Editors Committee

Effect of Positioning on Respiratory System Function of Preterm Neonate with Respiratory Distress Syndrome

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Abstract
Positioning is an important tool for improving respiratory function and it is one of the major nursing activities. **This study** aimed to investigate the effect of positioning on respiratory system function of preterm neonate with respiratory distress syndrome. Quasi-experimental research design was used to conduct this study. The **subjects** incorporated 30 preterm infants at Neonatal Intensive Care Unit (NICU) in Assiut University Children Hospital. **Neonatal Assessment sheet** included two parts: Part one**:** Bio-demographic data, part two: Monitoring respiratory rate, heart rate and Oxygen saturation of preterm. **Results**: The main results were the mean of respiratory rate was 53.63±11.38, and 59.42±11.3554 (c/min) in prone and supine position respectively. The mean of heart rate was 137.4±6.29 and 141.65±10.06 (beat/min) respectively. The mean of Oxygen saturation was 93.38±2.4 and 91.46±2.26 (%) respectively and these differences were highly statistically significant (P=0.001, 0.001 and 0.003 respectively). **Conclusion:** Both prone and supine positions are effective in improving the respiratory system function among preterm neonates with respiratory distress syndromes, while, prone position was more effective than supine position. **Recommendations:** The nurses in NICU could be recommended to put the preterm with respiratory distress syndrome in prone position, if there are no contraindications.

Keywords: Positioning, Respiratory System Function, Preterm Neonate & Respiratory Distress Syndrome.

Introduction
Premature neonate is defined as the delivery of neonate before accomplishment 37 weeks. The issue of preterm birth is still a major health problem in the world; 75% of neonatal mortalities are due to prematurity (**Kliegman et al., 2007** & **Cunningham et al., 2010 & Gibbs et al., 2008)** A variety of morbidities are significantly increased in preterm neonates who survive. However, the morbidity in multiple organs such as respiratory tract, cardiovascular, gastrointestinal, metabolic, neurological and urinary system is much more common in premature neonates comparative with those delivered at term (**Martin et al., 2009) & (Wilawan & Patcharee, 2005).**

Premature neonate after the birth is a great challenge to life on previous functional patterns against different stimuli. Currently, prematurity of neonate considered the most significant reason of admission in NICUs **(Saboute et al., 2015**). Prematurity of lung tissue and respiratory distress syndrome (RDs) are the common problems in premature neonate which illustrate the need for special attention for the respiratory cares **(Abdeyazdan et al., 2010 & Mobarak & Mohamed 2018).**

Respiratory distress syndromes (RDs) are the leading reason of morbidity and mortality in the early neonatal period, it occurs in 7% - 50% of neonates. Also, it is responsible for 30% - 40% of hospital admissions for preterm newborns **(Morris & Adappa, 2012)** The main cause of RDS is the presence of alveolar surface loss due to immaturity of the second type of lung, resulting in decreased compliance with the lungs, alveolar surface tension, low exchange of gases and demand for high respiratory pressure **(Edwards et al., 2013 & Khattab, 2015)**.

Clinical manifestations of Respiratory distress syndrome encompass apnea, tachypnea, grunting, inspiratory stridor, nasal flaring, poor feeding, tachypnea, cyanosis, retractions in the intercostal, subcostal, or suprasternal spaces. These signs and symptoms are present at birth or shortly afterward with getting worse over the first 48- 72 hours of infant's life (**Zhang et al., 2015 & Varvarigou et al., 2015).**

Positioning requires more diligent care by the ICU nurse. **(Chadwick, 2010),** one of the most important nursing cares at the NICU is premature neonate position. This can include supine, prone, side-lying, and head up tilted position. However, different outcomes can result from various positioning for the preterm infants (**Picheansathian et al., 2013** & **Shu et al., 2014)** These therapeutic positioning of premature infants is an essential intervention that the neonatology nurse can apply **(Zarem et al., 2013).**

