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ORIGINAL ARTICLE

Clinical Efficacy of Nebulized Magnesium Sulfate in Acute Exacerbations of COPD and Bronchial Asthma: Impact on Early Recovery and ICU Admission

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ABSTRACT

Background: *Acute exacerbations of (COPD) and bronchial asthma are major causes of hospital admission and are associated with significant morbidity and healthcare burden. Nebulized magnesium sulfate has been proposed as an adjunctive bronchodilator to improve clinical outcomes during acute exacerbations.* ***Methods & Materials:*** *This prospective comparative observational study was conducted in the Department of Medicine, Monno Medical College & Hospital, Manikganj, Bangladesh, from January to December 2025. A total of 250 hospitalized patients, including 125 with acute bronchial asthma and 125 with acute exacerbation of COPD, were enrolled by consecutive sampling. All patients received standard treatment with adjunctive nebulized magnesium sulfate. Clinical characteristics, pulmonary function, oxygen saturation, early clinical recovery, ICU admission, hospital stay, and adverse events were evaluated. Data were analyzed using SPSS version 25.0, and a p-value <0.05 was considered statistically significant.* ***Results:*** *Asthma patients showed significantly greater improvement in respiratory distress, wheezing, oxygen saturation, and PEFR than COPD patients (all p<0.05). Mean recovery time was significantly shorter in asthma patients (27.8±10.4 vs. 36.2±12.8 hours; p<0.001). ICU admission (7.2% vs. 19.2%), mechanical ventilation (4.0% vs. 11.2%), and mean hospital stay (3.5±1.3 vs. 4.9±2.0 days) were significantly lower in the asthma group. Nebulized magnesium sulfate was well tolerated, with only minimal adverse effects.* ***Conclusion:*** *Nebulized magnesium sulfate is a safe and effective adjunct to standard therapy, improving early clinical recovery and short-term outcomes in acute exacerbations of COPD and bronchial asthma.*

Keywords: *Chronic obstructive pulmonary disease (COPD); Bronchial asthma; Nebulized magnesium sulfate; Acute exacerbation; ICU admission.*

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) and bronchial asthma are among the leading chronic respiratory diseases worldwide and are major causes of morbidity, mortality, and healthcare utilization. Both conditions are characterized by airflow limitation, although the underlying pathophysiological mechanisms differ [1]. COPD is characterized by persistent airflow obstruction associated with chronic airway inflammation, usually resulting from long-term exposure to noxious particles or gases, whereas asthma is a heterogeneous inflammatory disease characterized by variable airflow obstruction and airway hyperresponsiveness. Acute exacerbations of both diseases represent medical emergencies that frequently require hospitalization and may progress to respiratory failure requiring intensive care unit (ICU) admission. These exacerbations are associated with accelerated decline in lung function, impaired quality of life, increased healthcare costs, and increased mortality [2-4].

Globally, COPD remains one of the leading causes of death, affecting hundreds of millions of people and placing a substantial burden on healthcare systems. Similarly, asthma affects more than 300 million individuals worldwide and continues to account for a significant number of emergency department visits and hospital admissions each year [5,6]. Although current treatment guidelines have significantly improved disease management, acute exacerbations continue to pose therapeutic challenges, particularly among patients who respond poorly to conventional bronchodilator therapy. Consequently, there is increasing interest in identifying effective adjunctive therapies that can accelerate recovery and reduce the need for ICU admission [7].

The standard management of acute exacerbations of COPD and bronchial asthma includes oxygen therapy, inhaled short-acting β_2-agonists, anticholinergic bronchodilators, systemic corticosteroids, and, when indicated, antibiotics or ventilatory support [8]. These interventions aim to relieve bronchospasm,

reduce airway inflammation, improve gas exchange, and prevent respiratory failure. However, despite optimal treatment, a considerable proportion of patients experience persistent airflow obstruction, prolonged hospitalization, and progression to severe respiratory compromise requiring ICU care. This has prompted investigation into adjunctive agents capable of enhancing bronchodilation and improving clinical outcomes [9].

