



Original Article

COPD with Bronchiectasis Versus COPD without Bronchiectasis: A Comparative Analysis of Clinical, Functional, Radiological and Microbiological Aspects

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is one of the leading causes of morbidity and mortality around the world. Understanding the presence of bronchiectasis in COPD is important for future intervention and disease prevention. The aim of this study is to find out the prevalence of bronchiectasis in COPD patients and to compare the clinical, functional, radiological and microbiological profile in COPD patients with and without bronchiectasis.

Methods: This observational study conducted over a period of six months, including 160 patients (151 men and 09 women) suffering from COPD: 90 without bronchiectasis (Group A) and 70 with bronchiectasis confirmed on HRCT (Group B). Demographic data, smoking status, pulmonary tuberculosis (PTB) history, clinical features, spirometry, laboratory parameters, sputum microbiology, and HRCT findings were analysed. Statistical comparisons were performed using appropriate parametric and non-parametric tests.

Results: Of the 160 patients assessed 90 (56.25%) were diagnosed to have COPD alone and 70 (43.75%) had bronchiectasis along with COPD. Patients with bronchiectasis have a higher prevalence of cough, sputum expectoration, and crackles ($p < 0.001$), as well as higher TLC and AEC values ($p < 0.01$). Spirometry patterns revealed that Group B (COPD with bronchiectasis) had a higher prevalence of Obstructive spirometry pattern (88.57%) compared to Group A (65.56%) ($p < 0.001$). Sputum culture revealed that COPD with bronchiectasis were significantly associated with *Pseudomonas*. Diffuse bilateral bronchiectasis (25.71%) and Unilateral lower lobe bronchiectasis (21.43%) were the most common patterns observed in Group B patients (COPD with bronchiectasis).

Conclusion: COPD with bronchiectasis represents a severe disease phenotype characterized by increased infective burden, airway-dominant pathology, frequent hospitalizations, and distinct microbiological profiles. Recognition of this overlap is crucial for risk stratification and individualized management, particularly in tuberculosis-endemic settings.

Keywords: COPD, Bronchiectasis, HRCT, *Pseudomonas aeruginosa*.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) and bronchiectasis are two major respiratory conditions that frequently coexist, leading to a complex clinical phenotype [1]. COPD is characterized by persistent airflow limitation, while bronchiectasis is marked by irreversible bronchial dilatation, chronic inflammation, and recurrent infections [2]. The overlap of these conditions poses significant challenges in diagnosis, management, and prognosis.

Recent studies have highlighted the importance of recognizing bronchiectasis in patients with COPD, as this coexistence is associated with increased symptoms, exacerbations, hospitalizations, and mortality [3]. However, the clinical, functional, radiological, and microbiological differences between COPD patients with and without bronchiectasis remain poorly understood.

A comprehensive understanding of these differences is essential for clinicians to develop personalized management plans, optimize treatment strategies, and improve patient outcomes. This study aims to compare the clinical, functional, radiological, and microbiological aspects of COPD patients with bronchiectasis versus those without bronchiectasis, providing insights into the complex relationship between these two conditions. By investigating these differences, this study will contribute to the growing body of evidence on the COPD-bronchiectasis overlap syndrome, ultimately informing clinical practice and improving the care of patients with these conditions.

METHODS

This was an analytical, observational, cross-sectional study with patients followed at the OPD of the Department of Respiratory Medicine, PGIMER & Capital Hospital, Bhubaneswar. All patients participated in the study signed the informed consent form.

The study was carried out over a period of six months, from January 2024 to June 2024. The study population included adult patients aged 26 years and above, diagnosed with Chronic Obstructive Pulmonary Disease (COPD) according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines, confirmed by spirometry showing a post-bronchodilator FEV₁/FVC ratio of less than 0.70.

A total of 160 patients attending the Outpatient Department (OPD) and Inpatient Department (IPD) of Respiratory Medicine, were included in the study. Patients with active tuberculosis, interstitial lung disease, lung cancer, or other significant pulmonary comorbidities and pregnant females were excluded from the study.

Study Groups

Patients were categorized into two groups based on radiological findings of the chest:

Group A (COPD with bronchiectasis): Patients diagnosed with COPD and radiological evidence of bronchiectasis.

