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Comparative Study of Two Different Approaches for Managing of Mechanically Ventilated Extremely Preterm Newborns

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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Original Research Article

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ABSTRACT

Aim: To compare between the effects of routine suctioning and positioning to that of chest physiotherapy on mechanically ventilated newborns.
Study Design: Prospective, randomized controlled study.
Place and Duration of Study: AL-jahra Hospital, Ministry of Health, Kuwait between January 2012 and April 2013.
Methodology: Sixty extremely preterm neonates with respiratory distress syndrome were enrolled in the study. They were mechanically ventilated. Their ages ranged from 4-6 days. They were divided into two equal groups (control and study). The control group received medical treatment, routine suctioning and positioning while the study group received the same medical treatment given to the control group in addition to the selected chest physical therapy program. Arterial blood gases (PaO_2, $PaCO_2$, pH) and vital signs (HR, RR, SAP, DAP) were measured. Cranial ultrasound and chest x-ray were done to diagnose any cerebral injuries or rib fractures. All measurements were recorded at baseline measurement, 2 days and 7 days post inclusion in the study.
Results: Significant improvement was recorded in arterial blood gases (PaO_2, $PaCO_2$, pH) and vital signs (HR, RR, SAP, DAP) for the study group after 2 and 7 days ($P< 0.05$). In addition to

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significant differences were observed between both groups in (PaO_2, $PaCO_2$, pH, HR, RR, SAP, DAP) in favor of the study one (P< 0.05). No adverse effects regarding to the incidence of rib fractures or cerebral injury were recorded in the study group.
Conclusion: Chest physiotherapy is an excellent supplement to the line of treatment of extremely preterm neonates who are mechanically ventilated with respiratory distress syndrome.

Keywords: Chest physiotherapy; Suctioning; Preterm; Mechanical ventilation; Respiratory distress syndrome.

1. INTRODUCTION

Prematurity is a term for the broad category of neonates born at less than 37 weeks' gestation. For premature infants born with a weight of less than 1000 g, the 3 primary causes of mortality are respiratory failure, infection, and congenital malformation [1]. Respiratory distress (RDS) in the neonate is a common problem [2]. The RDS was reported in approximately 0.5% to 1% of newborns. The incidence and severity are directly related to prematurity degree. It affects around 50% of preterm newborns lighter than 1500 gram (g). Deaths, associated to the disease, usually occur during acute phase of respiratory failure and are largely limited to extremely immature newborns which birth weight is lower than 1000 g [3]. In fact, nearly all infants born before 28 weeks of pregnancy develop RDS [4].

Sequelae of RDS include the following: Septicemia, bronchopulmonary dysplasia, patent ductus arteriosus, pulmonary hemorrhage, apnea/bradycardia, necrotizing enterocolitis, retinopathy of prematurity, Hypertension, Failure to thrive, intraventricular hemorrhage (IVH) and periventricular leukomalacia (PVL) with associated neurodevelopmental and audiovisual handicaps [5]. Both immaturity and the severity of RDS are limiting factors preventing routine early extubation of all preterm babies. Preventing immaturity is difficult and often this problem is unavoidable. However, there are some evidence-based interventions to reduce the severity of RDS [6]. Surfactant replacement therapy is crucial in the management of RDS. Respiratory support in the form of mechanical ventilation may also be lifesaving, but can cause lung injury, and protocols should be directed at avoiding mechanical ventilation where possible by using nasal continuous positive airways pressure or nasal ventilation [7]. The treatment of the infant with RDS requires Systemic antibiotics may be administered during the acute phase if sepsis is suspected, morphine or fentanyl for pain and sedation and Caffeine may be administered to treat apnea and to prepare for weaning from mechanical ventilation [8]. Chest physiotherapy (CPT) aims to remove the excess of bronchial secretions. The adverse effect arising from excess secretions and the fact that their removal may significantly improve the specific conductance of the airways has been demonstrated in previous studies [9].The forms of CPT more commonly used during the neonatal period are active CPT (tapping or vibration delivered on the chest) and non-active techniques (e.g. positioning and suction alone) [10].

