

The Effectiveness of Nebulizer Therapy and Pursed-Lip Breathing in the Management of Acute Asthma: A Case Study

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ABSTRACT

Background: Asthma is a chronic respiratory disorder marked by airway inflammation, narrowing, edema, and excessive mucus production, resulting in impaired ventilation and ineffective airway clearance. Effective interventions are essential to alleviate symptoms and optimize respiratory function. Nebulizer therapy and pursed-lip breathing are widely employed to manage asthma symptoms; however, the synergistic impact of these two modalities remains underexplored. **Methods:** This case study involved a patient with a clinical diagnosis of asthma presenting with acute shortness of breath. The intervention protocol consisted of 10 minutes of nebulizer therapy followed by 5 minutes of pursed-lip breathing. Clinical parameters oxygen saturation (SpO₂), respiratory rate, heart rate, sputum consistency, adventitious breath sounds, and dyspnea scale were measured before and after the intervention. **Results and Discussion:** Post-intervention assessment revealed notable clinical improvements. Oxygen saturation increased from 89% to 96%, respiratory rate declined from 37 to 24 breaths per minute, and heart rate decreased from 127 to 98 beats per minute. Additionally, sputum consistency became thinner, adventitious sounds such as wheezing and rhonchi subsided, and the dyspnea scale improved from level 2 (moderate) to level 0 (normal). These findings suggest that the combined application of nebulizer therapy and pursed-lip breathing enhances airway patency, reduces respiratory distress, and improves ventilation. **Conclusion:** The combined use of nebulizer therapy and pursed-lip breathing technique proved effective in improving airway clearance and respiratory function in an asthma patient, indicating potential for broader clinical application in acute asthma care.

INTRODUCTION

Asthma is a chronic condition in which the airways become inflamed, narrowed, and swollen, accompanied by excessive mucus production, thereby obstructing airflow and impairing effective respiration. It is one of the primary causes of dyspnea, or shortness of breath a condition characterized by difficulty breathing due to limited airflow into the lungs (1). According to the Global Asthma Network Report (2022), asthma accounts for an estimated 461,000 deaths annually, with over 1,000 fatalities each day, the majority of which are attributed to inadequate or inappropriate treatment. Data from Indonesia's Basic Health Research indicate that the national asthma prevalence has reached 2.4%, with the highest rates found in the Special Region of Yogyakarta (4.5%) and the lowest in Central Java (1.8%). Records from the Emergency Department of Temanggung Regional Hospital show 160 asthma cases in 2024, all of which involved adult patients of both genders.

Individuals with asthma commonly experience persistent coughing especially at night alongside wheezing, shortness of breath, and chest tightness, particularly when lying down or resting. Symptom presentation can vary between individuals and may worsen over time or under specific triggers (4). According to Rabe (2023), the clinical manifestation of asthma typically involves the sudden onset of dyspnea, which, if left untreated, can result in oxygen deficiency in the lungs and potentially fatal outcomes. Asthma is frequently accompanied by additional health complications, particularly respiratory issues. Common nursing diagnoses in asthma patients include ineffective airway clearance and ineffective breathing patterns.

Afgani and Hendriani (2020) identified several relevant nursing diagnoses in asthma care, including ineffective breathing patterns, ineffective airway clearance, and imbalanced nutrition with intake less than body requirements. Ineffective airway clearance is often due to excessive mucus production, while decreased lung expansion leads to ineffective breathing patterns. Nutritional imbalance is frequently associated with reduced appetite or anorexia.

Asthma management involves both pharmacological and non-pharmacological strategies. Pharmacologically, inhalation therapy is the preferred approach as it delivers bronchodilators directly to the airways, providing rapid relief from bronchospasm, reducing mucus viscosity, and enhancing airway patency (7). Nebulizer therapy is particularly beneficial for patients who are mechanically ventilated, cognitively impaired, or unable to operate handheld inhalers.

Among non-pharmacological interventions, breathing exercises such as diaphragmatic breathing, equal breathing, deep breathing, and pursed-lip breathing are recommended (9). Pursed-lip breathing has demonstrated effectiveness in improving respiratory patterns among asthma patients. This technique reduces dyspnea and respiratory rate, increases lung capacity, minimizes relapse risk, and promotes respiratory stability (6). Both nebulizer therapy and pursed-lip breathing have been shown to significantly alleviate dyspnea, improve breathing patterns, reduce adventitious breath sounds, and facilitate mucus expectoration. Moreover, these interventions offer psychological comfort and relaxation to patients.

