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Review article

Preventing Hypothermia in Preterm Neonates Using Polyethylene Plastic Bag Wrap: A Systematic Review

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Abstract

Inadequacy of current practices of routine thermal care for heat loss prevention in preterm infants leads to an additional need for immediate hypothermia prevention following delivery and during NICU admission. Plastic bag wrapping has been proven effectively to prevent the hypothermia in preterm infants. A review aimed to investigate the effectiveness of plastic bag wrapping toward hypothermia prevention in preterm infants after birth and during NICU admission. A review was performed by searching of RCT trials using CINAHL, Pubmed, Medline, and EBSCOHost and published in English between January 2013 and August 2023 related to plastic bag or plastic wrap or vinyl bag or polyethylene bag or polyethylene covering, core temperature, and hypothermia. Quasi-experimental studies and randomized controlled trials (RCTs) are included in this study. This study included 10 trials involving 1704 preterm infants: 8 trials reported on poststabilization temperature and incidence of hypothermia, 2 trials showed hypothermia, and one trial in poststabilization temperature for the outcome. Most studies conducted plastic wrap on preterm neonates < 28 weeks of gestational age and for 1-2 hours. Nine studies revealed that plastic bag wrapping was associated with a decline in hypothermia insidences, the higher temperature on baseline and poststabilization temperature compared with routine care or other thermal care. A plastic bag is considered an effective and safe additional intervention for preventing hypothermia in preterm infants less than 28 weeks of gestational age. However, further study could be ensured by performing better-designed studies and a longer follow-up period.

INTRODUCTION

Neonatal hypothermia is the most frequently common in preterm neonates after birth. at the hospital. It is a crucial issue that remains play important roles in both developing and developed countries [1,2] Its prevalence in hospital-based setting ranged from 32% to 85% [1] Hypotermia occurs immediately after the birth because extreme change of the temperature when newborn adjust to extra uterine environment from warm temperature inside intra uterine[3]. Although hypothermia is not frequent as direct etiology of mortality in newborn, but it plays role important as a major predisposition and comorbidity of severe

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infection, asphyxia and prematurity in the worldwide [1]. Insufficient thermal protection is one the significant cause and principal challenge in hypothermia prevention, especially in developing coutries. Consequently, prevention of hypothermia related to thermal protection is crucial for preterm infant for infant's survival and quality of life in advanced future.

In neonatal care, the current practice of routine thermal care in neonatal care and delivery room remains inadequate to maintain preterm neonates to normothermia and prevent heat lost through the radiation, convention or evaporation [4] The 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations reaffirmed its prior recommendations to apply additional thermal care interventions, such as keeping the delivery room at a temperature of 23 to 25 °C and utilizing warm blankets, plastic wraps without drying, thermal mattresses, and caps for neonates born at less than 32 weeks of gestation [5]

The thermal care in delivery room includes applying drying the neonates after the birth, using warm blanket or radiant warmer, or placing the infant into the incubator was inadequate for heat lost prevention especially in preterm newborn through the radiation, convention or evaporation [4]The application of the plastic wrap immediately after birth will prevent heat loss through evaporation and convection in delivery room. McCall et al [6] has proven the use of polyethilene plastic is effective to prevent heat loss on preterm babies. Also the International Liasison Commitee on Resuscitation (ILCOR) also recommended the plastic wrap as a standard technique to maintain the baby temperature [7]. However, several studies show inconsistent result in the effectiveness of plastic wrap bag. Consequently, application on the practic bag wrap for preterm infant in NICU immediately after the birth need further examination. A review aimed to investigate the effectiveness of plastic bag wrapping toward hypothermia prevention in preterm infants after birth and during NICU admission.

