



## Effectiveness of Nebulization Therapy with Chest Physiotherapy After Nebulization on Airway Clearance in Children with Bronchopneumonia

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### Abstract

Bronchopneumonia accounts for 15% of all deaths of children under five. The primary nursing problem of bronchopneumonia patients is ineffective airway clearance which can lead to more severe problems such as shortness of breath and even death. Management of airway ineffectiveness can be done by nebulization and corticosteroids, chest physiotherapy, suctioning and effective coughing. Nebulization accompanied by chest physiotherapy can remove secretions or phlegm effectively. This study aims to analyze the differences in airway clearance before and after nebulization and chest physiotherapy in the control and intervention groups in bronchopneumonia children. The research design used is Quasi-Experimental. A sample of 36 respondents with bronchopneumonia children was divided into two groups, namely control and intervention groups, which were obtained by consecutive sampling. Data collection techniques used observation sheets. The data analysis used in this study is the Mann-Whitney Test. The results showed that before chest physiotherapy after nebulization, all respondents had ineffective airway clearance (100%) in both the intervention and control groups. After chest physiotherapy after nebulization, almost half of the respondents in the intervention group had adequate airway clearance (44.4%). In contrast, in the control group, a small proportion of respondents had adequate airway clearance (16.7%). The analysis showed a p-value of 0.001, meaning there is a significant difference in airway clearance after being given nebulization and chest physiotherapy interventions in the intervention and control groups. Researchers hope that in future studies, airway clearance levels can be included. Thus, chest physiotherapy is effectively used for airway clearance in children after nebulization.

**Keywords:** Children, airway clearance, bronchopneumonia, chest physiotherapy, nebulization

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### 1. Introduction

Bronchopneumonia is an inflammation of the lung parenchyma that extends to the bronchioles, or in other words, inflammation that occurs in lung tissue through direct spread through the airway or hematogenous to the bronchioles which are blocked by mucopurulent exudate to form consolidated patches in the lobes (Harrison, 2010). The leading cause of bronchopneumonia is an infection caused by bacteria, viruses, fungi, and foreign bodies. Bronchopneumonia is common in children and accounts for 15% of all deaths of children under five years old, killing 808,694 children in 2017. It is estimated that every hour 230 children in the world die from bronchopneumonia, exceeding the number of deaths caused by other respiratory system diseases (Tiewsoh et al., 2009).

The prevalence of bronchopneumonia in Indonesia increased from 1.6% in 2013 to 2% in 2018 of the under-five population (Wati et al., 2021), and West Java Province ranked first in bronchopneumonia with 124,475 cases with the most age group in the age of 1-4 years with 78,616 cases (Faried et al., 2020). The mortality rate due to bronchopneumonia ranked first and second for inpatients in hospitals throughout Bandung Regency (Toharudin et al., 2020).

Nursing problems often found in children who experience bronchopneumonia, according to Pelander & Leino-Kilpi, (2004), are ineffective airway clearance due to the inflammatory process of the lung parenchyma extending to the bronchioles resulting in increased secretion production. Ineffective airway clearance is the inability to clear secretions or obstructions from the respiratory tract to maintain airway hygiene (Pelander & Leino-Kilpi, 2004).

Management to overcome these problems can be done pharmacologically and non-pharmacologically. Pharmacological management includes antibiotics, bronchodilators using steam (nebulization), and corticosteroids, while non-pharmacological management includes chest physiotherapy, suctioning and practical coughing (Ricciardolo et al., 2004). Effective coughing in toddlers is impossible because toddlers do not fully understand the commands given, so suctioning in toddlers is not recommended because it causes nausea and vomiting (Staggers et al., 2001).

Management using vapor (nebulization) can be done in all age categories, including in toddlers. The administration of nebulization therapy is the administration of drugs directly into the airway through inhalation, with the advantages of drugs working directly on the airway, the onset of action is fast, the dose used is small, and the side effects are minimal because the concentration of drugs in the blood is small or low. In addition to nebulization, chest physiotherapy is very effective in removing secretions, where the primary function is to restore and maintain the function of respiratory muscles and help clear secretions from the bronchi to prevent the accumulation of secretions (Staggers et al., 2001). Furthermore, according to Harrison, (2010), nebulization accompanied by chest physiotherapy can effectively remove secretions or phlegm.

Based on a survey conducted at AMC Hospital Bandung Regency in 2020, bronchopneumonia cases in children ranked 2nd out of the ten most common diseases. Nursing problems that often arise are airway clearance disorders. The management is only the provision of nebulization, while the provision of chest physiotherapy has never been applied even though there are Standard Operating Procedures (SOP) in the hospital. Based on the above background, the researcher is interested in examining "Effectiveness of nebulization therapy with chest physiotherapy after nebulization on airway clearance in children with bronchopneumonia."