The goal of therapy for patients with RDS is to maintain pH of 7.25-7.4, arterial oxygen tension (PaO_2) of 50 – 70 mm Hg and carbon dioxide pressure ($PaCO_2$) of 40 – 65 mmHg, depending on the neonate's clinical status [5]. There are still scarce and conflicting studies in neonatal CPT [11]. Information on adverse effects of CPT is not adequate enough in the trials included to gauge safety for practice. In view of this and the lack of clear evidence for benefit, it recommends using this intervention cautiously [12]. Previous studies highlighted the beneficial therapeutic effects of interventional procedures of physiotherapy. However, previous investigations reported deleterious effects, suggesting that the handling procedures of interventional therapy in preterm infants result in hemodynamic instability, and therefore it is not indicated [13]. However, unlike in children and adults, where the use of CPT has been proven to be beneficial to cardio-respiratory function. It is not recommended in neonatal RDS [14]. Reported complications of CPT include hypoxaemia [15], rib fractures and cerebral injuries [16] and encephaloclastic porencephaly [17]. Therefore, this study was conducted to test the hypothesis that a routine CPT program would reduce RDS and improve vital signs and arterial blood gases (ABG_S) of mechanically ventilated extremely preterm newborns without incidence of adverse outcomes including rib fracture and cerebral injury when compared with a program of routine positioning and suctioning.

2. SUBJECTS, RANDOMIZATION AND METHODS

2.1 Subjects

Sixty extremely preterm newborns with gestational age ranged from 26 to 28 weeks were enrolled in this study. They were admitted between January 2012 and April 2013 in the Neonatal Intensive Care Unit (NICU), AL-jahra Hospital, Ministry of Health, Kuwait. After birth, they were treated with exogenous surfactant replacement and citrate caffeine as prophylaxis of apnea of prematurity. They were diagnosed as RDS and were mechanically ventilated with Synchronized Intermittent Mechanical Ventilation (SIMV), with fraction of inspired oxygen (FiO_2) <0.6.

The most common cause of RDS in the new born is related to insufficient levels of surfactant in lung and most mortalities from RDS occurs within 72 hours after birth [18]. Most IVH occur in the first 72 hours after birth [19]. So, the chronological age of the selected children was from 4 to 7 days.

We considered the following inclusion criteria: birth weight equal or less than 1000 grams; clinical and radiological diagnosis of RDS. The radiological diagnosis (X-ray findings) was based on diffuse reticulogranular infiltrate (ground glass appearance) [20]. Clinical diagnosis was established when the newborn presented early respiratory distress (tachypnea, expiratory grunt, nasal flaring, chest retraction and cyanosis), early onset and progressive evolution [21]. They had RDS score ≥ 6 according to Downes' score [22].

The newborn who had one or more of the following criteria were excluded from the study: newborn with congenital malformations, asphyxia at time of birth, genetic syndromes, neurological disorders or congenital infection with clinical manifestations, seizures, who underwent surgical procedures, with IVH or major cerebral abnormality. Intraventricular hemorrhage was defined according to the classification described by Tudehope et al. [23]: Grade 1- IVH subependymal hemorrhage, grade 2- IVH filling<50% of the ventricle, grade3-IVH filling>50% of the ventricle and grade 4-IVH with parenchymal involvement. Major cerebral abnormality defined as one or more of the following: cerebral cyst formation (porencephalic cyst, periventricular leukomalacia , Periventricular- intraventricular hemorrhage , hydrocephalus [10].

The patients were assigned randomly into two groups of equal numbers: control group (14 boys, 16 girls) and study group (15 boys, 15 girls). The work was carried out in accordance with the code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. Parents of the newborns signed a consent form prior to participation as well as acceptance of the Ethics Committee of the Ministry was taken.

2.2 Randomization

Seventy newborns were assessed for eligibility. Ten were ineligible as they did not meet the inclusion criteria and sixty were enrolled in the study. Following the baseline measurements, randomization process was performed using closed envelopes. The investigator prepared two closed envelopes with each envelope containing a card labeled with either control group or study group. Finally, for each newborn we drew a closed envelope that contained one of the two groups. The study design is demonstrated as a flow chart in Fig. 1.

2.3 Methods

2.3.1 For evaluation

Daily review of the medical records was done. Observation for any signs of RDS, settings of the ventilator, evaluation of posture and muscle tone were conducted pre and post each CPT session for study group and daily for the control group.

Evaluation of vital signs, ABG_S, chest X-ray and cranial ultrasound were done for both groups pre, after 2 (post1) and 7 days of treatment (post 2). The diagnosis of intracranial abnormalities was made by cranial ultrasound performed according to routine policy for infants < 1000 g on days 5-8, so, the re-evaluation was done after 2 days from the starting of treatment. During our observation, the average day to transfer newborns who received CPT from SIMV to Continuous positive airway pressure (CPAP) was 7^{th} day after starting CPT. so; evaluation of newborns was done after 7 days.