METHODS

The articles that have been searched from CINAHL, Pubmed, Medline, EBSCOHost were searched using the following MeSH (medical subject heading) term that regarding with PICO's question (Table 1). For initial search, the inclusion criteria of the article are English-published, full text availability, have been published from 2013 to 2023. All potentially relevant titles and abstracts were retrieved and assessed independently for eligibility using EndNote. The initial search result was 222 articles which are eligible for the next investigated (Pubmed=74; CINAHL=34; Medline= 73; EBSCOHost = 41). This study adhered to Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) for reporting standard (see Figure 1).

Table 1
PICO's Question and MeSH

PICO's Questions	Description	MeSH
Population (P)	Preterm infant in Neonatal Intensive Care Unit	premature infant or preterm infant or neonatal prematurity NICU or Neonatal Intensive Care Unit or Neonatology Unit
Intervention (I)	Plastic bag Wrapping	Plastic bag or plastic wrap or Vinyl bag or polyethylene bag or polyethylene covering
Comparison (C)	standard care/standard thermal care	none
Outcome (O)	Hypothermia	Hypothermia or neonatal hypothermia

After finding the journal, the studies have been further selected involving the inclusion criteria including; (a) the participants were preterm infant (less than

37 weeks gestational age); (b) the intervention aimed to prevent the hypotermia that measured by standarized thermometer in rectal or in axilla (c) onset intervention: immediately after birth and during NICU admission; (d) the study design are randomized control trial (RCT) and/or quasi-experimental study in which the intervention program was compared with routine care or non-intervention control group. The primary outcome of interest was hypothermia incidence in preterm infant that can be obtained from axillary temperature in baseline temperature or poststabilization temperature (Figure 1).

