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Characterizing Microbial Profiles and Investigating Common Comorbidities in Acute Exacerbations of Chronic Obstructive Pulmonary Disease.

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Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD) ranks as the third leading cause of mortality on a global scale. Patients afflicted with COPD often experience colonization by respiratory pathogens. The indiscriminate administration of antibiotics, lacking comprehensive diagnostic assessments during acute exacerbations, contributes to the emergence and proliferation of antibiotic-resistant bacterial strains. COPD is also associated with various comorbid illnesses which need to be considered with great care and importance during management of such cases .

Aim: This study aims to document the clinical characteristics of patients experiencing acute exacerbation of COPD, with a specific focus on their microbiological profiles. The objective is to gather essential information that can facilitate the timely and appropriate administration of treatment interventions. It was also aimed to find out common co morbid illnesses in this part of India which may complicate the condition requiring special attention and care .

Materials and Methods: This observational cross-sectional study was carried out on a cohort of 104 patients admitted to a tertiary care hospital in North East India over the course of one year. All participants provided written informed consent prior to their inclusion in the study. A comprehensive evaluation of each patient included detailed history-taking, spirometry assessments, sputum culture and sensitivity testing along with acid-fast bacilli (AFB), Gram, and fungal staining. Additionally, chest X-rays, blood parameter analyses, and electrocardiograms (ECG) were conducted for all patients as part of the assessment protocol.

Results: Chronic Obstructive Airway Disease (COAD) was found to be more prevalent in individuals above 40 years of age, with a noticeable male predominance accounting for 63.46% of cases. Among the patients, 36.54% were active smokers, 25% had a history of being ex-smokers, and 38.46% had never smoker.Following Klebsiella pneumoniae, other identified pathogens included Pseudomonas aeruginosa (1.92%), Escherichia coli (0.96%), and Citrobacter freundii (0.96%). Notably, a significant proportion of Klebsiella pneumoniae (32%), Klebsiella oxytoca (40%), and all Citrobacter freundii isolates (100%) exhibited multidrug resistance pattern.

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Conclusion: Gram-negative bacteria were the predominant isolates in our study. The identification of the organisms particularly within the Klebsiella genus, highlights the pressing need for effective antimicrobial treatment strategies in the management of Chronic Obstructive Airway Disease (COAD). Early initiation of appropriate antimicrobial therapy as well as the early detection and early management concurrent comorbid illness will reduce the morbidity and mortality of the patients .

INTRODUCTION

Chronic Obstructive Airway Disease (COPD), encompassing conditions such as chronic bronchitis and emphysema, stands as a pervasive and relentless global health concern. Patients grappling with COPD often endure recurrent acute exacerbations, characterized by a sudden worsening of their symptoms, leading to increased morbidity, diminished quality of life, and substantial healthcare burden. These acute exacerbations frequently necessitate hospitalizations, contributing to the escalating cost of healthcare and posing a severe threat to patients overall well-being.The understanding of COPD has evolved significantly over recent years, not least due to the recognition that microbial factors play a pivotal role in its pathogenesis and the exacerbation of symptoms. Emerging research has unveiled complex microbial communities inhabiting the respiratory tract and their potential influence on disease progression and the exacerbation of symptoms. In this context, characterizing the microbial profiles associated with acute exacerbations of COPD becomes paramount. This paper aims to delve into the intricate interplay between microbial communities and the clinical presentation of COPD exacerbations.Moreover, COPD rarely travels alone. Comorbidities, including cardiovascular disease, diabetes, and anxiety, often coexist in individuals with COPD, further complicating management strategies and altering the disease trajectory. A comprehensive investigation of common comorbidities in the

context of acute exacerbations is essential to provide holistic care to COPD patients and to identify potential connections between these conditions. In this paper, we embark on a multifaceted journey to explore the microbial ecosystems associated with acute exacerbations of COPD and to shed light on common comorbidities that frequently accompany this debilitating respiratory condition. By characterizing these microbial profiles and examining comorbid conditions, we aim to not only enhance our understanding of the disease but also pave the way for more personalized and effective interventions, ultimately improving the lives of those affected by COPD

Materials and Methods:

This observational cross-sectional study was conducted within the Department of Medicine at Jorhat Medical College & Hospital, Jorhat, Assam. The study involved a cohort of 104 patients and spanned a one-year period, from July 1, 2020, to June 30, 2021.

