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Combination of Polyethylene Terephthalate Nesting and Prone Position at the Standard Box Care to the Vital Signs and Length of Stay on the Low Birth Weight Babies

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ABSTRACT
Background: The use of nesting and prone position conditioned Low Birth Weight (LBW) babies as the mother's womb that helped in the development of physiological functions and achieve physiological function stability. This study aims to test the effectiveness of designed nesting with polyethylene terephthalate materials and the position of prone with standard care using a box of baby warmers for the length of stay which is observed from the achievement of the stability of vital signs on LBW.
Methods: This is a quasi-experimental design study with non-equivalent control group design. The study population was all LBW treated in the Perinatal room with a sample of 36 LBW selected consecutively from newborns at RSUD RAA Soewondo Pati and RSUD Dr. R. Soetrasno Rembang.
Results: The combination of nesting polyethylene group with position prone achieved faster vital signs stability and shorter duration of treatment compared to the control group with p = 0.001 for temperature, respiration and oxygen saturation.
Conclusion: The combination of polyethylene terephthalate nesting and prone position is effective to reduce the duration of treatment and achieving the stability of vital signs of low birth weight infants. This intervention can be used as LBW care during hospital and home care.
Keywords: nesting, position prone, polyethylene tread, length of stay, baby vital signs
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1. Introduction

Newborn babies experience very rapid environmental changes, from intrauterine to extrauterine maternal environment. A significant difference between intrauterine and extrauterine conditions requires the baby to adapt, which becomes more difficult in high-risk infants such as LBW (Erb and Berman, 2009; Hockenberry and Wilson, 2018). Problems that often arise in the process of adaptation occur in the respiratory, neurology, cardiovascular, hematological, gastrointestinal, kidney and thermoregulation system as LBW infants are very susceptible to hypothermia due to the thin fat reserves under the skin and the immaturity of the heat-regulating center in the brain (Trihono et al., 2013). Therefore, LBW infants requires a longer time for hospital care than newborns with normal weight. The process of the long duration of treatment can increase morbidity and require higher maintenance costs (Khashu et al., 2009; Shapiro-Mendoza et al., 2006; Tomashek et al., 2006; Artana, 2016).

LBW infants can adapt as well as term newborns if given the environment and needs and treatments that resemble the condition in the womb (Trihono et al., 2013; World Health Organization and others, 2004). Various programs in NIDCAP are carried out to support the process and development of premature and LBW infants, including nesting and developmental positioning (Efendi and Rustina, 2013). Nesting is the use of tools shaped like conditions in the mother's womb that aim to maintain the baby's flexy position. Although various forms of nesting have been applied in hospitals, improper design can interfere the baby's comfort during sleeping and may affects the respiratory stability, pulse and infant oxygen saturation (Irva et al., 2016). In addition to nesting, the position of the baby has an effect on the stability of the physiological and neurological functions of the baby (Kahraman et al., 2018). Although the position of supine creates more pain and distress score than other positions, however, any potential adverse effects can be corrected or prevented through the use of support positioning. Prone positioning provides effective support for the development of neuromuscular and improve hand to mouth activities and comforts the premature or LBW infants (Comaru and Miura, 2009; Eichenwald and Stark, 2008).

This study aims to test the effectiveness of designed nesting using polyethylene terephthalate material and prone position with standard care using a box of baby warmer. The polyethylene terephthalate material was chosen considering its ability as thermal conductor in preserving temperature for the LBW newborns. The nesting was designed to maintain the newborns in her/his flexy position which beneficial in avoiding thermal lost and to provide the comfort in order to establish a stable respiratory system. The prone position maintains the newborn's head in a lower position than her/his feet to regulate better oxygen saturation to the brain. The vital signs are observed to determine the duration of hospitalization for LBW infants.

2. Method

This was a quasi-experimental with nonequivalent control group design. The treatment group received a combination of nesting polyethylene terephthalate and prone position whereas the control group were given standard care for LBW infants with baby warmers. A total of 36 LBW newborns treated in perinatal room of RAA Soewondo Pati Hospital and Dr. R. Soetrasno Rembang who were selected consecutively and divided into two groups equally. The study was conducted between May 8, 2018 to June 31, 2018.

