The Effect Of Neurophysiological Respiration Facilitation On Arterial Blood Gases In Early Childhood Bronchial Pneumonia

Omnia Hasan Kotb[1,2], Akram Abd Elaziz Sayed [1], Asmaa Mahmoud AbdelHamid Elmesiry[3,] Ramy Salama Draz [1]

1 Department of Physical Therapy for Cardiovascular/Respiratory Disorder and Geriatrics, Faculty of Physical Therapy, Cairo University

2 Department of Physical therapy, kafr elzayat general hospital

3 Department of Pediatric, Faculty of medicine, Tanta University

Corresponding author: Omnia Hasan Kotb, master degree student

Official email of the corresponding author: menna.hasan94@gmail.com

ABSTRACT

Background: *The "Neurophysiological Respiration Facilitation" terminology relates for the external use of proprioceptive and tactile cues that tend to alter the depth of breathing and its rate while triggering reflex respiratory movement responses. Purpose: The present research attempted to assess the efficiency of neurophysiological respiration facilitation on arterial blood gases in bronchial pneumonia.* ***Subjects and Methods:*** *This study was applied on sixty pediatric subjects struggling with bronchial pneumonia, with ages ranging from one to four years. The subjects were chosen from Pediatric ICU of Kafr ElZayat general hospital. All was assigned randomly into two groups (Group A was given conventional chest physiotherapy, while group B was given the same protocol plus neurophysiological facilitation technique). The experimental procedures and potential risks were fully explained to the caregivers before the study, and all caregivers provided written, informed consent. ABG on day 1 and after seven days of the protocol and PaO2 and PaCO2 levels are measured.* ***Result:*** *The result of study showed a significant increase in Pao2 level. The mean difference in PaO2 between groups post treatment was -15.03 mmHg. Group B had a significantly increased PaO2 level than group A post treatment (p = 0.001). And a significant decrease in PaCo2 level. The mean difference in PaCO2 between groups post treatment was 3.33 mmHg. Group B had a significantly decreased PaCO2 level than group A post treatment (p = 0.005).* ***Conclusion:*** *In conclusion there is a significant role of neurophysiological facilitation in treating bronchial pneumonia patients as it improve arterial blood gases.*

Keywords: *bronchial pneumonia, chest physiotherapy, neurophysiological facilitation*

INTRODUCTION

Pneumonia is a medical term of the parenchyma of the lung infection, Medical practitioners should keep in mind that pneumonia is a broad terminology for a group of syndromes caused by different microbes and not a single illness that leads to different symptoms and complications. There have been many ways to categorize pneumonia including the cause, clinical context of infection, and the pattern of the lung parenchyma involvement, with other classifications (1) Children less than five years make up for almost 13.4% of the overall population In Egypt while pneumonia accounts for 19% of under-five mortality. According to estimates in Egypt, there are between 0.11 and 0.20 cases of pneumonia cases per child-year. (2) In 2015, pneumonia killed 920,136 children, or 16% of all children less than 5 years, as it was the top source of death in developing nations for pediatric under five years. (3) Only one-third of the pediatric who suffers from bacterial pneumonia can receive vital medications, despite the fact that pneumonia may be caused by several viral, fungal, or bacterial pathogens (4) Bronchopneumonia is by far the most prevalent clinical sign of pneumonia and the top infectious killer when it comes to children less than five years old (5) Bronchopneumonia is an infection that starts in the airways from the bronchi and bronchioles and travels down into the lungs. Typically, the lower lobes are affected. Neutrophil accumulation in the alveoli and bronchi is indicated by patchy consolidation zones. (6) The (ABG) or arterial blood gas test analyzes blood directly drawn from the artery. The arterial blood gas analysis determines the PaO2 and PaCO2 levels in patients. PaO2 shows knowledge about the condition of oxygenation, and PaCO2 gives data about the status of ventilation either chronic or acute respiratory failure. PaCO2 levels are affected by hypoventilation if it is slow or shallow breathing and hyperventilation either rapid or deep breathing. (7). Pathogen infection causes lobular pneumonia, also called bronchopneumonia, which is manifested as localized acute suppurative inflammation in the bronchioles and bronchus. Pneumococcus, Staphylococcus aureus, and Streptococcus are common bacteria that may cause illness. In addition to bacterial infection, viral infection is another possible cause of the condition, however it is very uncommon. Pneumonia is most frequent in babies, although it may also affect teenagers, the elderly, and those with severe disabilities. (8) Assisting in the obstructive tracheobronchial secretions removal is the primary goal of CPT in pediatric respiratory disease. This, in turn, decreases resistance to airflow, improves breathing effort and exchange of gases, which allows for early withdrawal of the ventilator, speeds recovery, prevents or resolves respiratory complications, reexpands collapsed lobes, also helps with lung function. When it comes to maximizing functional outcomes after PICU, avoiding or reducing the consequences of severe illness and immobility Including postural problems and muscle deconditioning and other long-lasting effects of serious pediatric illness or injury are of the utmost importance. (9) Muscle strength can be enhanced by resistance training with proprioceptive neuromuscular facilitation (PNF), It improves breathing rate and depth by providing proprioceptive input to the respiratory muscles, which in turn stimulate reflex movements in the respiratory system.(10) Postural changes can lead