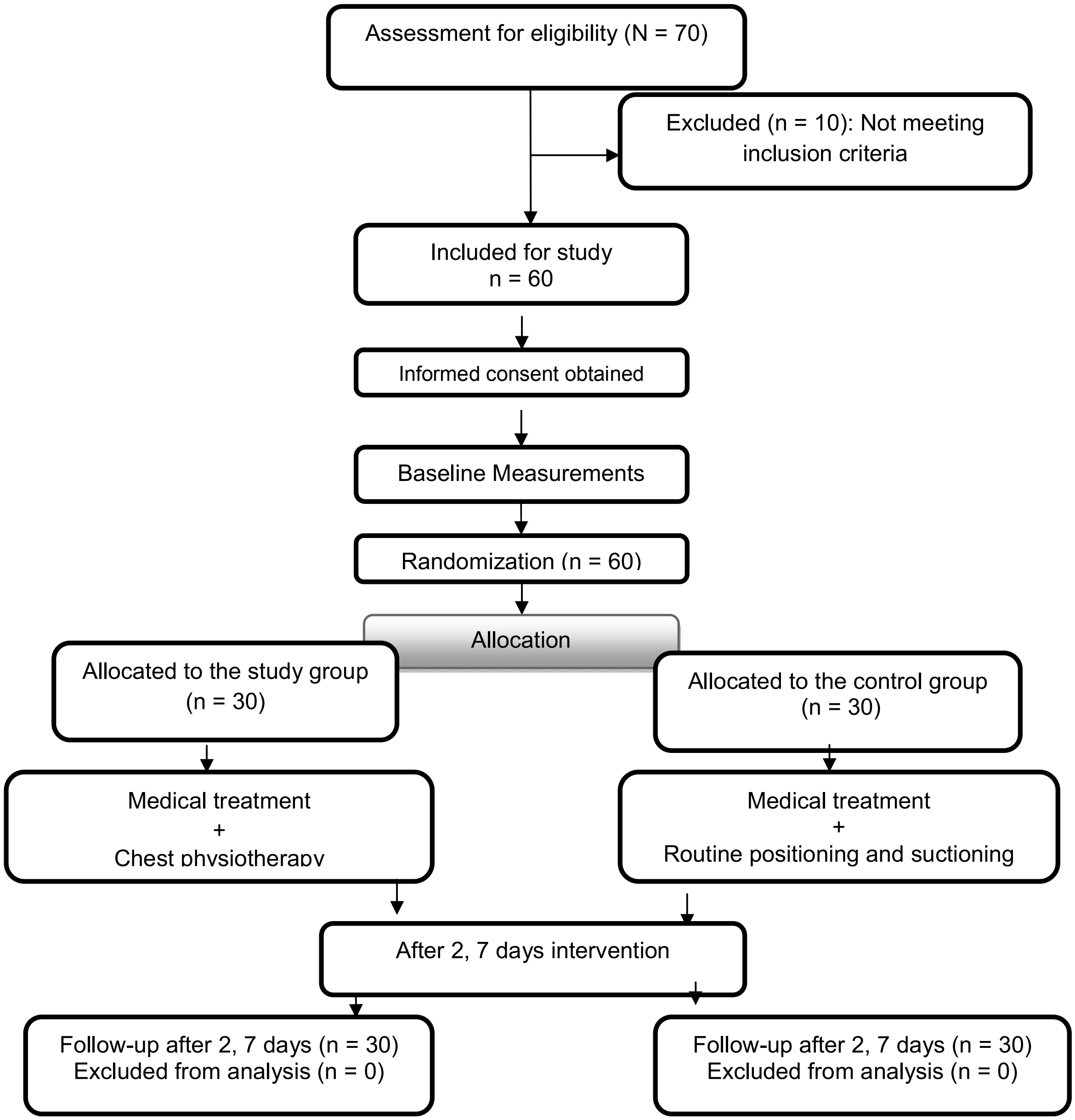

Fig. 1. Flow chart of the study design

Vital signs were measured including heart rate (HR), respiratory rate (RR), systolic arterial pressure (SAP) and diastolic arterial pressure (DAP). Arterial blood gases were including: PaO2, PaCO2, and pH. X-rays were done for follow of RDS and rib fracture which were interpreted by a pediatric radiologist who was blinded to group allocation. Cranial ultrasound scans using a color Doppler unit (Hewlett-Packard Doppler 'IMAGE POINT'), were performed with a 2.2-5 MHz transducer. When there was clinical suspicion of bleeding, additional ultrasound examinations were performed. Both coronal and sagittal sections were obtained through the anterior fontanelles to detect any cranial abnormality including IVH and major cerebral abnormality.

2.3.2 For treatment

Newborns of both groups were mechanically ventilated and controlled medically by neonatologist.

