Section: Respiratory Medicine

Original Research Article

CLINICAL OUTCOMES AND MANAGEMENT STRATEGIES IN AECOPD WITH RESPIRATORY FAILURE

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a progressive respiratory condition marked by airflow limitation and chronic symptoms, primarily caused by long-term exposure to harmful particles like cigarette smoke. As highlighted by the Global Initiative for Chronic Obstructive Lung Disease (GOLD), COPD is a major global health burden, with exacerbations playing a key role in disease progression and outcomes. **Aims:** To evaluate the clinical outcomes and effectiveness of various management strategies, including conservative therapy, non-invasive ventilation, and invasive ventilation, in patients with acute exacerbations of COPD (AECOPD) presenting with respiratory failure.

Materials and Methods: This cross-sectional observational study was conducted in the Department of Respiratory Medicine at Agartala Government Medical College and GB Pant Hospital over a period of 1.5 years, from October 2022 to March 2024. The study population comprised all patients with chronic obstructive pulmonary disease (COPD) admitted with acute exacerbations during the study period. A total of 270 patients were included as the final sample size, selected through a census sampling technique wherein all eligible cases were consecutively enrolled until the required number was achieved.

Results: In this study, dyspnea (90.3%) and productive cough (80.7%) were the predominant clinical features, while systemic symptoms such as fever (23.5%), fatigue (16.1%), and altered sensorium (13.9%) were less frequent. The distribution of respiratory failure across emphysema and bronchitis phenotypes showed no significant association for either type 1 or type 2 failure ($p=0.42$). Arterial blood gas analysis revealed comparable PCO_2, PO_2, bicarbonate, and SO_2 levels between phenotypes, though hydrogen ion concentration was significantly higher in emphysema ($p=0.017$). Conservative management (47.9%) and non-invasive ventilation (42.1%) were the main treatment modalities, while invasive ventilation was required in 10% of cases. Most patients had a hospital stay of more than 5 days, and outcomes were favorable, with 93.6% discharged after improvement and 6.4% mortality.

Conclusion: The findings of this study highlight that acute exacerbations of COPD with respiratory failure are predominantly characterized by respiratory symptoms and are more commonly associated with the emphysema phenotype, though without significant differences in respiratory failure distribution between phenotypes. Management was largely successful with conservative therapy and non-invasive ventilation, and only a minority required invasive support. Despite prolonged hospital stays in many patients, overall outcomes

were favorable, with a high rate of clinical recovery and discharge, and relatively low mortality, underscoring the effectiveness of timely intervention and appropriate ventilatory support.
Keywords: AECOPD, Respiratory failure, on-invasive ventilation (NIV), Invasive mechanical ventilation (IMV), Clinical outcomes, Management strategies.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a major global health concern characterized by persistent, progressive airflow limitation and chronic respiratory symptoms, largely attributable to prolonged exposure to noxious particles and gases, especially cigarette smoke. According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD), COPD remains a leading cause of morbidity and mortality worldwide, with exacerbations constituting pivotal events in its natural course.[1]Acute exacerbations of COPD (AECOPD) are defined as episodes of sustained worsening of respiratory symptoms beyond normal day-to-day variations, often requiring a change in regular medication.[2] Among these, exacerbations complicated by respiratory failure represent the most critical clinical scenarios, frequently necessitating hospitalization, intensive care support, and advanced ventilatory management.[3]

Respiratory failure in AECOPD typically manifests as hypoxemia, hypercapnia, or both, resulting from a combination of increased airway obstruction, respiratory muscle fatigue, and impaired gas exchange.[4]It is estimated that nearly 20–30% of hospitalized AECOPD cases develop acute respiratory failure, and these patients have significantly higher mortality and readmission rates compared to those without respiratory compromise.[5] The interplay between systemic inflammation, comorbidities such as cardiovascular disease, diabetes, and malnutrition, and delayed recognition of acute respiratory decompensating further compounds the risk of poor outcomes.[6]

The clinical outcomes of AECOPD with respiratory failure are influenced by multiple determinants including severity of baseline lung function, exacerbation frequency, presence of chronic hypercapnia, and appropriateness of initial management. Hospital mortality rates for AECOPD with respiratory failure range between 10–20%, and the one-year post-discharge mortality can exceed 40%.[7]In addition, recurrent hospitalizations contribute to accelerated decline in lung function, impaired quality of life, and heightened healthcare burden. Consequently, management strategies aim not only at acute stabilization but also at long-term prevention of recurrent episodes.

The cornerstone of acute management in AECOPD with respiratory failure involves rapid assessment, correction of hypoxemia, control of airway obstruction, and mitigation of underlying triggers such as infection or environmental insults.[8] Supplemental oxygen therapy remains the first-line intervention, but careful titration is essential to avoid worsening hypercapnia due to hypoventilation and ventilation–perfusion mismatch. Pharmacological measures include short-acting bronchodilators, systemic corticosteroids, and, where indicated, antibiotics. Non-invasive ventilation (NIV) has emerged as a pivotal strategy, shown to reduce intubation rates, hospital stay, and mortality in patients with acute hypercapnic respiratory failure.[9] In refractory cases, invasive mechanical ventilation may be required, although it carries significant risks including ventilator-associated pneumonia, barotrauma, and prolonged ICU stay.