to respiratory impairment by lowering the chest wall's mobility and expandability resulting in reduced flows and volume of the lungs. Therefore the exercise Proprioceptive Neuromuscular Facilitation (PNF) is an approch aimed at lowering variations in the function of respiration,
the respiratory muscles' commitment and allowing for better mobility of the chest wall, which reduces rib cage stiffness. (11)

MATERIALS AND METHODS

Study design:

year to 4 years)Minimal limit of oxygen saturation > 85 % Average Heart Rate (80-120 Bbpm) Average Respiratory Rate (20-30 breath/ minute). The patients were eliminated when they meet one or more of the next criteria: convulsions, fever, condition that is a contraindication for the use of Percussor palm cups such as over (fractures or tumor). If hemorrhage could easily occurs, recent neurosurgery, Severe anemia, Any congenital anomalies (Arterial septal defect ,ventriculae septal defect ,aortic stenois)

Study procedures:

Before starting the study:

The caregivers were informed of the study's purpose.

Each caregiver signed a consent form indicating that they agreed to be included in the study.

A doctor performed a medical examination on each patient to rule out any more health issues.

Patients were enrolled in two equal groups in numbers. Group A was given conventional chest physiotherapy, whereas group B was given the same protocol plus

The aim of the present study was assessment of the effect of neurophysiological respiration facilitation on arterial blood gases in bronchial pneumonia patients. It was carried out at pediatric patients suffer from bronchial pneumonia from Pediatric ICU of Kafr ElZayat general hospital.

Participants:

A number of sixty pediatric patients suffer from bronchial pneumonia and their ages ranged from (1

neurophysiological facilitation technique.

Testing methods:

All patients were evaluated before and after every session measuring oxygen saturation, Heart Rate and Respiratory Rate.

PaO2 & PaCo2 will be measured before and after treatment and will be collected from an ABG report

Treatment Procedures:

Group A: This group included 30 subjects who received 3 sessions per day for 7 days in form of modified postural drainage, percussion and positioning each treatment shouldn’t exceed 20 minutes.

Group B: This group included 30 subjects who received the same treatment as group A plus Neuro-facilitation technique like Peri-oral pressure,inter-costal stretch, anterior stretch-lifting posterior basal area and abdominal co-contraction. Each technique of this is given for 5 repetitions with 5 seconds hold between the gaps of 5 seconds. In peri-oral pressure, pressure is applied to the upper lib by the therapist finger. In vertebral pressure, manual pressure

over thoracic vertebrae in region T2 and T10 by the hypothenar eminence. In anterior stretch lifting posterior basal area, therapist put his hand under lower ribs of patient ribs and lift ribs upward. In intercostal stretch, stretch on expiratory phase in intercostal area and maintain. In abdominal co contraction, pressure provided laterally over lower ribs and pelvis.

Data analysis:

We applied an unpaired t-test to compare the age between groups. we also used the chi-squared test to compare the sex distribution between groups. For determining whether data had a normal distribution or not, the Shapiro-Wilk test was used. To determine the homogeneity of variances between groups, Levene's test was used. We used an unpaired t-test to compare the mean values of PaO2 and PaCO2 between groups. we used the paired t-test for comparing pre and post-treatment in each group. The level of significance was set at $p < 0.05$ for all statistical tests. All statistical analysis was performed using the statistical program social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA)

Results

- Subject characteristics:

The characteristics of subject in both groups (A &B) were illustrated in Table (1). And showed that, there was no significant difference between groups in age and sex distribution ($p > 0.05$).

