



Semi-Prone Position Can Influence Variability in Respiratory Rate of Premature Infants Using Nasal CPAP

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Objective To determine the effect of positions (supine, lateral, semiprone) on the physiological parameters (HR, RR, SpO₂) of premature infants receiving NCPAP who were non-oxygen-dependent and non-BPD, and to identify significant clinical changes associated with these variables.

Methods: A crossover study design with three different positions in the assigned sequence (supine–supine, supine–lateral and supine–semiprone) was used, and each position was maintained for 1 h. The subjects' vital signs were recorded 30 min after initiation of each position and measured for 30 min.

Results: Forty-seven infants with a median GA of 28.6 weeks (range 26–35) were studied, and their median BW was 1210 g (range 776–2920). Overall, position-related effects showed significant difference in the variability in RR (OR = 0.68; CI 0.51–0.89), with the variability in RR being significantly lower in the semiprone position. The lateral position was associated with increased RR ($B = 2.9; p = 0.02$). Previous use of ventilator (PUV) was associated with increased HR, whereas BW and GA were negatively associated with higher HR. Cesarean birth, use of surfactant and PUV were associated with lower SpO₂, whereas BW and GA were correlated with higher SpO₂. GA was identified as a protective factor, while PUV was a risk factor for the variability in both HR and SpO₂.

Conclusions: Premature infants receiving NCPAP sleeping in the semiprone position may have more stable RR, while the lateral position did not improve RR. Thus, the semiprone and supine positions may be considered preferable when positioning the monitored premature infants with NCPAP.

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Nasal Continuous Positive Airway Pressure (NCPAP) in Premature Infants

NASAL CONTINUOUS POSITIVE airway pressure (NCPAP) is used in the treatment of premature infants with

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low birth weight (LBW; defined as an infant born weighing less than 2500 g) to sustain their airway ventilation by projecting positive airway pressure continuously via nasal prongs (Bonner & Mainous, 2008). The NCPAP provides non-invasive ventilation support, maintains lung volume and improves ventilation (Buckmaster, Arnold, Wright, Foster, & Henderson-Smart, 2007). During NCPAP therapy, premature infants are usually provided nursing care in the supine position for the ease of managing medical equipment; however, they can sleep in any position given that care to prevent pressure ulcers is provided.

Literature Review

Position-Effects in Premature Infants

There are conflicting statements in the literature regarding which position is most appropriate and nurturing for LBW premature infants. The supine position for ready-to-be discharged premature infants has been recommended by national guidelines for the prevention of Sudden Death Infant Syndrome (SIDS) (Blair, Platt, Smith, & Fleming, 2006). The preferred practice of neonatal nurses, however, has been to position premature infants in the prone position when providing care in an attempt to increase oxygenation and decrease episodes of desaturation (Poets & Bodman, 2007). In addition, at the time of discharge, the parents of premature infants are often advised to use the lateral position for their child's sleeping because of the fear of aspiration when sleeping in the supine position (Aris et al., 2006).

The lungs of LBW premature infants are immature, making them at risk for alveolar collapse, decreased pulmonary residual volume, compromised ventilation and chronic lung diseases (Colin, McEvoy, & Castile, 2010). Many studies focusing on the care of premature infants have attempted to examine the position-related effects on vital signs such as cardio-respiratory activities (Bhat et al., 2003, 2006; Sahni et al., 2010), oxygenation (Kassim et al., 2007), lung functions (Saiki et al., 2009), and respiratory rates (Ammari et al., 2009; Malagoli, Santos, Oliveira, & Bouzada, 2012) and have shown positive outcomes.

There are mixed results from nursing LBW premature infants in the prone position. In the prone position, HR, body temperature and peripheral perfusion have shown increases which have been argued also to be one of the probable factors leading to SIDS (Sahni et al., 2010). Other clinical biomarkers improved as the result of prone position include oxygenation, functional residual capacity, thoracoabdominal synchrony, ventilation-perfusion ratio (V/Q ratio), reduced events of apnea, and promoting deep sleep. While lung compliance, tidal volume, respiratory rhythm and oxygenation are enhanced when sleeping in the prone position, the semiprone position (also known as the $\frac{3}{4}$ turn position) has also shown similar advantages on these parameters (Gillies & Wells, 2005; Hess, 2005). In the semiprone position, the premature infants are placed in a functional position that has similar advantages to the prone

position in that it can promote the synchronous movement of chest and abdominal respiratory muscles (Montgomery, Choy, Steele, & Hough, 2014).

Despite many studies investigating the positioning difference of prone and supine on premature infants, although rarely the semiprone position, there is a paucity of reports examining the effects of different positions on the physiological outcomes of premature infants receiving NCPAP. Thus, this study aimed to 1) determine the effects of three different positions (supine, lateral or semiprone) on the physiological parameters (HR, RR and SpO₂) of premature infants receiving NCPAP; and 2) identify predisposing clinical variables significant to the subjects' physiological parameters. We hypothesized that premature infants receiving NCPAP lying in the semiprone position will demonstrate improved vital signs (HR, RR and SpO₂) compared with those lying in the supine or lateral positions.

Ethics

This study was approved by the Institution Review Board of the Human Research Ethics Committee of the participating hospital and the parents gave informed written consent.

Patients and Methods

Study Design

We used a repeated measures crossover design to determine the effect of three different positions (supine, lateral and semiprone) on the physiological parameters (HR, RR and SpO₂) of premature infants receiving NCPAP (BP2001).

Sample

The required sample size of the study was determined based on a similar study by Kassim et al. (2007) where the primary outcome was functional residual capacity (FRC) between prone and supine positions. Given the mean levels of prone FRC and supine FRC of 23.38 (SD = 3.23) and 19.42 (SD = 5.05) respectively, with type I error rate (α) of 0.05 and type II error rate (1-power) of 0.80, a minimum sample size of 40 subjects was required (Kassim et al., 2007). The study had a purposive sample of 56 subjects, however nine subjects were removed (three subjects' parents withdrew from the study after initial consent, two subjects could not complete the three assigned position sequences due to emergency events, and four subjects had missing data). The inclusion criteria were that the subjects i) had a GA between 25 and 35 weeks; ii) were born in the previous 30 days; iii) had a BW less than 2000 g; iv) as confirmed by a pediatrician, had no congenital abnormality, inherited diseases, cardiopulmonary diseases including PDA, infectious or metabolic diseases; v) were not treated with respiratory drugs; and vi) were treated with use of 5 cm H₂O PEEP with room air. The exclusion criteria were i) being oxygen-dependent in sustaining an oxygen saturation of at least 92% (in line with the participated NICU protocol); ii) presence of any drugs (including oxygen) being used for improving ventilation; and iii) the inability to complete the sequence of assigned positions within one day.

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