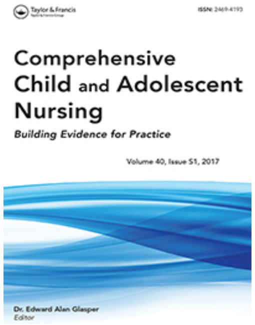

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The Quarter Prone Position Increases Oxygen Saturation in Premature Infants Using Continuous Positive Airway Pressure

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ABSTRACT

A primary problem that occurs in premature infants is oxygenation disorders, thus requiring respiratory support, including continuous positive airway pressure (CPAP). The effectiveness of CPAP can be improved by adjusting the body's position, so the aim of this study was to examine the effect of the quarter prone position on the oxygenation status of preterm infants using CPAP. This study used a randomized controlled trial with a crossover design. A group of 15 preterm infants receiving CPAP was selected, and randomization of allocation was done to divide the respondents into the intervention group (quarter prone) or the control group (supine). Oxygenation status was measured using an observation form, and the result showed a significant difference in the oxygen saturation levels of premature infants using CPAP in the quarter prone group compared to that in the supine group ($p = .045$). The quarter prone position was effective for improving the oxygenation status of premature infants using CPAP. It is recommended that the quarter prone position be applied as part of nursing care in neonatal nursing.

KEYWORDS
CPAP; oxygenation status; premature; quarter prone

Introduction

Respiratory Distress Syndrome (RDS) is the most common cause of death in premature infants, as they have a surfactant deficiency, so the respiratory system's adaptation to the extra uterine environment is disturbed (Course & Chakraborthy, 2015). The incidence of respiratory distress in newborns is found to be up to 7% of births and occurs primarily in premature infants (Hermansen & Mahajan, 2015). In Indonesia, the main cause of death in neonates aged 0–7 days is a respiratory problem, at a rate of about 35.9% (Badan Penelitian dan Pengembangan Kesehatan Depkes RI, 2008). This creates a challenge for health workers in carrying out respiratory distress interventions in premature infants to help them survive.

RDS can be managed in premature infants with non-invasive methods, such as continuous positive airway pressure (CPAP). The use of CPAP can

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improve the function of the diaphragm, increase compliance, reduce pulmonary resistance of the upper and lower respiratory tracts, prevent atelectasis, maintain surfactant inventories, limit the use of mechanical ventilation, and reduce mortality (Course & Chakraborthy, 2015; Esmaeilnia, Nayeri, Taheritafti, Shariat, & Moghimpour-Bijani, 2016).

The effectiveness of respiratory support can be improved by adjusting infants' sleep positions. The prone position is beneficial in lowering the heart rate and respiratory rate in children receiving nasal CPAP (Ghorbani, Asadollahi, & Valizadeh, 2013). Besides having numerous advantages, the prone position also has some drawbacks. Sleeping in the prone position can increase the incidence of sudden infant death syndrome (SIDS), edema of the face, the position of subcutaneous lesions of the cornea, loss of vascular access, injuries and developmental delays of the hips and shoulders (American Academy of Pediatrics, 2011; Antunes, Rugolo, & Crocci, 2003; Monterosso, Kristjanson, Cole, & Evans, 2003). The aim of this study is to identify the effect of the quarter position on oxygenation status, including the oxygen saturation, respiratory rate and heart rate of premature infants, using CPAP.

Methods

This study used a randomized controlled trial with crossover design. Respondents were premature infants who were admitted to the neonatal intensive care unit (NICU) and perinatology unit at two top referral hospitals in Jakarta from May–June 2017. Therefore, the researchers processed 15 premature infants, and randomization was performed using a random table to divide the respondents into an intervention group and a control group first. Subjects in the intervention group were placed in the quarter prone position, while those in the control group were placed in the supine position. The intervention lasted for 3 hours, followed by the measuring of oxygen saturation, respiratory rate, and heart rate using the bedside monitor at 30, 45, 60, 75 and 90 minutes. After 3 hours, each baby's position was changed to another position according to allocation randomization, then the same measurements were taken. The tool for data collection was an observation sheet designed by the researcher, and there was a shared understanding among the research assistants regarding how to complete it.