Beyond acute management, optimizing long-term outcomes requires comprehensive strategies including smoking cessation, pulmonary rehabilitation, vaccination, long-term oxygen therapy in selected patients, and pharmacological maintenance with inhaled bronchodilators and corticosteroids. Careful discharge planning, patient education, and structured follow-up are crucial in reducing readmission and mortality rates.[10] Despite advances in therapeutic options, AECOPD with respiratory failure continues to pose substantial clinical challenges, underscoring the importance of timely recognition, evidence-based management, and individualized treatment strategies to improve survival and quality of life in this vulnerable patient population.

MATERIALS AND METHODS

Study Design: Cross-sectional study
Study Type: Observational
Study Setting: Department of Respiratory Medicine, Agartala Government Medical College and GB Pant Hospital
Study Period: 1.5 years (October 2022 – March 2024)
Study Population: All COPD patients admitted with acute exacerbation
Final sample size = 270
Sampling Technique: Census sampling until required size reached
Study Tools
Case record proforma
Pulse oximeter
Arterial blood gas analyser (EDAN-i 15) and chemistry analyser with BG10/BG8 cartridge
Statistical Analysis
For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then

analysed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and Graph Pad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and Graph Pad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

RESULTS

In the present study, dyspnea was the most frequently reported clinical feature, observed in 253 patients (90.3%), followed by cough with expectoration in 226 patients (80.7%). Fever was present in 66 patients (23.5%), while fatigue was noted in 45 patients (16.07%). Altered sensorium was the least common manifestation, seen in 39 patients (13.9%). These findings highlight that respiratory symptoms, particularly dyspnea and productive cough, constituted the predominant clinical presentation, whereas systemic symptoms such as fever, fatigue, and neurological manifestations like altered sensorium were comparatively less common.

In the present study, the distribution of respiratory failure across phenotypes did not show any statistically significant association. Among patients with type 1 respiratory failure (n=67), emphysema phenotype was predominant, being present in 59 cases (88.1%), whereas bronchitis phenotype was observed in only 8 cases (11.9%). Similarly, in those without type 1 respiratory failure (n=221), emphysema accounted for 191 cases (86.4%) and bronchitis for 22 cases (10.3%) (p=0.42). A comparable trend was noted in type 2 respiratory failure, where emphysema remained the predominant phenotype, observed in 191 patients (89.7%) compared to 22 patients (10.3%) with bronchitis. Among those without type 2 failure (n=67), emphysema was noted in 59 (88.1%) and bronchitis in 8 (11.9%) (p=0.42).

Arterial blood gas parameters were compared between bronchitis and emphysema phenotypes. The mean PCO_2 level was higher in emphysema patients (64.05 ± 29.92 mmHg) compared to bronchitis (60.17 ± 25.38 mmHg), though the difference was not statistically significant (p=0.11). Mean PO_2 levels were also comparable between the groups (66.70 ± 25.03 mmHg in bronchitis vs. 68.62 ± 32.02 mmHg in emphysema, p=0.69). Interestingly, hydrogen ion concentration (H^+) was significantly higher in emphysema phenotype (50.94 ± 35.32) compared to bronchitis (43.52 ± 13.91), with a mean difference of 7.42 (p=0.017). Bicarbonate (HCO_3^-) levels were almost identical in both groups (34.32 ± 11.82 vs. 34.23 ± 11.62, p=0.96). Similarly, oxygen saturation (SO_2) did not differ significantly between phenotypes (89.70 ± 6.62 in bronchitis vs. 88.52 ± 12.50 in emphysema, p=0.53).

Regarding treatment modalities, conservative management was the most frequently adopted approach, offered to 134 patients (47.9%), followed by non-invasive ventilation (NIV) in 118 patients (42.1%). Invasive mechanical ventilation (IMV) was required in 28 patients (10%). The duration of hospital stay varied, with the majority staying more than 5 days; 71 patients (25.4%) had a stay of ≤3 days, 91 (32.5%) between 3–5 days, 100 (35.7%) between 5–10 days, and 18 (6.4%) stayed more than 10 days. Overall outcomes were favorable, with 262 patients (93.6%) being discharged after improvement, while mortality was recorded in 18 patients (6.4%).