Table 1. Subject characteristic

	Group A	Group B	MD	t- value	p-value
	Mean ± SD	Mean ± SD			
Age (years)	2.07 ± 0.82	2.23 ± 0.72	-0.16	-0.82	0.41
Sex, n (%)					
Girls	17 (57%)	16 (53%)		χ^2= 0.07	0.79
Boys	13 (43%)	14 (47%)			

SD, standard deviation; MD, mean difference; χ^2, Chi squared value; p-value, level of significance.

Treatment Effect on PaO2 and PaCO2:

- Within group comparison:

There was a significant increase in PaO2 and a significant decrease in PaCO2 in group A and B post treatment compared with that pre treatment ($p < 0.001$). The percent of change in in group A and B in group A was 76.47 and 19,18% respectively and that of group B was 129.15 and 28.03% respectively. (Table 2).

- Between groups comparison:

There were no significant differences between groups pre-treatment ($p > 0.05$). Post treatment, group B had a significantly higher PaO2 and a significantly lower PaCO2 than group A. ($p < 0.01$). (Table 2) **Table 2. Mean PaO2 and PaCO2 pre and post treatment of group A and B:**

	Pre treatment	Post treatment				
	Mean ± SD	Mean ± SD	MD	% of change	t- value	p value
PaO2 (mmHg)						
Group A	35.32 ± 12.16	62.33 ± 18.00	-27.01	76.47	-9.52	0.001
Group B	33.76 ± 11.59	77.36 ± 12.34	-43.6	129.15	-15.8	0.001
MD	1.56	-15.03				
t- value	0.51	-3.77				
	p = 0.61	***p = 0.001***				
PaCO2 (mmHg)						
Group A	51.57 ± 11.59	41.68 ± 4.95	9.89	19.18	5.44	0.001

Group B	53.29 ± 9.41	38.36 ± 3.75	14.93	28.02	10.0.3	0.001
MD	-1.72	3.32				
t- value	-0.63	2.92				
	p = 0.53	***p = 0.005***				

SD, standard deviation; MD, mean difference; p-value, probability value.

DISCUSSION

The results of this research study stated the following:

The mean age of group A (2.07 ± 0.82 years) is slightly lower than that of group B (2.23 ± 0.72 years), however this variation is not statistically significant (t-value = -0.82, p = 0.41). Therefore, we can conclude that age is not a confounding variable in the comparison of the two groups.

The frequency distribution of the sex of the participants in each single group. There were 17 of girls (57%) and 13 of boys (43%) in group A, and 16 of girls (53%) and 14 of boys (47%) in group B. The chi-squared test showed that there is no significant difference in sex distribution between the groups ($\chi 2$ value = 0.07, p = 0.79). Thus, we can assume that sex is not a confounding variable in the comparison of the two groups.

The mean values of the pre-treatment PaO2 and PaCO2 levels are similar between the two groups, indicating that the groups were comparable at baseline. After treatment, both groups showed significant improvements in their PaO2 and PaCO2 levels ($p < 0.001$ for both).

The result of the study revealed that:

The mean difference in PaO2 between groups post treatment was -15.03 mmHg. Group B had a significantly increased PaO2 level than group A post treatment (p = 0.001).

The mean difference in PaCO2 between groups post treatment was 3.32 mmHg. Group B had a significantly decreased PaCO2 level than group A post treatment (p = 0.005).

