

Effect of Chest Physiotherapy on Improving Chest Airways among Infants with Pneumonia

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Abstract: Pneumonia is the leading cause of childhood morbidity and death in many of developing countries. The aim of this study was to construct, implement and evaluate the effect of an intervention of chest physiotherapy (CPT) on improving chest airways of infants suffering from pneumonia. A quasi experimental design was utilized. The study conducted at 3 medicine floors at New Pediatric Hospital, Cairo University (NPHCU). A total of 60 infants (divided equally and randomly into 30 in study and 30 in control group) were recruited according to the inclusion criteria. The following tools were utilized to collect the required data which were a structured interview questionnaire schedule and medical history questionnaire schedule and infant's medical records. The mean age of infants was 4.93 ± 2.99 months for study group and 5.13 ± 2.92 months for control group. There were statistically significant differences between study and control groups regarding frequency of oxygen therapy and suctioning /day after applying intervention than before ($p \leq 0.05$). The current study concluded that CPT was effective in improving chest airways in infants with pneumonia in the form of decreasing oxygen requirement and frequency of suctioning. CPT should apply for infants with pneumonia whose condition required.

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1. Introduction

The World Health Organization (WHO) estimates that one in three newborn infant deaths is due to pneumonia. Over two million children under five die each year worldwide. WHO estimates that up to 1 million of these (vaccine preventable) deaths are caused by the bacteria *Streptococcus pneumoniae*, and over 90% of these deaths take place in developing countries. Mortality from pneumonia generally decreases with age until late adulthood [1]. Pneumonia is an infection of the lungs, most commonly caused by viruses or bacteria like *Streptococcus pneumoniae* and *Haemophilus influenzae*, Pneumonia can also be caused by foreign material such as food or stomach acid. Depending on the clinical presentation, pneumonia can be classified as very severe, severe or non-severe, with specific treatment for each of them except for antibiotic therapy. Severe and very severe pneumonia require hospitalization for additional supportive treatment such as suction, oxygen therapy and administration of bronchodilator [2].

Pneumonia is an infection in one or both lungs. Often, pneumonia begins after an infection of the upper respiratory tract (nose and throat). This causes fluid to collect in the lungs, making it hard to breathe. Children of any age can develop pneumonia. It is most common in fall, winter and early spring. Pneumonia can be caused by different types of germs, including bacteria, viruses, fungi, and parasites. Viruses are usually the cause of pneumonia in

children. Children with a viral pneumonia can also develop bacterial pneumonia. [3].

The first signs of classic bacterial pneumonia are the sudden development of shivering fits, fever, chest pains and coughing. The cough starts out dry, but patients soon begin to cough up phlegm, which can be yellow or bloodstained. Breathing can become fast and shallow and painful, and patients sometimes find themselves gasping for air. They may even start to go blue around the lips and nails due to a lack of oxygen [4]. Other symptoms may include loss of appetite, headaches, fatigue, nausea, vomiting, mood swings, and joint pains or muscle aches. Some patients develop a rash of cold sores around the mouth a sign that their immune system is depressed, viral pneumonia can have a slower onset and be less severe at first. Sometimes it may go unrecognized because the person may not feel very ill. These symptoms depend on age and other underlying health problems [5].

If the pneumonia is complicated, a painful rubbing sensation may be felt with each breath, less movement on the affected side of the chest, fast heart rate, tiredness, body weakness (general malaise). Pneumonia is treated with antimicrobial agents, oxygenation and techniques to improve clearance of secretions (humidification, aerosol therapy, chest physiotherapy (CPT) and correction of somatic dysfunctions) depending on the severity of the pneumonia [6].

The central function of CPT in pediatric

respiratory disease is to assist in the removal of tracheobronchial secretions; Postural Drainage and Percussion (PD & P), (known as CPT) are performed by placing the infant in various positions and gently tapping on his back or chest for about three to five minutes with a special cup, or by percussion (gently tapping) the chest and back with cupped hand. The vibrations from the tapping are transmitted through the chest wall, loosening the mucus and moving it from the smaller airways to the larger airways [7]. After CPT, the infant can cough up the secretions and either spit them out or swallow them [8]. The severity of the illness and cause of the disease direct the nursing care of the child with pneumonia. The infant and his/her family need to receive information about the disease and its treatment. Nurses should explain all procedures and treatments and encourages the parents to stay with their infant and participate in the infant's care. Nurses convey empathy for the family's feelings and concerns [9].

Pneumonia is the main respiratory disorder that leads to hospitalization in Cairo University children's hospitals and also showed the highest mortality rate among children if not treated effectively (about 40-50 % of dead cases) [10]. However, Pneumonia is successfully treated with antibiotics; infants also require support treatment, such as CPT and oxygen treatment. The research investigators observed that nurses and physicians neglect CPT and no one apply it upon infants in the NPHCU, even ask whether it performed or not.

