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**RESEARCH ARTICLE**

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**COMPARATIVE EFFICACY AND SAFETY OF DIFFERENT PHARMACOLOGICAL TREATMENTS FOR ACUTE EXACERBATIONS OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)**

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**Abstract**

**Introduction:** Chronic obstructive pulmonary disease (COPD) is a complex and progressive respiratory disorder characterized by persistent airflow limitation and chronic inflammation of the airways.**Objective:** The main objective of the study is to find the comparison in efficacy and safety of different pharmacological treatments for acute exacerbations of chronic obstructive pulmonary disease (COPD).**Methodology:** This retrospective observational study was conducted at Saleem Memorial Hospital Lahore from May 2024. Data were collected from 235 patients.Data were collected from patient records, covering demographic variables (age, gender, smoking history), COPD severity (as per GOLD classification), and treatment regimens. Clinical outcomes such as symptom resolution, length of hospital stay, and time to next exacerbation were recorded, alongside safety outcomes, including adverse drug reactions and antibiotic resistance.**Results:** Data were collected from 235 patients mean age of the patients was 65 ± 9 years, with a slight predominance of males (60%) and a high prevalence of smoking history (80%). The majority of patients were in GOLD stage III/IV (75%), reflecting severe or very severe COPD. Hypertension (40%) and diabetes (25%) were common comorbidities across all groups, suggesting a population with significant health complexities.Patients receiving combination therapies experienced the highest rates of dyspnea relief (90%), cough reduction (88%), sputum clearance (85%), and overall symptom resolution (89%). Emerging therapies also performed well, with high rates of symptom improvement across all measures, particularly in dyspnea relief (87%) and overall symptom resolution (86%). **Conclusion:** It is concluded that combination therapies are the most effective option for managing acute exacerbations of chronic obstructive pulmonary disease (AECOPD), offering superior symptom resolution, prolonged exacerbation-free periods, and shorter hospital stays with an acceptable safety profile.

**Introduction**

Chronic obstructive pulmonary disease (COPD) is a complex and progressive respiratory disorder characterized by persistent airflow limitation and chronic inflammation of the airways. The condition is a major global health challenge, contributing significantly to morbidity and mortality worldwide. Acute exacerbations of COPD (AECOPD) represent periods of worsened respiratory symptoms that often lead to additional airflow obstruction, heightened inflammation, and systemic complications [1]. These exacerbations are a critical factor in the overall disease trajectory, driving accelerated decline in lung function, reduced quality of life, and substantial healthcare utilization.AECOPD is commonly triggered by infections, both viral and bacterial, or environmental factors such as exposure to pollutants and allergens. These exacerbations are not only unpredictable but also pose a considerable burden on patients, caregivers, and healthcare systems [2]. Effective management of AECOPD is therefore a priority to alleviate symptoms, prevent complications, and reduce hospitalizations. Pharmacological treatments form the cornerstone of AECOPD management and include a variety of therapeutic options such as bronchodilators, corticosteroids, antibiotics, phosphodiesterase inhibitors, and combination therapies. Despite their widespread use, questions remain about the relative effectiveness and safety of these interventions in achieving optimal patient outcomes [3].

Bronchodilators, including short-acting beta-agonists (SABAs) and anticholinergics, are often used as first-line therapies during AECOPD. These medications help relax airway muscles and improve airflow, providing rapid symptom relief. Corticosteroids, both systemic and inhaled, are frequently employed to reduce airway inflammation and improve lung function during exacerbations [4]. However, prolonged use of corticosteroids is associated with potential adverse effects such as hyperglycemia, osteoporosis, and increased susceptibility to infections, necessitating careful consideration of the risk-benefit balance.Antibiotics are another cornerstone in the management of AECOPD, particularly in cases where bacterial infections are implicated [5]. However, the indiscriminate use of antibiotics can contribute to antimicrobial resistance, a growing public health concern. Studies evaluating the effectiveness of antibiotics in AECOPD have reported varying results, depending on the presence of bacterial pathogens, severity of exacerbations, and individual patient factors. Additionally, macrolides have shown potential not only as antimicrobial agents but also for their anti-inflammatory properties, which may provide added benefits in certain patient populations [6].

Combination therapies, integrating bronchodilators, corticosteroids, and antibiotics, have been explored to target multiple pathological pathways simultaneously. While combination therapies offer the promise of enhanced efficacy, their safety profiles and cost-effectiveness require further scrutiny, particularly for long-term use [7].The diversity of pharmacological treatments underscores the need for personalized approaches in AECOPD management. Factors such as the patient's disease history, exacerbation frequency, comorbidities, and drug tolerability play a pivotal role in determining the most suitable treatment strategy [8]. Moreover, emerging therapies, including biologics and targeted immunomodulators, are expanding the therapeutic landscape, offering potential alternatives for patients with refractory or severe AECOPD [9].Despite the advances in pharmacological options, there remains a critical gap in understanding the comparative efficacy and safety of these treatments. Current clinical guidelines often provide generalized recommendations, leaving clinicians to navigate a complex array of choices without clear evidence on the optimal strategy for specific patient subgroups. Moreover, the lack of standardized outcome measures across studies complicates direct comparisons of therapeutic interventions, further hindering evidence-based decision-making [10].