This results agrees with Ashtankar 2020 study that indicated enhancement in static and dynamic compliance, HR, RR, and PaCO2 measurements for the patients who received PNF in combination with Chest Physiotherapy compared to Chest Physiotherapy alone (12)

And also agrees with Kumar J ithendra 2008 who mentioned in his study that the ICU-based patient's PNF approach can enhance their medical condition by lowered respiratory rate and heart rate, raised SPO2.(13)

This result agrees with Sneha S et al 2017 who found that the parameters of static, dynamic compliance, minute ventilation, Spo2 and HR were all significantly improved after the administration of Chest Physiotherapy in conjunction with PNF as compared to Chest Physiotherapy alone. (14)

And also in lines with Bhakaney PR 2022 who concluded According to the current statistical analysis in his research, PNF techniques for the chest which included intercostal stretch and anterior basal stretch lift provide a rapid effect in increasing oxygen saturation (spo2) and can be added as an inpatient therapy program in the rehabilitation plan. (15)

This result agrees with Periyaswamy 2018 study as he stated that the neurophysiologic facilitation techniques have a significant effect on PaO2 and can be used for short term effects. (16)

Also this result agrees with the results of Dr Nandni K L 2024 research which demonstrates that both PNF respiratory approaches [Anterior Basal Lift and Abdominal Co-Contraction] are helpful for enhancing ventilator parameters, although Anterior Basal Lift has better effect by reducing Heart Rate & rate of respiration and optimizing Lung Compliance, SPO2 and Tidal Volume. (17)

It also agreed with Keswani Sh 2018, who stated that adopting the stretch technique of the neurophysiological facilitation in intensive care units has benefits since it reduces high heart rate, respiratory rate and improves levels of SPO2 to a range suitable for withdrawal of the ventilator. (18)

Also Liu CH 2019 has agreed with our research because the results of his post-treatment showed that averages of PaO2, PaCO2, O2 saturation, CRP, FEV and FVC of those in the group that received neurophysiological facilitation all showed significantly improved than pretreatment and comparable to the people in the control group (19)

This result agrees with the outcome measures of Raghupathy MA 2022 research that included Silverman Anderson Score, modified Downes Score and other vitals including oxygen saturation and rate of respiration. It was determined that applying a neurophysiological facilitation treatment to the newborn increases the oxygen saturation level and reduces the chest retractions (20)

This result also agrees with the analysis of Mankad DI 2024 studies that included HR, BP and Pulmonary [TV, Minute Ventilation, Lung Compliance, Rate of Respiration and spo2]. This demonstrated that proprioceptive neuromuscular facilitation strategies for respiration are efficient in improving hemodynamic parameters. (21)

Our results are in agreement with Mehmet Burak Uyaroglu 2021 who stated that neurophysiological facilitation methods are a dependable and successful way to increase vital signs and functional levels in the critical care unit.(22)

REFERENCES

1. Jain V, Vashisht R, Yilmaz G, Bhardwaj A. Pneumonia Pathology. In: StatPearls. Treasure Island (FL): StatPearls Publishing; July 31, 2023.
2. Fadl N, Ashour A, Muhammed Y. Medical management of pneumonia in children aged under 5 years in Alexandria, Egypt: mothers' perspective. East Mediterr Health J. 2020;26(9):1042-1051. Published 2020 Sep 24. doi:10.26719/emhj.20.013
3. World Health Organization Pneumonia. Fact sheet No. 331. 2016 Available at: http://www.who.int/mediacentre/factsheets/fs331/en/index.html.
4. El-Koofy NM, El-Shabrawi MH, Abd El-Alim BA, Zein MM, Badawi NE. Patterns of respiratory tract infections in children under 5 years of age in a low-middle-income country. J Egypt Public Health Assoc. 2022;97(1):22. Published 2022 Nov 7. doi:10.1186/s42506-022-00118-0
5. Kumar V, Abbas AK, Aster JC. Neoplasm. Robbins Basic Pathology. 2015;9:161-214.
6. Pahal P, Rajasurya V, Sharma S. Typical Bacterial Pneumonia. In: StatPearls. Treasure Island (FL): StatPearls Publishing; July 31, 2023.
7. Castro D, Patil SM, Zubair M, Keenaghan M. Arterial Blood Gas. In: StatPearls. Treasure Island (FL): StatPearls Publishing; January 8, 2024.
8. Han P, Yu C. Diagnostic Medical Imaging. 4th ed. Beijing: People's Medical Publishing House; 2017.
9. Morrow B. M. (2015). Chest Physiotherapy in the Pediatric Intensive Care Unit. J of pediatric intensive

