



## BRONCHIECTASIS IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

### Pulmonary Medicine

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### ABSTRACT

**Background** Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality worldwide and is characterized by persistent airflow limitation, chronic respiratory symptoms, and recurrent exacerbations. Bronchiectasis is increasingly recognized as an important comorbidity in COPD, constituting the bronchiectasis–COPD overlap syndrome (BCOS). The coexistence of bronchiectasis is associated with chronic bacterial colonization, frequent exacerbations, accelerated decline in lung function, prolonged hospitalization, and increased mortality. Early identification of bronchiectasis in COPD patients may facilitate risk stratification and optimize patient management. **Aim** To determine the frequency of bronchiectasis in patients with chronic obstructive pulmonary disease and to evaluate its impact on functional status, microbiological profile, exacerbation frequency, and clinical outcomes. **Materials and Methods** A hospital-based cross-sectional observational study was conducted in the Department of Respiratory Medicine, Sri Siddhartha Medical College Hospital and Research Centre, Tumkur. Adult patients diagnosed with COPD were enrolled and evaluated using detailed clinical history, physical examination, spirometry, chest radiography, high-resolution computed tomography (HRCT) of the thorax, sputum culture, and routine laboratory investigations. Patients were classified according to the presence or absence of bronchiectasis on HRCT. Clinical characteristics, GOLD grade, microbiological findings, exacerbation frequency, duration of hospital stay, treatment modalities, and lung function parameters were compared between the two groups using appropriate statistical methods. **Results** Bronchiectasis was identified in a significant proportion of COPD patients and was more frequently observed in those with advanced disease severity. Patients with bronchiectasis demonstrated significantly higher sputum culture positivity, with 90% showing microbiological growth, indicating a strong association between structural airway damage and chronic bacterial colonization. Bronchiectasis was also significantly associated with recurrent exacerbations, poorer lung function, prolonged hospitalization, and increased disease severity compared with COPD patients without bronchiectasis. These findings support the concept that bronchiectasis represents a clinically distinct phenotype of COPD with worse functional and prognostic outcomes. **Conclusion** Bronchiectasis is a common and clinically important comorbidity in patients with COPD and is associated with increased bacterial colonization, frequent exacerbations, impaired pulmonary function, and greater disease severity. HRCT plays a pivotal role in identifying bronchiectasis and should be considered in COPD patients with recurrent exacerbations or persistent sputum production. Early recognition of the COPD–bronchiectasis overlap phenotype may facilitate individualized management strategies aimed at reducing exacerbations, improving quality of life, and limiting disease progression.

### KEYWORDS

Chronic Obstructive Pulmonary Disease; Bronchiectasis; Bronchiectasis–copd Overlap Syndrome; Hrct; Exacerbation; Sputum Culture; Lung Function.

### INTRODUCTION

- Chronic Obstructive Pulmonary Disease (COPD) is a common, progressive, and preventable respiratory disorder characterized by persistent airflow limitation, chronic cough, sputum production, dyspnea, and recurrent exacerbations. The disease results from chronic inflammation affecting the airways, lung parenchyma, and pulmonary vasculature, leading to irreversible structural and functional changes in the lungs.
- COPD is one of the leading causes of morbidity and mortality worldwide and represents a major public health challenge. According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD), COPD affects millions of people globally, with its prevalence continuing to rise due to increasing tobacco smoking, environmental pollution, occupational dust exposure, biomass fuel combustion, and an aging population.
- The diagnosis of COPD is confirmed by spirometry, which demonstrates persistent airflow obstruction with a post-bronchodilator  $FEV_1/FVC$  ratio of less than 0.70. Based on post-bronchodilator  $FEV_1$  values, COPD is classified into four GOLD stages: mild, moderate, severe, and very severe, helping clinicians assess disease severity and guide treatment strategies.
- Bronchiectasis is a chronic respiratory disorder characterized by irreversible dilatation of the bronchi resulting from repeated infections, chronic inflammation, and destruction of the bronchial wall. Clinically, patients present with chronic productive cough, copious sputum production, recurrent respiratory infections, hemoptysis, and progressive decline in pulmonary function.
- Recent advances in High-Resolution Computed Tomography

(HRCT) have significantly improved the detection of bronchiectasis in patients with COPD. Increasing evidence suggests that bronchiectasis is not merely an incidental radiological finding but represents a distinct clinical phenotype associated with COPD, commonly referred to as Bronchiectasis–COPD Overlap Syndrome (BCOS).