## 2. Literature Review

Some previous studies that are referenced in this study are as follows:

Research conducted by Annoni et al., (2020) with the title "Effectiveness of chest physiotherapy and pulmonary rehabilitation in patients with non-cystic fibrosis bronchiectasis: a narrative review." Research design with Quasi Experiment with observation method with one group pre-post test. Data analysis using paired T-tests with the results showed the effect of chest physiotherapy, effective cough, and nebulizer on increasing blood oxygen saturation before and after intervention in COPD patients.

Another study conducted by Main et al., (2005), with the title "Conventional chest physiotherapy compared to other airway clearance techniques for cystic fibrosis", with data analysis using Chi-Square. The results showed no difference in airway clearance before and after chest physiotherapy, with a  $p$  – value of 0.225.

Manurung et al., (2021) conducted research titled "The Effectiveness Of Chest Physiotherapy With Tripod And Fowler Position To Increasing Oxygen Saturation" The results obtained by vibrating can help remove secretions from the lungs or trachea to maintain and improve respiratory function and other research conducted by Irwin et al.,(1998), postural drainage therapy can remove excessive secretions or aspirated material from the respiratory tract in patients who have impaired airway clearance in toddlers with ARI at the Lohbener Health Center.

## 3. Materials and Methods

### 3.1. Materials

The type of research used was quantitative research, with the research design used Quasi-Experimental (Nonequivalent with control group design). The population in this study were all toddlers diagnosed with bronchopneumonia in the pediatric inpatient room of AMC Hospital Bandung Regency. The sample was 36 toddlers with a non-probability sampling technique in the form of consecutive sampling; that is, the samples taken were subjects who met the research criteria until a certain period until the sample size was met. The sample was divided into two groups: the control group and the intervention group. The control group was given nebulization therapy, and the intervention group was given chest physiotherapy after nebulization. Both groups before and after being given nebulization and chest physiotherapy were assessed pre and post-test.

### 3.2. Methods

After the sample was divided into two groups, each group was previously observed for airway clearance using a checklist form that included breathing frequency, breathing rhythm, breathing depth, the presence of obstruction, and additional breathing sounds (wheezing or rhonchi). In the control group, researchers provided nebulization action by standard operating procedures in the hospital three times in 3 days. In the intervention group, researchers gave nebulization action and then performed chest physiotherapy three times in 3 days.

After all, groups get the intervention, then the observation of airway clearance is carried out again.

Data analysis was carried out by univariate and bivariate analysis. The univariate analysis uses frequency distribution, while the Mann-Whitney bivariate analysis, where previously data normality test has been carried out using the Shapiro- Wilk formula.

## 4. Results and Discussion

### 4.1. Airway Clearance Before Chest Physiotherapy and Nebulization in Intervention Group and Control Group

**Table 1:** Frequency Distribution of Airway Clearance Before Chest Physiotherapy and Nebulization in Intervention Group and Control Group (N=36)

Intervention Group			Control Group	
Airway Clearance	N	%	N	%
Ineffective	18	100	18	100
Total Respondents		36		

Based on Table 1, it can be described that all respondents had ineffective airway clearance (100%) in both the intervention and control groups. Judging from the results of the observation sheet of all respondents with ineffective airways in the intervention group and control group, most respondents had a fast-breathing frequency, irregular breathing rhythm, chest wall pull, airway obstruction, and additional breath sounds. The results of this study are also in line with the results of research conducted by Gauld (2009) where toddlers with pneumonia tend to have ineffective airway clearance, as evidenced by all respondents before being given therapy all had ineffective airway clearance.

Based on the findings during the study, toddlers with bronchopneumonia have problems with ineffective airway clearance due to the inability to remove secretions, causing rapid breathing frequency, irregular rhythm, chest wall pulls during breathing, airway obstruction, and additional sounds.

Ineffective airway clearance is when individuals cannot remove secretions from the airway to maintain airway patency (Richard et al., 2022). Factors that affect ineffective airway clearance are environmental factors such as active and passive smoking, airway obstruction, namely airway spasm, excessive amounts of mucus, and exudate in the alveolus; foreign objects are in the airway. At the same time, physiological factors are allergic airway and infection (Trueba et al., 2013). One of the infectious diseases that can cause ineffective airway clearance is bronchopneumonia.

Characteristics of ineffective airway clearance include no cough, additional breath sounds, changes in breathing patterns, changes in breath frequency, cyanosis, difficulty verbalizing, decreased breath sounds, dyspnea, excessive amounts of sputum, ineffective cough, orthopnea, restlessness, and wide-open eyes.

