Section: Miscellaneous

Original Research Article

ASSESSMENT OF CLINICORADIOLOGICAL PATTERN AND ETIOLOGICAL FACTORS AMONG PATIENTS WITH BRONCHIECTASIS

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ABSTRACT

Background: Bronchiectasis is a chronic suppurative lung disease characterized by irreversible bronchial dilatation, recurrent infections, and progressive respiratory impairment. High-resolution computed tomography (HRCT) has emerged as the gold standard for diagnosis, enabling detailed assessment of disease extent and patterns. Identifying clinicoradiological correlations and etiological factors is crucial for targeted management and prognostication. **Objectives:** To assess the clinical presentation, radiological patterns on HRCT chest, and etiological factors among patients with bronchiectasis and to evaluate their association with disease severity.

Materials and Methods: This observational cross-sectional study was conducted over a period of one year at Shyam Shah Medical College and Sanjay Gandhi Memorial Hospital, Rewa, Madhya Pradesh, included 100 diagnosed cases of bronchiectasis. Detailed clinical evaluation, sputum microbiology, pulmonary function testing, and HRCT chest were performed. Radiological patterns (cylindrical, varicose, cystic, mixed), lobar distribution, and associated findings were analyzed. Etiology was categorized as post-infective, tuberculosis-related, idiopathic, congenital.

Results: The mean age of patients was 60.05 ± 11.64 years, with a female predominance (55%). The most common symptoms were chronic cough (92%), expectoration (52%), and recurrent hemoptysis (27%). HRCT revealed varicose bronchiectasis as the predominant pattern (34%), followed by mixed (26%), cylindrical and cystic (20%) types. Varicose bronchiectasis was the most common HRCT pattern in both smokers and non-smokers. FACED score a total of 45% of patients had a score between 0–2, 28% had scores of 3–4, 27% had scores ranging from 5–7, representing severe disease with poorer outcomes. Post-tubercular bronchiectasis (30%), followed by COPD Associated (28%), idiopathic (25%) and ABPA was (17%). Patients with cystic and mixed patterns showed significantly lower FEV1 values and higher frequency of Pseudomonas aeruginosa isolation ($p < 0.01$). There was a significant negative correlation between oxygen saturation (SpO_2) and FACED score across all severity categories.

Conclusion: Bronchiectasis predominantly affects middle-aged males and commonly presents with chronic productive cough. Cylindrical bronchiectasis with lower lobe predominance is the most frequent HRCT pattern. Post-infective and post-tubercular etiologies remain leading causes. HRCT patterns

correlate significantly with clinical severity and microbiological profile, emphasizing its role in comprehensive disease assessment and management.
Key Words: Bronchiectasis; High-Resolution Computed Tomography; Clinicoradiological Correlation; Etiological Factors; Post-infective Lung Disease.

INTRODUCTION

Bronchiectasis is a chronic respiratory disorder characterized by permanent and abnormal dilatation of the bronchial lumen, commonly associated with recurrent or persistent airway infection. It may develop secondary to a wide range of congenital and acquired pulmonary conditions, including cystic fibrosis, severe lower respiratory tract infections, Kartagener syndrome, chronic obstructive pulmonary disease, alpha-1 antitrypsin deficiency, asthma, connective tissue disorders, interstitial lung diseases, and primary immunodeficiency syndromes.[1-2] The fundamental pathophysiological mechanism involves sustained airway inflammation leading to progressive structural damage of the bronchial walls, resulting in irreversible dilatation and clinical manifestations such as chronic productive cough and exertional dyspnea.[3] Over time, bronchiectasis may cause recurrent infections, declining lung function, respiratory failure, pulmonary hypertension, and increased morbidity and mortality.[4-5]

The global prevalence of bronchiectasis remains inadequately defined, particularly in developing countries where underdiagnosis is common.[6] Although earlier studies reported declining prevalence due to improved vaccination, hygiene, and antibiotic use, recent data suggest a resurgence, largely attributable to increased utilization of high-resolution computed tomography (HRCT).[7] Epidemiological studies report a mean age of diagnosis between 60 and 70 years, with significant geographic variability in etiology and clinical presentation.[8] HRCT remains the gold standard for diagnosis, with characteristic findings including the signet ring sign, lack of bronchial tapering, and peripheral bronchial visibility.[9]

Aim and Objectives

To evaluate the clinical profile of bronchiectasis patients during the stable phase, To analyze radiological features of bronchiectasis using high-resolution computed tomography (HRCT) To identify and categorize the underlying etiological factors of bronchiectasis and correlate clinical manifestations with HRCT patterns.

