Efficacy of Selected Chest Physical Therapy on Neonates with Respiratory Distress Syndrome

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Abstract: Chest Physiotherapy has been used to clear secretions, prevent accumulation of debris and improve mobilization or airways secretions and help lung ventilation in newborn for respiratory problems. Physical therapy modalities include positioning, postural drainage, percussion, vibration, and suction. The study was established to investigate efficacy of applying selected chest physiotherapy modalities on the neonates with Respiratory Distress Syndrome (RDS). The objective of chest physiotherapy was to increase the clearance of the lung secretions and to maintain lung expansion with the potential benefit of improving oxygenation, prevention of endotracheal tube obstruction and subsequent hypoxia, prevention of extubation failure and minimizing the need to ventilation or the duration of its use and avoiding complications resulting from its use or prolonged exposure to ventilation.
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1. Introduction

Respiratory Distress Syndrome (RDS), known as Hyaline Membrane disease (HMD), is a primary pulmonary disorder, which accompanies prematurity, due to immaturity of the lungs and to a lesser extent the airways. It is a disease of progressive atelectasis, which in its most severe form can lead to severe respiratory failure and death **(1).**

The neoborn with HMD exhibits tachypnea, grunting, nasal flaring, and retractions of the chest wall. The baby may have cyanosis in room air. Grunting occurs when the infant partially closes the vocal cords to prolong expiration and develop or maintain some (1).

Complications of RDS include clinical conditions associated with prematurity in general and conditions that arise as complications of therapy. During the acute phase of RDS, hypoxia, hypercapnia, and acidosis lead to pulmonary arterial vasoconstriction and increased pressure **(2)**.

RDS can be diagnosed by Clinical evidence of respiratory distress, Radiographic findings and Arterial blood gases (ABG) changes from impaired gas exchange **(1).**

Respiratory Distress Syndrome could be treated medically as endotracheal administration of exogenous surfactant immediately after birth in the delivery room or within a few hours of birth, Exogenous surfactant can be administered repeatedly during the course of RDS in patients receiving endotracheal intubation, mechanical ventilation, and oxygen therapy. Additional management includes the general supportive and ventilation care **(3).**

Physical therapy modalities as Chest Physiotherapy has been used to clear secretions; prevent accumulation of debris and improve mobilization or airways secretions and help lung ventilation in newborn for respiratory problems **(4)**.

Physical therapy modalities include positioning, postural drainage, percussion, vibration, and suction **(5).**

2. Methods

Thirty neonates of both sexes Their ages ranged from 1 to28 days since birth suffering from RDS The selected cases were complaining of RDS proved clinically, radiological and with arterial blood gas changes from neonatal intensive care unit of Om El-Atebaa hospital, they were divided equally into two groups group A or control one This group composed of 15 neonates who received the traditional medical treatment without physiotherapy intervention, the other group B was the Study group

This group was composed of 15 neonates who received the traditional medical treatment in addition to chest physical therapy sessions which include; postural drainage positions which were applied for 3-5 minutes for each segment with vibration and percussion. The chest physical therapy sessions were applied 3 times daily for 6 days/ week, each session was about 30 minutes, according to the neonate tolerance till complete clinical cure and discharge.

All evaluation procedures were conducted pre and post each chest physiotherapy (CPT) session for both study and control groups while being incubated.

1- Patients of both groups were incubated and controlled medically by neonatologist.

2- Patients of the control group (G1) were only monitored while being incubated. They would not receive any chest physiotherapy program.

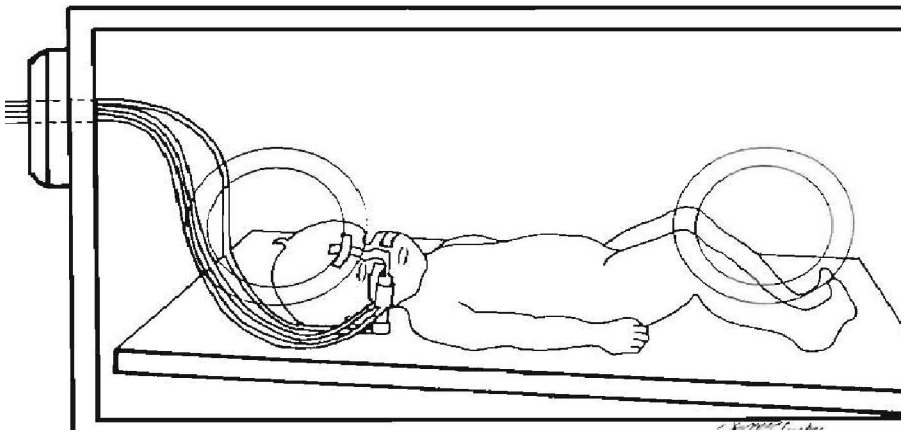
3- Patients of the study group (G2) were received a specially designed chest physiotherapy program daily, each session was conducted for 30 minutes until the baby discharged according to the medical condition.

