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Improvement of Oxygen Saturation in Patients with Airway Disturbance Using Nebulization Therapy in Semi-Fowler Position at Ibnu Sina Islamic Hospital Emergency Department, Bukittinggi (2025)

Asri Hidayah¹, Reny Chaidir¹, Andri

¹ Bachelor of Nursing Study Program, Faculty of Health Sciences, Bukittinggi, Indonesia

² Nurse Profession, Muhammad Natsir Bukittinggi, Indonesia

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Corresponding Author

Name : Asri Hidayah

E-mail : asrihidayah3112@gmail.com

ABSTRACT

Airway disorders are a group of complex conditions caused by various factors and can affect any part of the respiratory tract. Nebulization therapy is an effective treatment method that delivers medication directly to the lungs in the form of fine aerosol particles. The semi-Fowler position (45°) utilizes gravity to facilitate lung expansion and reduce abdominal pressure on the diaphragm, thereby improving ventilation. Oxygen saturation reflects the percentage of hemoglobin bound to oxygen compared to its maximum carrying capacity.

This study aimed to describe the improvement in oxygen saturation among patients with airway disorders who received nebulization therapy in the semi-Fowler position in the Emergency Department of Ibnu Sina Islamic Hospital, Bukittinggi in 2025. This research used a descriptive survey design. The population consisted of patients with airway disorders receiving nebulization therapy in the emergency room. A total of 96 respondents were selected using an accidental sampling technique, with inclusion criteria of patients receiving mucolytic and bronchodilator therapy. Data were collected using a nebulization standard operating procedure and pulse oximetry to measure oxygen saturation.

The results showed that 59 respondents (61.46%) experienced an improvement in oxygen saturation after receiving nebulization therapy in the semi-Fowler position. These findings indicate that nebulization therapy combined with the semi-Fowler position is effective in increasing oxygen saturation in patients with airway disorders. The semi-Fowler position supports optimal aerosol distribution, enhances lung expansion, and improves alveolar ventilation, contributing to increased oxygen saturation.

Introduction

Respiratory diseases represent a heterogeneous group of conditions caused by various etiologies and may affect any part of the respiratory tract. These diseases are among the leading causes of patient visits to healthcare facilities [1]. Respiratory arrest lasting 2–3 minutes in humans can result in fatal outcomes; therefore, prompt and efficient management is essential from the time patients arrive at the Emergency Department (ED) until definitive treatment is provided [2].

Diseases of the lungs and respiratory tract have a broad incidence and can affect individuals regardless of age or ethnicity. In daily life, common respiratory conditions such as asthma and acute respiratory infections (ARI/ISPA) are frequently encountered [1].

Based on a survey conducted by the Directorate General of PPM & PL in Indonesia, mortality due to respiratory diseases shows that Chronic Obstructive Pulmonary Disease (COPD) is the leading contributor (35%), followed by bronchial asthma (33%), lung cancer (30%), and others (2%) [3]. According to the 2018 Basic Health Research (Riskesdas), the prevalence of COPD in Indonesia is 3.7%, with higher rates observed in men. The highest prevalence was reported in East Nusa Tenggara (10.0%), followed by the Special Region of Yogyakarta (3.1%) and North Sumatra (2.1%) [4]. The prevalence of ARI cases in Indonesia reached 85.4%, with the highest rates reported in DKI Jakarta (99.8%), Bali (97.0%), West Sumatra (96.5%), East Nusa Tenggara (96.2%), Bangka Belitung (96.0%), North Maluku (93.7%), South Sumatra (93.3%), and Central Sulawesi (93.0%) [5].

Asthma remains a global health problem, affecting approximately 1–18% of the population worldwide. The World Health Organization (WHO), in collaboration with the Global Asthma Network (GAN), estimates that approximately 334 million people currently suffer from asthma, with projections reaching 400 million by 2025, and approximately

250,000 deaths annually attributable to asthma [2]. In Indonesia, the prevalence of asthma is 2.4% of the total population (273.5 million). Twelve provinces report prevalence rates exceeding the national average, with the highest in Yogyakarta (4.5%), East Kalimantan (4.0%), and Bali (3.9%) [6].

Respiratory disorders arise due to disturbances in the respiratory tract, often caused by prolonged exposure to air pollutants. The risk of developing respiratory complaints increases with the duration and intensity of exposure [7]. Various factors contribute to respiratory and pulmonary diseases, including environmental pollutants, bacteria, viruses, and other irritants [1]. Common respiratory conditions include asthma, acute respiratory infections (ARI), and chronic obstructive pulmonary disease (COPD) [8].

Clinical manifestations of respiratory disorders include cough, productive cough, dyspnea, wheezing, and chest discomfort, which may indicate early lung impairment. Among these, cough and shortness of breath are the most frequently reported symptoms [7].

Dyspnea occurs due to airway narrowing caused by airway hyperreactivity. This leads to a decrease in vital lung capacity and an increase in functional residual capacity and residual volume, ultimately reducing oxygen concentration in the blood and causing decreased oxygen saturation clinically [9].