The manner of oxygen saturation (O_2 Sat) is dependent on body position. However, the postural positions affect positively in preterm neonates,

donating to improvement in oxygenation, reduction in gastro-esophageal reflux episodes, and reduction in thoracic and abdominal asynchrony **(Ammari et al., 2009)** The prone position may be a noninvasive method of increasing oxygenation in neonates with acute respiratory distress. Because of intrinsic differences in respiratory regulations between adults and children and the risk of sudden infant death syndrome in young infants, a specific review of positioning is needed for infants and young children with acute respiratory distress **(Gillies et al., 2012).**

Significance of the study

Advances in neonatal care has led to increased survival rates of preterm neonates born at earlier gestational ages (GA) **(Anderson et al., 2016).** Preterm neonates have higher thoracic compliance which provides less stability to the different forces of the distortion imposed on the rib cage, leading to chest instability. Appropriate body position may reduce this instability and facilitate respiratory work (**Brunherotti & Martinez, 2013)** The common practice for preterm infants in a neonatal intensive care unit or special care unit should be in a prone position for >50% of the time, recognizing that respiratory function and oxygenation improves in the prone sleeping position (**Balaguer et al., 2013)**.

Aim of the study

This study was aimed to investigate the effect of positioning on respiratory system function of preterm neonate with respiratory distress.

Hypotheses

1. There are differences concerning respiratory system function of premature neonate when placed in prone or supine position.
2. The prone position is more effect on respiratory system function than supine position among preterm neonate with respiratory distress.

Subjects & Methods

Research Design:

Quasi-experimental research design was used for conducting this study.

Setting

The study was carried out at Neonatal Intensive Care Unit at Assiut University Children Hospital.

Subjects

A purposive sample composed of thirty preterm neonates with respiratory distress syndrome, the following criteria were considered**:**

- Preterm who born at 28 -37 weeks of gestation.
- Oxygen dependent preterm with respiratory distress syndromes.

Exclusion criteria:

- Preterm with invasive ventilator
- Whose parents are not accepted to participate in this study
- Preterm who were not able to tolerate the position either due to secretions, presence of nasogastric tube, cephalhematoma or sudden drop in saturation when change the position
- Preterm with congenital abnormalities
- Clinical/surgical reasons which made positioning contraindicated whose treated with sedative drugs were excluded.

Tool for Data Collection

One tool was used for collecting data in this study.

Neonatal Assessment sheet to collect data and it included two parts:

Part one: Preterm's bio-demographic data such as preterm' chronological age, gestational age, gender, birth weight, type of delivery (recorded data).

Part two: An assessment sheet for monitoring respiratory system functions including: Respiratory rate (RR), heart rate (HR), and oxygen saturation (O_2 Sat) level during each position and change of positioning.

Methods of implementation of the study

1. Data collection was done by the researchers during 3 months from the beginning of from April 2017 to June 2017. It was done during the routine work of the hospital in the morning. The sheet required about 60 minutes for filling it; about one preterm was collected per day.
2. An official permission was obtained from the director of NICU to implement the study after explaining the study aim by the investigators.
3. Research was approved from ethical committee in the faculty of nursing- Assiut University.
4. Written informed consent from parents of the studied preterm neonates' was obtained.
5. The tool was developed by the researchers after the thorough review of literature.
6. Pilot study was showed on thee neonates to test the applicability of the tool; these three neonates were included in the study.
7. Confidentiality of the research data was ascertained.
8. RR, HR, and O_2 Sat were measured 15 minutes after changing the position (time of watch out), measured while the infant was receiving the nursing care; the observer didn't interfere with the routine care of the infants and measured for an hour (at15 minutes, 30 minutes and 45 minutes and 60 minutes).
9. HR, and O_2 Sat were measured by the pulse oximetery. A tiny, lighted probe placed on the infant's hand or foot, projects a beam of light through the capillary beds in the tissue. The light

beam is converted into an electric signal by a photodetector in the probe that is processed within the module and displayed as both a wave form and a digital value, for both the oxygen saturation and the heart rate **(Meir. 2013)**.