### 4.2. Airway Clearance After Chest Physiotherapy and Nebulization in Intervention Group and Control

**Table 2:** Frequency Distribution of Airway Clearance After Chest Physiotherapy and Nebulization in Intervention Group and Control Group (N=36)

Intervention Group			Control Group	
Airway Clearance	N	%	N	%
Effective	8	44.4	3	16.7
Ineffective	10	55.6	15	83.3
Total	18	100	18	100
Total Respondents		36		

Based on Table 2, it was found that after the chest physiotherapy intervention after nebulization in the intervention group, more than half experienced ineffective airway clearance (55.6%). In the control group, most experienced ineffective airway clearance (83.3%). Based on the results of the observation sheet, almost all respondents experienced a decrease in airway clearance scores, such as a decrease in breathing frequency, changes in breathing rhythm, depth, airway obstruction, and additional breath sounds.

Management of ineffective airway clearance is divided into pharmacology and non-pharmacology (Manurung et al., 2021). Pharmacological management is the administration of antibiotics and bronchodilators using steam (nebulization) and corticosteroids, while non-pharmacological management is chest physiotherapy, suctioning and effective coughing.

In this study, the intervention group was given chest physiotherapy therapy after respondents were given nebulization therapy. Chest physiotherapy consists of chest clapping, chest vibration, and postural drainage. The main objectives of chest physiotherapy are to restore and maintain the function of the respiratory muscles, help clear secretions from the bronchi, prevent the accumulation of secretions, improve the movement and flow of secretions, and increase respiratory efficiency and lung expansion so that patients can breathe freely. The body gets enough oxygen and removes secretions from the respiratory tract.

Judging from the study results, more respondents with adequate airway clearance in the intervention group were more than in the control group. From the observation sheet, the intervention group was given physiotherapy chest action after nebulization and experienced improvement because all respondents had an average breathing frequency, and most respondents did not have airway obstruction. While the control group was given nebulization therapy, three respondents had adequate airway clearance.

Nebulization of chest physiotherapy dissertation effectively removes secretions in toddlers and affects airway clearance (Harrison, 2010). This is in line with research conducted by Siriawat et al., (2018), where the results of research obtained by children who were secreted after chest physiotherapy was more (11 children) than before chest physiotherapy (8 children). So, researchers argue that nebulization with chest physiotherapy is more effective for treating toddlers with bronchopneumonia who experience airway clearance ineffectiveness.

#### 4.3. Mean Difference in Airway Clearance Before and After Nebulization and Chest Physiotherapy in Intervention Group and Control Group

**Table 3:** Analysis of Differences in Mean Airway Clearance Before and After Nebulization Action and Chest Physiotherapy in Intervention Group and Control Group

Group		N	Mean	Sig.(2-tailed) P-Value
Before	Intervention	18	20.64	0.001
	Control	18	16.36	
	Total	36		
After	Intervention	18	12.67	
	Control	18	24.33	
	Total	36		

Table 3 shows the results obtained from 36 respondents, the mean value before nebulization and chest physiotherapy in the intervention group (20.64) while in the control group (16.36). Furthermore, the mean value after nebulization and chest physiotherapy was in the intervention group (12.67) while in the control group (24.33).

Based on the study's results, nebulization intervention after chest physiotherapy in bronchopneumonia patients showed better conditions in the intervention group compared to the control group, who only received nebulization therapy. A nebulizer is a treatment tool that administers drugs by inhalation after the drugs are first broken into smaller particles using aerosols or humidification (Bianco, et al., 2021). Meanwhile, chest physiotherapy is a way or form of treatment to restore the function of an organ using natural energy.

During the study, researchers found differences in improvement in each respondent, both in the intervention and control groups. Some respondents in the intervention group experienced immediate improvement after nebulization therapy and chest physiotherapy. Whereas in the control group, respondents tended to experience delayed improvement. This is in line with the theory that chest physiotherapy effectively removes secretions and improves ventilation in patients with impaired lung function.

Based on the results of the Mann-Whitney test, the alpha value is 0.001 ( $<0.05$ ), so it can be concluded that there is a significant difference in airway clearance after being given nebulization and chest physiotherapy interventions in the intervention group and control group. The results of this study state that chest physiotherapy has a significant effect on airway clearance. Based on the findings during the study, the researcher analyzed that in the control group given nebulization therapy, ineffective airway clearance was still found in most respondents. In the intervention group, almost half of the respondents experienced adequate airway clearance, so chest physiotherapy after nebulization effectively reduced airway clearance ineffectiveness in children.

## 5. Conclusion

The research results can be summarized as follows: (1) Airway clearance before being given nebulization and chest physiotherapy in children with bronchopneumonia was ineffective. (2) Airway clearance after nebulization in the control group was primarily ineffective, while in the intervention group, who received chest physiotherapy after nebulization, more than half had adequate airway clearance. (3) There is a significant difference in airway clearance after nebulization and chest physiotherapy interventions in the intervention and control groups.

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