2.3.2.1 Control group

Newborns of the control group received medical treatment and routine nursery care only. Routine nursery care of the ventilated infants included positioning, endotracheal tube (ETT) care. Routine ETT care was performed 4-6 hourly by instilling 0.25-0.5 ml of normal saline before suctioning by neonatal nurses. After suctioning, the baby was changed and repositioned.

2.3.2.2 Study group

The newborns in this group received the same medical treatment and routine nursery care given to the control group. In addition, they received a specially designed CPT three times per day in an interval of 4 hours between each session as recommended by Bertone [24]. Each treatment spent a maximum of 20 minutes (min.) which was not included preparation, physical examinations, diagnostic imaging when performed and variables measurement. The newborns were treated for 7 consecutive days. Non invasive monitoring of oxygen saturation (SpO2) and HR were maintained and analyzed during the entire CPT. According to Santos et al. [25] in cases of SpO_2 reduction below 87%, tachycardia or bradycardia (alterations >15% of that predicted for the age), the intervention was interrupted and FiO_2 increased by 10% over the baseline level. By stabilizing SpO_2 and HR, the newborn was again ventilated with the initial parameters and intervention is resumed. If the SpO_2 and/or HR were not reversed with these actions, physiotherapeutic intervention would be interrupted and appropriate therapeutic measures carried out with data recorded and evaluated. The CPT included the following:

2.3.2.2.1 Postural drainage

The patient's chest radiograph was reviewed and chest auscultation was performed prior to CPT to identify areas of particular involvement. Depending on the location of coarse crepitations, presence of secretions and the newborn tolerance, appropriate drainage positions were applied with avoidance of head down position and excessive neck flexion/extension. According to Crane [26] each postural drainage position was applied for 3-5 min. with Lung squeeze technique (LST) and vibration, followed by about 2 min. suctioning or until clear return of the fluid to the tube, according to the patient's tolerance. Every newborn was put in 3-4 positions according to coarse crepitations.

2.3.2.2.2 Lung squeeze technique

Each set of lung squeezes consisted of three or four sustained chest compressions lasting for about 5 seconds, followed by a gentle slow "release phase," with the chest wall being completely released [27,28].

The selected postural drainage positions used in the present study were as follows:

- Anterior segments of right and left upper lobes were drained with the newborn in flat, supine position. Lung squeeze technique followed by vibration was done over the chest directly under clavicles around nipple area, without direct pressure on sternum.
- Right and left lateral basal segments of lower lobes were drained at 30 degrees leaning forward, with LST and vibration over uppermost portions of lower ribs.
- Right and left anterior basal segments of lower lobes were drained at 30 degrees modified trendelenburg, while the newborn was lying on appropriate side with 30 degrees turn backward. Lung squeeze technique followed by vibration was done at anterior lower margin of ribs.

2.3.2.2.3 Suctioning

Nasotracheal and ETT suctioning was done by instilling 0.25-0.5 ml of normal saline before suctioning was done by neonatal nurses.

2.3.2.2.4 Positioning

Positioning of each newborn after CPT was done with advices given to the nurse to change each position every two hours. Each treatment episode should be carried out in a maximum of 2 positions with the particular area of collapse is uppermost. However, careful consideration must be taken as to whether the newborn tolerated a position especially when there was contraindication. The used positions were side-lying, half lying, prone, three quarter prone, with head to the right is useful with persistent right upper lobe collapse.

2.4 Statistical Analysis

Descriptive statistics were done in the form of mean and standard deviation to summarize patient's characteristics, vital signs and ABG_S. Inferential statistics assessed changes in all measuring variables including: Repeated Measures One-way analysis (ANOVA) was used to compare between the mean values of pre, post 1 and post 2 results for each group. Unpaired t-test was used to show the statistical differences between the two groups (pre, post 1 and 2). The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through SPSS (Statistical Package for Social Sciences) version 20.

4. RESULTS

4.1 Characteristics of the Enrolled Newborns

The mean and standard deviation of the characteristics of enrolled newborns at the beginning of the study including; gestational age (weeks), birth weight (grams), age (days) at enrollment, apgar score at 5 min. are presented in Table 1. No significant differences were recorded between both groups (P>0.05) which revealed that both groups were matched before starting of the study.

4.2 Vital Signs and Arterial Blood Gases

The collected data from this study represent the statistical analyses of the vital signs including (HR, RR, SAP, DAP) and ABG_S including (pH, PaO_2, $PaCO_2$).

4.2.1 Results between the groups

There were no significant differences between both groups in all measuring variables before starting the treatment suggesting proper sample subdivision while after 2 and 7 days of treatment, the results showed significant differences in all measuring variables between both groups (P <0.05) in favor of the study group as demonstrated in Figs. 2-5.