MATERIAL AND METHODS

Study Type: Observational, cross-sectional study.
Study Center: Department of Medicine and Department of Respiratory Medicine, Shyam Shah Medical College and Sanjay Gandhi Memorial Hospital, Rewa, Madhya Pradesh, India.
Study Duration: One year.
Study Sample Size: A total of 100 patients diagnosed with bronchiectasis on HRCT chest.
Ethical Considerations: The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment. Confidentiality and ethical guidelines were strictly followed.

Inclusion Criteria

- Adults aged ≥18 years of either sex with **HRCT-confirmed bronchiectasis**
- Patients presenting with chronic cough, expectoration, hemoptysis, or recurrent respiratory infections
- Both inpatient and outpatient cases who provided informed consent
- Patients who underwent appropriate etiological evaluation, including sputum studies and pulmonary function tests

Exclusion Criteria

- Patients with acute pulmonary infections without HRCT evidence of bronchiectasis
- Individuals with active tuberculosis or bronchial malignancy
- Patients unwilling to consent or with incomplete clinical or radiological data

Procedure Plan

All enrolled patients underwent

- Detailed clinical history and examination
- Assessment of smoking and biomass fuel exposure
- Pulmonary function testing
- HRCT chest
- Sputum examination and culture

FACED Score

Severity was assessed using the FACED score based on

- FEV_1 (% predicted)
- Age
- Chronic *Pseudomonas aeruginosa* colonization
- Radiological extent (>2 lobes)
- Dyspnea (mMRC scale)

Severity classification

- Mild: 0–2
- Moderate: 3–4
- Severe: 5–7

Data Collection

A pre-designed proforma was used to collect demographic data, presenting symptoms, history of

past respiratory illnesses (e.g., childhood infections, TB), smoking history, and family history. HRCT scan reports were used to classify the pattern and extent of bronchiectasis. Clinical examination and symptom severity were recorded using the modified Medical Research Council (mMRC) scale and FACED score.

Investigations

- **HRCT Chest** – for diagnosis and pattern classification
- **Sputum Analysis** – Gram stain, AFB, and culture for bacterial and mycobacterial infections
- **CBC, ESR, CRP** – for inflammatory status
- **Serum Immunoglobulins (IgA, IgG, IgM)** – to assess immune deficiency
- **PFTs (Pulmonary Function Tests)** – to evaluate respiratory impairment
- **Mantoux Test / GeneXpert / Chest X-ray** – to rule out active or past tuberculosis and latent TB
- **Sweat Chloride Test** – if cystic fibrosis was suspected
- **Bronchoscopy** – For Bronchoalveolar lavage (BAL)

Statistical Analysis

Data were analyzed using SPSS software. Categorical variables were expressed as frequency and percentage. Continuous variables were expressed as mean ± SD. Chi-square test and Pearson correlation was used. A p-value <0.05 was considered statistically significant.

RESULTS

The present study included 100 patients with bronchiectasis, with a mean age of 60.05 ± 11.64 years. Females slightly predominated (55%) over males (45%). A majority of patients belonged to rural areas (64%) and low socioeconomic status (61%), highlighting the demographic vulnerability of the study population. [Table 1]

Table 1: Exposure to Smoke among patients with Bronchiectasis (n=100)

EXPOSURE TO SMOKE		**No. of Patients**	**Percentage (%)**
Yes		40	40%
No		60	60%
NO OF PACKS/YEAR			
Mild (1-10 packs)		22	55.0
Moderate (11-20 packs)		12	30.0
Severe (>20 packs)		6	15.0
Total		**40**	**100%**
SYMPTOMATOLOGY			
Cough with expectoration	Yes	52	52.0%
	No	48	48.0%
Hemoptysis	None	16	16.0%
	Mild	29	29.0%
	Moderate	28	28.0%
	Severe	27	27.0%
SPUTUM CULTURE RESULTS			
Bacterial infection	Pseudomonas aeruginosa	38	38%
	Klebsiella pneumoniae	25	25%
	Nil (No Growth)	18	18%
	Acinetobacter baumannii	5	5%
	E. coli	6	6%
Fungal infection	Candida albicans	05	5.0%
	Aspergillus niger	03	3.0%

