

Factors that impact the accuracy with which nurses place preterm infants with respiratory distress syndrome in the prone position

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Abstract

Prone positioning is an important treatment procedure for preterm infants with Respiratory Distress Syndrome (RDS).

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However, the accuracy with which preterm infants in the Neonatal Intensive Care Unit (NICU) are placed in the prone position is impacted by several factors. The current study aimed to identify these factors. One hundred and twenty-eight nurses were included in this cross-sectional study. Direct observations of the research subjects were used to collect the research data. The participants completed a research questionnaire that included their demographic data and three others to obtain information on their clinical experience, knowledge of positioning, caring behaviors, and efficacy. Independent factors likely to affect preterm infant positioning were evaluated using multivariate logistic regression. The alpha level was set at 5%. Knowledge ($p=0.002$) and caring behavior ($p=0.009$) significantly influenced the accuracy with which nurses placed preterm infants with RDS in the prone position. Nursing efficacy, infant's bodyweight, gestational age, the institution, and DNR decisions did not significantly impact accuracy. NICU nursing staff require interventions to increase their knowledge of the accurate positioning of preterm infants with RDS.

Introduction

Respiratory Distress Syndrome (RDS) is commonly experienced by newborns, and it is a contributory cause of increased morbidity and mortality.¹ Two thirds (62%) of preterm births in Iran over the last five years have been characterized by RDS.² In Indonesia, respiratory problems are experienced by 29% of premature infants.³

Placing preterm infants with RDS in the prone position is an essential treatment procedure, and, compared to supine positioning,⁴ has been demonstrated to positively affect lung function, improve sleep quality, and reduce stress in ventilated preterm infants in the first week of life. It has also been shown to effectively maintain energy and support extrauterine adaptation in neonates.⁵ Other benefits of utilizing the semi-prone position include improving the oxygenation status [*i.e.*, peripheral capillary oxygen saturation (SpO_2) and respiratory frequency] of premature infants.^{6,7}

The prone position has proven effective in managing neonatal RDS. However, its application is associated with several challenges. Unstable hemodynamic conditions, tracheostomy use, facial trauma, abdominal surgery, obesity, and untrained nurses have been found to influence the use of the prone position by nurses in adult patients with RDS;⁸ however, the literature on this issue in newborn infants, especially preterm infants, is very limited. Thus, the objective of the current study was to identify factors that influence the accuracy with which nurses place preterm infants with RDS in the prone position.

Materials and Methods

Design

A cross-sectional design was selected for the current study. Consecutive sampling was used to select nurses working in the NICUs of three central hospitals in Jakarta, Indonesia, based on the criteria for levels of care according to the American Academy of Pediatrics.⁹ Ethical approval for the study was obtained from the Faculty of Nursing, Universitas Indonesia (SK-06/UN2.F12.DI.2.1/ETIK.FIK.2020).

Sample and setting

The research was conducted between May and July, 2020, in three central hospitals in Jakarta, Indonesia. A multivariate predictive formula for one-time measurement was used to calculate the sample size; with *P* being used to denote the frequency with which the prone position was used for RDS, based on a rate of 86% in a previous study.¹⁰ Ten predictive factors were identified; this number was multiplied by a constant of 10,¹¹ then divided by the rate at which the position was used, yielding 128 samples.

Inclusion criteria were i) NICU nurses who had worked in the NICU for a minimum of one year and ii) infants with a gestational age of <37 weeks, with RDS, based on the diagnosis of a neonatologist.

Data collection instruments

Direct observations of the research subjects were used to collect the research data. The participants completed a research questionnaire that included their demographic data and three others to obtain information on their clinical experience, knowledge of positioning, caring behaviors, and efficacy.

Nurses' knowledge of positioning

Nurses' knowledge of positioning is defined as information that a nurse has and utilizes when caring for and assigning positions to neonatal patients.¹² In the current study, this knowledge was measured using the Knowledge and Performance of Developmentally Supportive Positioning for Preterm Infants among Neonatal Intensive Care Unit Nurses Questionnaire,¹² which was translated into Indonesian by a certified agency. Thereafter, the translation was reviewed by a pediatric clinical nurse specialist who met the eligibility criteria and who had three years' experience in neonatal intensive care. The tool was retested, and it was found to be reliable (Cronbach's alpha=0.853).