Magnesium sulfate has emerged as a promising adjunctive therapy because of its bronchodilatory, anti-inflammatory, and smooth muscle relaxant properties. Magnesium acts by inhibiting calcium influx into airway smooth muscle cells, thereby promoting bronchial smooth muscle relaxation. Additionally, it suppresses acetylcholine release, stabilizes mast cells, reduces histamine release, and may attenuate airway inflammation [10]. These pharmacological effects provide a biological rationale for its use in acute bronchospasm associated with COPD and asthma exacerbations. Although intravenous magnesium sulfate has been extensively investigated, nebulized magnesium sulfate has attracted attention because it delivers the drug directly to the airways while minimizing systemic adverse effects [10,11].

Several randomized clinical trials have evaluated nebulized magnesium sulfate as an adjunct to standard bronchodilator therapy in acute asthma [12]. Some studies have demonstrated improvements in pulmonary function, including forced expiratory volume in one second (FEV_1) and peak expiratory flow (PEF), particularly among patients with severe exacerbations. However, other trials have failed to demonstrate significant reductions in hospital admission rates or clinically meaningful improvements compared with conventional therapy alone. Likewise, systematic reviews and meta-analyses have reported heterogeneous findings, suggesting that while nebulized magnesium sulfate may improve lung function in selected patients, its overall impact on hospitalization and clinical recovery remains uncertain [11,13].

Current international guidelines therefore do not recommend routine use of nebulized magnesium sulfate in all patients with acute asthma [14]. The Global Initiative for Asthma (GINA) recognizes intravenous magnesium sulfate for selected patients with severe exacerbations who fail to respond adequately to initial therapy but concludes that evidence supporting nebulized magnesium sulfate remains inconsistent. Similarly, COPD management guidelines emphasize optimized bronchodilator therapy and systemic corticosteroids, while the role of nebulized magnesium sulfate remains inadequately defined because of limited high-quality evidence [11,15].

Despite these uncertainties, nebulized magnesium sulfate continues to be an attractive therapeutic option because of its favorable safety profile, ease of administration, low cost, and potential to enhance bronchodilation without significant systemic toxicity. In resource-limited healthcare settings, where ICU resources are often constrained, any intervention capable of shortening recovery time and preventing progression to respiratory failure could provide substantial clinical and economic benefits. Furthermore, evaluating early clinical improvement following nebulized magnesium sulfate therapy may help identify patients who are less likely to require escalation of care [16].

Therefore, the present study aims to evaluate the clinical efficacy of nebulized magnesium sulfate in patients with acute exacerbations of COPD and bronchial asthma, with particular emphasis on its effect on early recovery and ICU admission. The findings may contribute to the growing body of evidence regarding adjunctive bronchodilator therapy and help determine whether nebulized magnesium sulfate can improve short-term clinical outcomes in patients presenting with acute obstructive airway disease.

OBJECTIVE

The main objective was to evaluate the clinical efficacy of nebulized magnesium sulfate as an adjunct to standard therapy in patients with acute exacerbations of COPD and bronchial asthma, with particular emphasis on its impact on early recovery and ICU admission.

METHODS & MATERIALS

This prospective comparative observational study was conducted in the Department of Medicine, Monno Medical College & Hospital, Manikganj, Bangladesh, over a 12-month period from January 2025 to December 2025. The study was designed to evaluate the clinical efficacy of nebulized magnesium sulfate as an adjunct to standard therapy in patients presenting with acute exacerbations of chronic obstructive pulmonary disease (COPD) and bronchial asthma, with particular emphasis on early clinical recovery and reduction in intensive care unit (ICU) admission.

Inclusion Criteria:

- Patients aged 18 years or older.
- Patients diagnosed with acute exacerbation of COPD or bronchial asthma requiring hospital admission.
- Patients who provided written informed consent to participate in the study.

Exclusion Criteria:

- Patients with severe hemodynamic or cardiovascular instability.
- Patients with chronic kidney disease (Stage IV or V) or significant renal impairment.
- Patients with known hypersensitivity or allergy to magnesium sulfate.
- Pregnant or lactating women.
- Patients requiring immediate invasive mechanical ventilation at the time of presentation.
- Patients with other significant respiratory disorders, such as pulmonary tuberculosis, interstitial lung disease, pulmonary malignancy, or pulmonary embolism.