Table 1. Characteristics of the enrolled newborns

Variable	Control group	Study group	*t-value*	*p*-value
GA (weeks)	26.8±0.68	26.87±0.64	-0.32	0.75
WB (grams)	830±49.86	837.33±39.36	-1.09	0.29
Age (days)	4.73±0.59	4.67±0.62	0.24	0.82
AS	8.00±1.10	8.20±1.30	0.46	0.65

Data are expressed as mean ± SD; GA: gestational age; WB: weight at birth
AS: Apgar score at 5th minute; P. value: level of significance

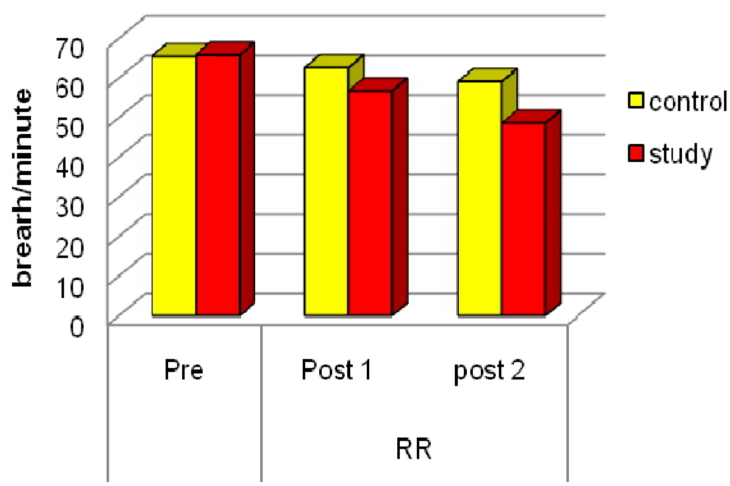

Fig. 2. Mean values of the respiratory rate between both groups

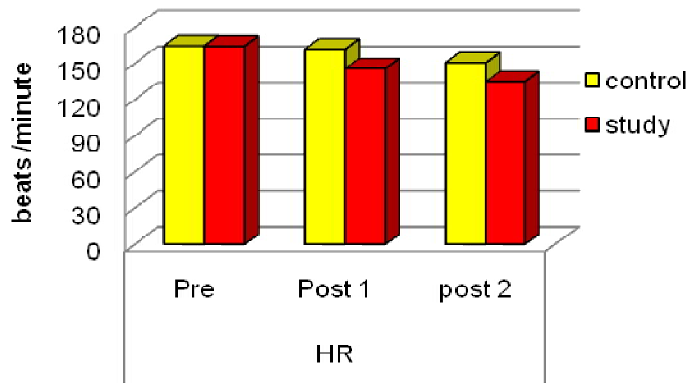

Fig. 3. Mean values of the heart rate between both groups

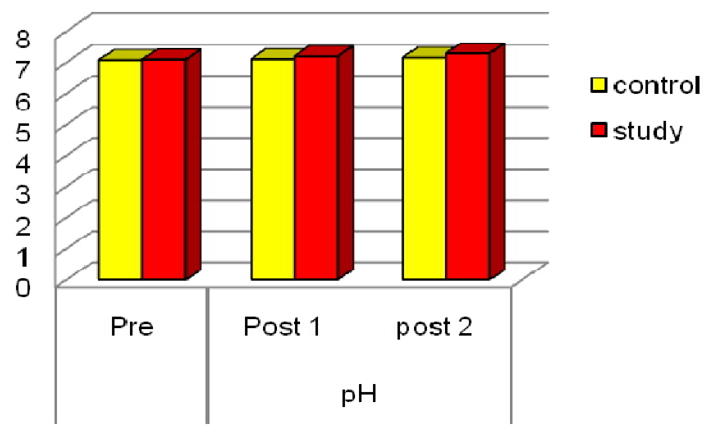

Fig. 4. Mean values of pH between both groups

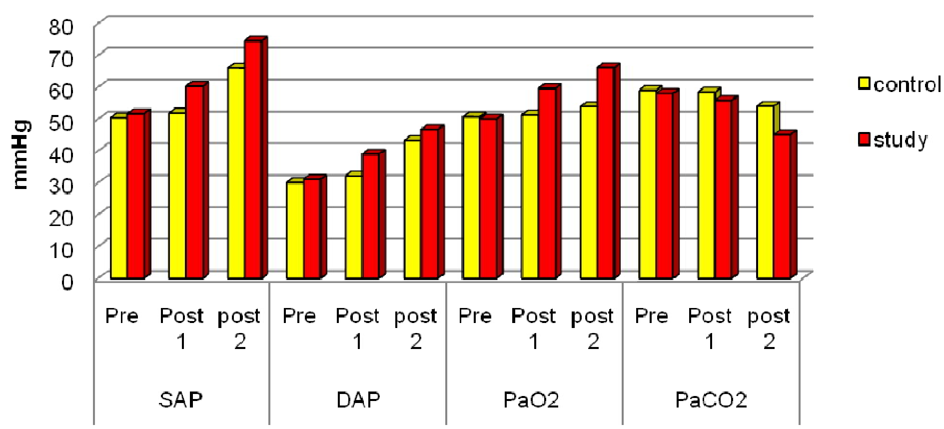

Fig. 5. Mean values of SAP, DAP, PaO_2 and $PaCO_2$ between both groups

4.2.2 Results within the groups

4.2.2.1 Control group

The differences obtained when comparing pre-treatment results to post (1) were statistically non significant (P>0.05) regarding to RR, SAP, DAP, PaO_2 and $PaCO_2$ variables while significant differences in the form of decrease in HR and increase in pH were recorded (P<0.05). Statistically significant differences (P<0.05) were recorded when comparing post (1) and (2); pre and post (2) of all measuring variables. The changes were in the form of increasing in (SAP, DAP, pH, PaO_2) and decreasing in (HR, RR, $PaCO_2$) as presented in Tables 2 & 3.

4.2.2.2 Study group

Repeated Measures ANOVA showed statistically significant differences (P <0.05) when comparing pre and post (1); post (1) and (2); pre and post (2) mean values of all measuring variables. The changes were in the form of increasing in (SAP, DAP, pH, PaO_2) and decreasing in (HR, RR, $PaCO_2$), as presented in Tables 4 & 5.

4.3 Adverse Outcome Measures

