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Case Study

The application of the quarter-prone position to improve oxygen saturation in patients with respiratory distress syndrome at dr. Haryoto General Hospital

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Abstract:
Respiratory distress syndrome (RDS) was a syndrome that occurred in premature or less than full-term infants with immature lungs and surfactant deficiency. The corrected position of the baby was very important to noted. This could have a negative impact, namely increased breathed, heart rate, oxygen saturation and impaired comfort and slept quality. The purpose of this studied was to determine the increased in the provision of Quarter prone positions in infants with RDS. This studied began on January 11 to January 13, 2025. The sample of this studied was Mrs. AVE with a medical diagnosis of premature neonates, RDS and BBLSR who treated in the NICU room of Dr. Haryoto Lumajang Hospital. This studied took the diagnosis of ineffective breathed patterns, the desired outcome criteria improved breathed patterns by lifted airway management interventions and focusing interventions on the used of accessory respiratory muscles decreased and increased breathed depth. the intervention given was the Quarter prone position. Provided a Quarter prone position to RDS patients with observation after 15 minutes, 30 minutes and 60 minutes twice a day. Gave this position could increased oxygen saturation and stabilize breathing and pulse. Therefore, there is an increase in the provision of prone quarter position in infants with RDS.

Keywords:
respiratory distress syndrome, quarter prone, oxygen saturation

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INTRODUCTION

Newborns or neonates are infants less than 28 days old. During the first day of life, newborns face a high risk of mortality. Neonatal deaths are influenced by several factors, including infant-related factors, maternal factors, healthcare service factors, and environmental factors. Mortality among neonates is commonly caused by asphyxia, low birth weight, preterm gestational age, sepsis, and respiratory distress syndrome (RDS). RDS is an acute and severe pulmonary condition in premature infants characterized by an inability to perform normal gas exchange without respiratory support. The syndrome results from insufficient lung maturation, rendering the lungs unable or unready to function normally (Ulfatun Zaiyan et al., 2024).

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Globally, in 2018, approximately 2.5 million newborns died, with nearly 7,000 neonatal deaths occurring daily due to RDS. The number of neonatal deaths due to RDS has increased by 40% since 1990. RDS is one of the most common causes of neonatal morbidity worldwide. Several countries report high prevalence rates, including Pakistan (4.24%), France (18.5%), and China (20.5%). In Indonesia, the neonatal mortality rate in 2018 was 33.78 per 1,000 live births (Efriza et al., 2022). Data from the NICU register of dr. Haryoto General Hospital, Lumajang, show an annual increase in RDS cases, with 99 neonates recorded in 2022, 111 in 2023, and 129 from January to November 2024.

Respiratory distress syndrome (RDS), also known as hyaline membrane disease (HMD), is a major cause of neonatal mortality. It is characterized by rapid breathing (tachypnea, defined as more than 60 breaths/minute), chest retractions, and cyanosis. Surfactant deficiency further contributes to the onset of RDS (Silaban et al., 2024). Management for neonates with RDS typically includes respiratory support such as continuous positive airway pressure (CPAP). In addition to CPAP, optimal positioning is recommended as part of RDS management (Susanthy & Rustina, 2022).

An innovative approach to improve oxygen saturation in neonates with RDS involves applying proper and comfortable positioning. Correct positioning can enhance pulmonary function and optimize respiration. Several positions may be used for neonates with RDS, including the supine, prone, lateral, and quarter-prone positions. Among these, the quarter-prone position has been identified as one of the most effective positions for improving oxygen saturation. The quarter-prone position is a semi-prone posture designed to reduce respiratory failure and help regulate respiratory rate in infants (Mega Ulita & Astuti, 2024). This study aims to investigate the use of the quarter-prone position in enhancing oxygen saturation in neonates with respiratory distress syndrome.