care, 4(4), 174–181. https://doi.org/10.1055/s-0035-1563385
10. Paulraj M, Shristhudhi S, Supriya K, Vinod AK, Anandbabu K. Effectiveness of PNF of respiration to improve the exercise capacity in patients with COPD: a pilot study. Int J World Res. 2017;1(35):1-6.
11. Barros CR , Efficacy of Pattern Respiratory PNF Associated Aerobic Training on Lung Volumes and 6MWT Test in Parkinson Individuals, Universidade Federal de Pernambuco.,2016 Available at https://clinicaltrials.gov/study/NCT02600052
12. Ashtankar, A. P., & Kazi, A., Comparative Effect of Proprioceptive Neuromuscular Facilitation (PNF) and Chest Physiotherapy with Chest Physiotherapy alone on SP02, Heart Rate, Respiratory Rate, & Lung Compliance in Mechanically Ventilated Patient, J of pharmaceutical science and research 2020. Available from:
13. http://www.pharmainfo.in/jpsr/Documents/Volumes/vol11issue10/jpsr11101925.pdf
14. Kumar JA, Maiya AG, Pereira D. Role of physiotherapists inintensive care units of India: A multicenter survey., 2008 Mar 5 Available from: https://tspace.library.utoronto.ca/handle/1807/46142
15. Sneha S , Chordiya S , Kazi A, Shetty A , Gunjal S, Lamuvel M & Kalam A, Effect of Respiratory Proprioceptive Neuromuscular Facilitation technique with Chest Physiotherapy in Mechanically ventilated Organophosphorus Poisoning Patients. International Journal of Development Research. 2017; 4: 01-06
16. Bhakaney PR, Walke RR, Kulkarni CA, Vardhan V. Immediate Effectiveness of Chest Proprioceptive Neuromuscular Facilitation (PNF) Technique on Hemodynamic Status in COVID-19 Patients: An Original Research. Cureus. 2022;14(9):e29477. https://doi.org/10.7759/cureus.29477
17. Periyaswamy MU, Shinde DH , Waghmare S & Palekar Tu. Effect of Chest Proprioceptive Neuromuscular Facilitation versus Body Positioning in Mechanically ventilated patients: A cross over study. International Journal of Basic & Applied Sciences. 2018;8: 480-495.
18. Dr Nandni KL, Dr Shreya TR & Dr Janvi P B To Compare the Effect of Anterior Basal Lift Versus Abdominal Co-Contraction Technique on Ventilatory Parameters in Mechanically Ventilated Patients - A Randomized Control Trial ,International Journal of Health Sciences and Research 2024 ;14(1) 72-81 DOI: https://doi.org/10.52403/ijhsr.20240110
19. Keswani, SH., Kalra, S., & Sharma, A. ROLE OF PROPIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUES OF RESPIRATION IN INTENSIVE CARE UNIT PATIENTS A REVIEW. *Paripex Indian Journal of Research* 2018; *7* https://api.semanticscholar.org/CorpusID:59299676
20. Liu CH, Wan MI, Duan LI, Fei QU ,Effects of neurophysiological facilitation and external pacing of diaphragm on post-stroke respiratory function , Chinese Journal of Physical Medicine and Rehabilitation, 2019 ; 41: 321-324 https://pesquisa.bvsalud.org/portal/resource/pt/wpr-756172
21. Raghupathy MA , Lewis LE , & Shubha G , Does Neurophysiological Facilitation (NPF) influence respiratory function in a preterm infant with respiratory distress? A Case Report, Manipal Academy of Higher Education Kasturba Medical College Manipal, 2022 https://www.authorea.com/users/505025/articles/584245-does-neurophysiological-facilitation-npf-influence-respiratory-function-in-a-preterm-infant-with-respiratory-distress-a-case-report
22. Mankad DI, Trivedi SH & Bhatt JA. Role of proprioceptive neuromuscular facilitation techniques of respiration in mechanically ventilated patients – a systematic review of clinical evidence. Int J Health Sci Res. 2024; 14(1):51-64. DOI: https://doi.org/10.52403/ijhsr.20240108
23. Uyaroglu ME, Cirak YA, Elbasi NU, Parlak HA Effect of

neurophysiological facilitation techniques on functional levels and respiratory in intensive care patients, European Respiratory Journal., 2021 DOI: 10.1183/13993003.congress-2021.PA3326