Inclusion Criteria:

1. Patients admitted to the Department of Medicine at Jorhat Medical College & Hospital due to acute exacerbation of COPD.

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2. Patients who provided written informed consent.

3. Patients aged 40 years or older.

Exclusion Criteria:

1. Individuals with pneumonia or bronchiectasis as evident in chest X-ray results.

Patients who tested positive for HIV.

2. Individuals with lung malignancies.

3. Patients with active pulmonary tuberculosis.

4. Individuals who had received antibiotic treatment within 24 hours prior to admission.

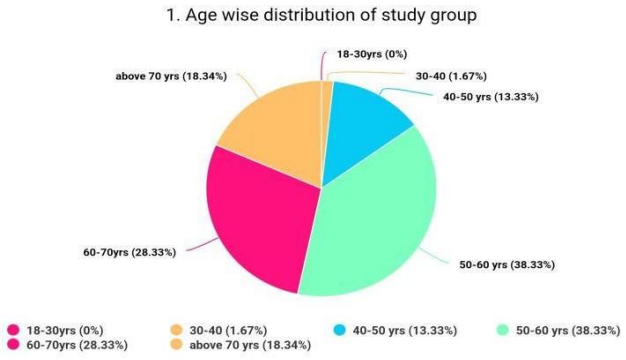
5. Patients without a suitable sputum specimen.

6. Sputum specimens that did not meet the criteria of the Bartlett score.

For this study, patients aged 40 years or older experiencing acute exacerbation of COPD were included. Each patient, accompanied by their caregiver, underwent interviews to collect detailed medical histories. Clinical examinations were conducted and the findings recorded. A range of investigations, including biochemical, microbiological, radiological, and spirometry tests, were performed and their results documented. All collected data were compiled and analyzed using MS Excel 2007. Data were expressed in terms of percentages, means, and standard deviations. Chi-square tests were employed to assess associations between smoking status and gender, with a significance level set at $p < 0.05$.

RESULTS :

1. Pie diagram showing age wise distribution of cases



2. Pie diagram showing sex wise distribution of cases.

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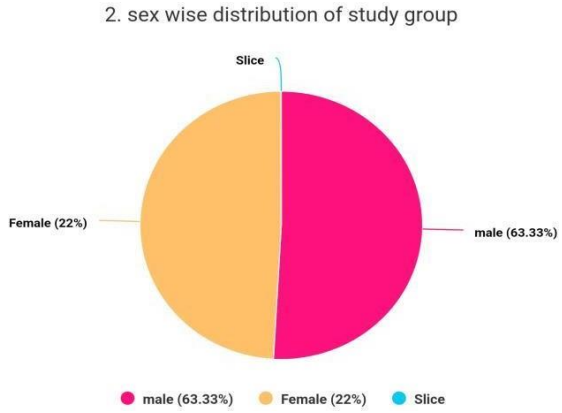
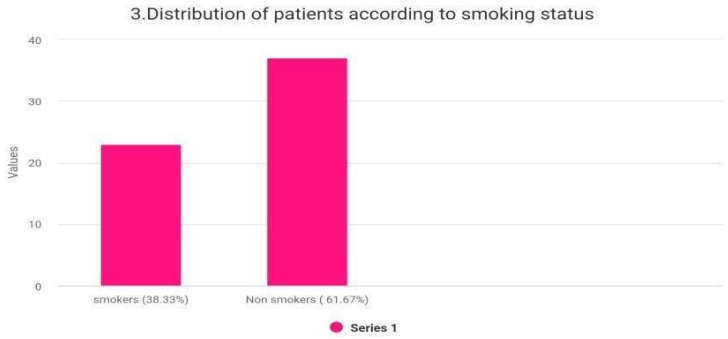
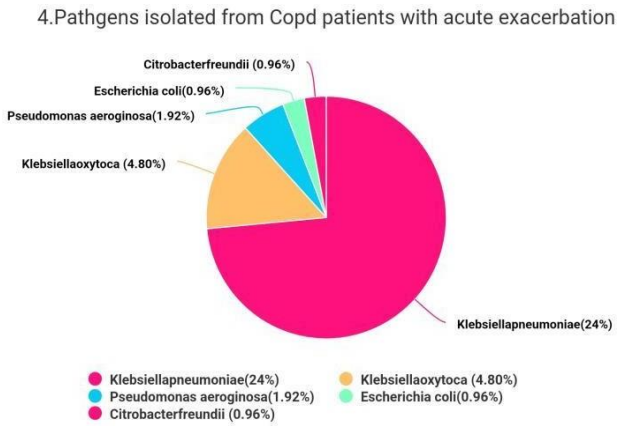