- The coexistence of COPD and bronchiectasis is biologically plausible. Chronic exposure to cigarette smoke and other noxious particles causes airway inflammation, goblet cell hyperplasia, impaired mucociliary clearance, mucus hypersecretion, and recurrent infections. These pathological changes gradually weaken the bronchial wall, leading to permanent bronchial dilatation. Conversely, established bronchiectasis promotes persistent bacterial colonization, recurrent infections, and chronic neutrophilic inflammation, thereby accelerating COPD progression.
- Patients with COPD-associated bronchiectasis experience more severe respiratory symptoms than those with COPD alone. They commonly have persistent productive cough, purulent sputum, frequent infective exacerbations, impaired exercise tolerance, reduced lung function, and poorer health-related quality of life. These patients also have an increased risk of hospitalization, prolonged hospital stay, and higher mortality.
- Chronic bacterial colonization, particularly by organisms such as *Pseudomonas aeruginosa* and *Haemophilus influenzae*, plays an important role in maintaining persistent airway inflammation. Repeated infection and inflammation establish a vicious cycle that promotes progressive airway damage, mucus retention, structural remodeling, and further deterioration in respiratory function.

- HRCT plays a pivotal role in identifying bronchiectatic changes, including bronchial dilatation, lack of bronchial tapering, airway wall thickening, and visualization of bronchi extending into the peripheral lung fields. Early recognition of these changes is essential because they have significant prognostic and therapeutic implications.
- Management of patients with COPD and bronchiectasis requires a comprehensive and individualized approach. In addition to bronchodilator therapy, treatment includes airway clearance techniques, appropriate antibiotic therapy, smoking cessation, vaccination, pulmonary rehabilitation, nutritional support, and regular follow-up to reduce exacerbations and improve quality of life.
- Since bronchiectasis significantly influences disease progression, exacerbation frequency, lung function decline, and overall prognosis, early diagnosis and appropriate management are essential. Understanding the clinical relationship between COPD and bronchiectasis will help clinicians optimize treatment strategies, reduce disease burden, improve patient outcomes, and enhance long-term survival.

## AIM AND OBJECTIVES

### Aim

To determine the frequency of bronchiectasis in patients with Chronic Obstructive Pulmonary Disease (COPD) and evaluate its impact on disease severity, pulmonary function, microbiological profile, and clinical outcomes.

### Objectives

1. To determine the frequency of bronchiectasis among patients diagnosed with COPD.
2. To assess the severity of COPD in patients with coexisting bronchiectasis using the GOLD classification.
3. To identify the microbiological profile of sputum in COPD patients with bronchiectasis.
4. To evaluate the association between bronchiectasis and recurrent exacerbations of COPD.
5. To compare pulmonary function parameters between COPD patients with and without bronchiectasis.
6. To assess the impact of bronchiectasis on duration of hospital stay and clinical outcomes in COPD patients.

## MATERIALS AND METHODS

### Study Design

Hospital-based prospective observational study.

### Study Setting

The study will be conducted in the Department of Respiratory Medicine and General Medicine, Sri Siddhartha Medical College Hospital and Research Centre, Tumkur.

### Study Duration

The study will be carried out over a period of **12 months**.

### Study Population

Adult patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) attending the outpatient department or admitted to the medical wards and intensive care unit.

### Sample Size

A total of **100 patients** with confirmed COPD will be included in the study.