Oxygen saturation can be measured using pulse oximetry [10]. Oxygen saturation reflects the proportion of hemoglobin bound to oxygen compared to total hemoglobin (Padila et al., 2024). Low oxygen saturation (<94%) may lead to various health problems, including hypoxemia, characterized by dyspnea, increased respiratory rate (up to 35 breaths per minute), tachycardia, cyanosis, and decreased level of consciousness [2]. Reduced oxygen saturation decreases oxygen delivery to tissues, leading to hypoxia. In addition, the accumulation of thick secretions makes airway clearance difficult, further affecting respiratory patterns [11].

These conditions require prompt medical intervention. Physiotherapy, nebulizer therapy, and breathing exercises are commonly used as treatment modalities [12,13]. Nebulizer therapy directly affects the lungs by delivering medication in the form of aerosolized particles, allowing rapid onset of action. It helps dilate airways, relax respiratory muscles, and thin secretions. The use of nebulizer therapy has been shown to improve oxygen saturation (SpO₂), reduce respiratory rate, and normalize breath sounds from tachypnea to eupnea [12,13].

Furthermore, nebulizer therapy using oxygen as a driving gas remains effective in improving respiratory patterns, increasing SpO₂ levels, reducing respiratory rate, and converting abnormal breath sounds such as rhonchi or wheezing into normal vesicular sounds [14]. Additional advantages of nebulizer therapy include ease of use, portability, rapid onset of action, lower required dosages, and fewer systemic side effects. Therefore, researchers are interested in conducting a literature review on the effectiveness of nebulizer therapy in patients with chronic obstructive pulmonary disease (COPD), based on the concerns described above [15].

Actions to improve oxygen saturation can be achieved through oxygen therapy combined with appropriate patient positioning, such as the semi-Fowler position at a 45-degree angle. This position utilizes gravity to facilitate lung expansion and reduce pressure from the abdominal organs on the diaphragm. The effectiveness of this intervention can be evaluated through the respiratory rate, with normal adult values ranging from 16 to 24 breaths per minute [16].

Positioning patients in a semi-Fowler position (45°) helps reduce oxygen consumption, enhances maximal lung expansion, and improves gas exchange by optimizing alveolar membrane function. Additionally, this position can alleviate dyspnea and improve both the duration and quality of sleep. The primary goal of positioning in

patients with respiratory distress is to reduce oxygen demand, maximize lung expansion, and maintain patient comfort [17].

A study conducted on the effectiveness of nebulizer use in reducing dyspnea among patients with bronchial asthma at Dr. Tadjuddin Chalid Hospital, Makassar, found that out of 30 samples, 22 respondents (73.3%) showed effective outcomes [18]. This indicates that nebulizer therapy is generally effective in managing dyspnea in bronchial asthma patients [9]. This finding is supported by research which demonstrated that the semi-Fowler position can increase lung expansion and reduce the frequency of dyspnea by optimizing respiratory muscle function [19,20,21]. Similarly, a study by Suwaryo reported that the semi-Fowler position is effective in reducing respiratory rate and improving oxygen saturation in asthma patients [17].

This study will be conducted at Rumah Sakit Islam Ibnu Sina Bukittinggi. Based on a preliminary survey conducted in the Emergency Department, cases of respiratory disorders showed an increasing trend. In February 2023, there were 412 asthma cases, 84 COPD cases, and 67 pneumonia cases, while in June 2023 there were 10 cases of ARI. In January 2024, asthma cases increased to 561, COPD cases to 89, pneumonia cases to 64, and ARI cases to 11. Furthermore, from January to May 2025, a total of 1,228 respiratory disorder cases were recorded.

With the increasing number of respiratory cases, the use of nebulization therapy has also risen. However, the patient's position during nebulization has not been a primary concern. As a result, repeated nebulization is often required, and improvements in oxygen saturation are sometimes minimal.

Observations conducted in the Emergency Department in July 2025 identified three patients undergoing nebulization therapy. Two patients received nebulization in a supine position, and it was observed that nurses did not specifically consider patient positioning during

the procedure. Consequently, oxygen saturation improved only slightly (approximately 1–2%), requiring repeated nebulization. In contrast, one patient who received nebulization in the semi-Fowler position showed a greater improvement in oxygen saturation (approximately 3–5%). Nurses reported that patient positioning during nebulization is often not given special attention, as the primary focus is on medication administration and general clinical monitoring.

Based on these findings, the researcher proposes the study entitled: “Improvement of Oxygen Saturation in Patients with Airway Disturbance Using Nebulization Therapy in Semi-Fowler Position at Ibn Sina Islamic Hospital Emergency Department, Bukittinggi 2025.”

Methods

This study employed a descriptive survey design. The population consisted of patients with respiratory disorders in the Emergency Department (ED) who received nebulization therapy in the semi-Fowler position.

A total of 96 respondents were selected using an accidental sampling technique. The inclusion criteria were patients who received nebulization therapy using mucolytic and bronchodilator medications.

The research instruments included the Standard Operating Procedure (SOP) for nebulization and a pulse oximeter device used to measure oxygen saturation levels.