A total of 250 patients admitted with acute exacerbations of COPD and bronchial asthma were enrolled in the study. Of these, 125 patients were diagnosed with acute exacerbation of bronchial asthma and 125 patients with acute exacerbation of COPD. Patients were selected using a consecutive sampling technique from individuals admitted to the emergency department and the medicine wards during the study period. The diagnosis of acute exacerbation of COPD and bronchial asthma was established based on clinical history, physical examination, previous medical records (where available), and relevant laboratory and radiological investigations, in accordance with internationally accepted diagnostic guidelines.

All enrolled patients received standard treatment for acute exacerbations according to hospital protocols. Standard therapy included controlled oxygen therapy, nebulized short-acting bronchodilators (salbutamol with or without ipratropium bromide), systemic corticosteroids, antibiotics when clinically indicated, and other supportive measures. In addition to standard therapy, nebulized magnesium sulfate

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was administered as adjunctive treatment. Patients were closely monitored throughout their hospital stay to assess their response to therapy, early clinical recovery, improvement in respiratory status, and the requirement for ICU admission.

Baseline demographic and clinical characteristics, including age, sex, smoking status, body mass index (BMI), duration of respiratory illness, comorbidities, respiratory rate, pulse rate, systolic blood pressure, peripheral oxygen saturation (SpO_2), and peak expiratory flow rate (PEFR), were recorded at admission. Patients were subsequently assessed at predetermined intervals following the initiation of treatment to evaluate changes in clinical symptoms, vital signs, pulmonary function, duration of hospital stay, time to early clinical recovery, requirement for ICU admission, need for mechanical ventilation, and treatment-related adverse events.

Data were collected using a pretested structured case record form specifically designed for the study. All collected data were checked for completeness and accuracy before being entered into the database. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean ± standard deviation (SD), whereas categorical variables were presented as frequency and percentage. Comparisons between the asthma and COPD groups were performed using the independent-samples t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, as appropriate. A p-value of less than 0.05 was considered statistically significant.

Prior to the commencement of the study, ethical approval was obtained from the Institutional Ethics Committee of Monno Medical College & Hospital. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment, and the confidentiality of patient information was strictly maintained throughout the study.

RESULT

Figure 1 shows that patients with bronchial asthma were generally younger than those with COPD. The largest proportion of asthma patients belonged to the 31–40 years age group (28.0%), whereas the highest proportion of COPD patients was aged over 60 years (32.8%), indicating a significant difference in age distribution between the two groups.

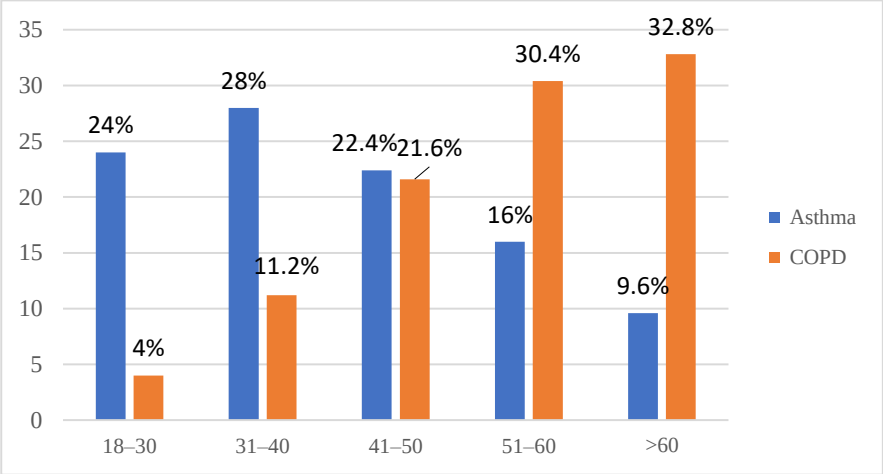

Figure 1: Age distribution of the respondents

Table I demonstrates that the mean age was significantly lower in the asthma group than in the COPD group (43.1 ± 14.1 vs. 57.6 ± 12.7 years; p<0.001). Male participants were more common among COPD patients (72.0%), while females predominated in the asthma group (52.8%) (p<0.001). Smoking history was significantly more frequent in COPD patients than in asthma patients (68.0% vs. 23.2%; p<0.001). No significant difference was observed in residence (p=0.792). The mean BMI was significantly higher in the asthma group than in the COPD group (25.6 ± 3.9 vs. 23.9 ± 3.5 kg/m^2; p=0.002).