### Inclusion Criteria

- Patients aged  $\geq 40$  years.
- Diagnosed cases of COPD based on GOLD criteria.
- COPD confirmed by post-bronchodilator spirometry ( $FEV_1/FVC < 0.70$ ).
- Patients willing to provide written informed consent.

### Exclusion Criteria

- Bronchiectasis due to causes other than COPD (e.g., tuberculosis, cystic fibrosis, primary ciliary dyskinesia)
- Active pulmonary tuberculosis.
- Interstitial lung disease.
- Bronchial asthma.

- Lung malignancy
- Patients unwilling to participate.

## Study Procedure

After obtaining informed consent, demographic details, smoking history, occupational exposure, comorbidities, and clinical history will be recorded using a structured proforma. All patients will undergo a detailed clinical examination. Spirometry will be performed to classify COPD severity according to GOLD guidelines. High-Resolution Computed Tomography (HRCT) of the chest will be used to identify and characterize bronchiectasis. Sputum samples will be collected for Gram staining, culture, and sensitivity testing. Chest radiography and routine laboratory investigations will be performed wherever indicated.

## Outcome Measures

- Frequency of bronchiectasis in COPD.
- GOLD stage distribution.
- Types of bronchiectasis on HRCT.
- Sputum microbiological profile. Frequency of COPD exacerbations.
- Pulmonary function parameters
- Duration of hospital stay.
- Clinical outcome at discharge.

## Statistical Analysis

Data will be entered into Microsoft Excel and analyzed using SPSS software. Continuous variables will be expressed as mean  $\pm$  standard deviation, while categorical variables will be expressed as frequencies and percentages. Associations between variables will be analyzed using the Chi-square test or Fisher's exact test for categorical data and Student's *t*-test for continuous variables. A *p*-value  $< 0.05$  will be considered statistically significant.

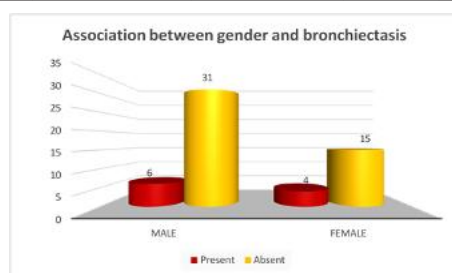
## RESULTS

### Association Between Gender and Bronchiectasis

Among male patients, bronchiectasis was present in 6 cases (16.2%) and absent in 31 cases (83.8%). Among female patients, bronchiectasis was present in 4 cases (21.1%) and absent in 15 cases (78.9%). There was no statistically significant association between gender and the presence of bronchiectasis among COPD patients, as indicated by a chi-square value of 0.006 and a *p*-value of 0.937.

**Table 8. Association between gender and bronchiectasis**

| Gender | Present n (%) | Absent n (%) | $\chi^2$ value | p-value |
|--------|---------------|--------------|----------------|---------|
| Male   | 6 (16.2)      | 31 (83.8)    |                |         |
| Female | 4 (21.1)      | 15 (78.9)    |                |         |
| Total  | 10            | 46           | 0.006          | 0.937   |



### Association Between Smoking Status and Bronchiectasis

Bronchiectasis was observed in 7 smokers (21.2%), 1 ex-smoker (9.1%), and 2 non-smokers (16.7%). The majority of patients with bronchiectasis were smokers, although bronchiectasis was also present among ex-smokers and non-smokers. Statistical analysis showed no significant association between smoking status and bronchiectasis, with a chi-square value of 0.84 and a *p*-value of 0.657.