Discussions

A. General Description of the Study

This study aimed to describe the improvement in oxygen saturation among patients with respiratory disorders who received nebulization therapy in the semi-Fowler position in the Emergency Department of Rumah Sakit Islam Ibnu Sina Bukittinggi in 2025.

The research was conducted from August 1 to August 20, 2025, using a descriptive

survey design. The study sample consisted of 96 patients who met the inclusion criteria. After data collection was completed, data processing was carried out to determine the description of oxygen saturation improvement in patients with respiratory disorders receiving nebulization therapy in the semi-Fowler position.

B. Univariate Analysis

1. Respondent Characteristics

Table 1. Frequency Distribution of Respondent Characteristics in the Emergency Department at Rumah Sakit Islam Ibnu Sina Bukittinggi, 2025

Characteristics	f	%
Age		
5-11 year	2	2.1
12-16 year	2	2.1
17-25 year	7	7.3
26-35 year	19	19.8
36-45 year	31	32.3
46-55 year	23	24.0
56-65 year	9	9.4
>65 year	3	3.1
Sex		
Man	64	66.7
Woman	32	33.3
Total	96	100

Based on the table, it was found that less than half of the respondents were aged 36–45 years, totaling 31 patients (32.3%). Regarding sex distribution, more than half of the respondents were male, with 64 patients (66.7%).

2. Respondent Temperature

Table 2. Distribution of Respondent Temperature in the Emergency Department at Rumah Sakit Islam Ibnu Sina Bukittinggi, 2025

Variab les	N	Me an	Mi n	Max	SD	Medi an
Tempe rature	96	36,3 66	36. 0	37.00	0.284 6	36,30 0

Based on the table, the average body temperature of patients was 36.4°C, with a standard deviation of 0.2846. This value falls within the normal temperature range of 36–37°C.

3. Oxygen Saturation of Respondents

Table 3. Distribution of Oxygen Saturation in Patients at the Emergency Department of Rumah Sakit Islam Ibnu Sina Bukittinggi, 2025

Saturation Oxygen	F	%
Increase	59	61.46
No Increase	37	38.54
Total	96	100

Based on the table, after receiving nebulization therapy in the semi-Fowler position, the majority of respondents (59 patients; 61.46%) showed an improvement in oxygen saturation among patients with respiratory disorders.

C. Univariate Analysis

1. Respondent Characteristics

The results showed that a proportion of patients were aged 36–45 years, totaling 31 patients (32.3%), representing the late adulthood group, which is associated with an increased risk of respiratory disorders. This condition is related to physiological aging processes, including a decline in lung vital capacity, as well as lifestyle factors such as smoking habits and environmental exposure [22].

Nebulization therapy using bronchodilators and mucolytics in the semi-Fowler position has been shown to be effective in dilating the airways, thinning secretions, and improving oxygen saturation. These findings are supported by previous studies conducted by Saini and Dalle, Padila, Sahrudi and Satria (2020), and Suwaryo [9,18,19,17].

In addition, the majority of patients were male, totaling 64 individuals (66.7%). This finding is consistent with the higher prevalence of respiratory diseases, particularly Chronic Obstructive Pulmonary Disease (COPD), among men, which is strongly associated with smoking behavior and exposure to environmental pollutants [23]. Nebulization therapy in the semi-Fowler position contributes to improved alveolar ventilation, as supported by studies [5,6,17,18].

The researchers assume that the dominance of this age group and male sex is

influenced by physiological factors, lifestyle patterns, and occupational environmental exposure, which also contribute to a more responsive outcome to rapid medical interventions.

2. Description of Oxygen Saturation Improvement in Patients with Respiratory Disorders Undergoing Nebulization Therapy in the Semi-Fowler Position

The results showed that after receiving nebulization therapy in the semi-Fowler position, the majority of respondents (59 patients; 61.46%) experienced an improvement in oxygen saturation. This improvement is associated with the underlying pathophysiology of respiratory disorders, including airway narrowing, decreased lung vital capacity, and oxygen saturation levels below 94%, which may lead to hypoxemia, dyspnea, and accumulation of thick secretions [11,24].

Nebulization therapy is effective in dilating the bronchi, reducing bronchospasm, and thinning secretions. Its effectiveness is further enhanced by the semi-Fowler position, which optimizes lung expansion through gravitational effects [17,25].

These findings are consistent with previous studies which reported a 73.3% effectiveness rate in asthma patients [18], as well as studies [19,26,27], all of which demonstrated improvements in oxygen saturation and airway clearance following nebulization therapy.

The researchers assume that the effectiveness of this intervention is influenced by respondent characteristics, particularly late adulthood age and male sex, the semi-Fowler position which enhances alveolar ventilation, and the use of mucolytic and bronchodilator medications that facilitate gas exchange.

Conclusion

Based on the study objectives and results, the following conclusions can be drawn:

1. A proportion of patients were aged 36–45 years, totaling 31 patients (32.3%), and the

majority were male, with 64 patients (66.7%).

2. After receiving nebulization therapy in the semi-Fowler position, the majority of respondents (59 patients; 61.46%) experienced an improvement in oxygen saturation among patients with respiratory disorders.

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