Despite the high asthma burden in Indonesia, especially in emergency settings, the standardized implementation of combined pharmacological and non-pharmacological interventions remains suboptimal in district-level hospitals such as Temanggung Regional Hospital. While nebulizer therapy is widely used, evidence-based respiratory techniques like pursed-lip breathing are rarely integrated into routine emergency care protocols. This gap may contribute to prolonged dyspnea, delayed recovery, and higher relapse rates. The Global Initiative for Asthma (GINA, 2023) underscores the importance of integrating pharmacological treatments with patient-centered strategies for airway clearance. However, in resource-limited settings, the application of such recommendations remains inconsistent. Pavord (2023) also emphasize the need for a holistic and multimodal approach in acute asthma care.

Therefore, this study aims to bridge the gap between existing clinical guidelines and real-world practice by evaluating the effectiveness of combining nebulizer therapy with pursed-lip breathing in the management of acute asthma in the emergency department. Based on the evidence and contextual data, the present case study explores the potential of this integrative approach to improve ineffective airway clearance in asthma patients, as part of the author's Final Scientific Paper (Karya Ilmiah Akhir) titled "The Effectiveness of Nebulizer Therapy and Pursed-Lip Breathing in the Management of Acute Asthma: A Case Study."

METHODS

The method used in this study is a case study (case report). The study was conducted in the Emergency Room of Temanggung Hospital on March 5, 2025. Participants were one patient diagnosed with asthma. Participants agree and sign informed consent before the study begins. The criteria for patients in the case study were asthma patients undergoing a treatment program in the Emergency Room. *Before the intervention, patients were given an informed consent sheet that had been previously provided by the researcher. The report follows the CARE (CAse REport) guidelines, which provide a standardized approach to ensure transparency and completeness in medical case reporting. All relevant items from the CARE were addressed in reporting this case.* The case study was conducted to determine whether there was an effect of nebulizer therapy and pursed lips breathing on the airway clearance status of asthma patients in the Emergency Room.

The instrument used is the patient's airway clearance status consisting of blood pressure, Oxygen Saturation (SpO₂), Respiratory Rate (RR), Heart Rate (HR), sputum characteristics, additional breath sounds, and degree of dyspnea. Data collection was carried out using assessment, intervention, and documentation methods. The assessment was conducted to explore data obtained from patients with asthma in the emergency room during treatment. The intervention given to the patient was using pharmacological therapy by administering a nebulizer and non-pharmacological therapy with pursed lips breathing to stabilize the patient's airway clearance status. At the documentation stage, the researcher collected data on changes that occurred in the patient's airway clearance status before and after the intervention was given using an observation sheet containing records of the patient's airway clearance status data.

The procedure in this study used nebulizer therapy and pursed lips breathing interventions that had been previously determined by the researcher. In the first emergency case in asthma patients, the airway clearance status will be checked first according to the parameters followed by nebulizer therapy with VP for 10 minutes. After nebulizer therapy, the patient will be taught the pursed lips breathing technique with the nurse giving an example first and then the patient demonstrating it. The pursed lips breathing technique is carried out for 5 minutes. Nebulizer therapy and the pursed lips breathing technique are carried out in a sitting position leaning back 45-90°.

After that, the airway clearance status is checked again and compared before and after the intervention, it can be concluded whether there is a change in the patient's airway clearance status before and after being given nebulizer therapy and the pursed lips breathing technique. Measurement of airway clearance status and this intervention is carried out consecutively while the patient is in the ER.

RESULT AND DISCUSSION

RESULT

In the primary survey assessment, the patient's airway had dry phlegm that could not come out, additional breathing sounds were heard in the form of wheezing. Breathing, the patient said that he was short of breath and his chest was slightly painful. Circulation, felt fast. Disability, the patient was fully conscious, all of the patient's extremities could be moved 5/5/5/5. Exposure, the patient's extremities felt warm.