Group B (COPD without bronchiectasis): Patients with COPD and no radiobiological evidence of bronchiectasis.

Data collection

All personal and medical, laboratory and radiological data of the recruited patients including the clinical chest and general manifestations were collected. A structured study proforma was used to record demographic details, clinical presentation, physical examination findings, laboratory investigations, radiological features, and microbiological results.

Clinical Assessment

Detailed clinical data were obtained from medical records, including demographic details, smoking history, duration of disease, frequency of acute exacerbations in the past year, and presence of symptoms such as chronic cough, sputum production, haemoptysis, expectoration etc. and general physical examination and systemic examination.

Laboratory investigations.

The laboratory investigations included complete blood count (CBC), fasting blood sugar (FBS), HbA1c, liver function tests (LFT), kidney function tests (KFT), C-reactive protein (CRP) and Oxygen saturation.

Microbiological Evaluation

Sputum analysis: Ziehl–Neelsen (ZN) stain, CBNAAT/TrueNat for Mycobacterium tuberculosis, bacterial culture, lactophenol cotton blue (LCB) mount, and fungal culture. Sputum samples showing growth of ≥ 2 organisms were categorized as mixed infection.

Pulmonary Function Testing

All patients underwent spirometry, and parameters such as Forced Expiratory Volume in one second (FEV₁), Forced Vital Capacity (FVC), and FEV₁/FVC ratio were recorded and compared between the two groups.

- At least three manoeuvres were recorded, and the best value was selected.
- Post-bronchodilator testing was done 20 minutes after administration of 4 puffs (100 mcg each) of salbutamol.
- Results were interpreted as normal, obstructive, restrictive, or nonspecific according to ATS/ERS guidelines [4].

Radiological Analysis

Chest X-ray (PA view) was taken for initial evaluation.

High resolution computed tomography (HRCT) of chest was performed from the level of the thoracic entrance to the level of the diaphragm, and completed at the end of inspiration. The presence, extent, and type of bronchiectasis

(cylindrical, varicose, cystic) were documented. Additional findings such as airway wall thickening, mucus plugging, and emphysematous changes were also noted.

Distribution was categorized as:

- Unilateral upper lobe (UUL)
- Bilateral upper lobes (BUL)
- Unilateral lower lobe (ULL)
- Bilateral lower lobes (BLL)
- Lingula & middle lobe (ML & L)
- Diffuse unilateral bronchiectasis (DUB: all lobes of one hemithorax involved)
- Diffuse bilateral bronchiectasis (DBB: ≥3 lobes bilaterally involved)

Statistical Analysis

Data were entered into a statistical software package (e.g., SPSS version 26.0). Continuous variables were expressed as mean ± standard deviation and compared using appropriate statistical tests (Student's t-test or ANOVA test). Categorical variables were compared using the chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

In the present study, a total of 160 patients analysed were categorised into two groups. Group A (COPD without bronchiectasis) consisted of 90 patients, and Group B (COPD with bronchiectasis) 70 patients. The mean age of patients was 65.65 ± 9.35 years in Group A and 61.1 ± 10.35 years in Group B. Male patients dominated the study population (94.375%). Demographic characteristics of the patients are summarized in Table 1.

Table 1: Demographic Characteristics of the Study Population COPD patients with and without bronchiectasis

Variable	Category	Number (%)		p- Value
		Group A (COPD without bronchiectasis) (n = 90)	Group B (COPD with bronchiectasis) (n = 70)	
Age (years)	26 - 35	0	1 (1.43%)	0.004
	36 - 45	2 (2.22%)	5 (7.14%)	
	46 - 55	6 (6.67%)	15 (21.43%)	
	56 - 65	37 (41.11%)	21 (30.00%)	
	66 - 75	30 (33.33%)	25 (35.71%)	
	76 - 85	15 (16.67%)	3 (4.29%)	
Sex	Male	86 (95.56%)	65 (92.86%)	0.35
	Female	4(4.44%)	5 (7.14%)	
Smoking Status	Smokers	86 (95.56%)	62 (88.57%)	0.049
	Non-smokers	4(4.44%)	8 (11.43%)	
Pulmonary Tuberculosis status	PTB present	13 (14.44%)	22 (31.43%)	0.003
	PTB Absent	77 (85.56%)	48 (68.57%)	

Smoking exposure was significantly higher in Group A (95.6%) compared to Group B (88.6%) (p = 0.049). A prior history of pulmonary tuberculosis (PTB) was significantly more frequent in Group B (31.4% vs 14.4%; p = 0.003).