The chest physiotherapy program as following:

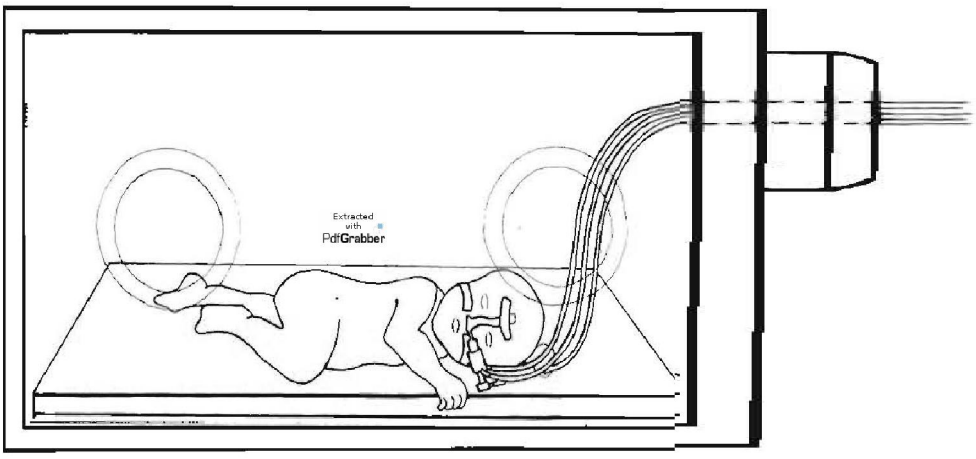
Postural drainage

The technique of postural drainage can increase the diameter of the airways through secretion mobilization, then ventilation may also be improved and the work of breathing reduced. In postural drainage the patient was positioned in, so the gravity had the greatest effect on the lung segment that has to be drained.

Whereas positional rotation programs for adults emphasize the lower lobes, positional programs for infants must emphasize all lung areas. The upper lobes and right middle lobe are common sites of airway collapse and atelectasis in infants, and the right middle lobe bronchus is surrounded by a collar of lymph nodes, making it vulnerable to extrinsic compression [6].



Fig(1)The anterior segments of the upper lobes (right and left side).

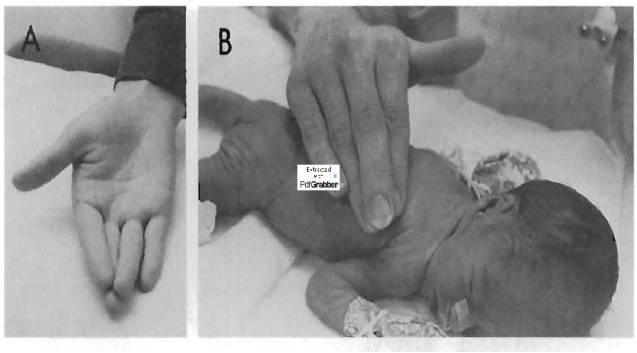


Fig(2)The posterior segment of the right upper lobe.

Chest percussion

Percussion and vibration are used in conjunction with postural drainage to augment the effect of gravity in the removal of secretions. There are several ways to perform percussion on infants. For a smaller infant, some modification of this technique is needed.

Chest percussion for a smaller infant is accomplished by the use of tenting three fingers, four fingers, or using any of the commercially available percussion devices made for neonates. A small anesthesia mask or "palm cup" can also be used effectively [7].



Fig(3): Manual percussion

Vibration

Vibration is done though a rapid, fine ripple type of movement applied during exhalation, it follows percussion. It is accomplished either through manual vibratory motion of the therapist's fingers on the infant's chest wall or through the use of a mechanical vibrator. Manually by placing the fingers of one hand on the chest wall over the segment being drained with isometric contracting the muscles of the forearm and hand to cause a gentle vibratory motion and other hand support the baby s' head.

The vibration is given by the fingers of one hand molded to the shape of the baby s chest wall, with control lateral thumb support. It is applied at a rapid rate with minimal compression pressure, and within the baby's tolerance. The other hand is cupped to support the baby's head for the whole duration of treatment [8].