Table 1: Clinical features at initial presentation among study participants among study participants

Clinical Features Counts	
Dyspnea	253(90.3%)
Cough with expectoration	226(80.7%)
Fever	66(23.5%)
Fatigue	45(16.07%)
Altered sensorium	39(13.9%)

Table 2: Association between clinical phenotypes of COPD and types of respiratory failure (N=280)

Types of respiratory failure		Phenotypes		P value
		Bronchitis	Emphysema	
Type 1 resp. failure	**Present (67)**	8 (11.9)	59 (88.1)	0.42
	Absent (221)	22 (10.3)	191(88.1)	
Type 2 resp. failure	**Present (221)**	22 (10.3)	191 (89.7)	0.42
	Absent (67)	8 (11.9)	59 (88.1)	

Table 3: Relationship between Arterial Gas and clinical phenotype

Arterial Gas	Clinical phenotype	N	Mean	Std. Deviation	P value (sig.)	Mean difference
PCO2	**Bronchitis**	30	60.178	25.386	0.11	6.278
	Emphysema	250	64.051	29.923		
PO2	**Bronchitis**	30	66.702	25.0312	0.69	1.915

	Emphysema	250	68.618	32.0189		
H	**Bronchitis**	30	43.5255	13.91153	0.017	7.418
	Emphysema	250	50.9437	35.31993		
HCO3	**Bronchitis**	30	34.321	11.8164	0.963	0.087
	Emphysema	250	34.234	11.6198		
SO2	**Bronchitis**	30	89.702	6.6198	0.53	1.179
	Emphysema	250	88.523	12.5004		

Table 4: Short-time outcome among study cases (N=280)

Outcome		Frequency	Percentage
Treatment offered	**Conservative**	134	47.9
	Non-invasive ventilation (NIV)	118	42.1
	Invasive mechanical ventilation (IMV)	28	10
Duration of hospital stay	**≤ 3 days**	71	25.4
	>3 to ≥5 days	91	32.5
	>5 to ≤10 days	100	35.7
	>10 days	18	6.4
Outcome	**Discharge (Improved or relieved)**	262	93.6
	Death	18	6.4

DISCUSSION

In the present study, dyspnea emerged as the most frequent clinical feature (90.3%), followed by cough with expectoration (80.7%), while systemic manifestations such as fever (23.5%) and fatigue (16.07%) were less common, and altered sensorium was rare (13.9%). These findings are consistent with the study by Bhatt et al,[11] who reported dyspnea and productive cough as the predominant presenting symptoms in acute exacerbations of COPD (AECOPD), with systemic symptoms being less frequent. Similar trends were also noted by Singh et al,[12] who documented dyspnea in 88% and cough with expectoration in 79% of their cohort, reinforcing that respiratory manifestations dominate the clinical spectrum of AECOPD.

The present study also demonstrated that the distribution of respiratory failure across emphysema and bronchitis phenotypes did not show significant differences, with emphysema being predominant in both type 1 and type 2 respiratory failures. This aligns with the observations of Kim et al,[13] who found emphysema to be more strongly associated with advanced disease severity and respiratory failure, although they also highlighted a subset of chronic bronchitis patients progressing to hypercapnic failure. In contrast, Patel et al,[14] reported a higher frequency of type 2 respiratory failure among the chronic bronchitis phenotype, suggesting possible variability based on patient selection and diagnostic criteria.

Arterial blood gas (ABG) analysis in the present study revealed no significant differences in PCO_2, PO_2, bicarbonate, or oxygen saturation between emphysema and bronchitis phenotypes, although hydrogen ion concentration was significantly higher in emphysema patients. This contrasts with findings by Celli et al,[15]who documented more pronounced hypercapnia and acid–base disturbances in bronchitic patients. However, our results are in agreement with Hurst et al,[16] who emphasized that ABG derangements may reflect the severity of acute exacerbation rather than phenotype alone. The significant elevation of H^+ levels in emphysema patients in our study may indicate a greater degree of uncompensated respiratory acidosis during acute events, a finding also suggested by Wedzicha and Seemungal.[17]

In terms of management, conservative treatment was the most frequently adopted approach (47.9%), followed by non-invasive ventilation (42.1%), with only 10% requiring invasive mechanical ventilation. These results are consistent with the study of Brochard et al,[18]who demonstrated that the majority of patients with AECOPD and respiratory failure could be successfully managed with NIV, thereby reducing the need for intubation and its associated complications. Similarly, Keenan et al,[19] found that timely initiation of NIV was associated with improved survival and reduced ICU stay, a trend mirrored in the favorable outcomes observed in our cohort (93.6% discharged after improvement). The mortality rate of 6.4% in our study is comparable to the findings of Plant et al,[20]who reported mortality rates between 5–10% in patients with severe AECOPD requiring hospital admission, underscoring that with optimized care, outcomes remain largely favorable despite the severity of presentation.

Overall, the present study reinforces that AECOPD is predominantly characterized by respiratory symptoms with emphysema as the common phenotype across respiratory failure categories. While ABG parameters were largely comparable between phenotypes, subtle differences such as elevated H^+ in emphysema highlight potential underlying pathophysiological distinctions. Treatment outcomes further confirm the critical role of conservative and NIV-based strategies in ensuring favorable recovery and minimizing mortality.

CONCLUSION

The present study underscores that the majority of patients experienced favorable outcomes, with most showing clinical improvement following appropriate

management. Conservative measures and non-invasive ventilation formed the cornerstone of treatment, while only a smaller subset required invasive support. The overall prognosis was satisfactory, as evidenced by the high discharge rates, with only a limited proportion of patients succumbing to the illness. These findings highlight that timely recognition, early initiation of therapy, and appropriate ventilatory support play a pivotal role in improving patient survival and recovery in acute exacerbations of COPD.

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