Effects of Positioning on Respiration Rate, Heart Rate, and Oxygen Saturation in Preterm Infants During Feeding: A Cross-over Design

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Abstract: Positioning is important in preterm infants. Based on previous studies, the effects of positioning on respiration rate, heart rate and oxygen saturation are still controversial. This cross–over design aimed to compare respiration rate, heart rate, and oxygen saturation of preterm infants placed in four positions; a 10-degree head-elevated supine, prone, right lateral, and right anterior oblique positions, each for 3 hours, before and after orogastric feeding with breast milk. Purposive sampling was used to select 63 preterm infants at a tertiary hospital in the south of Thailand. All infants were placed in a 10-degree head-elevated supine first, then randomly allocated to either group 1 (with the sequence prone, right lateral, and right anterior oblique; *n* = 21), group 2 (with the sequence right lateral, right anterior oblique, and prone; *n* = 21), or group 3 (with the sequence right anterior oblique, prone, and right lateral; *n* = 21). Between each position, infants were placed in a supine position. The data were collected using a demographic data questionnaire and a record form for respiration rate, heart rate, and oxygen saturation of preterm infants which were assessed using a bedside monitor. Analysis of variance was used to analyze the data.

Results revealed normal ranges with no significant differences of the means of respiration rate, heart rate, and oxygen saturation among infants placed in the four positions before, immediately after, and after feeding. Thus, nurses need to consider our findings regarding their choice of positioning preterm infants before, during and after feeding. Further research is warranted in this area.

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Introduction and Background of the Study

An estimated 15 million infants are born preterm every year, and this number is rising.[1] The proportion of preterm birth ranges from 5% to 18% of preterm infants born among 184 countries.[1] In the United States, approximately 10% neonates are born prematurely and the rates of preterm birth are going up.[2] The proportions of live births of both preterm and full term with a weight lower than 2,500 grams reported by Ministry of Thai Public Health in 2015 was 10.6%.[3] The most common cause of admissions to the neonatal intensive care unit (NICU) of a tertiary hospital in the south of Thailand was prematurity and the percentages of preterm infants admitted in 2012-2016 were 38.7, 28.0, 47.0, 64.8, and 57.4, respectively.[4]

Preterm infants are those born before the beginning of the 38th week of gestation.[5] They are prone to problems that affect all systems, especially the respiratory system.[5] Preterm infants have immature lungs, a poorly developed cough reflex and narrow respiratory passages, which increase the risk of respiratory difficulty.[5] Physiologically immature, many preterm infants have a pliable thorax, immature lung tissue, and an immature regulatory center leading to periodic breathing, hypoventilation, and frequent periods of apnea.[6-7] Thus, they may have physiological problems such as a low respiration rate, irregular heart rate, low level of oxygen saturation, apnea, and increased gastric residual.[7-8] Proper positioning of the premature infant may solve those problems. Based on the anatomy-physiology of the respiratory system, head-elevated position causes abdominal organs to move lower, increases lung expansion, helps chest and abdomen movement simultaneously and smoothly, and increases lung vital capacity[7,9] resulting in infants having stable respiration rate and heart rate and improved oxygen saturation. The prone position increases oxygenation and enhances respiratory control, improves lung mechanics and volumes, and reduces energy expenditure.[5,7,10] The supine position increases standard deviation of heart rate above that in the prone position.[10] The left lateral position has been shown to improve oxygenation, lung mechanics, and breathing patterns.[10]

Based on previous studies, positioning either had effects or had no effects on respiration rate, heart rate, and oxygen saturation in preterm infants. Preterm infants placed in a lateral position during weaning ventilator had higher mean of oxygen saturation levels but no effects on heart rate and respiration rate.[11] Preterm infants placed in left or right lateral positions following feeding time had non-statistically significant differences but were more stable in mean oxygen saturation and heart rate,[12] and had a higher respiration rate than those placed in a supine.[12] However, those placed in the prone position had increased oxygen saturation,[13-14] more chest movement which was closely correlated with respiration,[13] reduced apnea episodes,[13] decreases respiratory distress[14] and decreased heart rate variability.[10,15] In the head-up 15-30 degree prone position, a greater increase in oxygen saturation than in a lateral position or supine position was reported.[16] A prone position can decrease premature infants' heart rate and respiratory rate, but a supine position might decrease them.[17] In very low birth weight neonates, the prone position made more desirable oxygenation and heart rate variability compared to the supine and left lateral positions.[18] Preterm infants who had symptomatic apnea or bradycardia and were placed in a supine position had a higher frequency of desaturation and had mild desaturation than did infants placed in a prone position.[19]