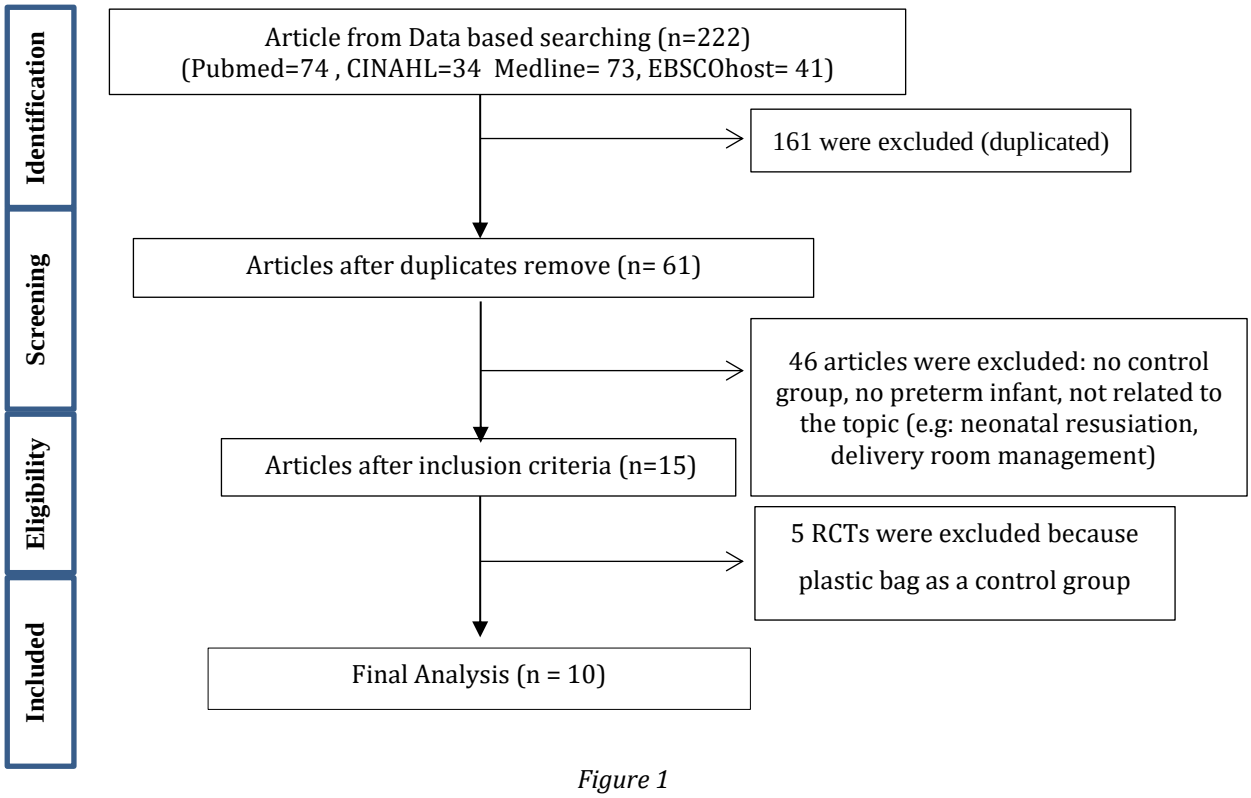

Figure 1
Flowchart of search strategy

RESULTS

This study included 10 trials with total number of samples is 1704 preterm neonates. All studies have comparison group, which are the most studies compare with routine care or standard thermal care, only Mathew et al [8] that using the Vinyl bags compared to thermal mattress. Eight out of ten trials reported on the outcome on post stabilization temperature and incidence of hypothermia. Meanwhile, one trial reported only on the hypothermia and the other in post stabilization temperature (Table 2).

Table 2
Data Extracting (n =10)

Source	n	GA	Design	Intervention	Control	Outcome	Major finding	AR
Doglioni et al., (2014)	100 (IG = 50, CG = 50)	< 29 weeks	RCT	Poyethylene wrap with total body (body and head)	Cover only the body	Baseline themperature and hypothermia	The hypothermia incidence= significant (12% vs 20%) Baseline temperature: n.s.	0%
Leadford et al., (2013)	104 (IG = 49, CG = 55)	26-34 weeks	RCT	Polyethylene bag	Standard thermal care	Post-stabilization temperature, hypothermia incidence	Post-stabilization (1 hour °C = significant (36.56 °C vs 36.1 °C) Hypothermia incidence = significant (59.2% vs 32.7 %)	0 %)
Reilly et al., (2015)	801 (IC = 404, CG = 397)	24 – 28 weeks	RCT	Poyethylene occlusive wrap	Conventional care	Baseline temperature, Poststabilization temperature	Baseline temperature = significant (36.3 °C vs 35.7 °C) Post-stabilization temperature = significant (36.6 °C vs 36.2°C)	1.4 %)
Smith et al., (2013)	92 (IG= 43, CG= 49)	< 29 weeks	RCT	Wrapped with Neowrap	Radiant warmer	Baseline temperature, Poststabilizati temperature,	Baseline temperature = n.s Post-stabilization temperature (2h°C) = significant (36.15°– 37.03°C vs 35.81° 36.75°C)	3%
Mathew et al., 2013	41 (IG=21, CG=20)	23-28 weeks	RCT	ViDrape Isolation bag (Vinyl bag)	Transwarmer mattress	Post-stabilization temperature	Post-stabilization = significant (36°C ± 0.4°C vs 35°C ± 1.3°C)	0%
Hu et al., (2017)	108 (IG = 5, CG = 54)	Not mentioned < 1500 gr	RCT	Standard thermoregulation and polyethylene plastic bag	Standard thermoregulation	Post-stabilization temperature and moderate hypothermia	Post-stabilization temperature = significant (36.4 ± 0.4°C vs 35.9±0.9°C) Moderate Hypothermia = significant (3.7 vs 27.8%)	1.8 %
Riaz et al., (2018)	200 (IG =100, CG = 100)	< 37 weeks	RCT	Plastic bag	Conventional method	hypothermia	Hypothermia = significant (45% vs 69%, *p* = 0.0000)	0
Mohamed et al., (2020)	100 (IG =50, CG = 50)	< 37 weeks	Quasi-experimental	Polyethylene cap	Routine care	axillary temperatures (2 h after admission), hypothermia	Hypothermia = significant (26% vs 62%) 2h °C = significant (36.59 ± 0.63 vs 35.83 ± 1.26 °C)	0
Ramawati et al., (2018)	11 (IG = 5, CG= 6)	< 37 weeks	quasy expertment	Plastic bag wrap	Routine care	Axillary temperature (t admission and at 1 and 2 h after admission)	1h°C and 2h °C = n.s	0
Nimbalkar et al., (2019)	151 (IG = 74, CG = 77)	< 34 weeks	RCT	Radiant warmer and polyethylene bag	Radiant warmer and warm cloth	Axillary temperature and hypothermia incidences	Hypothermia = significant (67.6% vs 87%) Mean axillary temperature = significant (*p* = < 0.001)	1.95%