Nurses' clinical experience

The nurses' clinical experience was defined in the current study as the learning processes they encountered while caring for patients with RDS. Experienced nurses are both knowledgeable and skilled. The nurses' experience was determined as units (*i.e.*, number of years worked).¹³

Nurses' efficacy

Nurse efficacy has been defined as self-awareness by nurses in relation to their responsibilities when carrying out their duties.¹⁴ An Indonesian questionnaire was utilized in the current study to evaluate nurses' efficacy in the application of developmental care as it was found to be reliable elsewhere (Cronbach's alpha=0.821).¹⁵

Nurses' caring behaviors

Nurses' caring behaviors relate to how they care for patients,

especially neonates.¹⁶ An instrument to measure caring behaviors, the Caring Behavior Inventory (CBI) Questionnaire, developed by Wolf, was selected in the current study as it has been used successfully in previous research (Cronbach's alpha=0.813).

Neonatal bodyweight

Birthweights of $\leq 2,500$ g, $\leq 1,500$ g, and $\leq 1,000$ g are classified as low birthweight, very low birthweight, and extremely low birthweight, respectively.¹⁷

Gestational age

The classification of preterm babies is divided into three categories by the World Health Organization: i) extremely preterm (*i.e.*, gestational age of below 28 weeks), ii) very preterm (*i.e.*, gestational age of 28–32 weeks), and iii) moderate to late preterm (*i.e.*, gestational age of 32–37 weeks).

Intubation

Typically, mechanical ventilation (*i.e.*, endotracheal tube placement or intubation) is used to manage the neonatal airways of preterm infants with RDS.¹⁸

Peripheral capillary oxygen saturation instability

The use of supplemental oxygen is important in the care of preterm infants with RDS, and pulse oximetry is helpful in estimating oxygen saturation (SpO₂).¹⁹ SpO₂ instability is the value of the SpO₂ measurement that has fluctuated and tends to be less than the normal value, which is <92%.²⁰ The data on neonatal SpO₂ instability were documented based on the nurses' reports.

"Do not resuscitate" decision

"Do not resuscitate" (DNR) refers to the decision taken not to continue cardiopulmonary resuscitation after 30 minutes and does not show any return of spontaneous circulation (reactive oxygen species).²¹ The decision taken by a family not to resuscitate their infant was one of the variables studied because previously it has been suggested that this is one of the reasons why nurses do not use the prone position.⁸

Measurement of research outcomes

The accuracy with which nurses placed preterm infants with RDS in the prone position was measured by recording observations based on specific checklist parameters: i) flexion of the hips and knees to form a frog's leg stance, ii) straight alignment of the hips with the body axis, without tilting on either side, iii) positioning the neonate's hands and feet under his or her body, with the tips of the hands toward the face, iv) ensuring a tight nesting position that supports and maintains the prone position, v) the use of soft thin pads under the sternum and abdomen to assist the neonate's breathing and prevent shoulder retraction, vi) monitoring respiratory and cardiovascular parameters to manage oxygenation status, and vii) facing the infant's head to one side to maintain airway patency.²²

The placement by nurses of preterm infants with RDS in the prone position was only considered accurate if all the checklist indicators were met. The accomplishment of each parameter meant a score of 2, and accurate prone positioning was only considered to have been realized if the final score was 14. Thus, a score of ≤ 12 signified inaccurate prone positioning.

Records of the observations were made by the researchers and their assistants. The research assistants were assigned to nurses working in the NICU and those providing special care with at least

five years' clinical experience. The result of the Bland–Altman test of the level of agreement between observers was a limit of agreement of <5.¹¹

Statistical analysis

Univariate analysis of each research variable was performed to determine the distribution of proportions, presented as frequencies, and the presentation of each variable. Ordinary least squares regression was used to perform further analysis as it requires the fulfillment of four assumptions before the results can be considered valid: i) the assumptions inherent in a data normality test (*i.e.*, Kolmogorov–Smirnov), with a p-value of >0.050 (0.2), ii) the assumption of homoscedasticity, carried out using a randomly patterned graph plot (*i.e.*, between -2 and 2) to ensure that this assumption is met, iii) an assumption of autocorrelation, carried out using the Durbin Watson Test [in the current study, a Durbin Watson test value of 1.273 was obtained. With the number of respondents being n=128, k=10 (the number of × variables), a dl value of 1.5468, and a du value of 1.8821 in the Durbin Watson table with α , the respondent's error in this equation fulfilled the requirements], and iv) the assumption of multicollinearity, met with a variance inflation factor of <10. Finally, multivariate linear regression was used to determine which factors most affected the accuracy with which nurses placed preterm infants with RDS in the prone position.

