



Original Article

Effectiveness of nesting and pronation on oxygen saturation in babies with respiratory distress syndrome

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ABSTRACT

Background: The infant mortality rate in Indonesia is still relatively high at 15 per 1000 live births. Cause of Infant death can occur due to intrapartum complications, one of which is a respiratory system disorder in the form of Respiratory Distress Syndrome (RDS). The nesting and prone positions intervention can be made to optimize the oxygenation status of babies with RDS. However, it is necessary to see the effectiveness of both positions in increasing oxygen saturation.

Objective: This study aims to determine differences in oxygen saturation in infants with RDS who are given nesting and pronation.

Methods: This is a quasi-experimental with a two-group pretest-posttest design. The total sample of 36 respondents was divided into the nesting and pronation group positions with the consecutive sampling technique. Oxygen saturation levels were measured using a pulse oximeter before and after the intervention for 15 minutes in one day. The analytical test is a paired t-test and an independent t-test.

Results: The statistical test results for the pretest-posttest difference in oxygen saturation ($p < 0.05$) in the pronation group increased by 3.6% compared to the nesting group by 0.3%, which means that the prone position is better at increasing oxygen saturation.

Conclusion: Pronation is more effective in increasing oxygen saturation than nesting in infants with RDS. So, pronation can be used as a nursing intervention in infants with RDS.

INTRODUCTION

The world's Neonatal Mortality Rate (NMR) in 2021 is 18 per 1,000 live births.¹ In Indonesia, NMR in 2021 is 11/1,000 live births.² One of the causes of neonatal death is complications of intrapartum events, 28.3% in the form of Respiratory Distress Syndrome (RDS).^{3,4} RDS is a condition of fetal lung development that cannot synthesize pulmonary surfactant until the end of pregnancy.⁵ RDS generally occurs in infants aged < 28 weeks in the womb (60-80%), 15-30% between 32-36 weeks, and 3% in infants >37 weeks.⁶

One of the signs of symptoms in infants with RDS is a lack of oxygen in the blood.⁷ It causes blue-colored lips, fingers,

and toes, rapid shallow breathing, flaring nostrils, a grunting sound when breathing, and apnea.⁸ The complications of RDS are pneumothorax, pulmonary and cerebral hemorrhage. If the baby's brain is damaged, it can lead to long-term developmental disabilities, such as learning difficulties, movement problems, impaired hearing, and impaired vision.^{9,10}

General nursing treatment for neonates with RDS is positioning.^{11,12} Nesting and pronation positions can prevent energy loss from the body,¹³ improve lung function and reduce the baby's shortness of breath^{14,15} increase oxygen and more regular breathing.¹⁶ Research on nesting positions has been carried out in previous studies with the result that nesting affects the physiological changes of low

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birth weight babies to oxygen saturation.¹⁷ Previous studies also carried out the prone position with increased oxygen saturation and respiratory rate after pronation intervention.¹⁸ Both positions are declared effective for increasing the baby's oxygen saturation. However, the two interventions had different durations and mechanisms for increasing oxygen saturation.

Studies comparing these two positions have been carried out on premature babies. However, the results did not show a difference between the two positions in increasing oxygen saturation in premature babies.¹² In previous studies, no studies have compared the effect of nesting position with pronation on the oxygen saturation of infants with RDS. There still needs to be research on infant subjects with RDS. Therefore, this study aimed to determine differences in oxygen saturation in infants with RDS who are given nesting and pronation.

METHOD

Study Design

This is a quasi-experiment with a two-group pretest-posttest design.¹⁹

Setting and Respondents

This research was conducted at Prof. Hospital. Dr. Margono Soekarjo and dr. R. Goeteng Taroenadibrata Hospital in December 2022-January 2023. The population in this study were infants with RDS. The number of samples in this study was 36, divided into two groups, namely the pronation and nesting groups, by consecutive sampling. The inclusion criteria were infants with RDS, having complete data, mild-moderate low score, live birth, and the baby's parents had signed informed consent. Exclusion criteria were babies with RDS who were stillborn and used breathing apparatus or ventilators.

Experimental Procedure

In the nesting group, Interventions are carried out by placing the nesting as a support for the baby and positioning the baby as in the mother's womb with legs bent towards the stomach and bringing the baby's hand closer to the front of the baby's chest close to the mouth. In the proning group, interventions are carried out by turning the baby over with the lower extremities bent and the head tilted to one side. The intervention was carried out for 15 minutes in each group.