The current study hopes to determine the effectiveness of applying PD & P on improving respiratory airways of infants with pneumonia in form of frequency of needing to oxygen and suctioning.

Aim of the study

The aim of this study was to construct, implement and evaluate the effect of an intervention about CPT (PD & P) on improving chest airways.

2. Subjects and methods

Research Design

A quasi experimental design was utilized to carry out this current study.

Research hypothesis

Infants exposed to PD & P needed oxygen and suctioning less frequently than those who do not.

Setting

This study was conducted upon patients at 3 medicine floors in NPHCU. NPHCU provides free treatment and care for all diseases and children from

all Egypt and free.

Sample

A total of 60 infants were recruited according to the following criteria which were conscious infant with pneumonia, age between 1-12 months, have no other medical problems and they have no contraindication for applying CPT. Those infants (60) were divided equally and randomly into 2 constructed groups (study and control), the researchers dealt and collected the required data from first 30 infants entered into medical floors to be included in the study group and when finished from the intervention with this required number started to receive and collect the required data from the 30 infants entered the medicine floors after collecting data from study group to be included in the control group. Actually there was about 200 infant admitted and diagnosed with pneumonia to NPHCU in 2008/2009. The determination of the size of the sample based upon this sample calculation formula:

$$N = \frac{T^2 \times P(1-P)}{M^2}$$

N = required sample size

T = Stander significance

T = 1.96

P = prevalence

M² = standard margined 0.5

$$N = \frac{3.841 \times 0.0200(1-0.0200)}{0.0025}$$

N = 60

Tools for Data Collection

Two tools were constructed to collect the required data for this study as following

- 1- A structured interview and medical history questionnaire schedule, which developed by the research investigators after reviewing the related literature. It included 6 questions related to the infant's, age, sex, residence and medical history of the infant as frequency of previous exposure of infants to pneumonia, signs and symptoms of pneumonia.
- 2-Infant's medical records which is documented by the physician about chest condition of the infant and prescribed management of pneumonia (frequency of required oxygen/day, frequency of required suctioning/day and chest sound).

Pilot study

An initial pilot study was done on 10 infants with pneumonia to test the feasibility of the tool and to evaluate the content of the structured interview and medical history questionnaire sheet. Slight modifications were done after analyzing the results of the pilot study. Infants included in the pilot study were included in the study.

Ethical considerations

The control group was left to hospital routine management of pneumonia as prescribed times/day according to infant's condition. All mothers of infants included in the study and control groups informed about the aim, tools and duration of the study after explaining to them the benefits of the study. Written consent of the mothers was obtained. Mothers were assured about confidentiality of the data which gathered from their infants during the study. During the study the researchers informed the mothers about their right to withdraw from the study any time without any effect on the care provided for them.

Content validity

Assessment sheets reviewed by 5 experts in the field of pediatric medicine and nursing to test content validity and according to their review few modifications were carried out.

As regard reliability of the structured interview and medical history questionnaire sheet, Cronbach's alpha between questions is .922. It obvious that the alpha value is quite high, indicating that the tool demonstrated internal consistency

Procedure:

An official permission was obtained from the director of the NPHCU after explanation of the aim of the research. The research investigators obtained the written consents from mothers of infants with pneumonia after an explanation of the aim, tools and duration of the research and informing them about the confidentiality of the results. The research investigators started an assessment by using the structured interview and medical history questionnaire schedule, infant's medical record, this was carried out for all infants in both study and control groups. Then the research investigators assessed chest of the infants in the study group by stethoscope to determine the site of secretions in the lung needs to apply PD & P upon it. Assessment of the chest by stethoscope took about 3-5 minutes and was performed before each time of applying PD & P. According to the site in the lung's lobe appropriate position of postural drainage applied and followed by percussion, during applying postural drainage the research investigators followed the following steps:

- 1- Hand washing before procedure, wearing disposable gloves.
- 2- Assessment of vital signs of the infant and color of the infant.
- 3- Place the infant in appropriate position according to site of secretions.

- 4- Applying percussion by cupped hand or sometimes tips of the fingers according to age of the infant.
- 5- Hand washing after finishing the procedure.

The researchers took the assessment in the first day after infant's admission followed by applying PD & P in the same first day but sometimes applying PD & P postponed to the second day until the condition of the infant determined and the results of lab investigations appeared. Applying PD & P took about 7-10 minutes, PD & P were done 2-3 times/day as the following one in the morning 9-10 a.m and one at about 12-1 p.m and last one was in the afternoon at 3-4 p.m. PD & P were applied for 3-4 days according to physician prescribed stoppage of PD & P to infant. There were certain precautions the researchers followed before applying PD & P which were PD & P applied before feeding or after feeding by 2 hours and removing clothes of the infant, just leave light clothes (T-shirt) and stopping it if the infant gets tired.