Table 6 represents the adverse outcome measures including incidence of rib fractures and any cranial abnormalities (including IVH and major cerebral abnormalities). Neither rib fractures nor cerebral injuries were recorded in both groups pre treatment. After 2 days of treatment, one newborn developed IVH-grade 2 and another one developed PVL in the control group. While throughout the 7 days, no cases were recorded in the study group.

Table 2. Vital signs of the control group

	HR(Bpm)	RR(bpm)	SAP(mmHg)	DAP(mmHg)
Pre	164.53±1.81	65.40±124	50.40±3.11	30.07±2.05
Post (1)	161.73±1.39	62.60±5.83	51.93±3.96	32.20±2.98
Post (2)	150.40±0.91	59.1±4.32	66.07±1.87	43.33±1.68
MD (pre / post 1)	2.80*	-2.80	-1.53	-2.13
MD (post 1/post 2)	11.33*	-3.50*	15.67*	-13.27*
MD (pre/post 2)	14.13*	-6.30*	14.13*	-11.13*

*Data are expressed as mean ± SD; HR: Heart rate Bpm: Beat per minute; RR: Respiratory rate Bpm: breath per minute; SAP: Systolic arterial pressure; mmHg: millimeter mercury DAP: Diastolic arterial pressure; MD: Mean difference; * Mean difference is significant at p<0.05*

Table 3. Arterial blood gases of the control group

	pH	PaO_2(mmHg)	$PaCO_2$ (mmHg)
Pre	7.07±0.06	50.76±4.47	59.07±1.87
Post (1)	7.10±0.05	51.33±5.29	58.53±1.81
Post (2)	7.15±0.03	53.93±4.38	54.07±1.91
MD (pre / post 1)	-.03*	-0.47	0.53
MD (post 1/post 2)	-.05*	-2.60*	4.47*
MD (pre/post 2)	-.09*	-3.07*	5*

Data are expressed as mean±SD; mmHg: millimeter mercury; pH: Hydrogen ion concentration PaO_2: arterial oxygen tension; $PaCO_2$: Arterial carbon dioxide tension; MD: Mean difference
** Mean difference is significant at p<0.05*

Table 4. Vital signs of the study group

	HR(Bpm)	RR(bpm)	SAP (mmHg)	DAP(mmHg)
Pre	164.20±1.86	65.80±2.43	51.73±1.83	31.13±2.33
Post (1)	145.67±2.13	56.73±3.28	60.33±1.92	39±1.69
Post (2)	134.87±1.92	48.60±2.35	74.60±2.29	46.73±1.71
MD (pre / post 1)	18.53*	9.07*	-8.60*	-7.87*
MD (post 1/post 2)	10.80*	8.13*	-22.87*	-7.73*
MD (pre/post 2)	29.33*	17.20*	-14.27*	-15.60*