Pre-test was conducted by measuring the temperature, pulse, respiration rate and oxygen saturation during one minute respiratory. Intervention was given for 20 minutes for four days during hospitalization. Post-test was conducted to measure the similar vital signs of the newborns. Axilla body temperature was measured using calibrated digital thermometer and expressed in Celsius, ranged from 36.5 to 37.5°C to be defined as normal temperature. Calibrated oximetry was used to measure pulse and oxygen saturation; defining 120-160 pulse, 30-60 respiratory and 95-100% oxygen saturation per minute as normal.

As respiration rate and oxygen saturation were not normally distributed and all variables in each group were homogeneous, Wallis test was employed to test the differences of observed variables between intervention and control group while Wilcoxon test was practices to compare the difference outcomes in each group.

3. Result

Statistical test results showed that there was a significant difference of temperature before and after given a combination of nesting polyethylene terephthalate position prone at LBW on the first day of treatment with a significance value of 0.001 and an average increase of 0.2ºC (Table 1). There was no significant difference between the pulses before and after given a nesting combination of polyethylene terephthalate prone position in LBW with a value of $p = 0.183$ and a decrease in the mean pulse of 2 times / minute. The results showed the average pulse frequency experienced a slight decrease. However, the results of the statistical analysis show that there is no significant difference between the decrease in the mean pulse frequency. Polyethylene terephthalate material and prone position provided a significance difference on the vital signs of the newborns, shown by a p-value of 0.001 and a decrease in the average respiration 3 times/minute. It also affected oxygen saturation of LBW infants (p= 0.001), evidenced by an average increase in oxygen saturation by 0.2%.

Table 1. Body temperature, pulse, respiration and oxygen saturation of LBW on days I, II, III, IV

Day	Temperature						**p-value
	Combination 1			Control			
	Mean±SD	Min-max	*p value	Mean± SD	Min-max	*p value	
Day I	36,6± 0,09	36,5-36,8	0,000	36,6± 0,13	36,5-37,0	0,003	0,001
Day II	36,8± 0,08	36,7-37,0	0,968	36,6± 0,14	36,5- 37,0	0,014	0,119
Day III	36,8± 0,00	36,8-36,8	0,102	36,7± 0,19	36,6- 37,1	0,107	0,642
Day IV	36,9± -	36,9- 36,9	-	36,7± 0,00	36,7- 36,7	0,317	0,632
				Pulse			
Day I	145± 4,50	140-156	0,355	141± 2,15	140-148	0,270	0,242
Day II	144± 2,09	140-148	0,485	142± 2,59	140- 148	0,591	0,089
Day III	142± 1,00	142-144	0,141	143± 2,27	140- 146	0,564	0,269
Day IV	140± -	140- 140	-	147± 1,41	146- 148	0,180	0,325
				Respiration			
Day I	47± 3,85	40- 56	0,001	42± 2,74	40- 48	0,856	0,001
Day II	43± 2,10	40- 48	0,002	42± 2,33	40- 48	0,084	0,136
Day III	43± 1,91	42- 46	0,414	43± 2,27	40- 48	0,623	0,433
Day IV	40± -	40- 40	-	43± 4,24	40- 46	1,000	0,325
				Oxygen saturation			
Day I	96± 0,85	95- 98	0,000	96± 1,61	36,5-37,0	0,004	0,001
Day II	99± 0,85	97-100	0,001	98± 1,36	36,5- 37,0	0,005	0,001
Day III	100± 0,00	100-100	0,083	98± 1,36	36,6- 37,1	0,008	0,085
Day IV	100± -	100- 100	-				

* Wilcoxon test **test Kruskal Wallis

Among the newborns in the control group, the temperature changes before and after being given the heating box method showed that there was a significant difference between the temperature before and after being given the heating box at LBW with a significance value of 0.001 with an average increase in temperature of 0.1ºC . Nevertheless, there was no difference in the pulse, respiration and oxygen saturation before and after the newborns were placed in the baby warmer box. The results confirmed that the combination group was more effective in achieving temperature stability, respiration and oxygen saturation than the control group on the first day.

4. Discussion

The combination of nesting with polyethylene terephthalate material and the position of prone affect the vital signs such as temperature, pulse, respiration and oxygen saturation in LBW infants. As LBW has an unstable body temperature and tends to experience hypothermia (temperature <36.5°C), nesting with polyethylene terephthalate materia as a good thermal conductor can maintain temperature stability. The prone position also reduced the probability of heat loss because it lower the body's metabolism and reduce the amount of heat loss. In the prone position, the baby faced the blanket or bed to prevent excessive air exposure and allow a decrease in heat loss through the radiation process. The results correspond to previous studies with 3 LBW subjects given nesting, infants experienced an average increase in body temperature on the third day after being given interventions with a temperature of 36.7°C (Hegner, 2003; Bayuningsih, 2011).