The Variables, Instruments, and Measurement

The variable measured in the study was oxygen saturation (SpO₂), which was measured using a pulse oximeter. Measurements are taken by placing a pulse oximeter on the baby's leg. SpO₂ was measured twice before and after the intervention.

Data Analysis

Pair t-test and independent t-test were used to test the effectiveness of pronation and nesting positions.

Ethical Consideration

This research has received ethical approval issued by the ethical commission of the Faculty of Health Sciences Jenderal Soedirman University No. 941/EC/KEPK/XII/2022, which states that this research protocol complies with ethical principles.

RESULTS

The low birth weight group dominated respondents compared to other groups. Whereas based on gestational age, premature rupture of membranes, method of delivery, and the category of Downes score, most were preterm, premature rupture of membranes did not occur, were born by Cesarean Section (SC), and Downes score was in the mild category. The gender of the respondents varied considerably; both men and women dominated (Table 1).

Table 2 shows that the nesting intervention did not increase the baby's oxygen saturation, $p > 0.593$. Meanwhile, pronation was effective in increasing oxygen saturation, $p < 0.0001$. In the results of the comparison of the two interventions (Table 3), the results showed that there was an average difference in the increase in oxygen saturation of 3.3 between the two interventions ($p < 0.05$) for the advantage in the form of pronation position. This means pronation is more effective than nesting in increasing oxygen saturation in infants with RDS.

Table 1. Characteristics of Respondents (n=36)

Characteristics	Results
Birth Weight	
NBW (≥ 2500 gram)	7 (19.4%)
LBW (1500–2500 gram)	20 (55.6%)
VLBW (1000–1500 gram)	8 (22.2%)
ELBW (< 1000 gram)	1 (2.8%)
Gestational Age	
< 37 weeks	25 (69.4%)
≥ 37 weeks	11 (30.6%)
Premature Rupture Of Membranes	
Yes	5 (13.9%)
No	31 (86.1%)
Gender	
Man	19 (52.8%)
Woman	17 (47.2%)
Childbirth Method	
Spontaneous	10 (27.8%)
Sectio Caesarea	26 (72.2%)
Downes Score value on RDS	
Mild (1-3)	32 (88.9%)
Moderate (4-5)	4 (11.1%)

NBW: Normal Birth Weight; LBW: Low Birth Weight; VLBW: Very Low Birth Weight; ELBW: Extreme Low Birth Weight

Table 2. The Differences in Oxygen Saturation

Group	Mean \pm SD	t	p-value
Nesting			
Before	94.8 \pm 2.84	0.545	0.593
After	95.1 \pm 2.84		
Prone			
Before	93.2 \pm 2.44	5.918	<0.0001
After	96.8 \pm 1.80		

Table 3. The Effectiveness Comparison Between Groups

Group	Mean diff \pm SD	t	p-value
Nesting	0.3 \pm 2.16	4.159	<0.0001
Prone	3.6 \pm 2.55		

DISCUSSION

The results showed that the LBW data is related to the gestational age data where the gestational age is <37 weeks, so the baby will be born with a weight of <2500 grams. RDS often affects LBW babies because they have lungs with immature structures and functions as a result of gestational age <37 weeks making them more susceptible to RDS due to surfactant deficiency.²⁰ Alveoli in LBW babies are tiny, so the development of the alveoli is not perfect because the chest wall is still weak, and surfactant production is not perfect.⁴

Most respondent mothers did not experience premature rupture of membranes in both groups. This is in line with the previous research, which stated that of the 59 neonates who had RDS, 11.9% of their mothers had premature rupture of membranes, and 88.1% did not. Premature rupture of membranes with the condition that the fetal head has not reached the entrance to the pelvis following the release of amniotic fluid causes the fetal head to be squeezed between the pelvic walls; this condition is hazardous for the fetus because it causes hypoxia to fetal death in the womb and RDS.²¹

The results showed that the sex of male respondents was more than females. The male fetus has androgens which can delay the secretion of pulmonary fibroblasts, thereby delaying the development of type II alveolar cells and reducing surfactant release.²⁰ Meanwhile, the characteristics of multiple pregnancies, the majority of respondents did not experience multiple pregnancies in both groups. Multiple pregnancies have a higher risk of respiratory problems than single babies because of the risk of premature birth, so newborns are at high risk of experiencing respiratory distress.