Fig(4) Active gentle manual vibration technique.

Suctioning

Nasotracheal suctioning for tracheal aspiration is done by the nurse as a component of resuscitation and bronchial hygiene therapy. NTS is intended to remove accumulated saliva, pulmonary secretions, blood, vomits, and other foreign material from the trachea and nasopharyngeal area that cannot be removed by the patient's spontaneous cough or other less invasive procedures. It has been used to maintain a patent airway thus ensuring adequate oxygenation and ventilation. The clearance of secretions is accomplished by application of sub-atmospheric pressure applied to a sterile, flexible, multiyear catheter on withdrawal only which done by the nurse **9**.

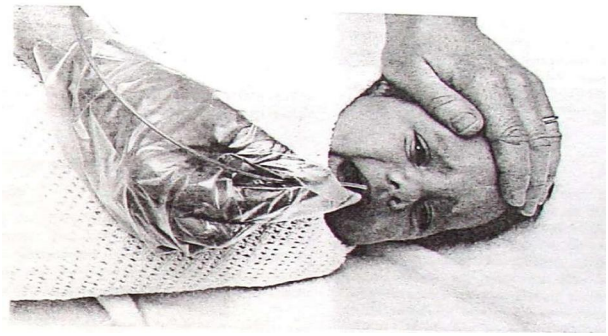


Fig (5)Nasopharyngeal suction.

Positioning

Careful positioning is important to optimize lung function, and supine is the least beneficial position. Prone has been shown to be advantageous, in terms of respiratory function gastro-esophageal reflux and energy expenditure and should be used in infants with respiratory distress who are being closely monitored [10].

3. Results

Timing of Arterial blood gases improvement

Table (1) demonstrate the duration required for correction in the arterial blood gases of both groups (A, B). There was a significant difference in the unpaired t-test between both groups (A) and (B) as follow, the mean value of (GA) was (**6.63±** 3.52) days and (GB) was (3.57±1.39) days where the t-value was (2.97) and P-value was (0.007).

Table (1) Number of days which showed correction in the arterial blood gases of groups (A & B)

Number of days after which Arterial blood gases showed improvement	**Group (A) (Control group)**	**Group (B) (Study group)**
Mean	**6.63**	**3.57**
±SD	**±3.52**	**±1.39**
Mean difference	**3.06**	
t-value	**2.97**	
***P*-value**	**0.007**	
S	**S**	

***SD: standard deviation, P: probability, S: significance, S: significant, DF: degree of freedom**

Duration required for clinical improvement of RDS.

The duration required for improvement in RDS symptoms and signs in both groups (A& B). There was a significant difference in the unpaired t-test between groups (A) and (B) as follow, the mean value of group (A) was (**7.45±** 3.75) days and for group (B) was (5.21±1.25) days where the t-value was (2.1) and P-value was (0.04).

Table (2) the duration of clinical improvement in RDS between (GA) & (GB).

Number of days after which respiratory distress symptoms showed improvement	**Group (A) (Control group)**	**Group (B) (Study group)**
Mean	**7.45**	**5.21**
±SD	**±3.75**	**±1.25**
Mean difference	**2.24**	
t-value	**2.1**	
***P*-value**	**0.04**	
S	**S**	

Duration required for radiological improvement

The duration in days needed to improve the RDS radiologically of groups (A& B). There was a significant difference in the unpaired t-test between group (A) and (B) as follow, the mean value of group (A) was (**8.63±** 5.97) days and for group (B) was (5.0±1.1) days where the t-value was (2.24) and P-value was (0.03).

Table (3) duration in days needed to improve the radiological finding of both groups (A& B).

Number of days after which X-ray showed complete improvement	**Group (A) (Control group)**	**Group (B) (Study group)**
Mean	**8.63**	**5.0**
±SD	**±5.97**	**±1.1**
Mean difference	**3.63**	
t-value	**2.24**	
***P*-value**	**0.003**	

Duration of ventilation

The duration of ventilation in group (A and B), There was a significant difference in the unpaired t-test between groups (A) and (B) as follow, the mean value of group (A) was (**4.54±** 3.35) days and for group (B) was (2.14±2.1) days where the t-value was (2.19) and *P*-value was (0.03).

Table(4) the duration of ventilation for both groups (A, B).

