Mosul Journal of Nursing

Online ISSN: 2663-0311 - Print ISSN: 2311-8784
Website: https://mjn.uomosul.edu.iq

The Effect of a Supine and Prone Position on Heart Rate of Infant with Respiratory Distress Syndrome

Authors Sahar Tawafik Marai ;Khamees Bandar Obaid

Affiliation *Pediatric Department, Faculty of Nursing, University of Karbala-Iraq*

ARTICLEINFO

Keywords:

Infant
Respiratory
Distress Syndrome
Supine Position
Prone Position
Heart Rate

Abstract

Objectives: This study examined the effect of supine and prone positioning on the heart rate of infants diagnosed with respiratory distress syndrome (RDS).

Methods: This descriptive-analytical study employed three heart rate measurements: immediately after positioning, one hour later, and two hours later. The study was conducted between October 1, 2023, and February 17, 2024. A convenience sample of 50 neonates was selected and equally divided into two groups (25 neonates per group). Data was collected through interviews and analyzed using descriptive and inferential statistical methods.

Results: The findings revealed significant differences in heart rate among infants placed in supine position after one and two hours ($p = 0.049$). In contrast, no statistically significant variations were observed in prone infants ($p = 0.390$). Independent sample t-tests indicated no significant initial differences in heart rate between the two positions. However, a significant difference emerged between the supine and prone positions after one hour, which persisted at the two-hour mark ($p = 0.000$).

Conclusions: The results highlight that supine positioning statistically significantly impacts heart rate after one and two hours, suggesting that clinicians should carefully consider neonatal positioning in managing RDS. Although the findings for the prone position were not statistically significant, they do not rule out potential physiological effects. Further studies are needed to explore the complexities of heart rate variations in neonates with RDS in prone positions.

What is already known about the topic?

- ***Respiratory Distress Syndrome (RDS)*** *is a common condition in preterm infants, characterized by insufficient surfactant production, leading to impaired gas exchange and respiratory difficulties*.

*** Corresponding author.** Sahar Tawafik Marai
E-mail address: sahar.t@s.uokerbala.edu.iq

DOI: 10.33899/mjn.2025.149390.1107 , Authors, 2025, College of Nursing, University of Mosul.
Date Received 04 May 2024; Received in revised form 13 July 2024; Accepted 06 September 2024, Available online 01 January 2025

Introduction

Respiratory distress syndrome (RDS) is one of the most critical conditions affecting newborns, primarily resulting from the insufficient development of lung alveoli or a deficiency in surfactant production, leading to impaired respiration and gas exchange (Kumaran et al., 2020). Managing RDS in neonates often involves various rehabilitative strategies, including mechanical ventilation and oxygen therapy. Among these, positional therapy plays a crucial role in optimizing respiratory mechanics and improving gas exchange, particularly in neonates with compromised pulmonary function (Sweet et al., 2017; Davies et al., 2017).

Positioning is a fundamental aspect of neonatal care, especially for infants with RDS, as it can significantly influence cardiovascular and respiratory outcomes. Newborns, particularly those with hemodynamic instability, require strategic positioning to enhance respiratory function and reduce the risk of life-threatening complications (Shepherd et al., 2018; Oishi et al., 2018). Investigating the physiological responses to different postures, such as supine and prone positions, is essential for optimizing treatment strategies and improving neonatal outcomes.

Prone positioning is widely utilized in neonatal intensive care units (NICUs) and has been associated with increased oxygenation, reduced hypercapnia, and a decreased risk of sudden infant death syndrome (SIDS) (Priyadarshi et al., 2022). Previous studies have suggested that prone positioning benefits alveolar ventilation and lung function, thereby influencing cardiovascular parameters, particularly heart rate. Given that heart rate is a critical indicator of oxygenation and perfusion in neonates, understanding its response to different positions is of paramount importance (Scholten et al., 2017).