The clinical and laboratory characteristics of COPD patients with and without bronchiectasis are given in Table 2. The results showed that patients with bronchiectasis (Group B) have a higher prevalence of cough, sputum expectoration, and crackles (p < 0.001), as well as higher TLC and AEC values (p < 0.01). The frequency of hospitalizations and exacerbations were also higher among those with bronchiectasis (p < 0.05).

Table 2: Clinical and laboratory characteristics of COPD patients with and without bronchiectasis

Variable	Group A (COPD without bronchiectasis) (n = 90)	Group B (COPD with bronchiectasis) (n = 70)	p- Value
Cough (%)	64 (71.11%)	70 (100%)	<0.001
Haemoptysis (%)	19 (21.11%)	18 (25.71%)	0.503

Sputum Expectoration (%)	38 (42.22%)	70 (100%)	<0.001
Breathlessness (%)	88 (97.78%)	70 (100%)	0.504
MMRC Grade (%) Grade -1	4 (4.44%)	0	
Grade -2	43 (47.78%)	45 (64.29%)	p < 0.05 (trend)
Grade -3	36 (40%)	21 (30%)	
Grade -4	7 (7.7%)	4 (5.71%)	
Fever (%)	11 (12.22%)	11 (15.71%)	0.523
Tachypnea (%)	22 (24.44%)	24 (34.29%)	0.173
Wheeze (%)	40 (44.44%)	37 (52.86%)	0.294
Crackles (%)	17 (18.91%)	70 (100%)	<0.001
Decreased Breath Sounds	41 (45.56%)	39 (55.71%)	0.201
Exacerbation in last one year	55 (61.11%)	48 (68.57%)	0.331
Hospitalisation in last one year	59 (65.56%)	56 (80.00%)	0.045
TLC (No./cc)	7120 ± 1803.41	10216 ± 4095.19	<0.001
Haemoglobin (g/dl)	11.96 ± 1.72	12.53 ± 1.83	0.038
AEC (cells/µl)	189.72 ± 118.19	437.86 ± 251.19	<0.001
SpO ₂ (%)	93.03 ± 1.63	98.23 ± 2.17	<0.001