In contrast, none of the individual studies or the meta-analyses showed a reduction in oxygen desaturation, or bradycardia with body positioning.[20] No significant differences in breathing movements, heart rate, or oxygen saturation were found among preterm infants placed in supine with no head-elevation, supine with head-elevated 15 degrees, or elevation of the thorax as with the 15 degree-head up tilt position.[21] There was no statistical difference in oxygen saturation, heart rate, ventilation rate and behavioral distress of preterm infants with mechanical ventilation placed in prone, supine, left lateral and right lateral positions.[22] Near-discharge preterm infants placed in prone and supine positions had no significant differences in inspiration, elastic, or resistive work of breathing, respiration rate, tidal volume, minute volume, or lung compliance.[23]

The findings of previous studies provide inconsistent evidence for the effects of body positioning during feeding on respiration rate, heart rate, and oxygen saturation in preterm infants having different health status. Weaknesses of the studies included no comparison of some positions (e.g., such as supine vs. right lateral, supine vs. left lateral, and supine with no head-elevation vs. supine with head-elevated), small sample size, non-normality of the data distribution, and use of non-parametric statistical analysis. Some studies did not show standard deviation, resulting in the researchers being unable to perform the sample size estimation in the current study.[21]

Therefore, this study aimed to compare respiration rate, heart rate, and oxygen saturation of preterm infants placed in four positions; namely a 10-degree head-elevated supine (P1), prone (P2), right lateral (P3), and right anterior oblique (P4) positions, each for 3 hours, before and after orogastric feeding with breast milk.

Research questions

a) During feeding, what position results in premature infants having more stable and within normal ranges of respiration rate, heart rate and oxygen saturation?

b) What position is the best position?

It was hypothesized that premature infants placed in a 10-degree head-elevated prone (P2), right lateral (P3) and right anterior oblique (P4) positions had respiration rate, heart rate, and oxygen saturation that were more stable and with normal range compared with infants placed in a 10-degree head-elevated supine (P1) position. The findings from this study should help nurses to position preterm infants with safety. This study was conducted from January 2015 to February 2016, and the findings presented here are part of a larger study on the effects of positioning on gastric residual in preterm infants.[24]

Methods

Design: Crossover experimental design.

Sample and Setting: The sample consisted of 63 preterm infants admitted to the NICU of a tertiary hospital in the south of Thailand. The inclusion criteria were premature infants who 1) had gestational age 26-32 weeks identified by the first day of the last menstrual period of mothers, and/or evaluated by a Ballard score, 2) could breath in room air or needed oxygen or non-invasive ventilator and were recovering from a crisis with stable signs and symptoms, 3) were placed in the incubator, 4) had no apnea, necrotizing enterocolitis, electrolyte imbalance, atelectasis, bone fracture, gastrointestinal system anomalies, sub temperature, or positioning limitation, 5) did not receive medications for patent ductus arteriosus or increased gastrointestinal motility, and 6) received breast milk less than 100 millitres per kilogram per day via an orogastric tube every 3 hours. The exclusion criteria were premature infants having gastric residual more than 50% per feeding, or had complications which such as respiratory problem, sub temperature, necrotizing enterocolitis, electrolyte imbalance, lung atelectasis, bone fracture, or need to change a position. In this study, no infants were excluded.

The sample size was based on the results of previous study.[25] Based on the effect size (Eta-squared) of .05, power .80, alpha level .05; the required total sample size for ANOVA was 62.[26] In order to have equal number of the sample in each group, the total sample was 63, 21 per group (e.g., group 1 = placed prone, right lateral, and right anterior oblique, n = 21; group 2 = placed right lateral, right anterior oblique, and prone, n = 21; group 3 = placed right anterior oblique, prone, and right lateral, n = 21).

Sampling and Allocation: A purposive sampling was used to select 63 infants. At first, all infants (n = 63) were placed in a supine, head-elevated 10 degrees during and after feeding (P1). After that, the infants were randomly allocated with lots without replacement to one or other of the three groups (n = 21 per group). Each group was alternately placed in 3 positions; thus, each infant was placed in 4 positions with a 10-degree head-elevated during and after feeding for one feeding for three hours. These 4 positions consisted of supine (P1), prone (P2), right lateral (P3), and right anterior oblique (P4). The sequences of each group are shown in **Figure 1**.