METHOD

The population of this study comprised neonates admitted to the neonatal unit of dr. Haryoto General Hospital. The inclusion criteria were a) neonates diagnosed with respiratory distress syndrome (RDS); and b) neonates with oxygen saturation levels below the normal range. The sample of this study was Baby AVE, who was treated in the NICU of dr. Haryoto General Hospital, Lumajang. This study was conducted over three days, from 11 to 13 January, using the quarter-prone positioning technique based on evidence-based nursing (EBN) taken from the guideline titled “Positioning and Nesting Care for Premature Infants: Evaluation of Implementation in the Neonatal Intensive Care Unit (NICU).” Observations included respiratory rate, heart rate, and oxygen saturation at 15, 30, and 60 minutes, twice daily.

RESULTS

The subject of this study, Baby AVE, was a 1-month-2-day-old female neonate diagnosed with NP + BBLSR + RDS. The infant was born on 9 December 2024 at Bhayangkara Hospital Lumajang at 10:30 AM, at 34–35 weeks of gestation via cesarean section for a twin pregnancy with breech

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presentation. The infant weighed 1,000 grams, measured 37 cm in length, had a head circumference of 25 cm, clear amniotic fluid, an Apgar score of 5–6, a patent anus, and no congenital anomalies. The extremities appeared cyanotic, with grimacing and signs of respiratory distress. After four days at Bhayangkara Hospital, the infant was referred to the NICU of dr. Haryoto General Hospital due to anemia (hemoglobin 13.7 g/dL), respiratory distress syndrome, prematurity, and very low birth weight. The infant received D10% 150 cc and cinam injections (2 × 150 mg). On 11 January 2025, assessment in the NICU revealed that Baby AVE appeared weak, reddish, used accessory muscles for breathing, had minimal retractions, had an IV line in the right hand, and received nasal oxygen at 0.1 L/min. Vital signs were RR: 55 breaths/min, SpO_2: 94%, HR: 135 bpm, and temperature: 35.1°C.

Based on these findings, the primary nursing diagnosis was an ineffective breathing pattern (D.0005), related to impaired respiratory effort, evidenced by chest retractions, an irregular breathing pattern, rapid and shallow respirations, oxygen saturation supported by nasal oxygen at 0.1 L/min, and a Down Score of 3, indicating mild respiratory distress. The ineffective breathing pattern was associated with prematurity at 34–35 weeks, twin gestation, and cesarean delivery.

The selected nursing intervention was airway management (L.01011), focusing on maintaining airway patency, implementing the quarter-prone position twice daily, and administering nasal cannula oxygen at 0.1 L/min. The expected outcome was improved breathing pattern (L.01004), defined as adequate ventilation during inspiration and expiration (SLKI, 2017). The intervention was planned over three 24-hour periods, with outcome criteria including decreased use of accessory muscles and improved respiratory depth.

On the first day, the researcher monitored the infant's breathing pattern and breath sounds, maintained airway patency, and applied the quarter-prone position twice daily for 60 minutes. The results showed an irregular breathing pattern with mild chest retractions and no adventitious breath sounds. After the first 60-minute positioning session, the infant's heart rate increased from 135 to 151 beats per minute, the respiratory rate decreased from 55 to 50 breaths per minute, and SpO_2 improved from 94% to 98%. During the second session, the heart rate increased from 128 to 145 beats per minute, the respiratory rate increased slightly from 41 to 46 breaths per minute, and SpO_2 improved from 94% to 99%.

On the second day, the researcher continued to monitor the breathing pattern, maintain airway patency, apply the quarter-prone position twice daily for 60 minutes, and provide oxygen via nasal cannula at 0.1 L/min. The findings indicated that the infant's breathing became regular, accompanied by mild chest retractions. After the first 60-minute positioning session, the heart rate decreased from 161 to 143 beats per minute, the respiratory rate decreased from 49 to 48 breaths per minute, and the SpO_2 increased from 93% to 96%. During the second session, the heart rate decreased from 153 to 134 beats per minute, the respiratory rate remained stable at 48 breaths per minute, and SpO_2 increased from 91% to 100%.