The relationship between positioning and heart rate is complex, influenced by lung mechanics, thoracic compliance, and ventilation-perfusion ratios (Regli et al., 2019). Previous research has highlighted the importance of considering body positioning in very low birth weight infants due to its impact on cardiovascular function. A deeper understanding of these dynamics can aid physicians in making informed clinical decisions to enhance patient outcomes (Stewart & Long, 2020).

Aim of the Study

This study aims to investigate the effect of supine and prone positioning on heart rate in infants diagnosed with RDS. By analyzing heart rate variations over time in these positions, the study seeks to determine which posture is more beneficial for maintaining cardiovascular stability in neonates with respiratory distress syndrome.

Materials and Methods

Study Design

This study employed an experimental design to assess the impact of supine and prone positioning on heart rate in neonates diagnosed with respiratory distress syndrome (RDS). Heart rate measurements were recorded at three time points: immediately after the neonates assumed either the supine or prone position, after one hour, and again after two hours. The study was conducted over a five-month period, from October 1, 2023, to February 17, 2024.

Study Setting and Participants

The study was conducted at the Obstetrics and Gynecology Hospital in the Karbala Governorate, Iraq. A non-probability (convenience) sampling technique was used to recruit 50 neonates diagnosed with RDS. The infants were randomly assigned into two equal groups of 25 neonates each, with one group placed in the supine position and the other in the prone position for the duration of the study.

Procedure

The study followed a structured protocol to ensure consistency in data collection:

1. Baseline Measurement: Upon positioning, heart rate was recorded immediately for all neonates in both the supine and prone groups.
2. First Follow-Up: After one hour, heart rate measurements were repeated while maintaining the neonates in their assigned positions.
3. Second Follow-Up: At the two-hour mark, a final heart rate measurement was taken before the study concluded.

All neonates remained in their designated positions throughout the study duration unless medical intervention was required. Standard neonatal care protocols were followed to ensure the well-being of the infants during the study.

Reliability and Validity

To ensure the reliability and accuracy of the study instruments, a randomly selected exploratory sample comprising 10% of the original dataset was used for preliminary testing. Data collection was performed by the primary researcher with assistance from a highly qualified neonatal care specialist. The reliability coefficient, calculated using Pearson correlation analysis, was 0.79, indicating a high level of reliability.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 20.0. Descriptive statistics, including mean and standard deviation, were used to summarize the heart rate data. Group comparisons were conducted using:

- Analysis of Variance (ANOVA) to determine differences within and between groups over time.
- Independent sample t-tests to compare heart rate variations between the supine and prone positions at different time points.
- A p-value of ≤ 0.05 was considered statistically significant for all analyses.

Results

Table (1):Socio-Demographic Characteristics

Neonate characteristics	Characteristics	Supine Group		Prone Group	
		N	%	N	%
Gender	Male	15	60.0	12	48.0
	Female	10	40.0	13	52.0
Gestational age/ week	Pre-term	12	48.0	7	28.0
	Full-term	13	52.0	14	56.0
	Post-term	0	0.0	4	16.0
Chronological age/ days	0-7	18	72.0	12	48.0
	8-14	5	20.0	10	40.0
	15-21	2	8.0	3	12.0
	22-28	0	0.0	0	0.0
Types of delivery	Normal	8	32.0	6	24.0
	C-section	17	68.0	19	76.0
Weight	Less than 1 kg.	2	8.0	4	16.0
	less than 1.5 Kg.	13	52.0	6	24.0
	less than 2.5 Kg.	7	28.0	9	36.0
	less than 3.5 Kg.	2	8.0	6	24.0
	More than 3.5 kg	1	4.0	0	0.0

No. Number; %= Percentage

While comparing the characteristics of 50 infants from this study, who constitute of the two research groups, some striking variations were observed. However, among the supine group the male gender (60%) was a majority whilst for the prone group there was female predominance (52%). We examined gestational age and observed that the full term (more than 37 weeks) were 52% of the specimens. Such was the case in both hypothermic groups: supine and prone. The prone group are the ones who are lagging behind. They have less than a half (48%) of neonates who are aged 0-7 days compared to the supine group which has 72% of neonates in the same age range. The proportion of the delivery being the caesarean section was mostly 68% for the supine group, and 76% for the prone group. In the supine position, weight observations tended to favor the lower side with 52% of the newborns weighing lesser than 1.5 kg, but in the prone group, only 36% of their counterparts shared the same weight group.