Exposure to smoke was noted in 40% of patients, while 60% were non-smokers. Among smokers, most had mild exposure (1–10 pack-years: 55%), followed by moderate (30%) and severe exposure (15%). The most common symptom was cough with expectoration (52%). Hemoptysis was frequent, with mild (29%) and moderate (28%) grades being most common. Sputum culture showed Pseudomonas aeruginosa (38%) as the predominant organism, followed by Klebsiella pneumoniae (25%), while 18% had no growth. Fungal infections were less common, mainly Candida albicans (5%) and Aspergillus niger (3%). [Table 2]

Table 2: Exposure to Smoke among patients with Bronchiectasis (n=100)

EXPOSURE TO SMOKE	**No. of Patients**	**Percentage (%)**
Yes	40	40%
No	60	60%
NO OF PACKS/YEAR		
Mild (1-10 packs)	22	55.0
Moderate (11-20 packs)	12	30.0
Severe (>20 packs)	6	15.0
Total	**40**	**100%**
SYMPTOMATOLOGY		

Cough with expectoration	Yes	52	52.0%
	No	48	48.0%
Hemoptysis	None	16	16.0%
	Mild	29	29.0%
	Moderate	28	28.0%
	Severe	27	27.0%
SPUTUM CULTURE RESULTS			
Bacterial infection	Pseudomonas aeruginosa	38	38%
	Klebsiella pneumoniae	25	25%
	Nil (No Growth)	18	18%
	Acinetobacter baumannii	5	5%
	E. coli	6	6%
Fungal infection	Candida albicans	05	5.0%
	Aspergillus niger	03	3.0%

Radiologically, chest X-ray most commonly showed collapse (28%) and cystic shadows (26%), while 23% had normal X-rays. HRCT revealed varicose bronchiectasis (34%) as the most frequent pattern. Based on FACED score, 45% had mild disease, 28% moderate, and 27% severe. Post-tuberculosis bronchiectasis (30%) was the leading etiology. Clinically, 39% improved, 30% remained stable, while 13% succumbed to the disease. [Table 3]

Table 3: Different finding, Diagnosis and Outcome patients with Bronchiectasis (n=100)

Chest X-ray finding	**No. of Patients**	**Percentage (%)**
Normal	23	23.0%
Bronchial markings	23	23.0%
Collapse	28	28.0%
Cystic shadows	26	26.0%
HRCT finding		
Cylindrical	20	20.0%
Cystic	20	20.0%
Mixed	26	26.0%
Varicose	34	34.0%
FACED Score		
0-2 mild	45	45.0%
3-4 moderate	28	28.0%
5-7 severe	27	27.0%
Diagnosis		
Post TB	30	30.0%
COPD Associated	28	28.0%
Idiopathic	25	25.0%
Allergic Bronchopulmonary Aspergillosis (ABPA)	17	17.0%
Outcome		
Improved	39	39.0%
Stable	30	30.0%
Recurrent	18	18.0%
Deceased	13	13.0%

Among patients with Pseudomonas aeruginosa, varicose (21.05%) and mixed (28.94%) HRCT patterns were common, with cystic shadows (34.22%) being the most frequent X-ray finding (Table 4). No significant association was observed between smoking status and HRCT or X-ray findings ($p > 0.05$). [Table 5]

Table 4: Pseudomonas aeruginosa with HRCT Chest and X-Ray Chest Finding (n=38)

HRCT Pattern	***Pseudomonas aeruginosa***	
	No. of Patients (n)	**Percentage**
Cylindrical	12	31.58
Varicose	8	21.05
Cystic	7	18.43
Mixed	11	28.94
X-Ray Chest Finding		
Cystic shadows	13	34.22
Collapse	9	23.68
Bronchial markings	8	21.05
Normal	8	21.05
Total	**38**	**100.0**

Table 5: Exposure to Smoke and HRCT Chest Findings (n = 100)