3. Diagram showing association smoking with gender



4. Pie diagram showing pathogens isolated from patients with acute exacerbation of COAD.



5. Diagram showing the multidrug resistant strains among the isolates

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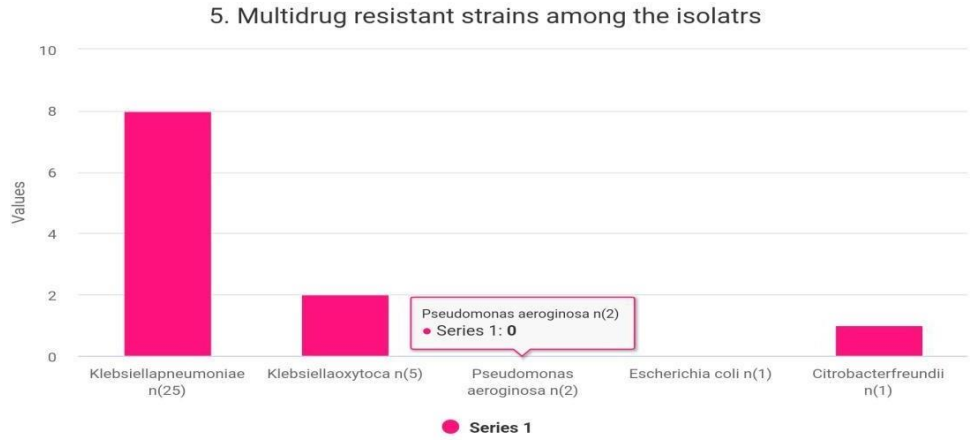

6. Table showing comorbid illness among COPD patients

COMORBID ILLNESS	NO. OF PATIENTS	PERCENTAGE %
DIABETES MELLITUS	23	22.12
HYPERTENSION	9	8.86
CORONARY ARTERY DISEASE	5	4.80
HYPERTENSION + DIABETES MELLITUS	1	0.96
HYPERTENSION + CORONARY ARTERY DISEASE	1	0.96
NO COMORBID ILLNESS	65	62.5

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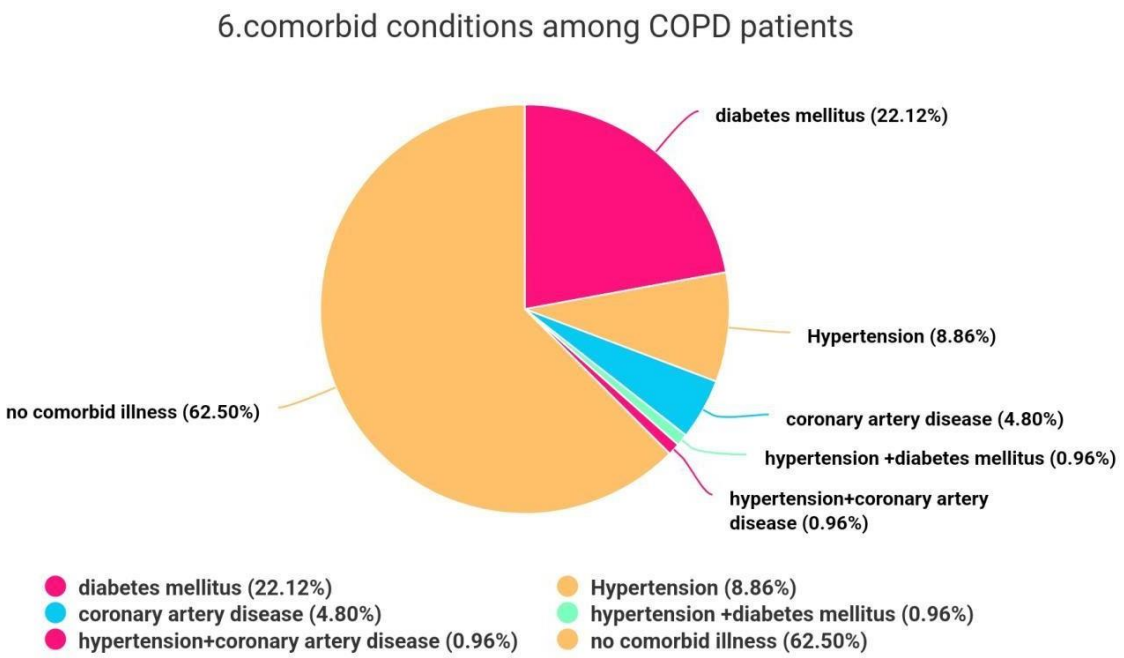