On the third day, the researcher monitored the breathing pattern, maintained airway patency, and applied the quarter-prone position twice daily for 60 minutes. The results showed mild chest retractions and a regular breathing pattern; the infant was no longer requiring respiratory support. After the first 60-minute quarter-prone session, the heart rate decreased slightly from 156 to 154 beats per minute, the respiratory rate remained stable at 49 breaths per minute, and SpO_2 increased from 87% to 92%. During the second session, the heart rate decreased slightly from 143 to 142

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beats per minute, the respiratory rate increased from 44 to 45 breaths per minute, and SpO_2 improved from 86% to 90%.

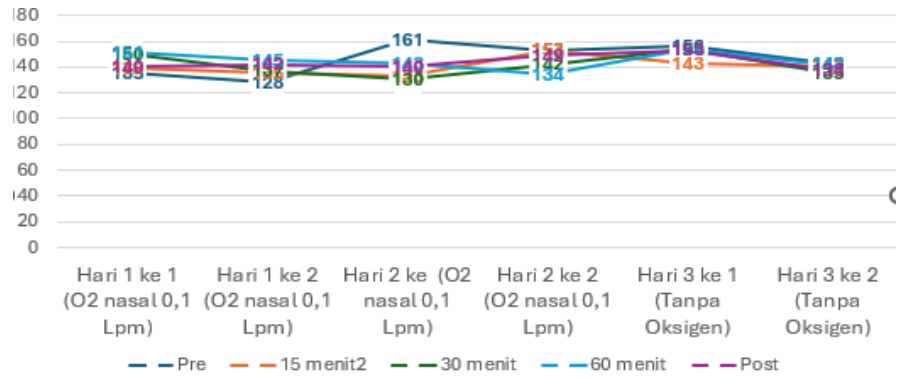

Figure 1. Heart Rate Outcomes Following the Application of the Quarter-Prone Position

Based on the observations summarized in Figure 1, the heart rate measurements over the three-day intervention period show notable changes after 60 minutes in the quarter-prone position. On Day 1, the heart rate increased to 151 beats per minute during the first session and to 145 beats per minute during the second session. On Day 2, the first session resulted in a heart rate of 143 beats per minute, while the second session showed a further decrease to 134 beats per minute. On Day 3, the first session produced a heart rate of 154 beats per minute, followed by 142 beats per minute in the second session. Additionally, a 10-minute post-positioning observation using the prone position indicated a general reduction in heart rate across the three days: from 151 to 140 beats per minute on Day 1, from 143 to — on Day 2 (data incomplete in the original text), and from 154 to 153 beats per minute on Day 3.

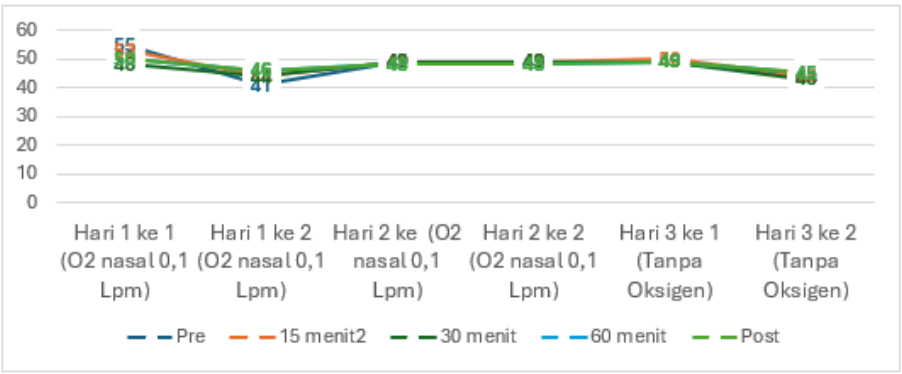

Figure 2. Respiratory Rate Outcomes Following the Application of the Quarter-Prone Position

Based on the observations presented in Figure 2, respiratory rate measurements over the three-day intervention period demonstrated generally favorable outcomes after 60 minutes in the quarter-prone position. On Day 1, the respiratory rate decreased to 50 breaths per minute during the

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first session and to 46 breaths per minute during the second session. On Day 2, both sessions resulted in similar respiratory rates of 48 breaths per minute. On Day 3, the infant demonstrated a respiratory rate of 49 breaths per minute during the first session and 45 breaths per minute during the second session. Furthermore, a 10-minute post-positioning assessment using the prone position revealed no significant changes in respiratory rate during the three-day intervention period.