Instrumentation: The experimental instruments consisted of 1) disposable syringe 20 ml (Nipro) for withdrawing the gastric residual and feeding in preterm infants, 2) feeding tube 5 French, 100 centimeters long, outer diameter 1.7 millimeters (Terumo), made from Polyvinyl Chloride, polyethylene, with marks at 25, 50, and 75 centimeters, 3) tape measure for measuring the height of feeding tube during feeding in centimeters, 4) Magnetic Base for measuring the degree of head-elevated after adjusting the incubator to a 10 degree angle (This can measure the angle from 10 to 90 degree, produced in Taiwan, http://mumbai.quikr.com/Angle-Finder-with-Magnetic-Base-TAIWAN-W0QQAdIdZ180101271), 5) incubator (Drager, Air-shields C 2000) with temperature adjustment in to 0.1 degree Celsius (it had been checked for quality by the technician of the Company and the hospital every 6 months),[27] 6) breast milk from mothers of preterm infants, 7) diaper cloth for making a nest, size 32 X 32 inches, 4 pieces, and 8) bedside monitor (Nikon kohden, BSM 6000 series) for monitoring respiration rate, heart rate, SpO_2, and body temperature, that was checked for sensitivity by the E for LM Company every 6 months.

The data collection forms consisted of 1) Demographic data questionnaire of preterm infants including gender, gestational age, age, birth weight, and bodyweight; and 2) a record form developed by the researchers for recording respiration rate, heart rate, and oxygen saturation of preterm infants, which were assessed using the bedside monitor. It was a fill-out format. The research assistant (RA) recorded the data before and immediately after positioning, at every 15 minutes for the first hour, and at every 30 minutes for the following two hours. The total of record was 10 times per position.

Validity testing: All instruments were tested for face validity by three experts, namely a neonatologist, a lecturer in pediatric nursing, and a neonatal nurse. All instruments were considered appropriate and no additional suggestions were made by the three experts.

Reliability testing: The inter-rater reliability of the record form for assessment of respiration rate, heart rate, and oxygen saturation of preterm infants was established. The researcher and research assistant independently and simultaneously recorded respiration rate, heart rate, and oxygen saturation of 10 preterm infants from the bedside monitors. In this study, the inter-rater reliability was high (97%).[28]

Ethical Considerations: Study approval was given by the Research Ethics Review Committee of Faculty of Nursing, Prince of Songkla University (ID 0521.1.05/778, 18/03/ 2015) and the ethics committee of the study hospital (ID1 30, 21/05/2015, protocol number 30/58). All parents were informed regarding the study's objectives, procedures, potential risks and benefits, voluntary participation, and protection of confidentiality and rights to withdraw at any point in the study without any consequence to current treatment or hospital service. Prior to signing the informed consent form, parents were assured of confidentiality and anonymity and had enough time to ask questions about the study. During the study, the primary investigator (PI) stayed with the infants all the time. If infants were to develop abnormal signs or symptoms such as respiratory distress, desaturation, aspiration, and inability to receive feeding; they were withdrawn from the study and immediately received care such as re-positioning, respiration adjustment, or suction. In this study, no such events occurred.

Data collection: The PI performed all positions and the research assistant collected the data. The RA, a registered nurse in the NICU of the study hospital, was trained by the PI regarding aims, scope of the study, research methodology, instruments, and data collection.

Procedure of the experimental study

The following steps were conducted during the experiment.

1. The PI continuously attached the bedside monitor at the left side and right side of the chest and

at the left side of the stomach of the infant in order to observe and record respiration rate and heart rate before, immediately after, and at 15, 30, 45, 60, 120, 150, and 180 minutes after each positioning, on the record form. For oxygen saturation, the sensor was continuously attached on either a palm or sole and observed and recorded.

2. The PI checked for the appropriate position of the OG tube using 20 ml of syringe to withdraw the gastric residual.

3. All infants were placed in a supine, 10 degree head-elevated position by the PI at 6.00 a.m. The 10 degree head-elevated position was performed by manually adjusting the incubator to a 10 degree angle and the degree confirmed by using a tool for measuring the degree of head elevation after adjusting the incubator to a 10 degree angle (Magnetic Base). After the infants were allocated into 3 groups, the PI positioned each infant on the different position at 9.00 a.m., 3.00 p.m., and 9.00 p.m. alternately for each group as shown in **Figure 1**. Each position was maintained for 3 hours starting before, and continuing during, and after feeding. Each infant was placed on a supine, 10 degree head-elevated position (control position, P1) between the intervention positions (P2-P4), at 12.00 Noon, and 6.00 p.m. (**Figure 1**).