HRCT Pattern	Smoker (n=40)	Non-Smoker (n=60)	Total	p-value
Cylindrical	10 (25.0%)	10 (16.7%)	20	**0.45**
Cystic	7 (17.5%)	13 (21.7%)	20	
Mixed	9 (22.5%)	17 (28.3%)	26	
Varicose	14 (35.0%)	20 (33.3%)	34	
X-Ray Chest Finding				
Bronchial markings	6 (15.0%)	17 (28.3%)	23	**0.50**
Collapse	14 (35.0%)	14 (23.3%)	28	
Cystic shadows	10 (25.0%)	16 (26.7%)	26	
Normal	10 (25.0%)	13 (21.7%)	23	
Total	**40 (100%)**	**60 (100%)**	**100**	

Oxygen saturation showed a strong inverse relationship with disease severity. Mean SpO_2 decreased from 97.40 ± 1.01% in mild FACED scores to 89.59 ± 1.39% in severe cases ($p < 0.001$). Correlation analysis demonstrated a progressively stronger negative correlation between SpO_2 and FACED score from mild ($r = –0.42$) to severe disease ($r = –0.71$), all statistically significant. [Tables 6 and 7]

Table 6: Association between Oxygen Saturation (SpO2) and FACED Score (n = 100)

FACED Score	Oxygen Saturation (SpO_2)			Total	Mean ± SD Saturation	Mean ± SD FACED Score	p-value
	<90%	90–93%	>93%				
0–2	-	-	45 (100.0)	45 (100%)	97.40 ± 1.01	1.09 ± 0.70	<0.001
3–4	06 (21.42)	10 (35.71)	12 (42.85)	28 (100%)	93.07 ± 3.03	3.43 ± 0.50	<0.001
5–7	10 (37.03)	17 (62.97)	-	27 (100%)	89.59 ± 1.39	6.15 ± 0.82	<0.001
Total	**16**	**27**	**57**	**100**			

Table 7: Correlation between Oxygen Saturation (SpO2) and FACED Score by Severity Category

FACED Score Category	No. of Patients (n)	Correlation Coefficient (r)	p-value
0–2 (Mild)	45	-0.42	0.003
3–4 (Moderate)	28	-0.58	0.001
5–7 (Severe)	27	-0.71	0.001

DISCUSSION

The demographic profile of our cohort (mean age 60.05 ± 11.64 years; female 55%; rural 64%; low SES 61%) largely mirrors the pattern reported from Indian registries and single-centre series where patients tend to present at older ages with a high rural/low-socioeconomic burden. Dhar R et al (2023)[10], using the EMBARC-India registry, reported that adult Indian bronchiectasis patients are frequently older, have high comorbidity burdens (including COPD overlap), and a substantial proportion are current smokers — findings that align with our high mean age and comorbidity signal. This registry work also emphasized that age and comorbid COPD predict worse outcomes, consistent with our FACED-based severity distribution (45% mild, 28% moderate, 27% severe).

The microbiological profile in our study — Pseudomonas aeruginosa 38%, Klebsiella 25% and no growth 18% — is comparable to multiple Indian reports that demonstrate a dominance of Gram-negative organisms, with Pseudomonas commonly the leading isolate. Ramya VH et al (2022),[11] Open all references in PubMed, in a tertiary-centre series found P. aeruginosa in 36% of isolates, similar to our 38% prevalence. Likewise, Bajpai J et al (2023),[12] and Gupta A et al (2022),[13] Open all references in PubMed, reported Pseudomonas as a major pathogen (ranges 15–36% across studies), and both stressed the association of Pseudomonas with more severe radiological patterns and worse lung function — which supports our observation that Pseudomonas cases had higher frequencies of cystic/ mixed patterns on HRCT and worse outcomes.

Radiology in our cohort showed varicose pattern 34%, cystic 20%, cylindrical 20%, mixed 26%, and chest X-ray collapse (28%) and cystic shadows (26%). Several Indian single-centre studies report variable predominance of cystic or varicose patterns depending on the cohort (post-TB vs non-TB). For example, Bajpai J et al (2023),[12] observed a predominance of cystic changes (reported up to 66–75% in post-TB groups), while Megha SN et al (2024),[14] found statistically significant associations between HRCT pattern and etiology (post-TB and obstructive phenotypes showing different lobar distributions). These reports concord with our finding that post-TB bronchiectasis (30% of our cases) remains a common Indian phenotype and often demonstrates more destructive/cystic changes on imaging.