In the secondary survey, the examination results showed that the patient was fully conscious with GCS: E4M6V5 (Compos Mentis). The patient's vital signs (TTV) were: blood pressure 134/89 mmHg, heart rate 127x/minute, respiratory rate 25x/minute, body temperature 36.8°C, and SpO₂ 89-90%. The patient appeared to be experiencing dyspnea, with CRT <2 seconds. On auscultation examination, additional breath sounds were heard in the form of wheezing and ronchi. Complete blood count results showed: Hemoglobin 13.9 g/dL, Leukocytes $8.9 \times 10^3/\mu\text{L}$, Basophils 0.7%, Monocytes 4%, Erythrocytes 6.58 million cells/mm³ (high), Hematocrit 42%, Eosinophils 2%, Lymphocytes 29%, Neutrophils $6.7 \times 10^3/\mu\text{L}$, Platelets 277,000 cells/mm³, Urea 17 mg/dL (low), Creatinine 0.9 mg/dL, Sodium 138 mmol/L (high), Potassium 4.3 mmol/L, Chloride 103 mmol/L, and Random Blood Glucose 183 mg/dl. Thoracic radiology results showed that the size of the lungs and heart were normal. Medical therapy that has been given to the patient includes: NaCl 0.9% infusion, Antrain 1 gr Inj, Combivent UDV 2.5 ml ampoule & Budesma 0.25 mg/ml, Pantoprazole Inj, Tomit 5 mg Inj, and pharmacological therapy in the form of nebulizer and oxygenation with a flow of 3 lpm. In addition, the patient was also given an intervention in the form of a pursed lip breathing technique during treatment, which was carried out after the nebulizer session was completed, while monitoring his respiratory condition.

Based on the results of the assessment and examination that has been carried out, the nursing diagnosis that can be determined is Ineffective Airway Clearance due to hypersecretion of the respiratory tract. According to the Indonesian Nursing Intervention Standards (SIKI), the intervention given is Airway Management with the number I.01011. During treatment in the Emergency Room of Temanggung Hospital, the patient was monitored for vital signs (blood pressure, respiratory rate, heart rate, SpO₂), as well as monitoring for additional breath sounds (such as gurgling, wheezing, wheezing, dry rhonchi), examining sputum/phlegm (amount, color, aroma), and assessing the degree of dyspnea which is classified as moderate (grade 2). The patient was also positioned in a semi-fowler or fowler position, taught the pursed lip breathing technique to reduce shortness of breath and keep the airways open, and collaboration was carried out on the administration of bronchodilators in the form of Combivent UDV 2.5 ml Ampoule and Budesma 0.25 mg/ml via nebulizer. The actions or interventions provided include administering pharmacological therapy via a nebulizer as well as a non-pharmacological approach using the pursed lip breathing technique.

Before the intervention, a re-examination was performed on the patient who showed oxygen saturation of 93% with a 3 lpm nasal cannula, a respiratory rate of 28x/minute, additional breath sounds in the form of wheezing and ronchi, sputum/phlegm that could not be expelled, and a degree of shortness of breath of 2 (moderate). The intervention was carried out with nebulizer therapy for 15 minutes, followed by the pursed lip breathing technique for 5-10 minutes. After the intervention, a re-measurement was carried out which showed that oxygen saturation increased to 96% with a 3 lpm nasal cannula, the respiratory rate decreased to 24x/minute, additional breath sounds in the form of wheezing and ronchi decreased, and the sputum/phlegm that began to come out little by little with an amount of 5 ml was clear yellow and odorless. The results of the observation showed improvement after the nebulizer therapy and pursed lip breathing technique