4. The PI fed breast milk to the infants according to the physician's order. If the infant had gastric residual content as a curd or digested milk that was <50% of the total amount of the breast milk in that feeding, the PI would slowly push the gastric residual back and continue to feed the amount of the breast milk that was deducted from the gastric residual. The plunger was pulled out and the milk was poured into a 20 ml syringe that was connected with the OG tube and the milk allowed to slowly flow into the stomach by gravity. The syringe was attached on the incubator and the height from the end of the OG tube connected with the syringe was 8 centimeters above the edge of the infant's mouth. Based on the pilot study, this height was the lowest height that the milk could slowly flow by gravity to the infant's stomach.

5. The experiment and data collection were performed until the sample size was completed according to the plan (**Figure 1**). The baseline data from infants in a supine position were collected only at the first time of positioning.

Data analysis: The data were analyzed using statistical software, and the alpha level was set at .05. Descriptive statistics were used to analyze the demographic data and respiration rate, heart rate, and oxygen saturation. Mean differences of respiration rate, heart rate, and oxygen saturation among data points (different positioning) were analyzed using analysis of variance (ANOVA).

Before performing the data analysis, the assumptions of ANOVA were tested. All dependent variables were measured at the ratio level. Within each sample, the observations were sampled randomly and independently of each other. The normality of the data distribution was tested by considering the skewness value and kurtosis value (Z-value < 3.29).[29] All data had normal distribution except 1) mean scores of respiration rate after position at 120 minutes, and oxygen saturation after positioning at 90 and 120 minutes in infants with head-elevated in a supine position (3 outliers); 2) mean score of oxygen saturation before and after positioning at 150 minutes in infants with head-elevated in a prone position (2 outliers); 3) mean scores of respiration rate before and after positioning at 180 minutes in infants with head-elevated in a right anterior oblique position (2 outliers); 4) mean score of respiration rate after position at 30 minutes, and oxygen saturation after positioning at 15 minutes in infants with head-elevated in a right lateral position (2 outliers). After deleting all outliers, this assumption was met.

Homogeneity of variance was tested by Levene's test (must be non-significant, $p > .05$).[30] The results showed that the Levene's tests of the variances of RR, HR, and O_2 saturation in each position and each time measured were not significantly different