Table I: Socio-demographic characteristics of the study participants (*n* = 250)

Variables		Asthma (n=125)	COPD (n=125)	p value
Age (Mean ± SD)		43.1 ± 14.1	57.6 ± 12.7	<0.001
Gender	Male	59 (47.2%)	90 (72.0%)	<0.001
	Female	66 (52.8%)	35 (28.0%)	
Residence	Rural	79 (63.2%)	81 (64.8%)	0.792
	Urban	46 (36.8%)	44 (35.2%)	
Smoking history	Present	29 (23.2%)	85 (68.0%)	<0.001
	Absent	96 (76.8%)	40 (32.0%)	
BMI (kg/m^2), Mean ± SD		25.6 ± 3.9	23.9 ± 3.5	0.002

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Table II shows the baseline clinical presentation of the study participants at admission. The mean oxygen saturation (SpO_2) and peak expiratory flow rate (PEFR) were significantly higher among asthma patients than COPD patients (p=0.001 and p=0.003, respectively). The mean duration of symptoms before hospital admission was significantly shorter in the asthma group (3.8 ± 1.4 days) compared with the COPD group (4.6 ± 1.8 days) (p=0.002). However, there were no statistically significant differences in respiratory rate, pulse rate, or systolic blood pressure between the two groups (p>0.05).

Table II: Clinical presentation at admission of the study participants

Variables	Asthma (n=125)	COPD (n=125)	p value
Respiratory rate (breaths/min)	30.9 ± 4.3	29.8 ± 4.6	0.084
Pulse rate (beats/min)	104.6 ± 11.7	102.4 ± 10.9	0.131
SpO_2 (%)	90.7 ± 3.8	88.6 ± 4.5	0.001
PEFR (% predicted)	49.3 ± 11.6	44.8 ± 10.9	0.003
Systolic BP (mmHg)	122.4 ± 13.8	124.9 ± 14.5	0.157
Duration of symptoms (days)	3.8 ± 1.4	4.6 ± 1.8	0.002

Table III summarizes the early clinical response following nebulized magnesium sulfate therapy. A significantly higher proportion of asthma patients experienced relief of respiratory distress (88.0% vs. 76.0%; p=0.014), reduction in wheezing (85.6% vs. 73.6%; p=0.019), improvement in oxygen saturation (87.2% vs. 75.2%; p=0.016), and improvement in PEFR greater than 20% (77.6% vs. 65.6%; p=0.034) compared with COPD patients.

Table III: Response to nebulized magnesium sulfate therapy within 24 hours

Variables	Asthma (n=125)	COPD (n=125)	p value
Respiratory distress relieved	110 (88.0%)	95 (76.0%)	0.014
Wheezing reduced	107 (85.6%)	92 (73.6%)	0.019
Improvement in SpO_2	109 (87.2%)	94 (75.2%)	0.016
PEFR improvement (>20%)	97 (77.6%)	82 (65.6%)	0.034

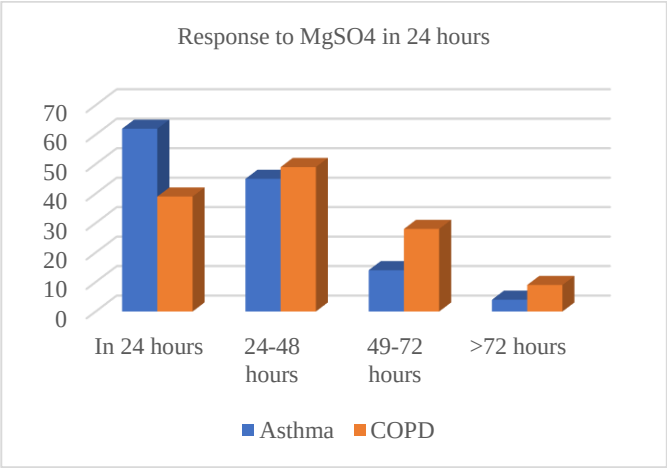

Table IV demonstrates the time required for early clinical recovery after nebulized magnesium sulfate therapy. Nearly half of the asthma patients (49.6%) achieved clinical recovery within 24 hours compared with 31.2% of COPD patients. The mean recovery time was significantly shorter in the asthma group than in the COPD group (27.8 ± 10.4 vs. 36.2 ± 12.8 hours; p<0.001), indicating more rapid clinical improvement among asthma patients.