Data are expressed as mean ± SD; HR: Heart rate Bpm: Beat per minute; RR: Respiratory rate Bpm: breath per minute; SAP: Systolic arterial pressure; mmhg: millimeter mercury DAP: Diastolic arterial pressure; MD: Mean difference; Mean difference is significant at p<0.5*

Table 5. Arterial blood gases of the study group

	pH	PaO_2 (mmHg)	$PaCO_2$ (mmHg)
Pre	7.09±0.04	50.07±1.88	58.13±1.60
Post (1)	7.19±0.05	59.67±2.41	55.87±2.33
Post (2)	7.29±0.04	66.2±3.39	45.07±2.37
MD (pre / post 1)	-0.10*	-9.60*	2.27*
MD (post 1/post 2)	-0.11*	-6.53*	10.80*
MD (pre/post 2)	-0.21*	-16.13*	13.07*

Data are expressed as mean ± SD; mmHg: millimeter mercury; pH: Hydrogen ion concentration
PaO_2: arterial oxygen tension; $PaCO_2$: Arterial carbon dioxide tension; MD: Mean difference
** Mean difference is significant at p<0.05*

Table 6. Adverse outcome measures between both groups

Variable/ frequency	Pre		Post (1)		Post (2)	
	control	study	control	study	control	study
IVH- Grade 1	-	-	-	-	-	-
IVH –Grade 2	-	-	1	-	1	-
IVH- Grade 3	-	-	-	-	-	-
IVH –Grade 4	-	-	-	-	-	-
Major cerebral abnormalities	-	-	1	-	1	-
Rib fracture	-	-	-	-	-	-

IVH: Intraventricular hemorrhage, Major cerebral abnormality defined as one or more of the following: cerebral cyst formation (porencephalic cyst, periventricular leukomalacia, Periventricular- intraventricular hemorrhage or encephaloclastic poreencephaly) or hydrocephalus

5. DISCUSSION

During the last few decades, the survival of preterm infants has increased dramatically. This improvement is mainly due to advances in perinatal medicine and neonatal intensive care [29]. The present study compared between the effects of routine suctioning and positioning to that of chest physiotherapy on extremely preterm neonates who were mechanically ventilated with RDS. The measuring variables were vital signs, ABG_S and incidence of adverse outcomes including rib fracture and cranial abnormality (IVH and major cerebral abnormality). However, numerous studies evaluated the effects of CPT on preterm with RDS, but to our knowledge, this study is the first controlled randomized one.

Comparing between the mean values of vital signs and ABG_S in the starting of the study and after 2 days for the control group showed statistical significant differences (P<0.05) which was in the form of decreasing in HR and increasing in pH and non significant differences regarding to RR, SAP, DAP, $PaCO_2$ (P >0.05), while there were significant differences between mean values after 2 and 7 days of all measuring values (P<0.05). These differences were in the form of decreasing in (HR, RR, $PaCO_2$) and increasing in (SAP, DAP, PH, PaO_2).

The improvement recorded in the control group could be attributed to the combined effects of medical treatment and routine suctioning of the neonates. This could be explained by Cleary et al. [30] who stated that, an improved oxygenation during SIMV in neonates with RDS, allowed a reduction in ventilation pressure or oxygen exposure in this group of neonates, who were at risk of having complications of ventilation.

Early supportive care of premature infants, especially in the treatment of acidosis, hypoxia, hypotension, and hypothermia, may lessen the severity of RDS [18]. There were decrease in the severity of RDS, improved gas exchange, lowered ventilatory requirements and decrease the incidence of IVH by using the medications [31]. Multiple doses of surfactant results in a greater improvement in ventilation and reduce risk of acute lung injury [32].

Lowering of surface tension that allows the alveolus to remain inflated, and permits gas exchange due to administration of surfactant [19]. Endotracheal suctioning should be performed regularly in ventilated neonates to remove obstructive secretions [33].

Improvement in all measuring variables was recorded in the study group after 2 and 7 days of treatment. This improvement could be attributed to the combined effects of the designed CPT and the same medical treatment given to the control group. There was decreasing in HR, RR, and $PaCO_2$ and increasing in SBP, DBP, PaO_2 and PH. Also, there were significant differences between control and study groups in favor of the study one when comparing the post treatment mean values of all measuring variables.

These findings could be explained by Hough et al. [34] who stated that, CPT results in lung mechanical effects, providing optimal respiratory function in order to facilitate gas exchange and adjust ventilation-perfusion adequacy of respiratory support, to prevent and treat pulmonary complications, to provide good maintenance of airways and to facilitate weaning from mechanical ventilation and oxygen therapy.