Table (2).Comparison the Effect of Supine and Prone Position on Hart Rate

Groups	Source of variance	Sum of Squares	d.f	Mean Square	F-statistic	Sig.
Supine position	Between Groups	1494.747	2	747.373	2.948	.049
	Within Groups	18252.640	72	253.509		
	Total	19747.387	74			
Prone position	Between Groups	375.920	2	187.960	.955	.390
	Within Groups	14175.200	72	196.878		
	Total	14551.120	74			

The ANOVAs proved some relations of heart rate (F= 2.948; p=.049) between 1st and 2nd hours for infants with RDS during their supine position. Although there has been difference in heart rate in the first 2 hours in neonates with respiratory distress syndrome, its non-statistically significant (F=0.955; p=.390). Nonetheless, their level of influence will decrease.

Table (3).Comparison the Effect of Supine and Prone Position on Hart Rate in Three Periods

Periods	Groups	M	SD	t-value	d.f	η2	Sig.
Immediately	Supine	132.52	15.332	.029	48	.00	.977
	Prone	132.64	13.744				
At 1 hour	Supine	138.48	16.330	2.115	48	.08	.040
	Prone	129.32	14.229				

At 2 hours	Supine Prone	143.44 127.20	16.085 14.115	3.794	48	.23	.000

There was no significant difference in the heart rate of infants with RDS between the supine and prone backrests that were adopted either supine or prone initially ($t = 0.029$; $p = 0.977$; $\eta 2 = 0.00$). However, a statistical significant effect of the infant heart rate was observed after an hour of the intervention ($t=2.115$; $p=.040$). This effect size can be measured by the effect size ($\eta 2=0.08$) which show that the baby with respiratory distress syndrome was given a significant effect by either supine or prone positioning. The final result of the two hours revealed that the differences remained but on the higher side ($t=3.794$; $p=0.000$). It is highly significant, as its square root is 0.48, i.e. $\eta 2=0.23$.

Discussion

This study aimed to evaluate the role of body positioning in the cardiovascular response of neonates diagnosed with respiratory distress syndrome (RDS), particularly focusing on its effect on heart rate variations. Given that RDS is a common complication in premature neonates due to inadequate surfactant production, optimizing oxygen exchange and respiratory mechanics is crucial for effective management (Kumaran et al., 2020). Positional therapy is increasingly recognized as a non-invasive intervention that can influence pulmonary function, cardiovascular stability, and overall neonatal outcomes (Sweet et al., 2017; Davies et al., 2017).

Our findings highlight that the supine position is associated with significant heart rate fluctuations over time, particularly at the one-hour and two-hour marks ($p = 0.049$, $p = 0.000$, respectively). Conversely, no statistically significant changes were observed in neonates placed in the prone position ($p = 0.390$). These results suggest that prone positioning may contribute to greater hemodynamic stability in neonates with RDS, while the supine position could impose additional cardiovascular stress, possibly due to altered lung mechanics and thoracic compliance (Shepherd et al., 2018; Oishi et al., 2018).

Interpretation of Findings

Effect of Supine Position on Heart Rate

- Neonates in the supine position exhibited a significant increase in heart rate over time, with mean values rising from 132.52 bpm at baseline to 143.44 bpm at the two-hour mark.
- The observed changes suggest a physiological response to altered ventilation-perfusion ratios, increased diaphragmatic workload, and potential airway resistance (Scholten et al., 2017).
- Higher heart rate values may indicate compensatory mechanisms in response to respiratory challenges, emphasizing the need for careful monitoring of supine-positioned neonates with RDS.