Table IV: Time to early clinical recovery following nebulized magnesium sulfate therapy

Time to early clinical recovery	Asthma (n=125)	COPD (n=125)	p value
Within 24 hours	62 (49.6%)	39 (31.2%)	0.004
24–48 hours	45 (36.0%)	49 (39.2%)	
48–72 hours	14 (11.2%)	28 (22.4%)	
>72 hours	4 (3.2%)	9 (7.2%)	
Mean recovery time (hours), Mean ± SD	27.8 ± 10.4	36.2 ± 12.8	<0.001

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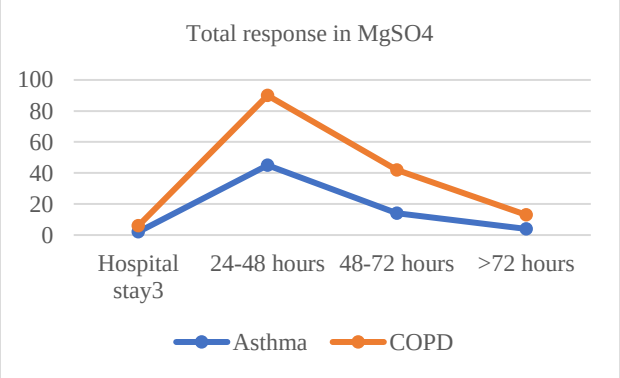
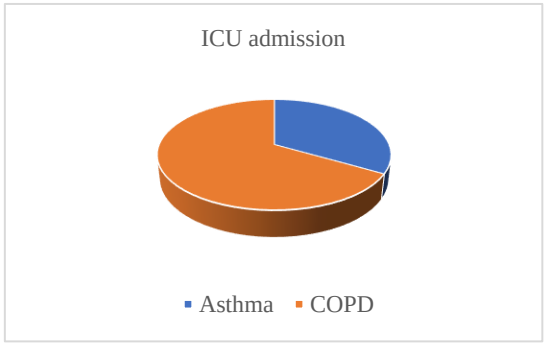


Table V presents the clinical outcomes of the study participants. ICU admission was required significantly less frequently among asthma patients than COPD patients (7.2% vs. 19.2%; p=0.006). Likewise, the requirement for mechanical ventilation was significantly lower in the asthma group (4.0% vs. 11.2%; p=0.036). The mean duration of hospital stay was significantly shorter in asthma patients (3.5 ± 1.3 days) than in COPD patients (4.9 ± 2.0 days) (p<0.001). Furthermore, the proportion of patients discharged with clinical improvement was significantly higher in the asthma group (96.0% vs. 88.8%; p=0.028).

Table V: Clinical outcomes and ICU admission of the study participants

Variables	Asthma (n=125)	COPD (n=125)	p value
ICU admission	9 (7.2%)	24 (19.2%)	0.006
Mechanical ventilation required	5 (4.0%)	14 (11.2%)	0.036
Mean hospital stay (days)	3.5 ± 1.3	4.9 ± 2.0	<0.001
Discharged with clinical improvement	120 (96.0%)	111 (88.8%)	0.028



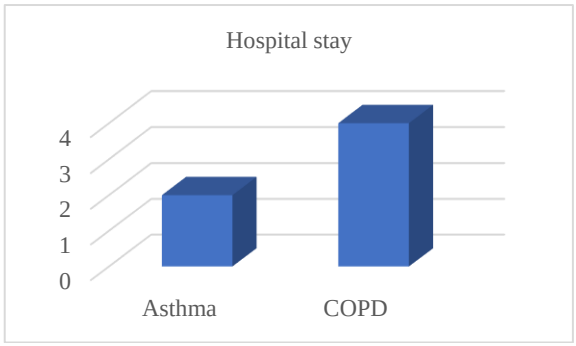


Table VI shows the adverse effects associated with nebulized magnesium sulfate therapy. Most participants in both groups experienced no adverse effects (89.6% in the asthma group and 85.6% in the COPD group). Mild hypotension, nausea, and facial flushing occurred infrequently, and there was no statistically significant difference in the overall incidence of adverse effects between the asthma and COPD groups (p=0.621).