10. RR was measured through observation of chest wall and abdomen movement for one minute.
11. Several normal physiological criteria were used to determine the relation to changing position, these were:
    - Desaturation when the O_2 was less than 88%
    - High oxygen saturation when the O_2 was 95% or more.
    - Bradycardia when the HR was less than 100 b/m
    - Tachycardia when the HR was more than 160 b/m
    - Bradypnea when the RR was less than 30 breath/minute
    - Tachypnea when the respiratory rate was more than 50 breath/minute
12. The procedure was performed in the following way:

Changing positioning

The pediatric nurse picked up the preterm infant during a calm period one continuous motion.

- **The supine position** was performed by supporting the preterm's head, feet and the body in the midline by using soft rolls around them. A roll under the shoulders was placed to support the newborn's (preterm's) airway and allowed slightly forward flexion of the head.
- **As regards the prone position** was performed by putting the newborn's (preterm's) body prone. The arms should be close to the body with the hands symmetrically close up to the mouth. Flexion of the legs can be encouraged with the knees brought up to the chest, raising the hips slightly. This position was maintained by using a rolled blanket to make a boundary; the small hip roll was used to assist in maintaining flexion. Use of a rolled cloth placed under the infant (from top of the head to umbilicus) to provide elevation of the body. A careful observation was achieved while preterm infants were in a prone position to evade sudden infant death syndrome.

13. Preterm neonates were assessed at waking and one hour after feed.
14. O2 Sat, RR and HR were assessed after poisoning the preterm neonates.
15. The obtained sequence position was donning on two days (the first day for supine position and the second day for the prone position).

Statistical analysis

The data were tested for normality using the Anderson-Darling test and for homogeneity variances prior to further statistical analysis. Categorical variables were described by number and percent (N, %), where continuous variables described by mean and standard deviation (Mean, SD). where compare between continuous variables by T-test. The p value was considered statistically significant when <0.05. All analyses were performed with the IBM SPSS 20.0 software.

Results

Table (1): Percentage distribution of the preterm neonates according to their bio-demographic characteristics

Bio-demographic Characteristics	No = 30	%
Chronological age /days		
Range	1-3	
Mean ±SD	2.1±0.75	
Gender		
Male	18	60.0
Female	12	40.0
Gestational age/ weeks		
28-	10	33.3
30-	11	36.7
33-34	9	30.0
Birth weight / grams		
1000	13	43.3
1500-2020	17	56.7
Type of delivery		
Cesarean section	30	100.0

Table (2): Mean and standard deviations of respiratory rate among studied preterm in prone and supine position (n=30).

Respiratory rate	prone position	supine position	P. value
RR at 15 minutes	60.83±15.72	65.8±15.15	0.001**
RR at 30 minutes	55.67±12.09	60.27±11.88	0.003**
RR at 45 minutes	50.5±11.07	56.37±11.05	0.000**
RR at 60 minutes	44.17±13.03	53.4±18.83	0.021*

Table (3): Mean and standard deviations of heart rate among studied preterm in prone and supine position (n=30).

Heart rate	prone position	supine position	P. value
HR at 15 minutes	144.93±10.53	148.83±16.14	0.047*
HR at 30 minutes	140.77±8.19	144.13±12.68	0.110
HR at 45 minutes	135.7±6.27	141.37±9.74	0.001**
HR at 60 minutes	129.97±7.42	131.57±24.2	0.697

Table (4): Mean and standard deviations of Oxygen saturation among studied preterm in prone and supine position (n=30).

Oxygen saturation	prone position	supine position	P. value
O_2 at 15 minutes	94.63±4.13	92.7±3.89	0.022*
O_2 at 30 minutes	93.1±2.41	91±3.1	0.002**
O_2 at 45 minutes	92.47±2.16	91.03±2.27	0.024*
O_2 at 60 minutes	94.5±2.39	92.1±2.58	0.000**

Table (5): Mean and standard deviations of Oxygen saturation, respiratory and heart rate among studied preterm in supine and prone position.