The process of changing the pulse rate is influenced by changes in heart rate to stimuli caused by the sympathetic nervous system and parasympathetic nerves. Sympathetic stimulation can increase the speed of the heart rate such as when the body is awake or anxious, while parasympathetic stimulation can reduce the speed of the pulse as in a calm sleep condition (Als, 1986; Aylott, 2006). The baby's pulse rate is different when sleeping calmly and awake. The baby's pulse tends to decrease when in a calm sleep state. In this study the pulse rate decreased to 142 times/minute, wherein this phase the baby was in a state of calm sleep. During this calm sleep phase there is a decrease in peripheral vascular tone and arterial blood pressure, decreased pulse frequency, dilatation of skin blood vessels, sometimes increased gastrointestinal activity, and muscles are experiencing a complete resting state (Guyton and Hall, 1990). While this study obtained a lower pulse frequency after being given an intervention because at the time of intervention the respondent was in a slow wave sleep condition, the results are similar to research conducted on premature infants in comparing pulse frequency with nesting and prone position, which showed that there was no significant difference between pulse frequency and nesting and prone position, with p values of 0.087 and 0.236 (Kahraman et al., 2018).

The mean respiration in this study decreased 4 times per minute (normal respiration in infants is 30-60 times per minute) as many babies with LBW need supplemental oxygen and ventilatory assistance. However, the position of prone in the baby can increase tidal lung volume, lung development and breathing become more regular (Maynard et al., 2000). Nesting that gives a sense of comfort provides a stimulus to the hypothalamus which can release corticotropin-releasing factor (CRF) and also endorphins that can provide a sense of calm in the baby which causes a change in respiratory rate (Gouna et al., 2013). When the LBW infants are in a comfortable condition and relax, the breathing pattern will become regular and will experience a decrease when in the calm phase of sleep (Hockenberry and Wilson, 2018; Zen, 2018).

The findings of the study revealed that there were significant differences in oxygen saturation values between nesting positions and prone positions with an average increase of 96% oxygen saturation. This results similar to previous studies on the state of organ immaturity in LBW infants that may cause the newborns to have an oxygen saturation level below 90% (Bayuningsih, 2011). The results of other studies also explained that there was a significant difference between oxygen saturation and the prone position (Maynard et al., 2000).

The use of baby box warmers affected the duration of hospitalization that was measured by the changes in the newborns' temperature, pulse, respiration and oxygen saturation. The result corresponds with previous study that found there was a linear relationship between temperature and power (Setyaningsih and Wahyunggoro, 2015). Baby boxes with lights as heating are one of the essential components that must be present to provide warmth to the baby. In infants with less birth weight and premature babies, an increase in body temperature will increase metabolism in the body and will affect the need for increased oxygen consumption (Pantiwati, 2010). The results of the study explained that the use of baby boxes with heating lamps significantly affected the baby's body temperature but did not affect respiration and frequency (Ng et al., 2017; Pfohl and Uphold, 1991).

The difference in the effectiveness of the combination of nesting polyethylene terephthalate and position-prone affected the duration hospitalization, observed from the achievement of temperature, pulse, respiration and oxygen saturation in LBW. Previous research conducted on the effect of use nesting on LBW showed that there was a significant decrease in the duration of treatment with an average duration of treatment for 5 days (Hendricks-Muñoz et al., 2002). Other study suggest that the position of prone with nesting facilitation greatly affects the improvement of oxygen saturation, lung development, chest wall development and decreased incidence of apnea in premature infants (Picheansathian et al., 2009). Different studies related to the prone position in LBW and preterm infants with oxygen saturation showed a decrease in pulse frequency and respiratory frequency (Zen, 2018). The results of the study on the position of the baby explained that the position of prone decreases the respiratory frequency and increases oxygen saturation in infants and produces better analgesic effects than position supine. The results of research on nesting use in LBW by observing impromptu movements in infants and evaluating posture and movement in infants who do not use nesting whereas infants with nesting experience a lower incidence of impending movements compared to infants who do not use nesting (Ferrari et al., 2007).

Conclusion

The combination of nesting polyethylene terephthalate and position is prone more effectively applied to achieve temperature stability, respiration and oxygen saturation at LBW and reduce the duration of treatment.

Conflict of Interest

There is no conflict of interest. Nothing to disclosure.

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