The results showed that most babies were born by the SC method. Delivery with CS allows the mother to experience impaired uterine blood perfusion, which can cause the baby to experience asphyxia which predisposes to RDS.⁴ In this study, researchers took two categories of RDS degrees: mild and moderate RDS; the dominant respondents were at mild degrees. Researchers set inclusion criteria at

mild and moderate degrees of RDS because severe RDS is often accompanied by hemodynamic instability, more frequent apneic periods, higher risk of intraventricular hemorrhage.²²

The results showed significance in the intervention of pronation position to increase breathing in infants with RDS. This can be seen from the increase in the respondent's oxygen saturation score before and after the intervention. The pronation position is more effective than the position of nesting because pronation has a mechanism of action that can affect the development of the baby's lungs compared to the nesting position.

Several studies have stated that determining position through pronation and nested helps increase oxygen saturation.^{17,18} Both groups accept position determination but in two different ways. In this study, a prone position for 15 minutes improved oxygen saturation in infants with RDS. A prone position can increase SPO2 because this position supplies air to the lungs perfectly. It is proven that when the intervention is carried out, the baby's breathing has a regular frequency, and SPO2 increases. The results of this study are comparable to previous studies, which state that the position of the prone affects SPO2 in premature babies.²³ The results of this study follow previous studies that found that statistically prone positions were proven effective in increasing oxygen saturation with $p < 0.002$ for 20 minutes.²⁴ For 15 minutes, oxygen saturation increased by 3.6% of the pre-intervention value. Compared to giving a vulnerable position for 20 minutes, with the same results, this research is better because it can increase oxygen saturation 5 minutes earlier than previous studies.

The prone position is the baby's position inverted or facing down with knees bent under the abdomen, where gravity can pull the tongue forward to open the airway, supply air to the lungs, and improve all body tissues.^{14,25} Pronation causes homogeneity of intrapleural pressure, transpulmonary pressure, and lung inflation, especially in the dorsal region of the thoracic. Intra-abdominal organs can reduce lung pressure to increase oxygenation and carbon dioxide cleaning. Prone position can also reduce compression in the stomach and distribute pressure in the lungs more evenly so that the lungs are fully developing and have more optimal oxygenation.²⁶ This can increase lung tidal volume that supports the development of the lungs so that the baby can breathe more regularly.²⁷

The nesting position was not found to have a significant effect on increasing respondent oxygen saturation scores. This can occur because the nesting position in increasing oxygen saturation is to put the baby in a bent condition, such as in intrauterine and surrounded by a nesting device so that it can help provide comfort for the baby to reduce stress and stabilize breathing.¹⁷ Nesting is a technique around the baby using a nesting device with a baby in a

bent position as in the uterus, and the mother uses a circle/oval-shaped device made of foam and cloth.¹³ Nesting can minimize environmental stimulation that causes stress in infants that can affect the function of the body or hypothalamic activity that affects growth, heat production, and neurological mechanisms. Stress can be caused by various drastic changes such as air temperature, bright light, resistance to movement, crying and confusion, tachypnea, tremor, shock, and environmental noise very different from intrauterine conditions.¹⁴

The results of this study are not in line with previous research, which states that SpO₂ increases after the intervention, with $p < 0,0001$ for 1 hour in 1 day.²⁸ Previous research has more respondents (45 respondents) than current research (18 respondents), affecting the study results. Previous research also has a design in the form of one group posttest pretest, which means there is no comparison (control) in this design, so there is no guarantee that changes in SpO₂ variables occur due to intervention or nesting treatment. This result also does not align with previous studies, which state differences in SpO₂ LBW before and after nesting.²⁹ SpO₂ data collection before and after intervention only has a range of 15 minutes so that the baby is still adapting to nesting.

When intervening, researchers' observations still show signs of stress, such as crying and tachypnea. This can increase the workload, and energy absorption can be excessive, which causes a loss of energy in infants, affecting the increase in SpO₂.³⁰ The disadvantage of nesting is that it takes a long time to help the baby feel comfortable and calm. This is evidenced by a nesting intervention conducted by researchers for 15 minutes that does not affect increasing SpO₂. This is supported by several studies that show that lodes can affect the increase in SpO₂ with a minimum of 30 minutes and also need to be done for several days.^{17,31,32} In addition, nesting requires fixation because when collecting research data with nesting interventions, the baby still makes movements that can affect the baby's posture so that it does not match the researcher's procedure, which has a position like Intrauterine that can affect the benefits of this position.

CONCLUSIONS AND RECOMMENDATION

Giving a prone position for 15 minutes in one day increases oxygen saturation in infants with RDS. Researchers suggest that the prone position for 15 minutes can be chosen as one of the hospital policies in interventions to optimize oxygen saturation in infants with RDS. Further researchers can develop this research by examining the effect of nesting position and pronation of infants with RDS on other variables such as respiratory frequency, sleep quality, and body temperature.

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