Table VI. Adverse effects of nebulized magnesium sulfate

Variables	Asthma (n=125)	COPD (n=125)	p value
Mild hypotension	4 (3.2%)	6 (4.8%)	0.621
Nausea	7 (5.6%)	9 (7.2%)	
Facial flushing	2 (1.6%)	3 (2.4%)	
No adverse effects	112 (89.6%)	107 (85.6%)	

DISCUSSION

The present prospective interventional study evaluated the clinical efficacy of nebulized magnesium sulfate in patients with acute exacerbations of bronchial asthma and chronic obstructive pulmonary disease (COPD), with particular emphasis on early clinical recovery and ICU admission. The findings demonstrated that patients with bronchial asthma exhibited a more favorable early clinical response, shorter recovery time, reduced ICU admission, and shorter hospital stay than patients with COPD following nebulized magnesium sulfate therapy. The present study showed a significant difference in age distribution between the two disease groups. The mean age of patients with asthma was 43.1 ± 14.1 years, whereas patients with COPD had a significantly higher mean age (57.6 ± 12.7 years, p<0.001). Furthermore, asthma was more prevalent among younger adults, whereas COPD

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predominantly affected elderly individuals. These findings are consistent with the epidemiological characteristics described in the Global Initiative for Asthma (GINA) and the Global Initiative for Chronic Obstructive Lung Disease (GOLD) reports, which indicate that asthma commonly develops earlier in life, while COPD primarily affects older adults with long-term exposure to cigarette smoke and environmental pollutants [4,17]. Similar age differences have also been reported by Mohammed and Goodacre, who observed that COPD patients enrolled in clinical studies were generally older than patients presenting with acute asthma exacerbations [10]. Gender distribution also differed significantly between the two groups. Females constituted the majority of asthma patients (52.8%), whereas males accounted for 72.0% of COPD patients. This finding agrees with previous epidemiological studies demonstrating that smoking-related COPD remains substantially more common among men in South Asian countries, whereas asthma affects both sexes relatively equally depending on age and environmental exposure [17,18]. The higher prevalence of smoking among COPD patients (68.0%) observed in the present study further supports the established role of tobacco exposure as the principal risk factor for COPD development and acute exacerbation [4,19]. Similar observations were reported by Vogelmeier et al., who identified cigarette smoking as the most important modifiable risk factor associated with COPD severity and frequent hospitalization [19]. Body mass index (BMI) was significantly higher among asthma patients than COPD patients. Lower BMI in COPD is frequently associated with chronic systemic inflammation, increased resting energy expenditure, and skeletal muscle wasting, particularly in patients with advanced disease [20]. This finding is in agreement with previous studies reporting that nutritional depletion is associated with increased morbidity, prolonged hospitalization, and poor prognosis among patients with COPD exacerbations [20,21]. Regarding the clinical presentation, the present study demonstrated that oxygen saturation (SpO_2) and peak expiratory flow rate (PEFR) at admission were significantly higher among asthma patients than COPD patients. Conversely, COPD patients experienced longer symptom duration before hospital presentation. These findings suggest relatively greater baseline respiratory impairment among patients with COPD. GOLD guidelines similarly describe that COPD exacerbations are commonly associated with persistent airflow limitation and impaired gas exchange, whereas bronchial asthma generally demonstrates greater reversibility following bronchodilator therapy [4]. Previous clinical investigations have also shown that COPD patients frequently present with lower oxygen saturation and poorer pulmonary function than patients with acute asthma exacerbations [10,19]. Following administration of nebulized magnesium sulfate, substantial clinical improvement was observed in both disease groups. Nevertheless, patients with bronchial asthma demonstrated significantly greater relief of respiratory distress, reduction of wheezing, improvement in oxygen saturation, and increase in PEFR compared with COPD patients. The bronchodilatory effects of magnesium sulfate are attributed to calcium channel antagonism, inhibition of acetylcholine release, stabilization of mast cells, and reduction of airway smooth muscle contraction [10, 22]. These mechanisms appear to produce a more pronounced response in asthma because bronchospasm is largely reversible, whereas airflow limitation in COPD is partly irreversible owing to structural airway remodeling and emphysematous destruction. The present findings are supported by several randomized controlled trials evaluating nebulized magnesium sulfate in acute asthma. Hughes et al. demonstrated significantly greater improvement in pulmonary function when nebulized magnesium sulfate was administered in combination with β_2-agonists compared with standard bronchodilator therapy alone [23]. Likewise, Nannini et al. reported improved PEFR and symptom relief among patients receiving nebulized magnesium sulfate during acute asthma attacks [24]. More recently, Mohammed and Goodacre's systematic review concluded that magnesium sulfate provides additional improvement in pulmonary function, particularly among patients with severe asthma exacerbations, although its effect on hospital admission remains less consistent across studies [10]. Although improvement was also observed among COPD patients in the present study, the magnitude of response was comparatively smaller. This observation is supported by a recent systematic review by Ni et al., which suggested that nebulized magnesium sulfate may improve lung function and reduce dyspnea in acute COPD exacerbations; however, the certainty of evidence remains low because of heterogeneity among clinical trials [8]. Consequently, current GOLD guidelines do not recommend routine use of nebulized magnesium sulfate but acknowledge that additional high-quality randomized trials are required to establish its clinical role [4].