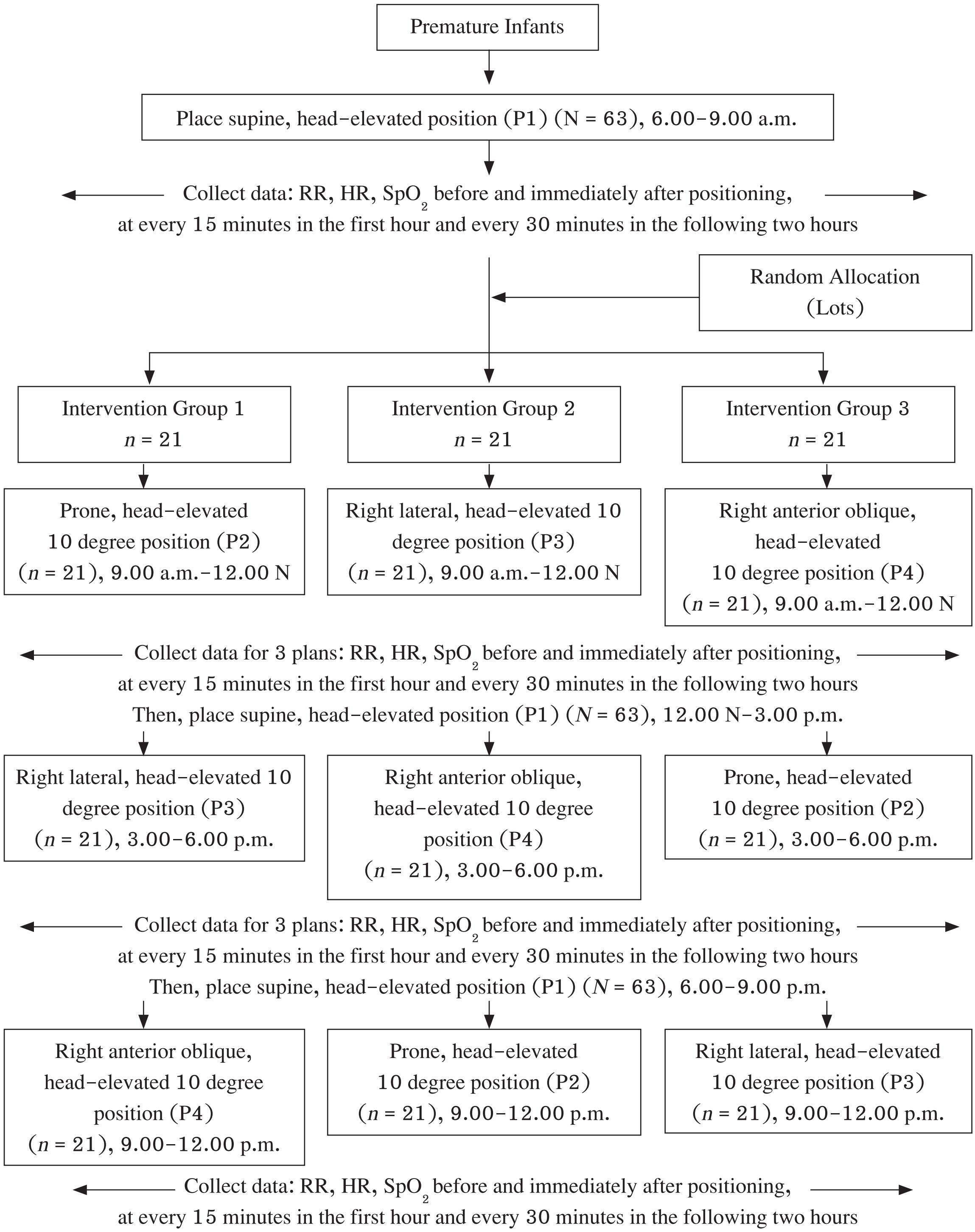

Figure 1 Experimental procedure

(p > .05; met assumption) except the Levene's tests of the variances of RR after supine positioning 30 minutes, HR after supine positioning 60 minutes, and oxygen saturation after immediately supine positioning and after 150 minutes, which were significant (p < .05).

After performing ANOVA analysis of each time point both before and after deleting outliers, the results showed that the means of RR, HR, and oxygen saturation in each position and each time were not significantly different (p > .05). Thus, the results after deleting the outliers were chosen to report in this study.

Results

Of the total of 63 preterm infants, 54% were boys. Their gestational age was 29-32 weeks (82.5%). They received humidified high-flow nasal canula with oxygen concentration more than 1 liter per minute (38.1%). Their birth weight was 720-2180 grams (*M* = 1457.30, *SD* = 353.15). Their body weight was 700 - 2200 grams (*M* = 1508.57, *SD* = 308.09). Postnatal age was 26 - 32 weeks (*M* = 29.94, *SD* = 1.55). The range of age of infants was 4 -52 days (*Md* = 10, *QD* = 3.5). The ranges of body temperature at 06.00 a.m., 09.00 a.m., 03.00 p.m., and 09.00 p.m. were 36.8 - 37.4°C (*M* = 36.9, *SD* = .15), 36.8 - 37.4°C (*Md* = 37, *QD* = 0.05), 36.8 - 37.4°C (*M* = 36.9, *SD* = 0.14), and 36.7 - 37.3°C (*M* = 36.9, *SD* = 0.12) respectively. None of the infants had complications (e.g., apnea, bone fracture, lung atelectasis, gastrointestinal abnormality, necrotizing enterocolitis, electrolyte imbalances, subtemperature) or positioning restriction.

Comparisons of respiration rate, heart rate, and oxygen saturation of preterm infants among 4 positions

The results showed that before positioning (baseline data), the means of respiration rate (46.38-48.20 times per minutes), heart rate (151.33-155.69 beats per minutes), and oxygen saturation (96.97-97.31%) were within normal range. One-way ANOVA showed that the means of respiration rate, heart rate, and oxygen saturation of infants positioning in head-elevated with supine (P1), prone (P2), right lateral (P3), and right anterior oblique (P4) positions before positioning, immediately after positioning, and at 15, 30, 45, 60, 120, 150, and 180 minutes after positioning, had no significant differences (*p* > .05) (**Tables 1-3**). Thus, no further data analysis or interpretation of the mean differences of each pair at each time and each position with the Scheffe test and the Dunnett T3 test was done. These results did not support the hypothesis and could not answer the research questions.