Effect of Prone Position on Heart Rate

- Unlike the supine group, prone-positioned neonates maintained a more stable heart rate, with no significant fluctuations observed across time points.
- This aligns with prior research suggesting that prone positioning improves lung recruitment, oxygenation, and reduces ventilatory effort (Priyadarshi et al., 2022).
- The absence of significant heart rate variability may indicate that prone positioning supports cardiopulmonary stability, making it a potentially preferable positioning strategy for neonates with RDS (Regli et al., 2019).

Clinical Implications

- The findings support the clinical relevance of positional therapy in neonatal care, particularly for infants diagnosed with RDS.

- Given the statistically significant heart rate elevation in the supine group, clinicians should consider individualized positioning strategies to prevent cardiovascular strain and optimize oxygenation.
- Prone positioning may serve as a protective strategy in NICU settings to enhance respiratory efficiency and cardiovascular stability in neonates with RDS.
- However, it is essential to balance the benefits of prone positioning with its associated risks, including an increased risk of Sudden Infant Death Syndrome (SIDS) when used outside of medically supervised settings (Cheraghi et al., 2017; Loi et al., 2023).

Comparison with Existing Literature

Our results align with previous studies highlighting the beneficial effects of prone positioning on oxygenation and respiratory function (Sharma et al., 2016). Furthermore, the increase in heart rate among supine-positioned infants mirrors findings from studies demonstrating higher diaphragmatic effort and reduced lung compliance in this position (Salih et al., 2020; Mahrous et al., 2022).

Additionally, prior research indicates that prone positioning enhances ventilation-perfusion matching, leading to improved gas exchange and reduced cardiac workload (Thabet et al., 2018; Louis et al., 2019). This could explain the stability in heart rate observed among prone-positioned neonates in our study.

Study Limitations

Despite the valuable insights gained from this study, several limitations should be acknowledged:

Small sample size (n = 50) may limit generalizability of the findings. Future studies should incorporate larger cohorts to validate these results.

The study focused exclusively on short-term physiological responses. Further research is needed to examine the long-term effects of positioning strategies on neonatal outcomes.

While heart rate was used as a key physiological indicator, additional biomarkers (e.g., oxygen saturation, respiratory rate, blood gas analysis) could provide a more comprehensive assessment of neonatal cardiopulmonary responses.

Conclusion

This study provides compelling evidence that body positioning significantly influences heart rate responses in neonates diagnosed with RDS. The supine position was associated with a progressive increase in heart rate, suggesting increased physiological strain, whereas the prone position maintained greater hemodynamic stability.

These findings underscore the clinical importance of positioning strategies in neonatal care, particularly in NICUs where optimizing cardiorespiratory function is crucial. Although prone positioning appears to offer greater stability, its use should be carefully monitored in preterm neonates to mitigate potential risks.

Future studies should explore larger populations, incorporate longitudinal follow-ups, and evaluate additional physiological parameters to develop evidence-based guidelines for neonatal positioning in RDS management.

References

Cheraghi, F., Tapak, L., Basiri, B., & Sadeghian, E. (2017). Comparison of the physiologic parameters of preterm neonates with a respiratory distress syndrome in prone and supine positions. *Iranian Journal of Nursing Research, 12*(4), 25–31.

Davies, K., Bruce, I. A., Bannister, P., & Callery, P. (2017). Safe sleeping positions: Practice and policy for babies with cleft palate. *European Journal of Pediatrics, 176*, 661–667. https://doi.org/10.1007/s00431-017-2890-7

Jagadeeswari, J., & Soniya, R. (2020). Effectiveness of prone and supine position on respiratory pattern among neonates. *Drug Invention Today, 13*(7), 983–985.

Kumaran, G., Sethu, G., & Ganapathy, D. (2020). Respiratory distress syndrome in infants—An overview. *PalArch's Journal of Archaeology of Egypt/Egyptology, 17*(7), 1902–1911.