The present study further demonstrated that patients with bronchial asthma achieved significantly faster clinical recovery than patients with COPD following nebulized magnesium sulfate therapy. Nearly half of the asthma patients (49.6%) recovered within 24 hours compared with only 31.2% of COPD patients, while the mean recovery time was significantly shorter in the asthma group (27.8 ± 10.4 hours vs. 36.2 ± 12.8 hours; $p<0.001$). This difference may be explained by the underlying pathophysiology of the two diseases. Airway obstruction in asthma is largely reversible and predominantly results from bronchial smooth muscle constriction and airway inflammation, whereas COPD is characterized by fixed airflow limitation due to airway remodeling and emphysematous destruction. Consequently, therapies aimed at bronchodilation are generally more effective in producing rapid clinical improvement in asthma than in COPD [4,17]. Similar findings have been reported by Hughes et al., who demonstrated more rapid improvement in pulmonary function among patients receiving nebulized magnesium sulfate as an adjunct to standard bronchodilator therapy during acute asthma exacerbations [23]. Likewise, Mohammed and Goodacre concluded that magnesium sulfate significantly improves lung function in severe asthma, although its influence on overall hospital admission varies among studies [10].

An important finding of the present study was the significantly lower requirement for ICU admission among asthma patients compared with COPD patients (7.2% vs. 19.2%; $p=0.006$). Similarly, the requirement for mechanical ventilation was significantly lower in patients with asthma (4.0%) than in those with COPD (11.2%). These observations probably reflect the greater reversibility of bronchospasm in asthma and the more favorable response to adjunctive bronchodilator therapy. Acute exacerbations of COPD are frequently associated with chronic respiratory insufficiency, impaired gas exchange, and multiple comorbidities, all of which increase the likelihood of respiratory failure requiring intensive care support [4]. Previous studies have consistently reported that COPD exacerbations account for a substantial proportion of ICU admissions and invasive mechanical ventilation among patients with obstructive airway diseases [4,8]. Although few randomized studies have specifically

evaluated ICU admission as a primary outcome following nebulized magnesium sulfate therapy, the observed reduction in respiratory distress and improvement in pulmonary function may contribute to decreasing the need for escalation of care.

The duration of hospital stays also differed significantly between the two groups. Patients with bronchial asthma had a significantly shorter hospital stay than patients with COPD (3.5 ± 1.3 days vs. 4.9 ± 2.0 days; p<0.001). Earlier symptom resolution and better improvement in pulmonary function following treatment probably contributed to earlier discharge among asthma patients. Similar findings have been described by Knightly et al. in a Cochrane review, which reported that inhaled magnesium sulfate, when used as an adjunct to conventional therapy, may accelerate clinical improvement in selected patients with severe asthma exacerbations, although evidence regarding reduction in hospital admission and duration of hospitalization remains inconsistent [15]. Likewise, recent systematic reviews have suggested that magnesium sulfate may shorten recovery time in selected patients when administered early during acute exacerbations [10].

The present study also demonstrated that a significantly higher proportion of asthma patients were discharged with clinical improvement compared with COPD patients (96.0% vs. 88.8%; p=0.028). This finding is consistent with previous clinical evidence showing that patients with acute asthma generally exhibit greater reversibility of airway obstruction following aggressive bronchodilator therapy than patients with COPD [10,17]. Current GINA recommendations emphasize that prompt bronchodilator therapy together with systemic corticosteroids can substantially improve clinical outcomes during acute asthma exacerbations, while GOLD guidelines acknowledge that recovery following COPD exacerbations is often slower because of persistent airflow limitation and chronic structural lung damage [4,17].