Table 1 Comparisons of the means of respiration rate (breaths per minute) of infants in each position and time using one-way ANOVA

Time	Supine (P1) (*n* = 60)		Prone (P2) (*n* = 61)		Right Lateral (P3) (*n* = 61)		Right Anterior Oblique (P4) (*n* = 61)		*F*	*p*
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Before positioning	48.20	7.56	47.75	9.33	47.00	7.57	46.38	7.34	0.618	.604
After positioning										
Immediately	52.55	9.51	49.39	9.92	51.18	9.90	49.72	7.77	1.467	.224
15 minutes	48.42	7.82	46.82	8.86	46.39	9.63	47.34	8.95	0.589	.623
30 minutes	48.62	10.38	46.84	8.80	47.82	8.17	46.82	9.47	0.532	.661
45 minutes	46.98	8.24	45.85	8.20	47.79	9.05	45.92	7.02	0.786	.503
60 minutes	47.79	9.05	44.82	7.01	46.57	9.05	46.46	8.29	2.013	.113

Table 1 Comparisons of the means of respiration rate (breaths per minute) of infants in each position and time using one-way ANOVA (continued)

Time	Supine (P1) (*n* = 60)		Prone (P2) (*n* = 61)		Right Lateral (P3) (*n* = 61)		Right Anterior Oblique (P4) (*n* = 61)		*F*	*p*
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***		
90 minutes	48.63	8.26	46.52	9.15	49.48	7.67	48.48	8.32	1.358	.256
120 minutes	49.60	7.74	47.07	8.76	45.79	7.54	48.56	9.21	2.436	.065
150 minutes	46.28	8.99	45.16	7.70	46.61	7.73	46.13	7.71	0.363	.780
180 minutes	46.63	8.25	46.62	7.21	46.31	7.41	46.33	7.15	0.034	.992

Table 2 Comparisons of the means of heart rate (beats per minute) of infants in each position and time using one-way ANOVA

Time	Supine (P1) (*n* = 60)		Prone (P2) (*n* = 61)		Right Lateral (P3) (*n* = 61)		Right Anterior Oblique (P4) (*n* = 61)		*F*	*p*
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***		
Before positioning	151.33	11.04	155.69	13.04	154.18	10.22	151.54	11.30	2.068	.105
After positioning										
Immediately	156.02	10.85	158.15	12.69	156.41	10.99	155.59	10.45	0.603	.614
15 minutes	150.62	13.37	154.59	11.11	154.30	12.62	151.38	10.36	1.737	.160
30 minutes	151.45	10.75	154.85	12.49	155.43	13.17	154.08	11.27	1.301	.275
45 minutes	152.08	11.68	153.90	12.24	156.74	13.10	155.02	12.94	1.478	.221
60 minutes	153.97	9.01	156.05	14.05	156.28	13.97	154.54	11.57	0.510	.676
90 minutes	152.68	12.67	154.92	12.81	157.23	13.58	155.11	12.27	1.266	.287
120 minutes	152.98	11.30	155.67	13.49	156.18	13.32	154.34	14.45	0.714	.544
150 minutes	153.08	12.64	155.95	11.83	156.48	13.60	154.62	13.51	0.832	.477
180 minutes	152.03	11.91	155.89	12.35	157.21	11.99	154.59	11.82	2.040	.109

Table 3 Comparisons of the means of oxygen saturation (%) of infants in each position and time using one-way ANOVA

Time	Supine (P1) (*n* = 60)		Prone (P2) (*n* = 61)		Right Lateral (P3) (*n* = 61)		Right Anterior Oblique (P4) (*n* = 61)		*F*	*p*
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***		
Before positioning	97.02	2.13	96.97	2.01	97.18	1.61	97.31	1.93	0.406	.749
After positioning										
Immediately	96.92	2.30	96.30	3.14	96.80	2.14	97.21	2.49	1.375	.251

Table 3 Comparisons of the means of oxygen saturation (%) of infants in each position and time using one-way ANOVA (continued)