Results

The characteristics of the study participants are depicted in Table 1. All the nurses were female, with an average age of 35 years. Most nurses (69%) had attained a three-year diploma, and approximately half (51%) worked in an NICU. The average number of years of clinical experience was 5.86. The nurses attained an average score of 81.5 for their level of knowledge of positioning, an average score of 31.1 for efficacy (minimum and maximum scores of 25 and 38, respectively); they also attained an average score of 158.4 for caring behaviors (maximum and minimum scores of 182 and 125, respectively).

Approximately two thirds of the infants (67%) had a neonatal weight that ranged from 1,500–2,499 g (Table 2). The gestational

age of two thirds (66%) of the respondents was 32–37 weeks. The SpO₂ of the infants ranged from 88–93%, based on the nurses' reports (Table 1). Virtually all the families (99%) undertook a DNT decision with respect to their infants. A quarter (26%) and three quarters (74%) of the neonates were intubated and not intubated, respectively.

Discussion

Nurses' knowledge of positioning

The results of the current study support the researchers' hypothesis that a significant relationship exists between knowledge of prone positioning by nurses and the accuracy with which they in place preterm infants with RDS in the prone position. Linear regression analysis established that an increase of one unit in the knowledge score correlated with an increase of 0.1 units in the score for the accuracy of the prone position when the other variables remained constant.

The current study's findings are in accordance with those of a previous study that demonstrated that a significant relationship existed between knowledge of positioning by nurses and their use of positioning in preterm babies.¹² Nurses' knowledge is an important consideration in relation to their clinical decision-making and identification of which patient needs have priority.²³ Elsewhere, it was shown that the lack of knowledge and experience of nurses in performing prone positioning in infants was an inhibiting factor in their use of positioning (Table 3).²⁴

Nurses' caring behaviors

A significant relationship was found between caring behaviors and the accuracy with which nurses placed preterm neonates with RDS in the prone position in the current study. A decrease of one unit in the caring score corresponded with a decrease of 0.7 units in the score for the accuracy of the prone position when the other variables were constant. This is in line with the findings of previous studies that reported a significant association between caring behaviors and the quality of care.²⁵ Caring is a major aspect of nursing. It is reflected in every aspect of care implemented by nurses, their commitment to the well-being of patients, and positive patient outcomes.²⁶

Table 1. Characteristics of respondents (n=128).

Variable	n	%	Mean	Min-Max
Gender				
Male	-	-		
Female	128	100		
Education				
3-year Diploma	88	68.8		
Bachelor	40	31.3		
Room on duty				
NICU	65	50.8		
Special Care Nursery - 2B	32	25		
Special Care Nursery - 2A	31	24.2		
Age			35.15 (8,031)	22-56
Clinical experienced			5.86 (6,338)	0-35
Knowledge			81.5(9,344)	49-99
Efficacy			31.08 (2,748)	25-38
Caring			158.37(16,45)	125-182

Nurses' efficacy

A significant relationship was not identified in the current study between the efficacy of nurses and the accuracy with which they placed preterm neonates with RDS in the prone position. This contrasts with the findings of previous research that demonstrated that efficacy had the greatest influence on developmental care practices. Efficacy and professionalism have been shown to greatly influence the clinical decision-making of pediatric nurses.¹⁴

Nurses' clinical experience

A significant relationship was not found between the clinical experience of nurses and the accuracy with which they placed preterm neonates with RDS in the prone position in the current study. This supports the findings of a previous study that did not establish a relationship between nurses' clinical experience and the application of developmental care in the NICU.²⁴

In contrast to the findings of other research, there is a significant relationship between the quality of care and clinical experience ($p \leq 0.050$).²⁷ Nurses' competencies were considered to be high in nurses who had worked for five years.¹³ Inadequate clinical experience makes nurses less competent in implementing the prone position.²⁸

Neonatal bodyweight

A significant relationship was not observed in the current study between neonatal bodyweight and the accuracy with which nurses placed preterm neonates with RDS in the neonatal position. The initial definition of prematurity was weight of $\leq 2,300$ g, which meant that low neonatal weight was closely associated with preterm neonates regardless of gestational age. Neonatal weight greatly impacts neonatal health status and requires special attention for extrauterine adaptation.²⁹

Gestational age

A significant relationship was not detected between gestational age and the accuracy with which nurses placed preterm neonates with RDS in the prone position in the current study. The most frequent problems related to physiological status are closely related to neonatal maturity and usually involve chemical disorders due to the immaturity of organs or systems.¹⁷

Peripheral capillary oxygen saturation instability

A significant relationship was not established in the current

study between SpO₂ and the accuracy with which nurses placed preterm neonates with RDS in the prone position. Unlike the findings of previous research, a significant association was established between the accuracy of prone positioning and increased cerebral SpO₂ in preterm neonates.³⁰ The use of the prone position may increase oxygenation in neonates undergoing mechanical ventilation. Regularly changing position is needed because different positions provide different benefits. However, a change in position in itself can stimulate physiological changes and stressors for the neonate.³¹ Thus, further research is required on this topic.