In the present study of 104 patients 23 cases had Diabetes mellitus, 9 cases had hypertension , 5 cases had coronary artery disease , 1 case had hypertension with coronary artery disease , 1 case had hypertension and diabetes mellitus and 65 cases had no any comorbid illnesses .

DISCUSSION

In the current study, a total of 104 patients were enrolled over a one-year period, from July 1, 2020, to June 30, 2021. Our study's findings were compared with those of similar studies. In our study, the age of the participants ranged from a minimum of 43 years to a maximum of 87 years. The mean age of the study population was 64.32 years with a standard deviation of 10.87 years. Among the 104 COPD patients, the majority fell into the age group of 60-70 years, accounting for 33.65% of the cases, followed by 27.88% in the age group above 70 years. These findings align with previous research, such as a study by Bajpai et al. in 2019, where the mean age of smokers with COPD was 59.29±10.28 years. Similarly, our results are consistent with Hoogendoorn et al.'s 2006 study, which reported a mean age of 63.8 years for patients with COPD. John et al. in 2005 also noted a mean age of 61±1 years in their study.In our study, out of the 104 patients, 66 (63.46%) were male, and 38 (36.54%) were female, resulting in a male-to-female ratio of 1.7:1. This indicates a male predominance in our study, which is consistent with findings from other studies. For instance, Almagro et al. in 2010 reported 89% men and 11% women out of 398 patients, while Ferrari et al. in 2010 found 60 males and 30 females among 90 COPD patients. Likewise, Kundu et al. in 2015 and Tamakuwala et al. in 2017 reported the percentages of male and female COPD patients as (88.75% and 11.25%) and (80% and 20%), respectively.Furthermore, in our study, among the 66 male COPD cases, 48 (72.7%) were smokers, and 18 (27.3%) were non-smokers. Out of the total 38 female patients, 16 (42.1%) were smokers, and 22 (57.9%) were non-smokers. A statistical analysis using the chi-square test demonstrated a significant association between smoking and gender with a p-value of 0.001. These findings are consistent with a study by Xu X et al. in 1994, which

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indicated a higher smoking prevalence in men leading to the development of COPD. Similar results were reported by Greaves LJ et al. in 2007, highlighting higher smoking rates in male COPD patients compared to females. Torres JP et al. in 2005 also observed that women were younger and smoked less than men. In our study, a positive sputum culture was obtained from 34 patients (32.69%) out of the 104 total patients. The most common organism isolated was Klebsiella pneumoniae, found in 25 cases (24%), followed by Klebsiella oxytoca in 5 cases (4.80%), Pseudomonas aeruginosa in 2 cases (1.92%), Escherichia coli in 1 case (0.96%), and 1 case of Citrobacter freundii (0.96%). These results are in line with a study by Lin SH et al. in 2007, which reported potential pathogenic microorganisms in 66.4% of patients with acute exacerbation of COPD. The primary bacteria identified were Klebsiella pneumoniae (19.6%), Pseudomonas aeruginosa (16.8%), and Haemophilus influenzae (7.5%), followed by Acinetobacter baumannii (6.9%), Enterobacter species (6.1%), and Staphylococcus aureus (6.1%). In contrast to our present study, Groenewegen et al. in 2003 observed different results in their research. They found that the most frequently isolated organisms in their study were Haemophilus influenzae (45%), Streptococcus pneumoniae (27%), and Pseudomonas aeruginosa. Similarly, Moghoofei M et al. in 2020 reported a prevalence of bacterial infection at 49.59% in patients experiencing acute exacerbation of COPD. The bacteria they identified included Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis, Acinetobacter baumannii, Pseudomonas aeruginosa, and Staphylococcus aureus'