Duration of ventilation	**Group (A)**	**Group (B)**
Mean	**4.54**	**2.14**
±SD	**±3.35**	**±2.1**
Mean difference	**2.4**	
t-value	**2.19**	
P-value	**0.03**	

Duration of Hospitalization

The duration of hospitalization which spent in group (A and B), There was a significant difference in the unpaired t-test between groups (A) and (B) in the duration of hospitalization as follow, the mean value of group (A) was (**14.09±** 5.71) days and for group (B) was (10.35±2.49) days where the t-value was (2.2) and P-value was (0.03).

Table (5) duration of hospitalization that needed in group (A and B).

Duration of hospitalization	**Group (A) (Control group)**	**Group (B) (Study group)**
Mean	**14.09**	**10.35**
±SD	**±5.71**	**±2.49**
Mean difference	**3.73**	
t-value	**2.2**	
***P*-value**	**0.03**	

The duration of hospitalization in both groups (A and B) at the end of the study after doing CPT for GB was due to correction in ABG, improvement in X-rays and RDS symptoms and the time of M.V. which explains the shorter duration of the hospital stay.

4. Discussion

Neonatal respiratory distress syndrome (RDS) is the most common disease seen in premature neonates. The condition makes it difficult to breathe [(11)].

Treatment of RDS consists of respiratory support by different ways of oxygen administration and endotracheal intubation, medications such as (surfactant replacement therapy, bronchodilators, diuretics, sedative and steroids), supportive therapy which is temperature control, adequate nutrition and management of anemia [(3)].

Chest Physiotherapy has been used to clear secretions, prevent accumulation of debris, improve mobilization of airways secretions and help lung ventilation in neoborn with respiratory problems by

improves the efficiency and delivery of oxygenation [5].

Chest physiotherapy improves the efficiency and delivery of oxygenation. CPT consists of several discrete techniques: percussion, vibration, postural drainage, oropharyngeal, and tracheal suctioning [12]. **Halliday (2003)[13]** reported that mechanical ventilation is a life saving for many preterm babies but prolonged use can have adverse effects increasing the risk of subglottic injury and chronic lung disease.

Both groups showed ABG abnormalities as increased ↑PCO_2 and decreased↓ PO_2 with a degree of acidosis. Clinically the degree of RD ranged between 2 to 4. In addition, radiological diagnosis was confirmed by radiological findings in the form of air bronchogram, ground glass and white lung.

Correction of ABG was observed early among GB compared to GA as our results showed a highly statistically significant differences between both groups in PH, $PaCO_2$, PaO_2, and O2 saturation (p=.007).

Flenady & Gray, (2005)[5] concluded that it could be due to improvement of oxygenation and improvement of alveolar surface tension which facilitates gas exchange.

These results come in agreement with **Abd El-Fattah *et al.* (2001)**[14] who confirmed that CPT has a positive effect on blood gases in RDS. The follow up of blood gases in their study on RDS showed that patients who subjected to CPT had significant decrease of their $PaCO_2$ after 48 hours.

The results of the current study disagree with that mentioned in **Royal college pediatrics and child health (2008)[15]** who stated that routine CPT is not recommended in neonatal RDS.

These results come in agreement with those obtained by **Abd-ElFattah *et al.* (2001)[14]** who stated that the duration of ventilation was less in those who subjected to CPT.

Long-term complications of mechanical ventilator might develop because of oxygen toxicity, high pressures delivered to the lungs, the severity of the condition itself, or periods when the brain or other organs did not receive enough oxygen [11].

Prolonged mechanical ventilation induces pulmonary inflammation in preterm infants. Lung inflammation plays an important role in pathogenesis of chronic lung disease in preterm infants. Results show a strong correlation between duration of mechanical ventilation and the amount of pro-inflammatory mediators, so it is achievement to reduce the duration of exposure to mechanical ventilation [16]

Our results showed a statistical significant correlation between both GB and GA regarding the laboratory, ABG, x-rays and the duration of MV results, which reflected on the hospitalization. The results showed statistical significant difference in the duration of hospitalization between both group (P=.03).

The duration of hospitalization in both groups (A and B) at the end of the study after doing CPT for GB was due to correction in ABG, improvement in X-rays and RDS symptoms and the time of M.V. which explains the shorter duration of the hospital stay.

Conclusion

The study concluded that Chest Physiotherapy program minimize the need for mechanical ventilation, as well as the time of its use and time of hospitalization in newborn with RDS and also economically, it is cost-effective for patients and hospitals. Fewer complications were observed among RDS cases who received CPT.

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