Safety is an important consideration when introducing any adjunctive therapy. In the present study, nebulized magnesium sulfate was well tolerated in both patient groups. Approximately 90% of asthma patients and 86% of COPD patients experienced no adverse effects. Mild hypotension, nausea, and facial flushing occurred only occasionally, and there was no statistically significant difference in adverse events between the two groups. These findings are consistent with previous randomized controlled trials and systematic reviews, which have reported that nebulized magnesium sulfate possesses an excellent safety profile with very few clinically significant adverse reactions [10,15, 25]. Hughes et al. similarly observed no increase in serious adverse events among patients treated with nebulized magnesium sulfate compared with conventional bronchodilator therapy [23]. Furthermore, the Cochrane review by Ni et al. concluded that magnesium sulfate administration during acute COPD exacerbations was generally safe and not associated with increased treatment-related complications [8].

The therapeutic benefit of magnesium sulfate is biologically plausible because magnesium acts as a physiological calcium antagonist, inhibiting calcium-mediated contraction of bronchial smooth muscle. In addition, magnesium suppresses acetylcholine release at neuromuscular junctions, stabilizes mast cells, inhibits histamine release, and reduces inflammatory mediator production, thereby enhancing bronchodilation and reducing airway hyperresponsiveness [10,22]. These mechanisms explain why the addition of nebulized magnesium sulfate to conventional bronchodilator therapy may improve oxygenation, relieve bronchospasm, and accelerate symptom resolution, particularly in patients with severe reversible airway obstruction.

Despite these encouraging findings, several studies have reported conflicting results regarding the overall effectiveness of nebulized magnesium sulfate. While many randomized trials have demonstrated significant improvement in pulmonary function, others have found limited benefit in reducing hospital admission or mortality [8,10,15]. Differences in study design, disease severity, dosage of magnesium sulfate, timing of administration, nebulization technique, and concomitant therapies may account for these inconsistent findings. Therefore, further multicenter randomized controlled trials with larger sample sizes are warranted to establish the optimal dosage, timing, and patient selection for nebulized magnesium sulfate therapy in both acute asthma and COPD exacerbations.

Overall, the findings of the present study indicate that nebulized magnesium sulfate is a safe and effective adjunct to standard therapy for acute exacerbations of obstructive airway diseases. Although both asthma and COPD patients benefited from treatment, the clinical response was significantly greater among patients with bronchial asthma, who demonstrated more rapid recovery, lower ICU admission, reduced need for mechanical ventilation, shorter hospital stay, and excellent treatment tolerance. These findings support the potential role of nebulized magnesium sulfate as an adjunctive bronchodilator, particularly in patients with acute severe asthma, while highlighting the need for further high-quality studies to define its role in acute exacerbations of COPD.

LIMITATIONS

This study was conducted at a single tertiary care hospital with a relatively limited sample size, which may affect the generalizability of the findings. The study assessed only short-term clinical outcomes during hospitalization, and long-term follow-up was not performed. Further multicenter studies with larger sample sizes are recommended to validate these findings.

CONCLUSION

The present study demonstrated that nebulized magnesium sulfate is a safe and effective adjunct to standard therapy in the management of acute exacerbations of COPD and bronchial asthma. Patients receiving nebulized magnesium sulfate showed significant improvement in respiratory symptoms, oxygen saturation, and pulmonary function, resulting in earlier clinical recovery. The therapy was also associated with lower rates of ICU admission, reduced need for mechanical ventilation, and shorter hospital stay, with more pronounced benefits observed among patients with bronchial asthma than those with COPD. Moreover, nebulized magnesium sulfate was well tolerated, with only minimal adverse effects. These findings support the use of nebulized magnesium sulfate as an adjunctive treatment in the acute management of obstructive airway diseases. However, further large-scale, multicenter randomized controlled trials with long-term follow-up are recommended to confirm these findings and establish its role in routine clinical practice.

FUNDING

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CONFICTS OF INTEREST

There are no conflicts of interest.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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