“Do not resuscitate” decision

A significant association was not observed between the DNR decision and the accuracy with which nurses placed preterm neonates with RDS in the prone position in the current study. Dissimilar to the findings of a previous study, a significant relationship was identified in the current study between patients and the DNR decision, and the latter was associated with inaccurate prone positioning.⁸

In one study, neonates with unstable conditions, such as apnea and cyanosis, deterred nurses from manipulating their position to maintain the patency of their airways unless they were in a supine condition.³²

Table 2. Neonates characteristic included in study.

Variable	n	%
Neonate weight		
1000 – 1500 gr	42	32.8
1500 – 2499 gr	86	67.2
Care environment		
Treated in incubator	118	92.2
Treated outside in the incubator	10	7.8
SpO ₂		
SpO ₂ <88%	9	7
SpO ₂ >88%	119	93
DNR decision		
Yes	1	0.88
No	127	99.2
Age of gestation		
<28 weeks	2	1.6
28 – <32 weeks	42	32.8
32–37 weeks	84	65.6

DNR, Do not resuscitate.

Table 3. An evaluation of factors that impact the accuracy with which nurses place preterm infants with respiratory distress syndrome in the prone position (n=128) using multivariate linear regression analysis.

Factors	Unstandardized beta	Standard error	Standardized beta	t	Sig.
Constant	-1.897	7.681		-0.247	0.805
Nurses' clinical experience	0.107	0.064	0.144	1.662	0.099
Nurses' knowledge of positioning	0.149	0.048	0.295	3.093	0.002*
Nurses' caring behaviors	-0.073	0.027	-0.255	-2.672	0.009*
Nurses' efficacy	0.159	0.163	0.093	0.975	0.332
Neonatal weight	-1.574	0.983	-0.157	-1.600	0.112
Neonatal gestational age	0.805	0.897	0.088	0.897	0.372
Intubation	-1.187	1.028	-0.111	-1.155	0.250
SpO ₂ instability	2.775	1.715	0.151	1.618	0.108
DNR decisions	3.071	4.729	0.058	0.649	0.517

DNR, Do not resuscitate; SpO₂, peripheral capillary oxygen saturation; *, The alpha level (*i.e.*, significance) ≤ 0.050 .

Intubation

A significant relationship was not found in the current study between intubation and the accuracy with which nurses placed preterm neonates with RDS in the prone position in the current study. In contrast to a previous study on 206 neonatal infants who were given mechanical ventilation while in the prone position, an increase in hemoglobin oxygen saturation (from 1.2% to 4.4%), measured by pulse oximetry, was recorded. In addition, there was a slight decrease in the number of desaturated episodes. Thus, accurate positioning increased neonatal oxygen saturation.³³

Knowledge of prone positioning and caring behaviors influenced the accuracy with which nurses placed preterm neonates with RDS in the prone position in the current study. Thus, promoting improvements in the provision of neonatal care is essential.

The current study had some limitations. Specifically, the use of purposive sampling is known to reduce the generalizability of the research results. However, as this was a multicenter study, it is reasonable to assume that the impact of this would have been reduced. In addition, the qualifications of the nurses who acted as enumerators were varied. However, training and similarity testing, using the Bland–Altman test, would have reduced the assumption of heterogeneity when implementing the research protocols. Lastly, a scarcity of similar studies on preterm neonatal subjects meant that the authors were unable to perform valid comparisons.

Conclusions

Knowledge of prone positioning and caring behaviors had a significant impact on the accuracy with which nurses placed preterm neonates with RDS in the prone position in the current study. By contrast, clinical experience, nurses' efficacy, body-weight, gestational age, the institution, and the DNR decision were not similarly associated. Increasing nurses' knowledge of positioning and related caring behaviors is required to support the accurate prone positioning of high-risk neonates, and, in particular, preterm neonates with RDS.

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