Note: AR = Atrittion Rate; CG= control group; GA = Gestational Age; IC= intervention group; n.s = not significant; RCT = Randomized Control Trial

Nine out of ten trials revealed that plastic bag wrapping was associated with a declined hypothermia incidence and the higher temperature on post stabilization temperature (1- 2 hours after wrapping) compared with routine care or other thermal care. The majority of study stated that plastic bag whether it is polyethilene bag or Vynil bag are considered as an effective and safe additional intervention for preventing hypothermia in preterm infant. However, one study from Ramawati et al [9] revealed that there is no difference in hypothermia incidences and temperature post and post-stabilization temperature between plastic bag wrap and control group. Beside that one trial reported no significant in baseline temperature difference, but the hypothermia incidence was lower in intervention group[10]

For the premature neonates and plastic wrap procedure, most studies included the preterm neonates having gestational age <28 weeks of gestational age. The majority of study apply the intervention within 1 to 2 hours after birth. Unfortunately, this study found six trials reported the incidence of hyperthermia in the wrapped group ([8,10–14]. For the withdrawal rate, most studies have no withdrawal rate. All studies applied this intervention have short follow-up that only 1 hour to 2 hours after plastic wrapping, so it can be high possible that the total sample before and after intervention are similar.

DISCUSSIONS

This study displayed that most studies showed that plastic bag is effective for preventing hypothermia incidence. According to a metanalysis by Li et al [15] the effectiveness of plastic bags in reducing incidence of hypothermia as 70% (RR= 0.70, 95%CI 0.63 to 0.78), obtaining higher baseline temperature that 57% (RR 0.57, 95%CI 0.40 to 0.73) and obtaining poststabilization temperature 45% (RR 0.45, 95%CI 0.37 to 0.53). Unfortunately, this study found three studies reported no differences between intervention and control group. This finding is possible due to heat loss immediately through evaporation from infants' skin when the premature neonates were unwrapped for a while to auscultation procedure and resuscitation access. Limited sample in the trial also might be a possible cause for this insignificant finding.

Plastic bag wrapping can help to prevent hypotermia especially in preterm infant by protecting infants from heat loss through radiation, evaporation and convection[16]. The plastic bag wrap prevent the evaporative heat loss by trapping the thin layer of the air and the high humidity and increased the vapor pressure resulting in further evaporative losses preventing. Also, all the exposed area of the plastic bag and the infant skin is transparent that can prevent the heat loss from radiation [17]. Abiramalatha et al., [18] reported a metanalysis using Surface Under the Cumulative Ranking Curve value (SUCRA) showed the most effective intervention for hypothermia prevention is plastic bag or wrap combined with a heating mattress that can reduce 89.1% risk of hypothermia and improve core temperatures at admission or within two hours of life. Beside reducing hypothermia, plastic bag wrapping also can reduce the risk of mortality and brain injury for premature infant [18].