COMORBID ILLNESSES AMONG COPD PATIENTS : In our present study, it was observed that 62.5% of the cases had no comorbid illnesses, while 37.5% had comorbidities. Out of the 39 patients with comorbidities, 23 (22.12%) had diabetes mellitus, 9 (8.65%) had hypertension, and 5 (4.80%) had coronary artery disease. Additionally, there was 1 case of comorbid hypertension and diabetes mellitus, and 1 case of comorbid hypertension and coronary artery disease. As a result, diabetes mellitus emerged as the most common comorbid illness. This finding is consistent with a study by Mannino et al. in 2008, where 48.9% of subjects had no comorbid illnesses, and the three most common comorbid conditions were diabetes, hypertension, and cardiovascular diseases, with prevalences of 12.7%, 40.1%, and 15.2%, respectively. Some subjects had multiple comorbid conditions, with 12.8% having two comorbid conditions and 2% having three comorbid conditions simultaneously. Other studies, such as ParappilA et al. in 2010, reported that diabetes was a comorbid condition in 22% of admissions for acute exacerbation of COPD. Cazzola M et al. in 2010 also noted a higher prevalence of type 2 diabetes mellitus in COPD patients (18.7%) compared to the general population. Lee CT et al. in 2013 found in their study that COPD patients had a higher risk for diabetes mellitus compared to control subjects after adjusting for confounding factors.

However, in contrast to our study, Schnell K et al. in 2012 found that hypertension (60.41%) was the most common comorbid illness among COPD patients, followed by arthritis (54.6%), hypercholesterolemia (47.6%), depression (20.6%), cancer (16.5%), diabetes (16.3%), osteoporosis (16.9%), heart failure (12.1%), coronary artery disease (12.7%), and anxiety (8.6%). Similarly, Varela MV et al. in 2013 indicated that the comorbidities associated with COPD, in decreasing order of frequency, were cardiovascular disease, hypertension, peptic ulcer, diabetes, cerebrovascular disease, asthma, and lung cancer.

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LIMITATIONS :

The present study had several limitations. First, the ongoing COVID-19 crisis restricted our sample size to only 104 participants. Conducting the study with a larger sample size would have increased its reliability. Additionally, due to the relatively small population and the study's shorter duration, the findings may not be generalizable to a broader patient population. Another limitation of the study was the lack of isolation of viral and fungal isolates from the sputum cultures of patients experiencing acute exacerbation of COPD. This is a notable limitation, as viral and fungal infections contribute significantly to the organisms responsible for acute exacerbations of COPD.

CONCLUSION :

In conclusion, our study provides valuable insights into the microbial infections and comorbid conditions associated with Chronic Obstructive Pulmonary Disease (COPD). We found that microbial infections, particularly bacterial infections, play a significant role in acute exacerbations of COPD. Klebsiella pneumoniae was the most common bacterial isolate, and its sensitivity to various antibiotics was varied. These findings are consistent with previous research, reinforcing the importance of identifying and managing these infections in COPD patients. Furthermore, our study highlighted the prevalence of comorbid conditions in COPD patients. Diabetes mellitus emerged as the most common comorbid illness, followed by hypertension and coronary artery disease. These comorbidities can complicate the management of COPD and have implications for patient care. Our results align with prior studies that have emphasized the need to consider and address these comorbid conditions in the management of COPD.

In light of these limitations, our study underscores the importance of conducting more extensive and long-term research to gain a more comprehensive understanding of microbial infections and comorbid conditions in COPD. Such knowledge can aid in the development of better strategies for managing and treating COPD patients, ultimately improving their overall quality of life and health outcomes.

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