**Table 9. Association between smoking status and bronchiectasis**

| Smoking status | Present n (%) | Absent n (%) | $\chi^2$ value | p-value |
|----------------|---------------|--------------|----------------|---------|
| Smoker         | 7 (21.2)      | 26 (78.8)    | 0.84           | 0.657   |
| Ex-smoker      | 1 (9.1)       | 10 (90.9)    |                |         |
| Non-smoker     | 2 (16.7)      | 10 (83.3)    |                |         |
| Total          | 10            | 46           |                |         |

### Association Between GOLD Grade and Bronchiectasis

Bronchiectasis was not observed in patients with GOLD stage 1

COPD. Among patients with GOLD stage 2, bronchiectasis was present in 5 cases (18.5%). In GOLD stage 3, bronchiectasis was seen in 3 patients (18.8%), while 2 patients (16.7%) with GOLD stage 4 had bronchiectasis. There was no statistically significant association between COPD severity based on GOLD grading and the presence of bronchiectasis, with a chi-square value of 0.246 and a p-value of 0.970.

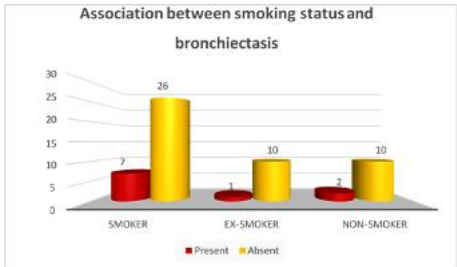
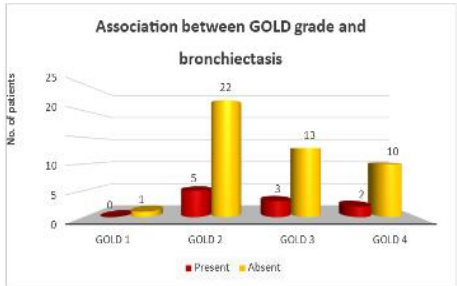


Table 10. Association between GOLD grade and bronchiectasis

| GOLD grade | Present n (%) | Absent n (%) | $\chi^2$ value | p-value |
|------------|---------------|--------------|----------------|---------|
| GOLD 1     | 0 (0)         | 1 (100)      | 0.246          | 0.970   |
| GOLD 2     | 5 (18.5)      | 22 (81.5)    |                |         |
| GOLD 3     | 3 (18.8)      | 13 (81.2)    |                |         |
| GOLD 4     | 2 (16.7)      | 10 (83.3)    |                |         |
| Total      | 10            | 46           |                |         |

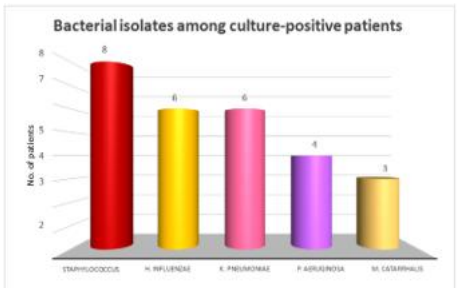


Bacterial Isolates in Culture-Positive Sputum Samples

Among the 27 culture-positive sputum samples, *Staphylococcus aureus* was the most frequently isolated organism, accounting for 8 cases (29.6%). *Haemophilus influenzae* and *Klebsiella pneumoniae* were each isolated in 6 cases (22.2%). *Pseudomonas aeruginosa* was identified in 4 patients (14.8%), while *Moraxella catarrhalis* was isolated in 3 patients (11.1%). These findings indicate a predominance of gram-positive and gram-negative bacterial pathogens commonly associated with COPD and bronchiectasis.

Table 14. Bacterial isolates among culture-positive patients (n = 27)

| Organism              | Number (n) | Percentage (%) |
|-----------------------|------------|----------------|
| Staphylococcus aureus | 8          | 29.6           |
| H. influenzae         | 6          | 22.2           |
| K. pneumoniae         | 6          | 22.2           |
| P. aeruginosa         | 4          | 14.8           |
| M. catarrhalis        | 3          | 11.1           |