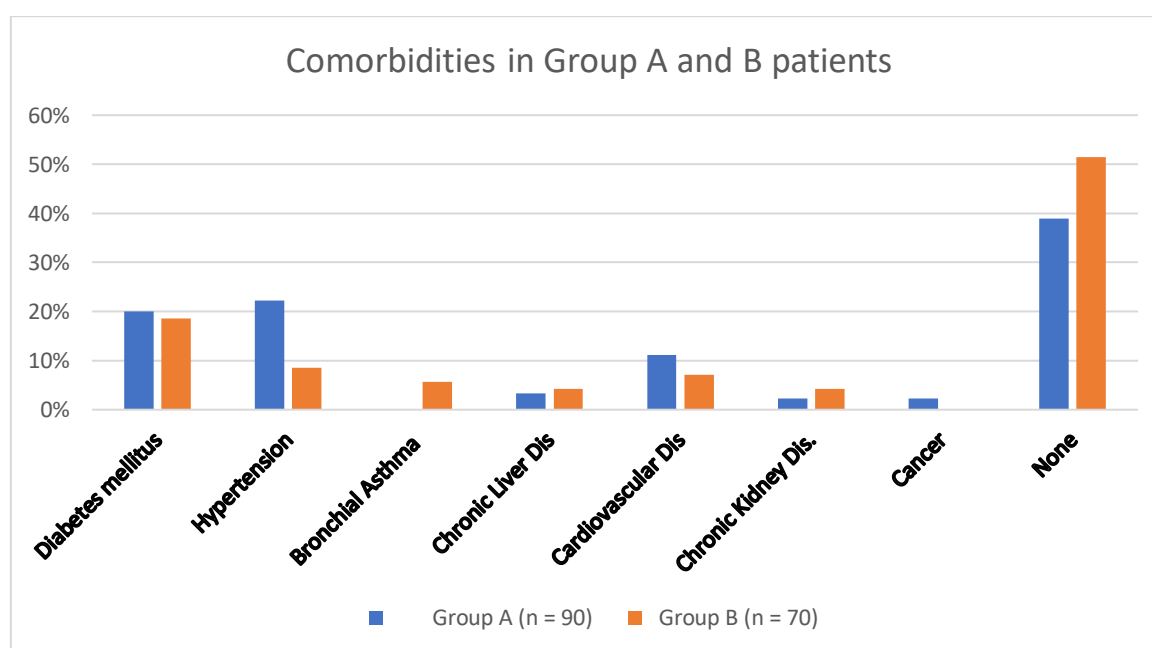


Figure 1: Comorbidities in Group A & B

Comorbidities observed in Group A & B patients during this study were demonstrated in Figure-1. Spirometry patterns between Group A and Group B (Table-3) revealed that Group B (COPD with bronchiectasis) had a higher prevalence of Obstructive spirometry pattern (88.57%) compared to Group A (65.56%) (p 0.001). Sputum cultures revealed higher colonization by potentially pathogenic microorganisms in Group B (71.43%) compared to Group B (41.11%). The predominant pathogen in Group B was *Pseudomonas aeruginosa* (31.4%), followed by *Klebsiella pneumoniae* (15.71%) (Table 4).

Table 3: Spirometry findings

Spirometry Pattern	Group A (n=90)	Group B (n=70)	P value
Mixed/Non-specific	31 (34.44%)	8 (11.43%)	0.001
Obstructive	59 (65.56%)	62 (88.57%)	0.001

Table 4: Microbiological Profile of Sputum Samples

Organism Isolated	Group A (n=90)	Group B (n=70)
<i>Pseudomonas aeruginosa</i>	10 (11.11%)	22 (31.43%)
<i>Klebsiella pneumoniae</i>	6 (6.67%)	11 (15.71%)
<i>Acinetobacter</i>	5 (5.55%)	3 (4.29%)
<i>Escherichia coli</i>	4 (4.45%)	8 (11.43%)
<i>Staphylococcus aureus</i>	8 (8.88%)	3 (4.29%)
<i>Streptococcus pneumoniae</i>	4 (4.45%)	0

<i>Tuberculous mycobacterium</i>	0	3 (4.29%)
No growth	53 (58.89%)	20 (28.57%)

HRCT findings of the study group are shown in Table 5 and figure 2. Group B has a higher prevalence of cystic changes (100%), peri bronchial thickening (64.3%), tree in bud appearance (57.14%), and mucoid plug (40%). Diffuse bilateral bronchiectasis (25.71%) and Unilateral lower lobe bronchiectasis (21.43%) were the most common patterns observed in Group B patients (Table 6).

Table 5: CT Findings

CT Findings	Group A (n=90) %	Group B (n=70) %	P value
Cystic changes	0	100	-
Peri bronchial thickening	0	64.3	-
Tree in bud appearance	11.11	57.14	<0.001
Mucoid Plug	4.44	40	<0.001
Air trapping	100	100	-
Bullae	50	25.71	0.002
Emphysema	83.33	64.29	0.007
Traction bronchiectasis with fibrosis	14.44	31.43	0.012
Fibro cavitory lesions	7.78	21.43	0.017