This research was conducted with ethical clearance from the Nursing Faculty of Universitas Indonesia and the Ethics Committee of Medicine Faculty Universitas Indonesia, protocol number 17-04-0339, and informed consent was obtained from the parents.

The sample size was determined with a sample size formula to compare two dependent means. The inclusion criteria were premature infants with a gestational age of ≥ 28 weeks to < 37 weeks and using CPAP; who do not have a congenital disorder that is a contraindication to changing positions;

Table 1. Characteristics of the 15 premature infants included in the study.

Variable	Mean (SD)	Range	*n*	%
Gestational Age (weeks)	32.07 (2.82)	30.80–33.33		
Birth Weight (grams)	1,352.47 (265.47)	1,205.33–1,499.60		
Current Weight (grams)	1,416.67 (246.82)	1,279.98–1,553.36		
Postnatal Age (days, median)	11	0–45		
Duration CPAP (days, median)	3	1–11		
Gender				
Male			10	66.7
Female			5	33.3
Type of Delivery				
Spontaneous			5	33.3
Caesarean Section			10	66.7

who do not have contraindications to being placed in the quarter prone position, such as post-surgery; and who have no fractures of the pelvis or long bones. The exclusion criteria were premature infants who showed a worsening oxygenation status, such as recurrent apneic episodes requiring stimulation; increased work of breathing (sternal and intercostal recession; grunting; and tachypnea).

First, the characteristics and oxygenation status of the respondents were analyzed using a univariate analysis. In addition, the bivariate analysis was applied to identify the differences between the oxygenation status means using Wilcoxon and Paired *t* test.

Results

The characteristics of 15 premature infants are shown in Table 1. The main results of this study indicate there is a significant difference between the oxygen saturation in premature infants using CPAP in the quarter prone group compared to that in the supine group ($p < .05$; Table 2). The results show there is no significant difference between the respiratory rates of premature infants using CPAP in the quarter prone and supine positions ($p > .05$). The results also show there is no significant difference between the heart rates of premature infants using CPAP in the quarter prone and supine positions (Table 3).

Discussion

Premature babies who were born before 34 weeks' gestation often have respiratory distress syndrome due to pulmonary surfactant deficiency

Table 2. The differences in the average score of oxygen saturation in premature infants using CPAP.

Variables	Median (Min–Max)	*p* value
Intervention	98.80 (93.00 to 100.00)	.045
Control	97.80 (89.00 to 100.00)	

Table 3. The differences in the average score of respiratory rate and heart rate among premature infants using CPAP.

Variable	Mean (SD)	Range	*p*
Respiratory Rate			
Interventions	46.07 (4.91)	3.76–5.04	.760
Control	46.71 (8.21)		
Heart Rate			
Interventions	150.28 (20.08)	6.62–13.28	.484
Control	153.61 (13.96)		

(Hermansen & Mahajan, 2015). Because of an inadequate surfactant level, the lungs will collapse at the end of each expiration, making it difficult for them to expand again, so the baby must provide strong pressure on every breath (Bowden & Greenberg, 2014). This is compounded by the condition of the respiratory muscles, which are still weak. CPAP provides positive pressure, so it helps premature babies whose lungs tend to collapse at the end of expiration (Kattwinkel, 2011). There was a significant association between birth weight and respiratory rate. In addition, an increased age means the lungs produce more surfactants, which can decrease the baby's attempts to meet oxygen requirements. In contrast, in infants of a younger gestational age, the amount of surfactants is lesser, so increased effort to breathe, a faster respiratory rate, chest retractions, and grunting are signs of respiratory distress.

Newborns need to adapt to the extra uterine environment, which differs greatly from the intrauterine environment. The breathing process is stimulated by chemical factors and temperature changes, but some infants fail in the adaptation process. About 10% of newborns need assistance to begin breathing at birth (Kattwinkel, 2011). Premature infants also have low birth weight, their skin has a thin layer of fat, and their body surface areas are greater than their weights, so they are vulnerable to heat loss, increasing metabolic requirements (Kattwinkel, 2011; Rustina, 2015).