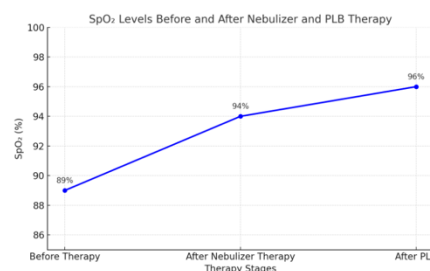


Figure 1. SpO₂ change graph

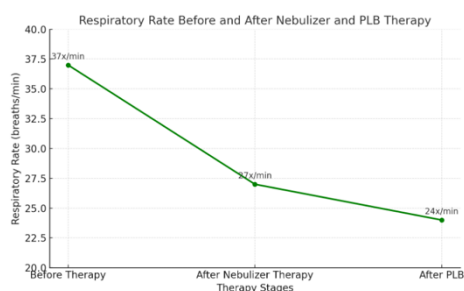


Figure 2. Respiratory Rate (RR) change graph

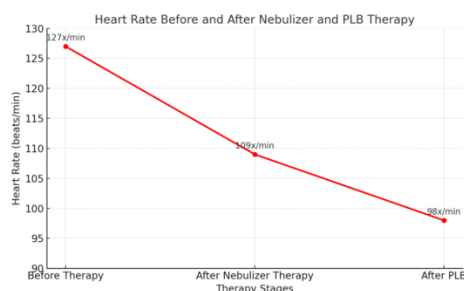


Figure 3. Heart Rate (HR) change graph

Table 1 Parameters before and after nebulizer therapy & pursed lip technique breathing

Parameter	Before nebulizer therapy & pursed lip breathing technique	After nebulizer therapy	After the pursed lip breathing technique
MAP	104 mmHg	104 mmHg	104 mmHg
Phlegm/Sputum	Not coming out	Out (5ml, clear yellow, odorless)	Out (3 ml, clear yellow, odorless)
Breath sounds	Wheezing and rhonchi	Wheezing still, Ronchi decreased	Wheezing decreased, no rhonchi
Dyspnea degree	2 (medium)	1 (mild)	0 (normal)

DISCUSSION

Initial results in this case showed an increase in oxygen saturation levels (SpO₂). Before being given nebulizer therapy and pursed lip breathing technique, the patient's SpO₂ was in the range of 89–90%. After being given a nebulizer, the SpO₂ value increased to 94%, and then increased again to 96% after the pursed lip breathing technique was performed. This finding is in line with research by Thalib & Annisa (2023) which revealed that nebulizer inhalation therapy, chest breathing exercises, and pursed lip breathing techniques can increase oxygen saturation and smooth the airways. Thus, nebulizer therapy and pursed lip breathing have been proven effective in increasing SpO₂ to reach the normal range, which is 95–100%.

The second result showed a decrease in the respiratory rate (RR) in patients with asthma or shortness of breath. Before the intervention, the patient's RR was recorded as high at 37x/minute. After being given nebulizer therapy, the RR decreased to 27x/minute, and after the pursed lip breathing technique was performed, it decreased again to 24x/minute. This finding is in line with research by Sondakh (2020) who observed that nebulization had an impact on reducing the respiratory rate in patients with respiratory disorders at GMIM Pancaran Kasih Hospital Manado, with an average decrease from 26.50 to 18 times per minute. In addition, a study by Dwi (2024) which confirms the relationship between pursed lips breathing exercises and the effectiveness of respiratory rate control in asthma sufferers, especially in reducing RR.

The third result shows that in patients with asthma or shortness of breath there is no change in blood pressure or Mean Arterial Pressure (MAP), but there is a decrease in heart rate (Heart Rate/HR). Patients arrive at the ER

with blood pressure and MAP within normal limits, and after undergoing nebulizer therapy and pursed lip breathing techniques, blood pressure and MAP remain stable with a recorded MAP value of 104 mmHg. Meanwhile, the heart rate decreased, from 128x/minute before therapy to 109x/minute after the nebulizer was administered, and decreased again to 98x/minute after the pursed lip breathing technique was performed. This finding is supported by Hammad's research (2021), which reported that 73% of asthma patients have normal blood pressure of around 123 mmHg during an attack. However, as many as 56% of them experienced a decrease in heart rate from high to normal after receiving respiratory therapy such as slow deep breathing and nebulizers.

The fourth result shows a change in sputum status and additional breath sounds in asthma or dyspnea patients, where before nebulizer therapy and pursed lip breathing technique the amount of sputum was absent and additional breath sounds were wheezing and ronchi, after nebulizer therapy the amount of sputum that came out was 5ml, clear yellow in color but odorless and additional breath sounds of wheezing were still there but ronchi had decreased, after pursed lip breathing technique the amount of sputum that came out was again 3ml, clear yellow but odorless and additional breath sounds of wheezing had decreased but ronchi were no longer there. This is in line with research Sukma Saini, Ambo Dalle, & Junaidi (2023) which shows that nebulizer therapy can dilute so that it is easy to remove and also additional breath sounds will be reduced or absent. This is also in line with research Pramesti (2024) which shows that pursed lips breathing for 5-10 minutes can control phlegm or sputum because it opens the airways perfectly so that there are no additional breath sounds.