Items	Prone	Supine	P. value
RR	53.63±11.38	59.42±11.35	<0.001**
HR	137.4±6.29	141.65±10.06	<0.001**
O_2 Sat	93.38±2.4	91.46±2.26	0.003**

Table (1): Mean ±SD of preterm' chronological age were 2.1±0.75, 60.0% of them were males and 40.0% were females. With regards the birth weights of the studied preterm neonates 43.3% of them wt were 1000 g and 56.7% of them their wt were 1500-2020 g. All of the studied preterm neonates (100%) were delivered by Cesarean section.

Table (2): As regards to the respiratory rate (RR) the results showed that, the mean was 60.83±15.72, 55.67±12.09, 50.5±11.07 and 44.17±13.03 in the prone position at 15th minutes, 30th minutes, 45th minutes and 60th minutes respectively while 65.8±15.15, 60.27±11.88, 56.37±11.05, and 53.4±18.83 in supine positions respectively at the same times and the differences were statistically highly significant between the two positions (P=0.001, 0.003, 0.000 and 0.021 respectively).

As regarding the heart rate the results revealed **in Table (3):** That the mean of HR was 144.93±10.53, 140.77±8.19, 135.7±6.27 and 129.97±7.42 in prone positions at 15th minutes, 30th minutes, 45th minutes and 60th minutes respectively compared to 148.83±16.14, 144.13±12.68, 141.37±9.74, and 131.57±24.2 in supine position at the same times while no statistical differences were found between the two positions at 30th minutes and 60th minutes (P=0.110, and 0.697respectively).

In relation to Oxygen saturation in supine and prone position.

Table (4): Revealed that, the mean of Oxygen saturation in preterm neonates' with respiratory distress was 94.63±4.13, 93.1±2.41, 92.47±2.16, and 94.5±2.39 in the prone position on 15th minutes, 30th minutes, 45th minutes and 60th minutes respectively compared to 92.7±3.89, 91±3.1, 91.03±2.27, and 92.1±2.58 in supine positions respectively at the same times and the differences were statistically significant between the two positions (P=0.022, 0.002, 0.024, 0.000 and 0.000 respectively).

Table (5): Showed the mean of respiratory rate at 60th minutes was 53.63±11.38, and 59.42±11.3554 (c/min) in prone and supine position respectively.

The mean of heart rate at 60th minutes was 137.4±6.29 and 141.65±10.06 (beat/min) in prone and supine position respectively. The mean of Oxygen saturation at 60th minutes was 93.38±2.4 and 91.46±2.26 (%) in prone and supine position respectively and these differences was highly statistically significant (P=0.001, 0.001 and 0.003 respectively).

Discussion

It was found that the status of preterm infants in a prone or supine position has effects on physiological factors such as the function of the cardio-respiratory, thermoregulation, and O_2 saturation **(Sahni et al., 2010).** Respiratory functions of preterm infants should be supported, since they often experience respiratory distress. Proper positioning of the infant is one of the nursing interventions, which are accomplished for this objective **(Arslan et al., 2007).** So this study was aimed to investigate the effect of positioning on respiratory system function of preterm neonate with respiratory distress.

In our study, thirty preterm neonates participated; the mean ±SD of preterm neonates' age were 2.1±0.75 days**.** More than half of the studied neonates were males and their weights were 1500-2020 gm**.** All of the preterm were delivered by cesarean section. These results were matched with the results by **Malagoli et al., (2012)** who mentioned that forty-five preterm neonates born with a mean gestational age of 30.4 weeks and a mean birth weight of 1522gm. 51% of them were male and 56% of them were delivered by vaginal delivery **In Another Study by Jarus et al., (2011)** said thirty-two preterm neonates, the mean postmenstrual age 30.37±2.57, and mean birth weight 1250g ±313.86, participated in this study.