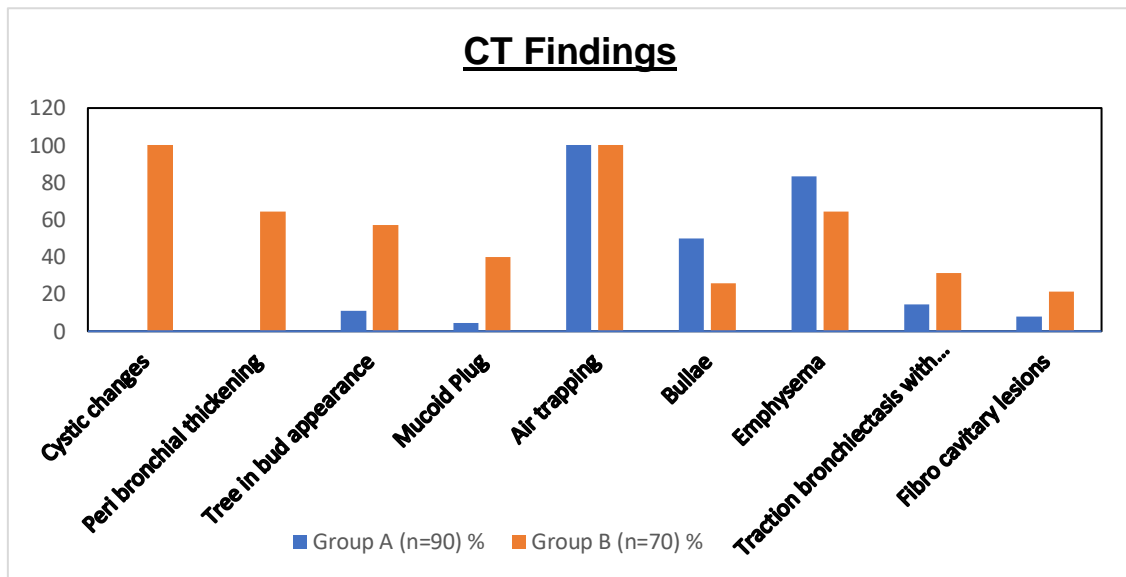
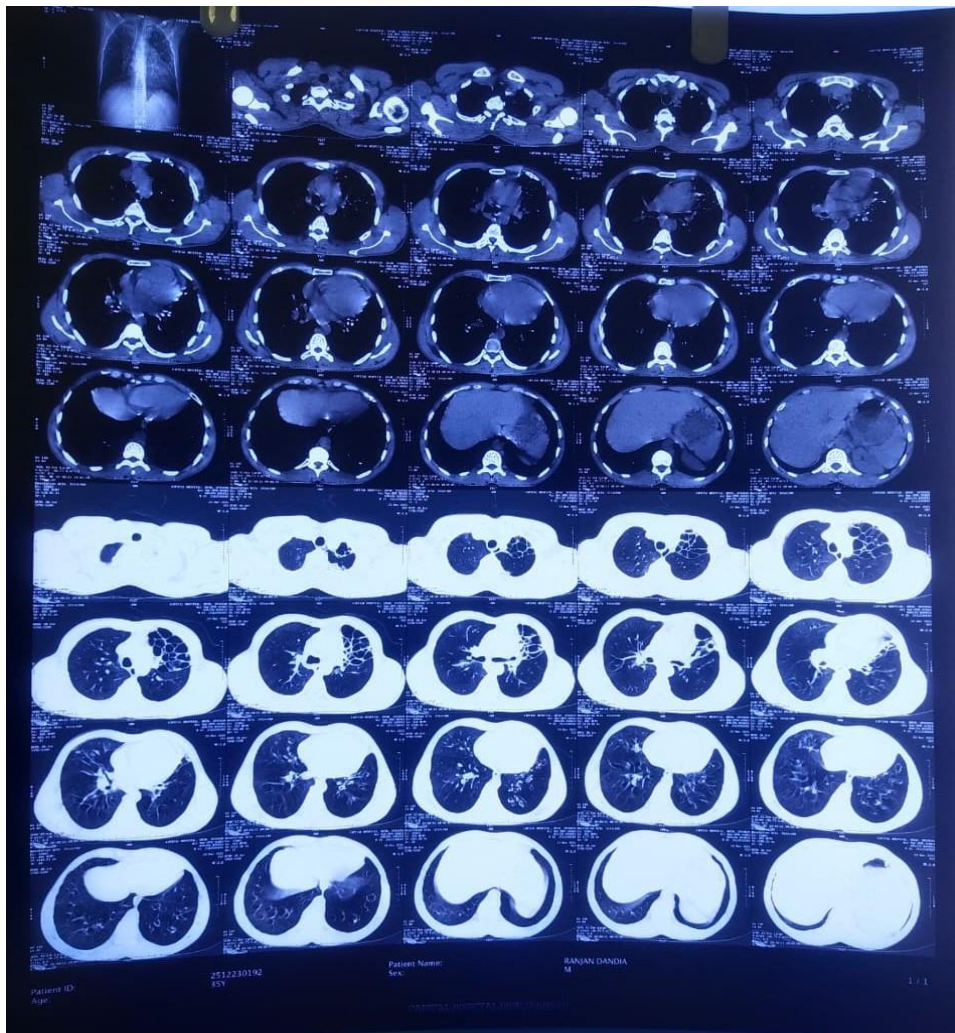