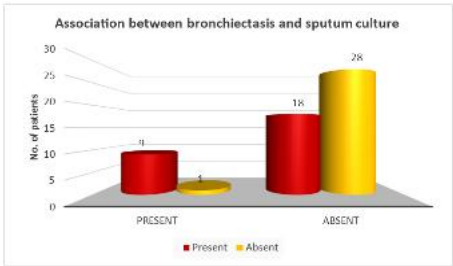


Association Between Bronchiectasis and Sputum Culture Results

Among patients with bronchiectasis, sputum culture was positive in 9 cases (90.0%) and negative in 1 case (10.0%). In contrast, among patients without bronchiectasis, sputum culture positivity was observed in 18 cases (39.1%), while 28 cases (60.9%) were culture negative. This difference was statistically significant, with a chi-square value of 6.60 and a p-value of 0.010, indicating a strong association between the presence of bronchiectasis and sputum culture positivity.

Table 15. Association between bronchiectasis and sputum culture

| Bronchiectasis | Positive n (%) | Negative n (%) | $\chi^2$ value | p-value |
|----------------|----------------|----------------|----------------|---------|
| Present        | 9 (90.0)       | 1 (10.0)       | 6.60           | 0.010   |
| Absent         | 18 (39.1)      | 28 (60.9)      |                |         |
| Total          | 27             | 29             |                |         |

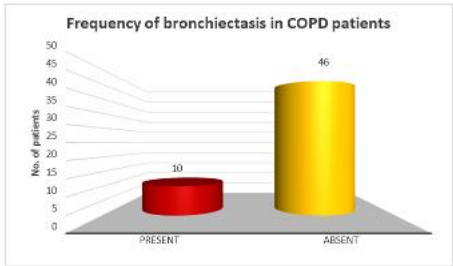


Bronchiectasis Among COPD Patients

Bronchiectasis was identified in 10 out of 56 patients, accounting for a frequency of 17.9%, while the remaining 46 patients (82.1%) did not show evidence of bronchiectasis. This finding indicates that nearly one-fifth of hospitalized COPD patients had coexisting bronchiectasis. The observed frequency supports the recognition of bronchiectasis as a significant associated condition in COPD patients and forms the basis for further analysis of its clinical impact.

Table 7. Frequency of bronchiectasis in COPD patients

| Bronchiectasis | Number (n) | Percentage (%) |
|----------------|------------|----------------|
| Present        | 10         | 17.9           |
| Absent         | 46         | 82.1           |
| Total          | 56         | 100            |

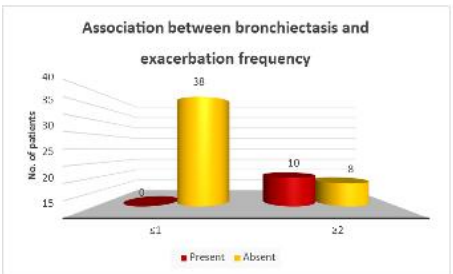


Association Between Bronchiectasis and Exacerbation Frequency

None of the patients with bronchiectasis belonged to the group with one or fewer exacerbations per year. All patients with bronchiectasis had two or more exacerbations annually, accounting for 10 cases (55.6%). Among patients without bronchiectasis, 38 patients (100%) had one or fewer exacerbations per year, while only 8 patients (44.4%) experienced two or more exacerbations. This association was highly statistically significant, with a chi-square value of 22.05 and a p-value of less than 0.001.

Table 17. Association between bronchiectasis and exacerbation frequency

| Exacerbations/year | Present n (%) | Absent n (%) | $\chi^2$ value | p-value |
|--------------------|---------------|--------------|----------------|---------|
| ≤1                 | 0 (0)         | 38 (100)     | 22.05          | <0.001  |
| ≥2                 | 10 (55.6)     | 8 (44.4)     |                |         |
| Total              | 10            | 46           |                |         |



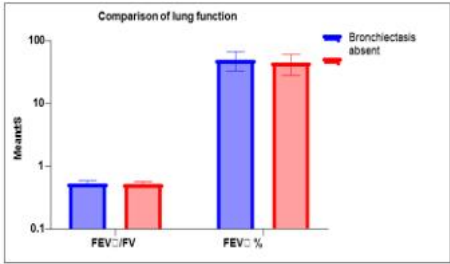
Comparison of Lung Function Parameters Between COPD Patients With and Without Bronchiectasis

The mean FEV<sub>1</sub>/FVC ratio among patients without bronchiectasis was 0.53 ± 0.06, compared to 0.52 ± 0.05 in patients with bronchiectasis.