Another interesting finding was the characteristic of the preterm infant especially the gestational age. All studies include the preterm infants having gestational age <28 weeks as participant in plastic bag wrap group. Previous metanalysis of plastic bag wrap [15] stated that the plastic bag is effective in preventing hypothermia for preterm infant who were less than 34 weeks, however McCall et al [6] in previous systematic review stated that plastic bag wrap were effective in reducing heat loss in preterm infant less than 28 weeks of gestational age during admission in NICU. Also, the majority of study apply the intervention in the 1 to 2 hour. Belsches

et al [16] demonstrated an absolute risk reduction of 13% hypothermia 1 hour after birth (RR 0.82, 95% CI 0.69 to 0.99, p<0.026) by placing wet into a plastic bag for 1 hour after birth, but then received standard thermoregulation care. Leadford et al [19] demonstrated a 26% absolute risk reduction in preterm (26–36 weeks) or low birthweight (1000–2500 g) infants placed into a plastic bag at birth after brief drying.

Several studies report that the plastic bag wrapping can induce the hyperthermia. Six studies reported the incidence of hyperthermia in the wrapped group, but it occurs in small quantities of the sample [8,10–12,14,17]. Hyperthermia occurred in most studies that combined plastic and warmer mattresses. Abiramalatha et al [18]displayed direct evidence that a plastic bag or wrap with a warmer mattress may increase the risk of hyperthermia. Hyperthermia is considered mild adverse effect because it can disappear immediately within 1 to 2 hours after unwrapping the preterm infant [20]. Therefore, plastic bag remains safe to be applied in premature neonates.

Polyethilene bag and Vinyl Bag are both are the most commonly used of occlussive barrier to prevent hypothermia. The mechanism of this occlusive barrier is similar with skin to skin contact with the mother which is one of the essential neonatal care recommended by WHO [19]. Previous study compared the polyethylene bag and Vinyl bag for preventing hypothermia in preterm infant[21] Çağlar et al [21]reported wrapping preterm infants of gestational age ≤ 32 weeks in vinyl bags immediately after birth is associated with lower incidences of hypothermia compared with the polyethylene bag, however it had not insufficient evidences. Generally, both of those kind of plastic bags are effective to prevent hypothermia in preterm infant. To prevent the adverse event of plastic bag wrap including hyperthermia, the temperature monitoring is highly recommended in every 30 minutes during the plastic bag wrap[22]

Plastic bag can be wrapped to preterm infant immediately after the birth until 1 hour to 2 hours. The majority of the studies applied the plastic bag to cover all body of infant excluding neck and head immediately following birth. There was no drying infang first before placing the infant into the plastic bag for at least 20 minutes until 1 hours or until reaching the nornothermia [23]Lester et al [24]also stated that plastic bag wrap can decrease the hypothermia by wrapping the infant at least 15 minutes for infant with normotheria and at least 1 hour for preterm infant with the hypothermia. There was still no standardization of the type of plastic wrapping that can be used, using the hat or not, and the ambient room temperature [23].

One of the standard thermal cares in neonatology unit is using the incubator, meanwhile for the low-resource hospital setting, it might be as barrier, because of insufficient availability of incubators. Overcoming these difficulties, the use of plastic bag significantly reduced hypothermia and its use will be effective in the hospitals that have minimal resources. The use of plastic bag is easy to implement, because it is effective, inexpensive and simple interventions to prevent hypothermia [16] Belsches, et al [16] reported plastic bag wrap is made from polyethylene plastic that is widely available. the prices for plastic bag about 3 cents US $/pouch (500 -600 IDR/plastic bag). Although the plastic bag is affordable, the application of plastic bag remains infrequent in the rural or remote setting. Also, because incorect application including wrong placement of preterm baby into plastic wrap might cause harm, so it is recommended to be provided in the health care setting with highe skill of health professional [24].

CONCLUSION

Plastic bag wrap using polyethilene immediately after the birth for 1-2 hours could be considered as an effective and safe additional intervention to prevent hypothermia in after delivery and during NICU admission for preterm neonates which have less than 34 weeks of gestational age. Considering the hyperthermia may be happen during the plastic wrapping, the temperature monitoring should be applied regularly. Future trials are recommended to perform better-designed studies and examine the long follow-up outcome, such as infant mortality and morbidity after plastic wrapping.

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