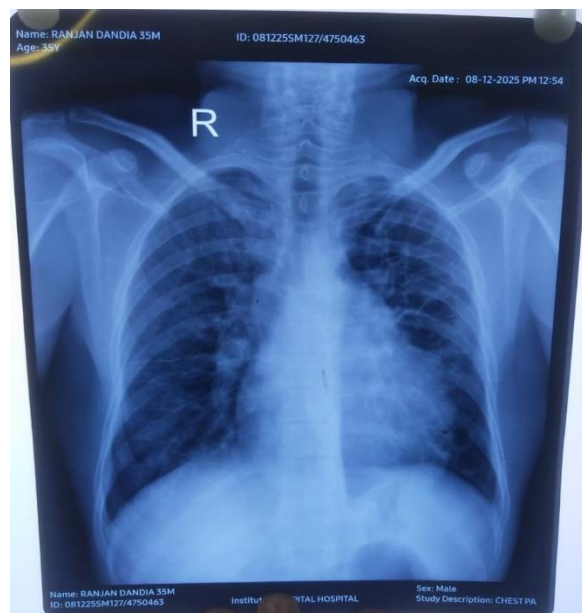
Figure -2: CT Findings

Table 6: Distribution of Bronchiectasis on HRCT (n = 70)

HRCT Pattern	Number (%)
Unilateral Upper Lobe (UUL)	8 (11.43%)
Bilateral Upper Lobes (BUL)	7(10%)
Unilateral Lower Lobe (ULL)	15 (21.43%)
Bilateral Lower Lobes (BLL)	6 (8.57%)
Middle Lobe & Lingula (ML & L)	10 (14.29%)
Diffuse Unilateral Bronchiectasis (DUB)	6 (8.57%)
Diffuse Bilateral Bronchiectasis (DBB)	18 (25.71%)



HRCT Thorax with features of bronchiectasis and emphysema



Chest Xray PA view of a case of COPD with Bronchiectasis

DISCUSSION

The present study demonstrates that COPD patients with co-existing bronchiectasis constitute a distinct and clinically severe phenotype compared to patients with COPD alone. Bronchiectasis was identified in 43.75% of the patients. Our

findings suggest that the coexistence of bronchiectasis in COPD patients is associated with a more severe clinical profile, increased functional impairment, greater radiological abnormalities, and a higher prevalence of pathogenic microbial colonization.

Patients with COPD–bronchiectasis was older and had a significantly higher prevalence of prior pulmonary tuberculosis. This finding is particularly relevant in tuberculosis-endemic countries such as India, where post-tubercular lung damage is a well-recognized cause of secondary bronchiectasis and chronic airflow limitation [5,6]. Structural airway distortion following healed Tuberculosis predisposes patients to chronic infection and progressive airway disease, thereby accelerating COPD severity.

The clinical symptom burden, particularly chronic cough and sputum production, was markedly higher in patients with coexisting bronchiectasis. These symptoms are consistent with the pathophysiology of bronchiectasis, where structural airway damage and impaired mucociliary clearance lead to persistent airway inflammation and mucus retention [7]. Bronchiectasis is a common etiology in hemoptysis presentations [8]. This is in agreement with our study as it was noticed that COPD with bronchiectasis were significantly associated with a higher incidence of hemoptysis as compared to COPD without bronchiectasis. Moreover, the frequency of exacerbations was nearly double in this group, which aligns with previous studies that have shown bronchiectasis to be a strong predictor of exacerbation risk and hospitalization in COPD [9].