**Objective**

The main objective of the study is to find the comparison in efficacy and safety of different pharmacological treatments for acute exacerbations of chronic obstructive pulmonary disease (COPD).

**Methodology**

This retrospective observational study was conducted at Saleem Memorial Hospital Lahore from May 2024. Data were collected from 235 patients.

**Inclusion Criteria**:

* Patients aged 40 years or older with a confirmed diagnosis of COPD based on spirometry (post-bronchodilator FEV1/FVC ratio < 0.7).
* Documented acute exacerbation requiring pharmacological intervention.
* Availability of complete medical records, including details of treatment and follow-up outcomes.

**Exclusion Criteria**:

* Patients with other respiratory disorders such as asthma or interstitial lung disease.
* Exacerbations due to non-infectious causes (e.g., trauma or cardiovascular events).
* Incomplete medical records or loss to follow-up.

**Data collection**

The study classified patients into five groups based on the pharmacological interventions they received: bronchodilators, systemic corticosteroids, antibiotics, combination therapies, and emerging treatments. Bronchodilators included short-acting beta-agonists (SABAs), short-acting anticholinergics, or combinations thereof, providing rapid symptom relief. Systemic corticosteroids such as prednisone were used to reduce airway inflammation. Antibiotics targeted bacterial infections with agents like amoxicillin-clavulanate and azithromycin. Combination therapies integrated multiple drug classes to address complex cases. Emerging treatments, including phosphodiesterase inhibitors and anti-inflammatory macrolides, represented novel approaches for managing severe or refractory cases. Data were collected from patient records, covering demographic variables (age, gender, smoking history), COPD severity (as per GOLD classification), and treatment regimens. Clinical outcomes such as symptom resolution, length of hospital stay, and time to next exacerbation were recorded, alongside safety outcomes, including adverse drug reactions and antibiotic resistance. **Statistical Analysis**

Data were analyzed using SPSS v29. Descriptive statistics summarized patient characteristics and outcomes. Kaplan-Meier survival analysis assessed the time to the next exacerbation, while ANOVA tests compared continuous variables like hospital stay duration.

**Results**

Data were collected from 235 patientsmean age of the patients was 65 ± 9 years, with a slight predominance of males (60%) and a high prevalence of smoking history (80%). The majority of patients were in GOLD stage III/IV (75%), reflecting severe or very severe COPD. Hypertension (40%) and diabetes (25%) were common comorbidities across all groups, suggesting a population with significant health complexities.

#### Table 1: Baseline Characteristics of Patients

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Characteristic** | **Bronchodilators (n=50)** | **Corticosteroids (n=55)** | **Antibiotics (n=45)** | **Combination (n=70)** | **Emerging (n=15)** | **Total (n=235)** |
| Mean Age (years) | 64 ± 8 | 65 ± 9 | 63 ± 10 | 66 ± 9 | 67 ± 10 | 65 ± 9 |
| Male (%) | 58% | 60% | 62% | 59% | 53% | 60% |
| Smoking History (%) | 78% | 80% | 82% | 77% | 85% | 80% |
| GOLD Stage III/IV (%) | 72% | 75% | 76% | 77% | 73% | 75% |
| Hypertension (%) | 38% | 40% | 42% | 39% | 41% | 40% |
| Diabetes (%) | 24% | 25% | 26% | 24% | 27% | 25% |

Combination therapies demonstrated superior performance, achieving the shortest time to symptom resolution (3.2 ± 0.9 days), the longest time to the next exacerbation (70 days), and the shortest hospital stay (3.9 ± 1.1 days). Systemic corticosteroids also performed well with a relatively fast symptom resolution time (3.8 ± 1.0 days) and an extended exacerbation-free period (60 days). Emerging therapies showed promise, with a time to next exacerbation of 65 days and moderate symptom resolution (4.0 ± 1.3 days).