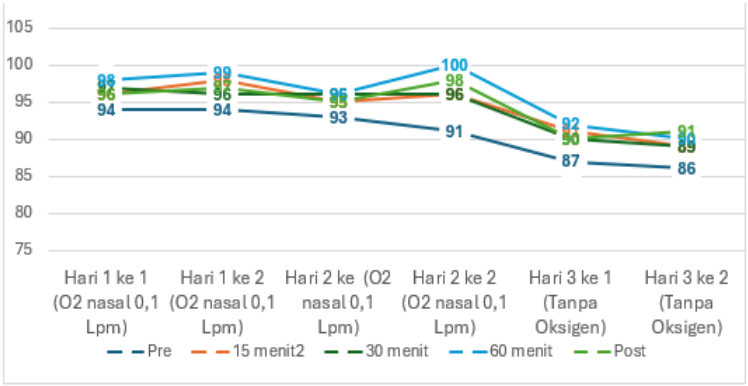

Figure 3. Oxygen Saturation Outcomes Following the Application of the Quarter-Prone Position

According to the observations summarized in Figure 3, oxygen saturation levels showed notable improvement after 60 minutes in the quarter-prone position over the three-day intervention period. On Day 1, oxygen saturation increased to 98% during the first session and to 99% during the second session, while receiving oxygen via nasal cannula at 0.1 L/min. On Day 2, saturation levels increased to 96% and 100% during the first and second sessions, respectively, with the same oxygen flow. On Day 3, oxygen saturation levels reached 92% in the first session and 90% in the second session, without the need for supplemental oxygen. The 10-minute post-positioning observation using the prone position showed slight, clinically insignificant fluctuations, ranging from 98% to 96% on Day 1 and from 90% to 91% on Day 3.

DISCUSSION

Maintaining airway patency in infants with respiratory distress syndrome (RDS) is critically important due to the immaturity of organ systems that are not yet fully developed and do not function optimally. One of the most common issues is the immaturity of the respiratory system, frequently observed in preterm infants and those with low birth weight. This immaturity often results in respiratory complications such as asphyxia. Additionally, respiratory problems are commonly referred to as RDS (Goreti Wea, 2024). Appropriate management of RDS is essential to prevent the infant from developing shortness of breath or respiratory failure. One alternative intervention is maintaining airway patency through the application of the quarter-prone position (Kurdaningsih, Nuritasari, et al., 2024).

The use of the quarter-prone position in infants with RDS has been shown to improve oxygen saturation and stabilize respiratory and heart rates. A study by Efendi et al. reported that the quarter-

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prone position facilitates synchronized thoracoabdominal movements, thereby enhancing ventilation effectiveness and pulmonary efficiency (Efendi et al., 2019). Similarly, research by Ulita (2024) demonstrated that the quarter-prone position is effective in improving oxygenation status, preventing apnea, and increasing respiratory rate (Mega Ulita & Astuti, 2024a). Another study by Kurdaningsih (2024) reported that this position increases oxygen saturation because the posterior lung fields are free from external pressure, allowing for greater lung expansion and ventilation. Furthermore, Haliza (2023) explained that the quarter-prone position produces a hydrostatic pressure gradient that promotes increased blood flow to the dependent anterior lung regions, which enhances oxygen saturation (Kurdaningsih, Nuritasari, et al., 2024).

Improved oxygen saturation in the quarter-prone (semi-prone) position reflects an increase in optimal pulmonary function. Infants with RDS commonly experience pulmonary immaturity, which impairs functional lung capacity. This positioning promotes synchronous breathing movements between the thorax and abdomen, thereby enhancing oxygen saturation and stabilizing both respiratory and heart rates. Additionally, this position induces a calming effect, potentially improving infant comfort and increasing survival chances (Kurdaningsih, Nuritasari, et al., 2024).