The research investigators evaluated the effect of the intervention (improvement of airways for study group) by assessment of frequency of required oxygen, suctioning/day and chest sound as reported by physician in the infant's record daily. In addition research investigators assessed frequency of required oxygen and suctioning/day and chest sound for the infants in control group as reported by physician in the infant's record daily. This evaluation was done at 4th and 5th day from admission of infants in both groups this period of time is the maximum period of staying in the hospital after the condition gets better and before discharge because of high rate of hospital's admission. Data collection took about 7 months as it started in June, till the end of December, 2009.

Statistical analysis

Data was analyzed using SPSS statistical package version 15. Numerical data were expressed as mean \pm standard deviation (SD). Qualitative data were expressed as frequency and percentage. Chi-square test was used to examine the relation between qualitative variables. For quantitative data, comparison between two groups was done using t-test. P-value \leq 0.05 was considered significant.

3. Results

Table 1 shows demographic characteristics of infants with pneumonia in study and control groups. The age of infants included in the study ranged from 1-6 months with a mean age of 4.93 ± 2.99 months for study group and 5.13 ± 2.92 months for control group,

regarding sex 70% & 63.3% respectively, of study and control groups were male infants. Concerning with residence of infants 66.6% & 70% were living in rural area. Regarding the number of having pneumonia previously recent hospital admission were 73.3% & 66.7% respectively, of study and control groups were exposed to pneumonia more than one time before. There was no a statistically significant difference between study and control groups regarding age, sex, residence and number of having pneumonia previously (t.test =0.273 at p = 0.786), ($\chi^2 = 0.300$ at p = 0.584), ($\chi^2 = 0.269$ at p = 0.547) and ($\chi^2=0.317$ at p = 0.573).

Table 2 indicates a comparison before and after CPT between study and control groups regarding frequency of oxygen therapy and suctioning required/day, it was observed that there was a statistically significant difference between study and control groups before and after CPT regarding

frequency of oxygen therapy required /day after research intervention as frequency of O₂ required/day in study group decreased less than in control group ($\chi^2= 60.0$ p=0.013). It was found from table 2 a statistically significant difference between both groups regarding frequency of suctioning /day as the frequency decreased in study group less than in control group ($\chi^2= 57.12$ p=0.000).

Table 3 explains a comparison before and after applying CPT between study and control groups regarding change in breath sounds and that there was a statistically significant difference between study and control groups regarding change in breath sounds after the intervention as the chest sound got better improved in study group than in control group ($\chi^2 = 55.70$ p=.010).

Table 1 Demographic Characteristic of infants with Pneumonia in Study and Control Groups

Item	Study group (No.=30)		Control group (No.=30)		test	p-value
	No.	%	No.	%		
Age:					t=	0.786
1≤ 6 months	22	73.34	19	63.33		
7≤ 12 months	8	26.66	11	36.67		
x ± SD	4.93±2.99		5.13±2.92			
Sex:					χ^2	0.584
- Male	21	70	19	63.3		
- Female	9	30	11	36.7	0.300	
Residence:					χ^2	0.547
-Rural	20	66.6	21	70		
-Urban	10	34.4	9	30	0.269	
History with Pneumonia:					χ^2	0.573
- First time	8	26.7	10	33.3		
- More than one time	22	73.3	20	66.7	0.317	

Table 2. A Comparisons about frequency of Oxygen Therapy before/after Applying CPT between Study and Control Groups.

Item	Study group (No.=30)				Control group (No.=30)				χ^2	p.value
	Before		After		Before		After			
	No.	%	No.	%	No.	%	No.	%		
Frequency of O₂/day									60.0	0.013*
1- All the 24 hours	28	93.34	0	0	25	83.34	15	50		
2- Little time/2hours	2	6.66	7	23.33	0	0	12	40		
3- As needed	0	0	23	76.67	5	16.66	3	10		
Frequency of suctioning/day									57.12	0.000*
1-once/3hours.	30	100	0	0	30	100	14	.66		
2-once/6hours	0	0	0	0	0	0	8	26.66		
3- /12hours.	0	0	3	10	0	0	0	0		
4- as needed	0	0	20	66.67	0	0	5	16.66		
5- no need for suctioning	0	0	7	23.33	0	0	3	10		

* Significance at p≤0.05

Table 3 A Comparisons Between Study and Control Groups Before and after Applying Chest Physiotherapy Regarding to Chest Sound.