The current study revealed that supine and prone positions together were effective in improving respiratory rate in preterm neonate with respiratory distress. But the influence of prone position was significantly higher in improving respiratory rate in preterm as compared with supine position, this result was agreed with the result of **Ghorbani et al., (2013)** who conduct study about comparison of the effect of sleep positioning on cardio-respiratory rate in noninvasive ventilated premature infants and stated that, there was a significant variance in respiratory rate of preterm neonates who were similar in gestational age and clinical status and were sited in two positions. While the premature neonates' respiratory rate became lower at the prone position than supine in both groups. Also, finding of the present study agreed with **Malagoli et al., (2012)** who stated that the mean respiratory rate in the 45 studied newborns was 57 cycle per minute in the supine position and 53.6 cycle per minute in prone (p=0.072).

The present study exhibited that the mean of heart rate was normal in the two positions but the mean heart rate in the prone position was less than the mean in supine position this result was agreed with another study of **Ghorbani et al., (2013)** who stated that premature infants' heart rate became lower at the prone position than supine in both groups. Also, the result is agreed with **Akbarian Rad et al., (2016)** who stated that, heart rate was normal in all three positions but the heart rate variability in the prone position was slightly lower than further positions (P=0.596). However, **Fifer et al., (2005) & Ammaria et al., (2009)** found adverse results in their study. While the rates of cardio and respiratory increase more likely in prone than in supine position**.** From the researchers' point of view, these results may be due premature infants in the prone position spends less time awake and more time quiet and asleep which can facilitate and improve the cardio-respiratory status.

In our study the mean of Oxygen saturation in the prone position was more than the supine position which indicates that this position improved oxygenation and there was a highly significant statistically difference between them (P=0.003), this result may be due to the preterm neonates in the prone position, exhibit less physical activity and energy expenditure which improved their oxygen saturation. This result was in accordance with the result of **Brunherotti, & Martinez, (2013)** & **Akbarian Rad et al., (2016)** who conduct study about the effect of position on oxygen saturation and heart rate in very low birth weight neonates and stated that the mean of O_2 saturation was 97.41±1.91%, 96.74±2.09% and 96.14±2.36% in the prone, supine and left lateral positions respectively, and difference was statistically significant (P=0.032). This result was also agreed with the study of **Balaguer et al., (2013)** who conduct study about infant position in neonates receiving mechanical ventilation and revealed that the oxygen saturation ratio was higher in the prone than supine position. Also, agreed with **Lal et al., (2013)** who conduct study about effects of position on oxygen saturation in acute respiratory distress in neonates and mentioned that prone position improved oxygenation in the majority of neonates with respiratory distress.

Additionally Eghbalian, (2014) conducted a study to determine the effectiveness of prone position on Oxygen saturation among premature infant with respiratory distress syndrom, it was concluded that, Oxygen saturation was significantly higher in the prone position than the supine position. Also, the results in the present study were similar with **Pelosi**

et al., (2002) & Das et al., (2011) who found that prone position improves Oxygen saturation and decreases RD when compared to the supine position in neonates with RDs. These results may be due to the fact that premature infants in the prone position may show better expansion in the dorsal lung regions, increased lung volume and reduced atelectatic lung regions and finally improve excretion of secretions with consequent improvement in Oxygen saturation.

Conclusion

According to the results of the study, the current study concluded that, both prone and supine positions are effective in improving the respiratory system function among preterm neonates with respiratory distress syndromes, while, prone position was more effective than supine position.

Recommendations

Based on the results of the current study, the study recommended that

- The nurses in NICU could be recommended to put the preterm with respiratory distress syndrome in prone position, if there are no contraindications.
- With regard to the fact that the prone position is a risk factor for sudden infant death syndrome, the prone position should be with careful nursing supervision.

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