This study illustrates that the average current weights of premature infants using CPAP do not differ much from the average birth weight. Infants who have a low birth weight will lose approximately 10% of their body weight immediately after birth in the first few days, but they then gradually gain weight between 7 and 14 days after birth (Perinasia, 2015). This condition causes babies to be at risk of hypothermia due to the lessened heat production and heightened heat loss. This increases the need for more oxygen, which can cause respiratory problems in infants.

Premature infants who use CPAP are primarily male, leading to an increased risk of RDS in males, which is due to the differences in hormonal regulation in lung development between men and women (Anadkat, Kuzniewicz, Chaudari, Cole, & Hamvas, 2012). Besides, most premature infants who use CPAP are born by caesarean section, and these babies are at risk of developing RDS. This is due to the anesthesia, as the infants did not have experience with chest compressions at birth (Fanny, 2015).

There is a significant relationship between the duration of use of CPAP and respiratory rates, and it relates to the benefits of using CPAP in premature infants who have RDS to maintain positive pressure in the airways during spontaneous breathing. Premature infants who use CPAP will show signs of improvement, such as decreases in the frequency of respiration and need for oxygen.

The main results of this study indicate there is a significant difference between the oxygen saturation in premature infants using CPAP in the quarter prone group and that in the supine group. Oxygen saturation is a percentage of oxygenated hemoglobin in the blood (Hockenberry & Wilson, 2013), which plays an important role in binding oxygen to each molecule. The results of this study are supported by other research studies that have identified better oxygen saturation in the quarter prone position than in the supine position (Hough et al., 2012).

Infants who sleep in the quarter prone position have the greatest influence of gravity. This position makes a difference in the gravitational effects of ventilation and perfusion from the top to the bottom of the lung (Sherwood, 2014). However, gravity has only a small effect on the regional distribution of ventilation in preterm infants who use CPAP, because it is influenced also by the anatomical pattern of the respiratory system (Hough et al., 2012). The posterior part of the lung has a greater ventilation distribution than the anterior, so the quarter prone position maximizes the ventilation distribution.

Adjusting infants' sleep positions is one application of the Levine Conservation Models. Nurses can help the adaptation process of premature infants to achieve wholeness through the principles of conservation. The quarter prone position supports the principle of the conservation of energy, so infants can save energy through a flexion sleeping position, as in the womb. In addition, the quarter prone position can provide comfort in premature infants and increase oxygen saturation.

The results show there is no significant difference between the respiratory rates of premature infants using CPAP in the quarter prone and supine positions. The results of this study differ from those of previous research studies that identified that the respiratory rates of premature infants in the quarter prone position were lower than those in the supine position (Montgomery, Choy, Steele, & Hough, 2014; Yin, Yuh, Liaw, Chen, & Wang, 2016). This may be related to the small sample size in this study. It would be useful to perform more studies with a larger sample size. Although significant differences in the frequency of breathing do not appear, the mean respiratory rate in the quarter prone position is still within the normal range. The respiratory rate was measured 30 minutes after changing positions to stabilize the breathing of preterm infants using CPAP. The breathing pattern in the prone position is efficient, because the movement of the chest wall is more stable, leading to a synchronized thoracoabdominal (Gouna et al., 2013).

The results also show there is no significant difference between the heart rates of premature infants using CPAP in the quarter prone and supine positions. The results of this study differ from those of other studies that identified the heart rates of premature infants who used CPAP in a prone position as lower than those in a supine position (Ghorbani et al., 2013). This difference may be caused by the differences in the characteristics of infant gestational age and by the fact that the data were collected after feeding; in previous studies, participants were nothing per oral (NPO). Even though there was no significant difference, it was identified that the average heart rate in the quarter prone group was lower than that in the supine group.

Conclusion

The quarter prone position is effective in improving the oxygenation status of premature infants using CPAP, especially oxygen saturation, and it is expected to be applied by nurses as an independent action when caring for infants using CPAP.

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Declaration of interest

The authors report no conflicts of interest.

References

American Academy of Pediatrics. (2011). SIDS and other sleep related infant death: Expansion of recommendations for a safe infant sleeping environment. *Pediatrics*, *128* (5), 1030–1039. doi:10.1542/peds.2011-2284

Anadkat, J. S., Kuzniewicz, M. W., Chaudari, B. P., Cole, F. S., & Hamvas, A. (2012). Increased risk for respiratory distress among white, male, late preterm and term infants. *Journal of Perinatology*, *32*, 780–785.