Item	Study group (No.=30)				Control group (No.=30)				χ^2	p.value
	Before		After		Before		After			
	No.	%	No.	%	No.	%	No.	%		
Chest Sound										
1- No change (before CPT)	30	100	6	20	30	100	27	90	55.70	0.010*
2- Get improved (after CPT)	0	0	24	80	0	0	3	10		

* Significance at $p \leq 0.05$

4. Discussion

Chest physical therapy has been and continues to be widely applied to patients in pediatric practice, based on beliefs of the potential benefits of this modality on evacuating inflammatory exudates and tracheobronchial secretion, removing airway obstruction, reducing airway resistance, enhancing gas exchange and reducing the work of breathing [11].

It was observed from the current results of the study that pneumonia was common in age group range from 1- 6 months. This result was in agreement with what found by Mohamed [12] in his study that the majority of his sample were children less than 1 year and diagnosed with pneumonia. In Egypt, this may be due to lack of immunity of these children due to poverty and lack of nutritional diet, lack of hygienic care provided by the mothers, lack of health care services available to children and lack of appropriate care provided by the mothers to their children. This lay a heavy burden on health care services in Egypt in terms of utilization of hospitals and health centers.

The current study revealed that the majority of study and control groups were male infants. This again was in agreement with what found by Mohamed [12] as he stated that the majority of his sample was male children. This does not mean pneumonia is common in males than females but may be due to over caring and value of male children which many of Egyptian women and families give it to male infants while for females' families commonly search another way of treatment as traditional medicine or going to nearest pharmacy for medication. Also this was in agreement with what found by Afifi [13] as he indicated in his study that about two thirds of the study sample were males. Attia [14] found in his study that more than two thirds of the children in both control and experimental groups were males.

The results of the current study revealed that the majority of infants in both groups live in rural area. This is because almost hospital referral of acute cases to NPHCU for better facilities and equipment. This in congruence with what was found by Afifi [13] as he found in his study that acute emergency cases

recorded in NPHCU, was respiratory disorder as pneumonia recorded the highest percentage and the chief cause of admission in the study to NPHCU.

It was observed that there was a statistically significant difference between study and control groups regarding decreasing frequency of oxygen requirement/ day with CPT. The results of the study are in contradiction with what stated by Chan, et al., [15] and Paludo, et al., [16] as they mentioned that no evidence to suggest that chest physiotherapy should be routinely done in pneumonia.

There was a statically significant difference regarding decreasing frequency of suctioning/day between study and control groups after applying CPT. This result is in agreement with results found in a study done by Oermann, Swank and Sockrider [17] as they indicated that the use of postural drainage, percussion and vibration for airway clearance has been a cornerstone in therapy for > 40 years, that studies have clearly shown CPT to be effective. Also the function of CPT is to assist in the removal of tracheobronchial secretions resulting increasing gas exchange and reduction in the work of breathing [18].

There was a significant relationship regarding improvement in chest sound between study and control groups after applying chest PD & P. These results are in congruent with what presented by McIlwaine [19] as he found in his study that CPT in the form of airway clearance techniques and exercise has played an important role in the treatment of pneumonia and improvement of lung sound. In addition this result is in agreement with result showed by Holland, et al., [20] as he found in his study that PD & P help unstick mucus from the lungs so that it can be coughed out which improve chest sound. In addition, Hill and Webber [21] as they mentioned in their study that with effective PD & P therapy, breath sound improved following the therapy as secretions move into the larger airways and increase in rhonchi.

Furthermore results also in agreement with results of study done by Mathews, et al., [22] as they found in their study that post percussion therapy auscultation resulted in improvement in chest sound

because of the better air entry and oxygenation. In addition, this was in congruent with what stated by Slonim [23] as he found in his study that effective chest physical therapy mobilize tracheobronchial secretions in his sample of children which resulted in clearance and improvement in chest sound. Also Susanand and Hintz [24] added that CPT used in infants has been reported to be associated with improved oxygenation and secretion clearance and improvement in chest sound. Overall, the results of the study indicated the positive effect of chest physiotherapy on chest airways of infants with pneumonia which support the study hypothesis.

Conclusion

The current study concluded that CPT is effective in improving chest airways in infants with pneumonia. This is manifested by decreasing frequency of suctioning, oxygen requirement/day and clearance chest airways after implementing CPT and this proved the hypothesis of the current study.

Recommendations

Based on the results of the current study, the following recommendations were reached:

- CPT should be applied for infants with pneumonia whose conditions require that.
- Parents of infants with pneumonia should be taught how to apply CPT to apply it on their infants when needed.
- Replication of this study on a larger and different age group.

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