Time	Supine (P1) (*n* = 60)		Prone (P2) (*n* = 61)		Right Lateral (P3) (*n* = 61)		Right Anterior Oblique (P4) (*n* = 61)		*F*	*p*
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
15 minutes	96.68	2.21	96.75	2.48	96.80	2.03	96.98	2.28	0.196	.899
30 minutes	96.68	1.90	97.05	1.93	97.08	2.09	97.20	1.81	0.796	.497
45 minutes	96.65	2.14	97.02	2.05	97.23	2.04	97.28	1.70	1.246	.294
60 minutes	96.33	2.38	96.82	2.16	96.93	2.04	96.93	1.99	1.076	.360
90 minutes	97.28	1.92	97.69	1.47	96.85	2.02	97.15	1.91	2.169	.092
120 minutes	96.77	2.25	97.13	1.72	97.13	1.99	97.26	1.73	0.735	.532
150 minutes	96.60	2.21	97.34	1.49	96.95	1.99	97.08	1.85	1.604	.189
180 minutes	96.93	1.99	97.48	1.51	97.13	1.99	97.70	1.42	2.354	.073

Discussion

The results in this study showed that there were no significant differences of the means of respiration rate, heart rate or oxygen saturation of preterm infants compared among four positions measured before positioning, immediately after positioning, or at 15, 30, 45, 60, 150, and 180 minutes after positioning. Preterm infants placed in all positions had normal ranges of respiration rate, heart rate and oxygen saturation. Based on anatomy and physiology of respiration system, head-elevated position causes the gastrointestinal organs to move lower resulting in increased space for lung expansion, more simultaneous chest and abdomen movement, and increased vital capacity.[7,9] Therefore, infants have more stability in respiration rate and heart rate, and better oxygenation. The reasons for these findings are probably that these infants had an average of postnatal gestational age of 29 weeks. Although, some of them had 26 weeks of postnatal gestational age or body weight of 700 grams, they could breathe by themselves or received oxygen or non-invasive ventilation. They had stable symptoms and no critical illness such as apnea, necrotizing enterocolitis, electrolyte imbalance, atelectasis, bone fracture, gastrointestinal disturbance, or patent ductus arteriosus. They stayed in incubators with adjusted temperature based on neutral thermal environmental temperature. Most of them had normal ranges of temperature. Thus, these could decrease infants' metabolism and oxygen use.[7]

These findings were both consistent with, and in contrast to, the findings of some positions reported in previous studies.[11-20,22-23,31] The congruent findings are as follows. The means of respiration rate,[11,22] oxygen saturation[12,22] and heart rate[11-12,22] of preterm infants placed in the lateral position were not significantly different from those of the infants placed in the supine position. The means of respiration rate of preterm infants placed in the prone position were not significantly different from those of the infants placed in the supine position.[22-23] There were no significant differences in oxygen saturation or bradycardia between preterm infants placed in the supine and prone positions, or the prone and right lateral positions.[20,22] The clinically significant episodes of apnea, (≥ 15 seconds), bradycardia (< 90 beat per minute), and oxygen desaturation (SpO2 < 80%) of preterm infants placed in the prone position were not significantly different from those of the infants placed in the supine position.[19]

The major reasons for these non-significant previous findings are similar to the present study, and probably due to the sample having more stability in their vital signs, breathing by themselves and having had no further critical illness. For example, most samples were well preterm infants,[23] or received positioning after mechanical ventilation.[22]

In contrast, these findings were not congruent with those of the following studies. Thematic analysis of the literature revealed that positioning had effects on oxygen saturation, heart rate and respiration.[31] The means of oxygen saturation of preterm infants placed in the lateral position[11] and prone position[13-14,16,18] were higher than those of the preterm infants placed in the supine position; this difference was primarily due to the lateral position being quite similar to the fetus position in the womb.[11] Meanwhile the prone position improved mechanical activity of lungs, increased lung volume, improved perfusion to ventilation,[18] and oxygen demand.[14,16] Preterm infants placed in the prone position had a higher level of oxygen saturation than preterm infants placed in the lateral position.[16,18] Preterm infants placed in the lateral position had higher respiration rate than did infants placed in the supine position.[12] Preterm infants placed in the supine position had a higher incidence of oxygen desaturation ($SpO2 < 90\%$) than did infants placed in the prone position; this difference was primarily due to an increased incidence of mild desaturation (SpO2 80-89%) in the supine position.[19] In terms of heart rate, preterm infants in a prone position had higher heart rate and lower heart period of variability than those of infants in a supine position;[15] it is unclear why heart rates are higher in the prone position.[15] Another study showed that infants' heart rate and respiration rate were lower at prone position than supine.[17] The differences between the findings from these previous studies and the present study are probably due to most samples in the previous studies receiving[16] or weaning[11-12] invasive ventilator, and had critical illness such as respiratory distress,[14] symptomatic apnea or bradycardia.[19] Meanwhile in the present study, all infants could breathe in room air or needed oxygen or non-invasive ventilator, were recovering from a crisis with stable signs and symptoms, and had no apnea.

