediately after birth, specially during resuscitation is problematic even when routine thermal care guidelines are followed. The newborn cannot shiver[13]& relies on interventions to protect it against exposure to cold. The ability to maintain an equilibrium between heat loss & heat gain[14] despite variation in environmental temperature is restricted during the first 12 hours of life.[15] So early intervention in the delivery room or immediately after admission to NICU is vital. The current trial shows that placement of the trunk and extremities of preterm LBW infants in polyethylene plastic bags reduces hypothermia without causing hyperthermia.

In this study total 108 preterm LBW infants were randomized enrolled, among them 54 were wrapped with polyethylene plastic bags immediately after admission and 54 were given standard thermoregulation. Most of the infants of the study were hypothermic (axillary temperature on admission in intervention group was 95.3±1.5°F & in control group was 95±1.3°F, p>0.05), documenting the high prevalence of this problem. Axillary temperature recorded after 1 day of admission was 97.6±1.4°F in intervention and 98.1±1.2°F in control group, p>0.05 and 35 infants (64.81%) in intervention & 42 (77.78%) in control group maintained normothermia. In x^2 test, at 5% level of significance against df=1, the table x^2 value is 3.841 but test statistic=2.3, so p>0.05 & there is no statistical significance of the study result.

There was also no significant difference of axillary temperature on discharge between intervention & control groups (98.9±0.4°F vs 99±0.6°F), in z distribution table, the z value at 5% level of significance 1.96 but the calculated z value =-1 , so p>0.05. These findings concurred with those of previous randomized controlled trials on the effectiveness of polyethylene wrap in lowering the rate of hypothermia in premature infants in delivery room or after admission in NICU[16,17,18].

Sunita et al[16] compared the effects of wrapping (with polyethylene) neonates of <31 weeks of gestation (n=62) by measuring rectal temperature at nursery admission. They reported that the use of occlusive wrapping resulted in significantly higher admission rectal temperature in infants <28 weeks compared to non wrapped group (36.94±0.56°C vs 35.04±1.08°C respectively p<0.001). No significant difference in temperature was seen in neonates 28 to 31 weeks of gestation. In the present study, the mean gestation was 33.2 weeks in the polyethylene group & 33.1 weeks in control group and like the observations of Sunita et al[16] the present study also recorded no significant difference of axillary temperature after 1 day of admission & also at discharge of the 2 groups.

Another study conducted between 60 neonates of d" 32 weeks of gestation & d" 1.5 kg birth weight in the Neonatal Service Division of the Department of Pediatrics, Pt. B.D.Sharma PGIMS, Rohtak[19] from 1.8.07 to 31.10.08 showed that polyethylene wrap decreased hypothermia after birth & mean axillary & rectal temperature recorded in both intervention and control group were comparable. Similar observation was made by Mathew et al[20] among 27 premature neonates less than 28 weeks of gestation & reported that vinyl bags prevented hypothermia at birth. The average axillary temperature recorded at admission to NICU in vinyl bag group was significantly higher (35.9±0.13°C vs 34.9±0.24°C) than control group. In my study I only observed axillary temperature not the rectal temperature (study limitation) which also shows no significant difference.

Kent et al.[21] observed improved admission temperature in infants<31 weeks gestation by increasing the ambient temperature in operation theatre & wrapping premature infants in polyethylene wrap. Ibrahim et al.[22]& Mc Call et al.[23] made similar observations.

The rate of maintenance of normothermia is slightly lower in intervention than control group (64.81% vs 77.78%), one possible cause may be that the room & environmental temperature were not well controlled. We used only 4 room heater to warm the room but the room temperature can t be monitored. Again most of the infants, were received at about 4-12 hours after birth, not immediately (mean admission age in hour 6.3±5.8 vs 4.7±34), which worst the outcome. Another problem we faced during the study period was the development of neonatal jaundice, which was the most common complications and the infants had to keep naked for phototherapy. As a result, most infants became hypothermic during phototherapy. However we overcomed the problem by using 2 table lamp of 200 watt bulb from both sides of phototherapy machine.

The final outcomes (the rate discharge 87.04% vs 83.33%) was better in intervention than control & also the rate of development of complications and the number of death was lower in polyethylene group which showed statistically no significant differences, similar to the study done by Alicia et al[24]. The rate of development of hypothermia and other complications were decreasing with increasing gestational age and birth weight in both groups.

Evaporation of amniotic fluid from the infant's skin surface is the mechanism of heat loss during immediate postnatal period. Plastic bag reduces evaporative heat loss[6] & allow radiative heat to pass through the plastic barrier to increase an infant´s body temperature. So considering importance of temperature maintenance in preterm LBW infants, it could be concluded that it would make sense to recommended the use of polyethylene plastic bags during their resuscitation.

Conclusion

Neonatal hypothermia after birth is a worldwide issue across all climates and placement of preterm LBW infants inside polyethylene plastic bags soon after birth reduces hypothermia and hypothermia related mortalities and morbidities without causing hyperthermia. It is a low-cost and promising intervention for infants born in limited resource settings where there is limited availability of radiant warmers and incubators. As hypothermia in preterm LBW infants and its consequences impose a significant burden in our country and scarcity of incubators and radiant warmers and affordability of these to general people has made our infants even more vulnerable, so polyethylene plastic bags can be applied as an alternative of incubators or radiant warmers for reducing hypothermia in preterm LBW infants of our country where these facilities are not so available.

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