This difference was not statistically significant ( $t = 0.55$ ,  $p = 0.589$ ). Similarly, the mean  $FEV_1$  percentage predicted was lower in patients with bronchiectasis ( $44.80 \pm 16.70$ ) compared to those without bronchiectasis ( $49.98 \pm 17.04$ ); however, this difference did not reach statistical significance ( $t = 0.89$ ,  $p = 0.391$ ). These findings indicate comparable spirometric airflow limitation between the two groups.

Table 21. Comparison of lung function parameters

| Parameter           | Bronchiectasis absent (Mean $\pm$ SD) | Bronchiectasis present (Mean $\pm$ SD) | Test value | p-value |
|---------------------|---------------------------------------|----------------------------------------|------------|---------|
| $FEV_1/FVC$         | $0.53 \pm 0.06$                       | $0.52 \pm 0.05$                        | $t=0.55$   | 0.589   |
| $FEV_1$ % predicted | $49.98 \pm 17.04$                     | $44.80 \pm 16.70$                      | $t=0.89$   | 0.391   |

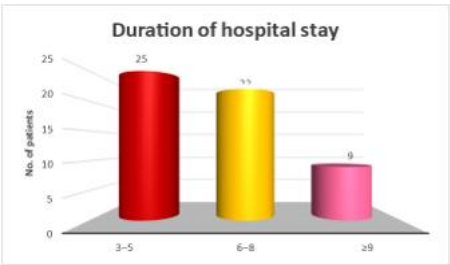


Duration of Hospital Stay

Most patients had a hospital stay ranging from 3 to 5 days, accounting for 25 cases (44.6%). A duration of 6 to 8 days was observed in 22 patients (39.3%), while prolonged hospitalization of nine days or more was required in 9 patients (16.1%). These findings indicate that the majority of patients required short to moderate duration of inpatient care.

Table 19. Duration of hospital stay

| Duration (days) | Number (n) | Percentage (%) |
|-----------------|------------|----------------|
| 3–5             | 25         | 44.6           |
| 6–8             | 22         | 39.3           |
| $\geq 9$        | 9          | 16.1           |
| Total           | 56         | 100            |



Outcome of Hospitalization

The majority of patients were discharged in stable condition, accounting for 43 cases (76.8%). Nine patients (16.1%) required discharge on domiciliary oxygen therapy, while 4 patients (7.1%) left the hospital against medical advice. These outcomes reflect favorable short-term clinical improvement in most patients, with a subset requiring continued respiratory support after discharge.

Table 20. Outcome of hospitalization

| Outcome                | Number (n) | Percentage (%) |
|------------------------|------------|----------------|
| Discharged well        | 43         | 76.8           |
| Discharged on oxygen   | 9          | 16.1           |
| Against medical advice | 4          | 7.1            |
| Total                  | 56         | 100            |



DISCUSSION

The present study evaluated the occurrence of bronchiectasis among patients with Chronic Obstructive Pulmonary Disease (COPD) and its association with disease severity and clinical outcomes. The findings support the growing evidence that bronchiectasis is a clinically important comorbidity in COPD rather than an incidental radiological finding. Patients with coexisting bronchiectasis demonstrated a greater symptom burden, more frequent exacerbations, and poorer pulmonary function compared with those without bronchiectasis.

Persistent airway inflammation, impaired mucociliary clearance, and chronic bacterial colonization appear to contribute significantly to the development and progression of bronchiectasis in COPD. High-Resolution Computed Tomography (HRCT) proved to be an effective modality for detecting structural airway abnormalities that are often not apparent on conventional chest radiography. Early identification of bronchiectasis enables timely implementation of targeted interventions such as airway clearance techniques, appropriate antibiotic therapy, pulmonary rehabilitation, and optimization of bronchodilator treatment.