Limitations

A limitation of the study is that the experiment was conducted at only one setting in limited conditions of the infants. This might limit the generalizability of the results.

Conclusions and Implications for Nursing Practice

The findings showed that there were no significant differences of the means of respiration rate, heart rate, or oxygen saturation compared among preterm infants who were in 4 positions; head-elevated 10 degree position for feeding in supine, prone, right lateral, and right anterior oblique positions measured before, immediately after, and after positioning. Thus, nurses in a NICU, a neonatal moderate care unit, and sick newborn unit probably can use these results to guide the positioning of the preterm infants before, during, and after feeding. It is a very cost-effective intervention. Further study should be conducted in preterm infants with different conditions e.g., on ventilator, gestational age less than 26 weeks, or having critical illness, that impact on feeding.

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ผลของการจัดท่าต่ออัตราการหายใจ อัตราการเต้นของหัวใจ และความอิ่มตัวออกซิเจนในทารกเกิดก่อนกำหนด: การวิจัยแบบไขว้กัน

บุษกร พันธ์เมธาฤทธิ์ จณัญญา โมรา*

บทคัดย่อ: การจัดท่าเป็นสิ่งสำคัญยิ่งในทารกเกิดก่อนกำหนด จากการทบทวนงานวิจัยที่ผ่านมา พบว่า ยังมีข้อถกเถียงกันเกี่ยวกับผลของการจัดท่าที่มีต่ออัตราการหายใจ อัตราการเต้นของหัวใจ และความอิ่มตัวออกซิเจน การวิจัยแบบไขว้กันนี้ เพื่อเปรียบเทียบอัตราการหายใจ อัตราการเต้นของหัวใจ และความอิ่มตัวออกซิเจนในทารกเกิดก่อนกำหนดที่ได้รับการจัด 4 ท่า คือ นอนศีรษะสูง 10 องศา ในท่านอนหงาย คว่ำ ตะแคงขวา และตะแคงขวากึ่งคว่ำ ท่าละ 3 ชั่วโมง ก่อนและหลังให้นมแม่ทางสายยางให้อาหาร เลือกทารกแบบเฉพาะเจาะจง จำนวน 63 คนในโรงพยาบาลศูนย์แห่งหนึ่งในภาคใต้ ประเทศไทย ทารกทุกรายถูกจัดให้นอนหงายศีรษะสูง 10 องศาก่อน จากนั้น ทารกถูกกำหนดแบบสุ่มเข้าสู่กลุ่มที่ 1 (นอนคว่ำ ตะแคงขวา และตะแคงขวากึ่งคว่ำ ตามลำดับ 21 ราย) กลุ่มที่ 2 (นอนตะแคงขวา ตะแคงขวากึ่งคว่ำ และคว่ำ ตามลำดับ 21 ราย) หรือกลุ่มที่ 3 (นอนตะแคงขวากึ่งคว่ำ คว่ำ และตะแคงขวา ตามลำดับ 21 ราย) ในระหว่างแต่ละท่า ทารกได้ถูกจัดให้นอนหงาย เก็บรวบรวมข้อมูลโดยใช้แบบสอบถามข้อมูลส่วนบุคคลและแบบบันทึกอัตราการหายใจ อัตราการเต้นของหัวใจ และความอิ่มตัวออกซิเจนในทารกเกิดก่อนกำหนด ซึ่งประเมินโดยเครื่องตรวจวัดข้างเตียงตลอดเวลา วิเคราะห์ข้อมูลโดยใช้สถิติความแปรปรวนทางเดียว

ผลการวิจัย พบว่า คะแนนเฉลี่ยอัตราการหายใจ อัตราการเต้นของหัวใจ และความอิ่มตัวออกซิเจน ระหว่างการจัดท่า 4 ท่า ณ เวลาก่อนจัดท่า หลังจัดท่าทันที และหลังจัดท่า อยู่ในเกณฑ์ปกติ และไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ดังนั้น พยาบาลอาจใช้ผลการวิจัยนี้ เป็นแนวทางในการจัดท่าทารกเกิดก่อนกำหนดทั้งก่อน ขณะและหลังให้นมทางสายยาง

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คำสำคัญ: การให้นมทางสายยาง อัตราการเต้นของหัวใจ ความอิ่มตัวออกซิเจน การจัดท่า ทารกเกิดก่อนกำหนด อัตราการหายใจ

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