Laboratory findings in the present study revealed significantly higher total leukocyte counts in the COPD–bronchiectasis group, supporting the presence of persistent systemic and airway inflammation driven by chronic infection. Absolute eosinophil counts were also significantly higher in this group. Blood leukocyte counts (e.g., eosinophil count) are important biomarkers for the onset, classification, and exacerbation of chronic obstructive pulmonary disease (COPD) [10]. Shoemark et al., in a large European multicohort study, demonstrated that eosinophilic bronchiectasis represents a distinct clinical phenotype with differing inflammatory profiles and clinical characteristics, supporting the concept that bronchiectasis is not a uniform disease entity [11]. These findings have potential therapeutic implications, particularly in the context of individualized anti-inflammatory treatment strategies.

Spirometric evaluation in the present study revealed a predominance of obstructive ventilatory defects in patients with COPD–bronchiectasis, suggesting advanced airway remodelling and fixed airflow limitation. This airway-dominant pattern has been consistently reported in COPD–bronchiectasis overlap cohorts and contrasts with emphysema-predominant disease, which is more frequently observed in COPD patients without bronchiectasis [3, 12].

The most common microorganisms isolated from Europe and Asia included *Pseudomonas aeruginosa* and *Haemophilus influenzae*. *Pseudomonas aeruginosa* is a familiar, opportunistic, Gram-negative bacterium that is commonly cultured in bronchiectasis patients [13]. The significantly higher rate of colonization with *Pseudomonas aeruginosa* and other pathogens suggests a distinct microbiome in this phenotype, which has important implications for disease management [14]. In our study also, *Pseudomonas aeruginosa* (36%) was the primary pathogen isolated, followed by *Klebsiella pneumoniae* (20%). Two patients in Group B had persistent *Pseudomonas* colonization, associated with frequent hospitalizations. Singh *et al.*, [15] reported that; patients with *Pseudomonas* growth in sputum cultures had the more severe disease in the form of a greater number of lobes involvement and cystic changes. The isolation of tuberculous mycobacteria exclusively in the bronchiectasis group further highlights the contribution of post-tubercular structural lung damage in this phenotype.

Radiologically, HRCT findings in COPD patients with bronchiectasis were characterized by cystic bronchiectatic changes, tree-in-bud opacities, mucoid impaction, traction bronchiectasis, and fibrocavitary lesions. These features are consistent with post-infectious and post-tubercular bronchiectasis patterns described in prior radiological and clinical studies [6,16]. The present study revealed that Diffuse bilateral bronchiectasis and Unilateral lower lobe bronchiectasis was the most common among cases of COPD with bronchiectasis, typical of post-infectious bronchiectasis. In contrast, emphysema and bullous changes were more prevalent in COPD patients without bronchiectasis, supporting the concept that the overlap phenotype is predominantly airway-centric rather than parenchymal. Singh et al. [12] study revealed the involvement of two or more lobes in bronchiectasis, and the most common pattern observed was bilateral lower lobe involvement. Ramya and Sidharthan [17] also reported that left lower lobe had more involvement in bronchiectasis patients.

These findings affirm that COPD patients with bronchiectasis constitute a distinct clinical and radiological phenotype with worse outcomes. Early identification of this overlap syndrome is essential, as it may warrant a more aggressive treatment approach, including targeted antibiotic therapy, airway clearance techniques, and closer monitoring of lung function.

Given the significant impact on patient outcomes, early identification and focused management of the COPD–bronchiectasis overlap could improve quality of life and reduce healthcare burden. Future prospective studies with larger cohorts and longer follow-up are warranted to further define optimal therapeutic approaches and to explore the mechanistic links between these two chronic airway diseases.

CONCLUSION

This comparative analysis demonstrates that COPD patients with coexisting bronchiectasis represent a distinct and more severe phenotype marked by increased clinical symptoms, poorer lung function, specific radiological abnormalities, and a greater burden of pathogenic airway colonization. The recognition of bronchiectasis in COPD patients is essential for developing targeted management strategies and improving outcomes. Further research is needed to investigate the impact of targeted treatment strategies on outcomes in COPD patients with bronchiectasis.

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