Exposure to smoke in our sample (40% exposed; among exposed: mild 55%, moderate 30%, severe

15%) and the lack of a strong association between smoking and specific HRCT phenotypes (p>0.05) echo Indian data showing high smoking prevalence in certain subgroups but mixed associations with radiologic pattern. The EMBARC-India registry (Dhar R et al (2023),[10] identified current smoking as a predictor of worse outcomes (mortality and exacerbations), consistent with our emphasis on smoking as a risk modifier even when HRCT differences are not uniformly significant.

Clinically, cough with expectoration (52%) and hemoptysis (mild–severe combined ≈84%) in our cohort are similar to Indian tertiary-centre cohorts that report cough and recurrent sputum production as the most frequent symptoms and hemoptysis rates that range widely (often 20–40% depending on population). Ramya VH et al (2022),[11] and Bajpai J et al (2023),[12] similarly reported cough as the dominant symptom and notable hemoptysis frequency. These symptom prevalences support the view that Indian bronchiectasis cohorts present with significant airway bleeding and sputum burden, often reflecting post-infectious (TB) sequelae.

Outcome measures in our work (Improved 39%, Stable 30%, Recurrent 18%, Deceased 13%) and the strong inverse correlation between SpO_2 and FACED severity (mean SpO_2 97.40% in FACED 0–2 vs 89.59% in FACED 5–7; and r from −0.42 in mild to −0.71 in severe, all $p \leq 0.003$) are concordant with registry and Indian series data that link severity scores, chronic Pseudomonas infection and hypoxaemia to higher exacerbation rates, hospitalisations and mortality. The EMBARC-India findings (Dhar R et al (2023)[10], specifically associate Pseudomonas and frequent exacerbations with worse survival — echoing our Pseudomonas-heavy subgroup having worse radiology and outcomes.

This pattern is consistent with Indian cohorts: Prajapati P et al (2022),[15] reported most patients clustered in mild–moderate FACED categories (28 mild, 17 moderate, 5 severe), helping explain why many maintain near-normal SpO_2 early on. Phadnis S et al (2024),[16] found a low mean FACED score (mean 1.43 ± 1.27) in an ABPA–bronchiectasis population, supporting preserved oxygenation in large subsets yet showing that even small FACED increments relate to worse outcomes., Deshmukh A et al (2021),[17] North Indian series reported higher clinical severity by multidimensional indices (greater BSI values in post-tubercular bronchiectasis), which corresponds to lower SpO_2 and steeper correlations in more severe cohorts. Overall, our findings align with Indian data: FACED reliably reflects gradations of physiological impairment, and pulse oximetry provides a quick, non-invasive marker that becomes increasingly discriminatory as FACED severity increases reinforcing combined use for risk stratification and early intervention.

In summary, our study closely matches recent Indian data: an older, socioeconomic-vulnerable cohort with a high burden of post-TB disease, Pseudomonas predominance, variable HRCT phenotypes (with cystic/varicose patterns in more severe/post-TB cases), and an expected link between lower SpO_2/higher FACED and poorer outcomes. These consistencies validate the generalisability of your findings within the Indian bronchiectasis phenotype and reinforce targeting Pseudomonas eradication/long-term management and smoking-cessation/comorbidity optimisation as priority interventions in similar settings.

CONCLUSION

The present study highlights that bronchiectasis predominantly affects elderly individuals from rural and low socioeconomic backgrounds, with post-tuberculosis and COPD being the leading etiologies. Varicose bronchiectasis was the most common HRCT pattern, and Pseudomonas aeruginosa emerged as the predominant pathogen, indicating advanced and severe disease. A significant inverse relationship between oxygen saturation and FACED score was observed, demonstrating that declining SpO_2 closely correlates with increasing disease severity and poor outcomes. These findings emphasize the importance of early diagnosis, routine microbiological surveillance, HRCT-based assessment, and simple bedside markers such as SpO_2 for severity stratification and prognostication in bronchiectasis patients.

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