The latest results show that there is a change in the status of the degree of dyspnea in asthma patients. Before nebulizer therapy and pursed lip breathing techniques, the degree of dyspnea was 2 [moderate], indicating that the airway was obstructed due to shortness of breath and had to stop for a moment when walking. After nebulizer therapy, the degree of dyspnea was 1 [mild], indicating that breathing was disturbed by shortness of breath when walking hurriedly. Then, after the pursed lip breathing technique was performed, the degree of dyspnea was 0, meaning that breathing was not disturbed when returning to activities such as walking. This is in line with research Rumampuk & Thalib (2020) which shows that nebulizer therapy and correct breathing techniques can affect airway clearance so that severe dyspnea becomes moderate or mild.

Nebulizers have a number of advantages in treating respiratory diseases, such as relieving shortness of breath in asthmatics, thinning sputum, and shrinking and cleaning the bronchial tubes. The way a nebulizer works involves a vaporization process, where liquid medicine is put into a tube and heated using electricity to produce steam which is then inhaled through a special mask. (17). Another benefit of nebulizer therapy is that it helps sputum that was previously difficult to expel become easier to expel, as well as reducing sputum production. When patients experiencing an asthma attack receive nebulizer therapy, the patient's respiratory rate will tend to decrease (14). Nebulizer administration is not always completely successful, because its success is very dependent on the correct application method, the correct dosage, the effectiveness of the treatment, and the severity of the patient's asthma (18)

Pursed Lips Breathing, also known as deep breathing relaxation technique, is a method of breathing that is done calmly and controlled, usually done slowly. It involves inhaling through the nose and exhaling through the mouth. By putting more effort into keeping the airways open, pursed lip breathing can help patients reduce uncomfortable symptoms, as well as promote proper ventilation and open up the airways. This makes it easier for patients to inhale and exhale oxygen and carbon dioxide-rich air, while opening up the airways and alveoli. In this way, the body can absorb more oxygen, improving the gas exchange process. (19)

Firmansyah (2023) explained that other management of asthma can be given pharmacological and non-pharmacological treatments including avoiding asthma triggers, health education, chest exercises, drinking warm water and effective coughing. In addition, deep breathing techniques, positioning, stretching of respiratory muscles, buteyko breathing techniques, pursed lip breathing techniques, and guided imagery therapy can be applied to help reduce shortness of breath. (21).

This study is limited by its single-case design, which restricts the generalizability of the findings. Without a control group for comparison, it is difficult to definitively attribute improvements solely to the combined intervention of nebulizer therapy and pursed lip breathing. Additionally, the lack of long-term follow-up means that sustained effects on airway clearance and asthma control remain unknown. Despite these limitations, the positive outcomes observed suggest potential benefits of integrating pursed lip breathing alongside standard nebulizer treatment in emergency asthma care. Clinically, these findings may encourage the inclusion of breathing exercises as a complementary non-pharmacological intervention in emergency protocols to enhance patient

recovery and comfort. For nursing education, this study underscores the importance of training nurses not only in pharmacological treatments but also in teaching and guiding effective breathing techniques, which could empower nurses to provide more holistic and patient-centered care in acute asthma management.

CONCLUSION

Based on cases of asthma in the Emergency Room of Temanggung Regional Hospital, administration of nebulizer therapy combined with pursed lip breathing techniques showed significant improvements: respiratory rate decreased from 37 to 24 breaths per minute, oxygen saturation (SpO₂) increased from 89% to 96%, and pulse rate decreased from 127 to 98 beats per minute. Additional breath sounds such as wheezing and ronchi diminished until inaudible, while mean arterial pressure (MAP) remained stable. Phlegm, initially absent, was successfully expelled, and the degree of dyspnea improved from moderate (grade 2) to normal (grade 0). These findings suggest that nebulizer therapy alongside pursed lip breathing effectively overcomes ineffective airway clearance in asthma patients. Patients are advised to reapply these techniques during dyspnea or asthma attacks, and hospitals are encouraged to integrate them into routine nursing care for asthma management.

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