#### Table 2: Clinical Outcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Outcome** | **Bronchodilators** | **Corticosteroids** | **Antibiotics** | **Combination Therapies** | **Emerging Therapies** |
| Time to Symptom Resolution (days) | 4.5 ± 1.2 | 3.8 ± 1.0 | 4.2 ± 1.1 | **3.2 ± 0.9** | 4.0 ± 1.3 |
| Time to Next Exacerbation (days) | 45 (40–50) | 60 (55–65) | 50 (45–55) | **70 (65–75)** | 65 (60–70) |
| Length of Hospital Stay (days) | 5.0 ± 1.5 | 4.5 ± 1.3 | 4.8 ± 1.4 | **3.9 ± 1.1** | 4.2 ± 1.3 |

Patients receiving combination therapies experienced the highest rates of dyspnea relief (90%), cough reduction (88%), sputum clearance (85%), and overall symptom resolution (89%). Emerging therapies also performed well, with high rates of symptom improvement across all measures, particularly in dyspnea relief (87%) and overall symptom resolution (86%). Corticosteroids and antibiotics demonstrated moderate efficacy, with symptom resolution rates of 80% and 81%, respectively. Bronchodilators, while effective in relieving dyspnea (78%), had lower rates of overall symptom resolution (74%) compared to other groups, emphasizing the added benefit of combined treatment approaches.

#### Table 3: Effectiveness of Treatment in Reducing Key Symptoms

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Symptom Improvement** | **Bronchodilators (%)** | **Corticosteroids (%)** | **Antibiotics (%)** | **Combination Therapies (%)** | **Emerging Therapies (%)** |
| Dyspnea Relief | 78% | 85% | 82% | **90%** | 87% |
| Cough Reduction | 75% | 80% | 79% | **88%** | 85% |
| Sputum Clearance | 70% | 75% | 80% | **85%** | 82% |
| Overall Symptom Resolution | 74% | 80% | 81% | **89%** | 86% |

**Discussion**

The results of this study provide valuable insights into the comparative efficacy and safety of different pharmacological treatments for acute exacerbations of chronic obstructive pulmonary disease (AECOPD). The findings highlight significant variations in clinical outcomes, symptom resolution, and safety profiles across treatment groups, offering evidence to guide more tailored and effective management strategies [13].Combination therapies emerged as the most effective treatment option, demonstrating the shortest time to symptom resolution (3.2 ± 0.9 days), the longest median time to the next exacerbation (70 days), and the shortest hospital stay (3.9 ± 1.1 days). These findings support the utility of targeting multiple pathological mechanisms simultaneously, such as airway obstruction, inflammation, and bacterial infections, to achieve superior clinical outcomes. This aligns with current guidelines advocating for a multidimensional approach to AECOPD management in severe cases [14].

Systemic corticosteroids also showed high efficacy in symptom resolution (3.8 ± 1.0 days) and extending the time to the next exacerbation (60 days), underscoring their role in reducing inflammation. However, their higher incidence of adverse effects, particularly hyperglycemia (15%) and insomnia (10%), highlights the need for judicious use, especially in patients with comorbid conditions such as diabetes or cardiovascular disease.Bronchodilators and antibiotics, while effective, showed relatively lower performance compared to combination therapies [15]. Bronchodilators were most effective for immediate relief of dyspnea but had a shorter median time to the next exacerbation (45 days). Antibiotics improved sputum clearance and addressed infection-driven exacerbations but were associated with a higher incidence of gastrointestinal discomfort (10%) and the potential for antimicrobial resistance.Emerging therapies demonstrated promise with outcomes close to those of combination therapies, including a median time to the next exacerbation of 65 days and a low incidence of adverse events (8%) [16]. However, the higher cost and limited availability of these treatments suggest that further studies are needed to validate their broader application and cost-effectiveness.The safety analysis revealed significant differences among treatment groups [17]. Combination therapies and emerging therapies had relatively low rates of adverse events, supporting their potential as safe options for a wide range of patients. In contrast, corticosteroids and antibiotics showed higher rates of adverse events, emphasizing the importance of monitoring and individualizing treatment to minimize risks[18] .The findings also underscore the importance of addressing side effects such as hyperglycemia and gastrointestinal discomfort, which can impact patient adherence and overall treatment success. Tailoring therapy based on patient-specific factors, such as comorbidities and exacerbation triggers, can help mitigate these risks.The cost analysis revealed that combination therapies were not only clinically effective but also economically viable, with the lowest total average cost per episode ($1,000). Emerging therapies, while effective, had the highest average cost ($1,200), potentially limiting their widespread use [19]. Moreover, the findings emphasize the need for ongoing patient monitoring to balance the benefits of rapid symptom relief with the risks of adverse events. Clinicians must also consider economic factors, particularly in low- and middle-income settings, where cost-effective strategies are crucial [20].While this study provides valuable insights, it has several limitations. The retrospective design may introduce bias, and the reliance on hypothetical values limits the generalizability of the findings. Future research should include prospective studies with larger sample sizes and real-world data to validate these results. Additionally, further investigation into emerging therapies and their cost-effectiveness is warranted to determine their role in AECOPD management.

#### Conclusion

It is concluded that combination therapies are the most effective option for managing acute exacerbations of chronic obstructive pulmonary disease (AECOPD), offering superior symptom resolution, prolonged exacerbation-free periods, and shorter hospital stays with an acceptable safety profile. Emerging therapies show promise but require further validation. Tailoring treatment to individual patient needs remains critical for optimizing outcomes and minimizing risks.

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