RDS is a respiratory disorder frequently observed in premature and low-birth-weight infants. It is characterized by conditions such as hyaline membrane disease, pneumothorax, and incomplete alveolar expansion. Without prompt management, infants with RDS may exhibit rapid respiratory rates (more than 60 breaths/min), cyanosis, grunting, and increased use of accessory respiratory muscles. These symptoms may progress to severe respiratory distress and even respiratory failure. The quarter-prone position serves as an alternative intervention that optimizes lung expansion and respiratory mechanics, thereby improving oxygen saturation and stabilizing heart and respiratory rates.

A decline in oxygen saturation may occur after transitioning from the quarter-prone position to the supine position due to uneven ventilation distribution. This uneven distribution is influenced by gravitational forces affecting lung expansion. Additionally, premature infants have structurally immature lungs that are highly sensitive to pressure changes. The supine position increases the load on the mediastinum and abdominal organs, which may compress the diaphragm and reduce breathing effectiveness (Ahmad et al., 2022).

The quarter-prone position is more effective at improving oxygen saturation compared to the supine position. The supine position often results in inadequate ventilation of the posterior lung fields due to compression, thereby impairing gas exchange. The quarter-prone position, widely used today, offers significant advantages for respiratory improvement. As a modified prone position—tilting the infant approximately 45 degrees to the left or right—it reduces anterior chest pressure while maintaining the benefits of the prone position, including increased tidal volume and more uniform pulmonary perfusion (Tanaffos et al., 2023).

The first outcome in this study showed an increase in the use of accessory respiratory muscles, from a score of 3 to 4. This finding is consistent with those of Modjo (2024), who reported that infants with RDS often experience increased work of breathing, characterized by the use of accessory muscles. The quarter-prone position helps improve oxygenation, respiratory mechanics, and lung volume, prevents atelectasis, and reduces the risk of ventilator-related lung injury (Modjo et al., 2024).

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The second outcome demonstrated an improvement in respiratory depth, increasing from a score of 3 to 5. Infants with RDS often exhibit respiratory instability due to impaired oxygenation, requiring interventions that enhance pulmonary function. Mursiah (2023) highlighted the importance of proper positioning, particularly the quarter-prone position, in optimizing lung function and improving oxygen saturation. This position may also positively influence heart rate stability, which is crucial for maintaining cardiac output, oxygen delivery, metabolism, nutrition, and neurological function (Mursiah et al., 2023).

Based on this study, the researcher concludes that the quarter-prone position significantly improves oxygen saturation and stabilizes heart and respiratory rates. This position offers comfort, facilitates optimal lung expansion, and enhances respiratory function by allowing greater freedom of lung movement during inspiration. These findings are consistent with previous studies demonstrating improved ventilation, increased respiratory rate, and reduced risk of respiratory failure among infants positioned in the quarter-prone posture.

CONCLUSION

Baby AVE, a twin infant delivered by cesarean section with very low birth weight, was diagnosed with neonatal pneumonia (NP), RDS, and VLBW. The infant presented with mild chest retractions, an irregular breathing pattern, rapid and shallow respirations, and an oxygen saturation of 94% on a 0.1 L/min nasal cannula, with a Downes score of 3, indicating respiratory distress. Therefore, the nursing diagnosis of ineffective breathing pattern (D.0005) was established, and the intervention of maintaining airway patency through the application of the quarter-prone position twice daily for three days was implemented.

The intervention resulted in increased oxygen saturation and stabilization of heart and respiratory rates. However, a decline in oxygen saturation was observed when the infant was returned to the supine position. These findings suggest that the quarter-prone position is effective in improving oxygen saturation and stabilizing vital signs, demonstrating a greater clinical benefit compared to the supine position.

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CONFLICT OF INTEREST

The researcher affirms that ethical considerations were strictly adhered to, particularly in the care of infants in the NICU, to prevent any potential harm.

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