Physiotherapy procedures provides stability of hemodynamic variables, such as HR [35], the functional maintenance of newborn cerebral circulation and maintenance of airways with turbulent flow and minimal secretion, which allow a increased permeability and reduced number of intrinsic airway that contribute to increased airway resistance and decrease in gas changes physiological events [36].

Abd El-Fattah et al. [37] confirmed that, CPT had significant decrease of $PaCO_2$ of neonates after 48 hours.

Study conducted on ventilated preterm neonates compared LST with conventional percussion and vibration, suggested that LST is more effective in treating atelectasis and can be used to treat signs of uneven distribution of ventilation, bronchial clearance and prevent the development of atelectasis [27].

Also these findings come in agreement with the finding of Kole and Metgud [38] who concluded that CPT, LST technique and reflex rolling are safe and effective for improving oxygenation in preterm neonates with respiratory problems and can be used in clinical settings.

Tudehope and Bagley [39] evaluated the effect of three different techniques of CPT (contact-heel percussion, cupping with a Bennett Face Mask and vibration with an electric toothbrush) in 15 premature infants requiring mechanical ventilation for RDS. Arterial blood gases were performed 5 min before and 15 min after. All babies had an increase in pO_2 following cupping with a mean rise of 16.6 mm Hg and ten babies had a rise in pO_2 with percussion. The improved oxygenation with cupping and percussion did not correlate with the amount of aspirate suctioned nor was there a concomitant improvement in ventilation as measured by pCO_2.

Regarding to the incidence of adverse outcome measures, no rib fractures were observed in both groups after the suggested period of treatment (7 days). Also, there were no cerebral injuries recorded in the study group after suggested period of treatment. This is supported by the findings of Beeby et al. [40] who found no evidence that CPT was associated with abnormal neurological outcomes in extremely preterm neonates. Also, Knight et al. [41] concluded that, encephaloclastic porencephaly emerged as a problem at a time when the use of CPT had decreased which began to appear because of some other factor.

This study is different to that one conducted by Wood [16] who reported a case of diffuse periosteal new bone formation involving the ribs in an infant who received physiotherapy of the chest performed with a vibrator. He stated that, the abnormality probably resulted from periosteal trauma caused by prolonged vibrator therapy. Since this form of pulmonary therapy is common in newborn intensive care nurseries, radiologists may encounter this finding occasionally.

Our findings are not in agreement with earlier studies by Raval et al. [42] who showed that a single randomized trial found an increased incidence of severe IVH in preterm neonates with RDS receiving early active CPT life.

There was one neonate developed IVH-grade 2 and another one developed PVL in the control group after 2 days of inclusion in the study. While no increase in the number of neonates developed cerebral injuries or its severity recorded after 7 days. This could be due to hypotension which continued with these two cases in the control group till the third day from the beginning of the study while the results in the study group could be attributed to improving the ventilation/perfusion ratio, circulatory status, and peripheral perfusion which lead to improving heart rate, respiratory rate and blood pressure. This is supported by Kliegman et al. [18] who stated that, there are two major complications of

RDS. The first is pneumothorax. This air causes the lung to collapse further, making breathing even harder and interfering with blood flow in the lung arteries. The blood pressure can drop suddenly, cutting the blood supply to the brain. The second complication is IVH which may be fatal.

Intraventricular hemorrhage is particularly common in infants, especially premature infants or those of very low birth weight. The cause of IVH in premature infants, unlike that in older infants, children or adults, is rarely due to trauma. Instead it is thought to result from changes in perfusion of the delicate cellular structures that are present in the growing brain, which is especially vulnerable to hypoxic ischemic encephalopathy. The lack of blood flow results in cell death and subsequent breakdown of the blood vessel walls, leading to bleeding [43]. Blood vessels in the germinal matrix next to the ventricles are very fragile and vulnerable to fluctuations in blood flow, which can cause the vessels to rupture and bleed [44].

6. CONCLUSION

This study was conducted to evaluate the effect of routine CPT on extremely preterm neonates when compared with a program of routine positioning and suctioning. The neonates had respiratory distress syndrome and were ventilated on non invasive mechanical ventilator. The obtained results showed significant improvement after 2 and 7 days of treatment in vital signs and arterial blood gases of the group received CPT. No adverse effects regarding to the cerebral injuries or rib fractures were recorded in this group while two neonates didn't receive CPT, developed cerebral injuries. Therefore, CPT is a safe and effective line of treatment for extremely preterm mechanically ventilated neonates with respiratory distress syndrome.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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