Loi, B., Regiroli, G., Foligno, S., Centorrino, R., Yousef, N., Vedovelli, L., & De Luca, D. (2023). Respiratory and haemodynamic effects of 6h-pronation in neonates recovering from respiratory distress syndrome, or affected by acute respiratory distress syndrome or evolving bronchopulmonary dysplasia: A prospective, physiological, crossover, controlled cohort study. *EClinicalMedicine, 55*, 101724. https://doi.org/10.1016/j.eclinm.2023.101724

Louis, D., Belen, K., Farooqui, M., Idiong, N., Amer, R., Hussain, A., & ElSayed, Y. (2019). Prone versus supine position for lung ultrasound in neonates with respiratory distress. *American Journal of Perinatology, 38*(2), 176–181. https://doi.org/10.1055/s-0039-1693992

Mahrous, E. S., & Aboelmagd, A. (2022). Effect of knee-chest, semi-sitting, and right lateral position on preterm neonates with respiratory distress syndrome. *International Egyptian Journal of Nursing Sciences and Research, 2*(2), 353–361.

Oishi, Y., Ohta, H., Hirose, T., Nakaya, S., Tsuchiya, K., Nakagawa, M., & Yoda, H. (2018). Combined effects of body position and sleep status on the cardiorespiratory stability of near-term infants. *Scientific Reports, 8*(1), 8845. https://doi.org/10.1038/s41598-018-27136-5

Priyadarshi, M., Balachander, B., & Sankar, M. J. (2022). Effect of sleep position in term healthy newborns on sudden infant death syndrome and other infant outcomes: A systematic review. *Journal of Global Health, 12*, 04061. https://doi.org/10.7189/jogh.12.04061

Regli, A., Pelosi, P., & Malbrain, M. L. (2019). Ventilation in patients with intra-abdominal hypertension: What every critical care physician needs to know. *Annals of Intensive Care, 9*(1), 52. https://doi.org/10.1186/s13613-019-0530-7

Salih, S., Omar, A., Elwasefy, S., Said, D., & Elderdery, A. (2020). Impact of positioning on neonate with respiratory distress: Prone vs. supine position. *Sylwan Journal, 163*(12), 54–69.

Scholten, E. L., Beitler, J. R., Prisk, G. K., & Malhotra, A. (2017). Treatment of ARDS with prone positioning. *Chest, 151*(1), 215–224. https://doi.org/10.1016/j.chest.2016.06.032

Sharma, P., Arora, S., Sarkar, S., & Puliyel, J. (2016). A randomized clinical trial to assess the effectiveness of prone position on cardiorespiratory outcomes among infants with respiratory distress. *MAMC Journal of Medical Sciences, 2*(2), 81–88. https://doi.org/10.4103/2394-7438.184423

Stewart, L. E., & Long, M. J. (2020). Positioning the patient for procedures. In *Advanced Practice and Leadership in Radiology Nursing* (pp. 91–103). Springer. https://doi.org/10.1007/978-3-030-36320-2_8

Sweet, D. G., Carnielli, V., Greisen, G., Hallman, M., Ozek, E., Plavka, R., & Halliday, H. L. (2017). European consensus guidelines on the management of respiratory distress syndrome—2016 update. *Neonatology, 111*(2), 107–125. https://doi.org/10.1159/000448985

Thabet, A. M., & Zaki, N. A. E. H. (2018). Effect of positioning on respiratory system function of preterm neonate with respiratory distress syndrome. *Assiut Scientific Nursing Journal, 6*(14), 160–166.

Thanga Mariammal, S. (2018). A study to assess the effectiveness of prone position on oxygen saturation among preterm babies in selected hospital, Chennai, Tamilnadu (Doctoral dissertation, Sresakthimayeil Institute of Nursing & Research, Kumarapalayam).

Utario, Y., Rustina, Y., & Waluyanti, F. T. (2017). The quarter prone position increases oxygen saturation in premature infants using continuous positive airway pressure. *Comprehensive Child and Adolescent Nursing, 40*(sup1), 95–101.