Antunes, L. C. O., Rugolo, L. M. S. S., & Crocci, A. J. (2003). Effect of preterm infant position on weaning from mechanical ventilation. *Jornal De Pediatria*, *79*(3), 239–244.

Badan Penelitian dan Pengembangan Kesehatan Departemen Kesehatan RI. (2008). *Laporan riset kesehatan dasar (Riskesdas) 2007*. Jakarta, Indonesia.

Bowden, V. R., & Greenberg, C. S. (2014). *Children and their families: The continuum of nursing care* (3rd ed). Philadelphia, PA: Lippincott Williams & Wilkins.

Course, C., & Chakraborthy, M. (2015). Respiratory support for preterm infants—the Cochrane evidence and beyond. *Pediatrics and Child Health*, *26*(4), 147–151.

Esmaeilnia, T., Nayeri, F., Taheritafti, R., Shariat, M., & Moghimpour-Bijani, F. (2016). Comparison of complications and efficacy of NIPPV and nasal CPAP in preterm infants with RDS. *Iranian Journal of Pediatrics*, *26*(2), 1–5. doi:10.5812/ijp.2352

Fanny, F. (2015). Sectio caesarea sebagai faktor resiko kejadian asfiksia neonatorum. *Majority*, *4*(7), 1–5. Retrieved from http://jukeunila.com/wp-content/uploads/2015/11/57-62-FADHILLAH-F.pdf

Ghorbani, F., Asadollahi, M., & Valizadeh, S. (2013). Comparison of the effect of sleep positioning on cardiorespiratory rate in noninvasive ventilated premature infants. *Nursing and Midwifery Studies*, *2*(2), 182–187.

Gouna, G., Rakza, T., Kuissi, E., Pennaforte, T., Mur, S., & Storme, L. (2013). Positioning effect on lung function and breathing pattern in premature newborns. *The Journal of Pediatrics*, *162*(6), 1133–1137. doi:10.1016/j.jpeds.2012.11.036

Hermansen, C. L., & Mahajan, A. (2015). Newborn respiratory distress. *American Family Physician*, *92*(11), 994–1002.

Hockenberry, M. J., & Wilson, D. (2013). *Wong's essentials of pediatric nursing* (9th ed.). St. Louis, MO: Elsevier Mosby.

Hough, J. L., Johnston, L. M., Brauer, S. G., Woodgate, P. G., Pham, T. M., & Schibler, A. (2012). Effect of body position on ventilation distribution in preterm infants on continuous positive airway pressure. *Pediatric Critical Care Medicine*, *13*(3), 1–6. doi:10.1097/PCC.0b013e31822f18d9

Kattwinkel, J. (2011). *Buku panduan resusitasi neonatus* (Edisi ke-6). Jakarta, Indonesia: Perkumpulan Perinatologi Indonesia (Perinasia).

Monterosso, L., Kristjanson, L. J., Cole, J., & Evans, S. F. (2003). Effect of postural supports on neuromotor function in very preterm infants to term equivalent age. *Journal of Paediatrics and Child Health*, *39*, 197–205.

Montgomery, K., Choy, N. L., Steele, M., & Hough, J. (2014). The effectiveness of quarter turn from prone in maintaining respiratory function in premature infants. *Journal of Paediatrics and Child Health*, *50*, 972–977. doi:10.1111/jpc.12680

Perinasia. (2015). *Manajemen bayi berat lahir rendah dengan perawatan metode kangguru*. Jakarta, Indonesia: Author.

Rustina, Y. (2015). *Bayi prematur: Perspektif keperawatan*. Jakarta, Indonesia: Sagung Seto.

Sherwood, L. (2014). *Fisiologi manusia dari sel ke sistem* (Edisi ke-8). Alih Bahasa, Indonesia: Brahm U.

Yin, T., Yuh, Y. S., Liaw, J. J., Chen, Y. Y., & Wang, K. W. K. (2016). Semi-prone position can influence variability in respiratory rate of premature infants using nasal CPAP. *Journal of Pediatric Nursing*, *31*(2), 167–174. doi:10.1016/j.pedn.2015.10.014