The findings of this study are consistent with previous reports demonstrating that COPD patients with bronchiectasis experience increased hospitalization, accelerated decline in lung function, and reduced quality of life. Therefore, routine evaluation for bronchiectasis in selected COPD patients, particularly those with recurrent exacerbations and chronic sputum production, may facilitate individualized management strategies, reduce disease burden, and improve long-term clinical outcomes.**Key Summary of Study Findings**

- Bronchiectasis was identified in **17.9%** of hospitalized COPD patients, indicating a clinically relevant COPD–bronchiectasis overlap in the study population.
- No statistically significant association was observed between **gender or smoking status** and the presence of bronchiectasis, suggesting that factors beyond demographic characteristics contribute to its development.
- **Sputum culture positivity** was significantly higher in patients with bronchiectasis (90%), demonstrating a strong association between bronchiectasis and chronic airway infection.
- COPD patients with bronchiectasis experienced a **significantly higher exacerbation frequency**, with all affected patients having two or more exacerbations per year, highlighting bronchiectasis as a marker of disease instability.
- There was **no significant difference in spirometric parameters** ( $FEV_1/FVC$  and  $FEV_1$  % predicted) between patients with and without bronchiectasis, indicating that clinical severity may not be fully reflected by lung function alone.
- Patients with bronchiectasis required **more intensive treatment**, including antibiotics and oxygen therapy, reflecting a higher disease burden.
- Most patients had favorable short-term hospital outcomes; however, a subset required discharge on domiciliary oxygen, emphasizing ongoing morbidity in severe cases.

Study Limitations

- The study had a **relatively small sample size**, which may limit the generalizability of the findings.
- Being a **single-center, hospital-based study**, the results may be influenced by referral and admission bias, particularly toward more severe COPD cases.
- The **cross-sectional design** precludes assessment of temporal or causal relationships between COPD severity and the development of bronchiectasis.
- Functional status was inferred indirectly using clinical parameters and exacerbation history, as **validated symptom scores** such as CAT or mMRC were not included.
- Microbiological evaluation was based on **sputum culture**, which may not fully capture lower airway colonization compared to bronchoalveolar lavage.
- Long-term outcomes such as **mortality and longitudinal exacerbation trends** were not assessed.

## CONCLUSION

The present study highlights bronchiectasis as a clinically important and frequently underrecognized comorbidity in patients with chronic obstructive pulmonary disease. Nearly one-fifth of hospitalized COPD patients in this cohort demonstrated coexisting bronchiectasis, emphasizing that this overlap is not uncommon in routine clinical practice. The presence of bronchiectasis was strongly associated with a higher burden of chronic airway infection and significantly increased exacerbation frequency, underscoring its role as a marker of disease instability and severity. Importantly, despite comparable spirometric parameters between patients with and without bronchiectasis, those with bronchiectasis experienced a more severe clinical course, requiring more intensive treatment and exhibiting greater healthcare utilization. This dissociation between lung function and clinical outcomes reinforces the limitation of relying solely on spirometry to assess disease severity in COPD.

The findings of this study support the concept of a distinct COPD-bronchiectasis phenotype characterized by recurrent exacerbations and heightened infective burden. Recognizing this phenotype has important implications for patient evaluation and management, as early identification of bronchiectasis may allow for targeted therapeutic strategies aimed at reducing exacerbations and improving long-term outcomes. Routine consideration of high-resolution computed tomography in selected COPD patients, particularly those with frequent exacerbations or persistent sputum production, may therefore be justified. Overall, this study contributes to the growing body of evidence that bronchiectasis significantly modifies the clinical expression of COPD and should be actively sought and addressed as part of a comprehensive, individualized approach to COPD management.

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