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Association between chest CT features and spirometry findings of patients with bronchiectasis

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Abstract

Introduction: Bronchiectasis is characterized by irreversible bronchial dilatation and leads to diverse pulmonary function impairment. While high-resolution computed tomography (HRCT) is the gold standard for structural diagnosis, spirometry assesses functional status. Data on the correlation between specific CT features and spirometry patterns locally are limited.

Method: A cross-sectional observational study was conducted at Chitwan Medical College, Nepal, over two months in 2023 using convenience sampling following ethical approval. Stable adult patients (>18 years) with HRCT-confirmed bronchiectasis were included. HRCT patterns (cylindrical, varicose, cystic, or fibrobronchiectasis) were compared for association with spirometry pattern (normal, obstructive, restrictive, or mixed) based on post-bronchodilator values. Chi-square test was used for association using IBM SPSS Statistics with 95% confidence interval (CI), and $p<0.05$ was considered significant.

Result: Among 54 patients (mean age 57.83±16.23 years, 57.4% male), fibrobronchiectasis was the most common CT type (38.9%), followed by cystic and cylindrical types (27.8% each). The most frequent spirometry pattern was mixed (44.4%). There was no significant association between the type of bronchiectasis and the spirometry pattern ($p=0.84$). Bronchodilator reversibility was present in 5.5% of patients, with no significant association to the CT type ($p=0.632$).

Conclusion: A mixed ventilatory defect was the most common spirometry finding. No significant association was observed between HRCT morphological types and spirometry patterns, highlighting the functional heterogeneity of bronchiectasis irrespective of structural subclassification.

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Introduction

Bronchiectasis is pathologically defined by chronic airway inflammation and irreversible dilatation of one or more bronchi, with impaired mucociliary clearance and reduced expiratory flow.[1] It is a heterogeneous disease with diverse aetiology including immune deficiency syndromes, metabolic and ultrastructural defects, post infectious causes, secondary airway obstruction, and inflammatory disorders. The dysfunction in mucociliary clearance leads to persistent bacterial infection, chronic inflammation of the bronchial tree, and progressive tissue destruction.[2]

The prevalence of bronchiectasis has declined in developed countries,[3] but in developing countries including Nepal, it remains among the most common diagnoses in adult patients attending chest clinics.[4,5] High resolution computed tomography (HRCT) scan is the imaging modality of choice for diagnosing bronchiectasis. It can differentiate between types of bronchiectasis, and accurately localize and describe areas of parenchymal abnormality.[6]

Although bronchiectasis is classified under obstructive airway disease, it can present with obstructive, restrictive, as well as mixed patterns on spirometry.[7] Lower pulmonary function is associated with more severe disease, higher risk of exacerbation requiring hospitalization, and increased mortality.[8,9] In addition, airway hyperresponsiveness in bronchiectasis has been associated with poorer quality of life, lower baseline spirometry values, and more frequent exacerbations.[10] Bronchodilator reversibility is often used as a clinical marker to guide the initiation of bronchodilators in the management of bronchiectasis.[11]

Studies evaluating spirometry patterns among different types of bronchiectasis are still limited in our setting. It is uncertain whether findings from previous studies are generalizable to our population. Most existing studies on bronchiectasis have been conducted in high-income countries, where cystic fibrosis and immune deficiencies are the predominant aetiologies. However, in low- and middle-income countries like Nepal, post-infectious causes—mostly post-tubercular—constitute the majority of cases. This highlights a significant difference in disease profile and underscores the need for region-specific data.

Method

This was a cross-sectional observational study conducted at Chitwan Medical College using a convenience sampling technique over a period of two months. Ethical approval was obtained from the institutional review board, and written informed consent was obtained from all study participants. The study included stable patients >18 years of age visiting the outpatient department with HRCT-confirmed bronchiectasis. The exclusion criteria included contraindications to spirometry, prior lung resection, and pregnancy.

CT scan findings were obtained from the finalized radiology reports issued by board-certified radiologists and were considered definitive for data collection. HRCT chest findings were classified into cylindrical, varicose, cystic bronchiectasis, and fibrobronchiectasis. Cylindrical bronchiectasis was diagnosed based on dilatation and thickening of the bronchial wall with a broncho-arterial ratio >1. Varicose bronchiectasis was diagnosed by the presence of intermittent narrowed and dilated segments in the affected bronchus when viewed in long axis. Cystic bronchiectasis was diagnosed by the presence of thin-walled cystic spaces seen in subsequent axial cuts. For patients with mixed morphological patterns on HRCT, the following hierarchical classification was applied: if fibrosis was present, patients were classified as having fibrobronchiectasis. If fibrosis was not present, classification prioritized the most severe subtype in this order: cystic > varicose > cylindrical. Specifically, cystic bronchiectasis was recorded if any cystic component was present. In the absence of cystic changes, varicose bronchiectasis was recorded when both varicose and cylindrical patterns coexisted. Cylindrical bronchiectasis was recorded only when no varicose or cystic components were present.

Spirometry was performed, and forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), and the FEV1/FVC ratio were measured. The best value from three acceptable attempts was recorded. Patients were categorized into four groups based on spirometry findings. Normal spirometry was defined as FVC and FEV1 greater than 80% predicted, along with a post-bronchodilator FEV1/FVC ratio greater than 70% predicted. An obstructive pattern was defined as a post-bronchodilator FEV1/FVC ratio less than 70% predicted. A restrictive pattern was defined as FEV1 and FVC values less than 80% predicted with a preserved post-bronchodilator FEV1/FVC ratio (>70%). A mixed pattern was defined as FEV1 and FVC values less than 80% predicted with a post-bronchodilator FEV1/FVC ratio less than 70%.[12] Bronchodilator reversibility was defined as an absolute increase in FEV1 of ≥12% and ≥200 mL from the pre-bronchodilator value.[12]

The collected data were entered into a Microsoft Office Excel worksheet, and statistical analysis was performed using IBM SPSS Statistics version 20 for Windows. Quantitative variables are presented as mean±standard deviation. Categorical variables were analysed using chi-square tests. For contingency tables with small expected cell counts (expected frequency <5 in more than 20% of cells), Fisher's Exact Test was used instead of the Pearson chi-square test. Statistical significance was determined at a p-value <0.05. The association between spirometry findings and HRCT subtypes was analysed using the chi-square test. Bronchodilator reversibility among different types of bronchiectasis was also assessed using the chi-square test.

Result

A total of 54 patients were included in the study, with an age range of 23 to 90 years and a mean age of 57.83±16.23 years, Figure 1.

Among the 54 study subjects, 31(57.4%) were male and 23(42.6%) were female. Body mass index (BMI) ranged from 13.85 to 30.47, with a mean BMI of 22.05±4.52.

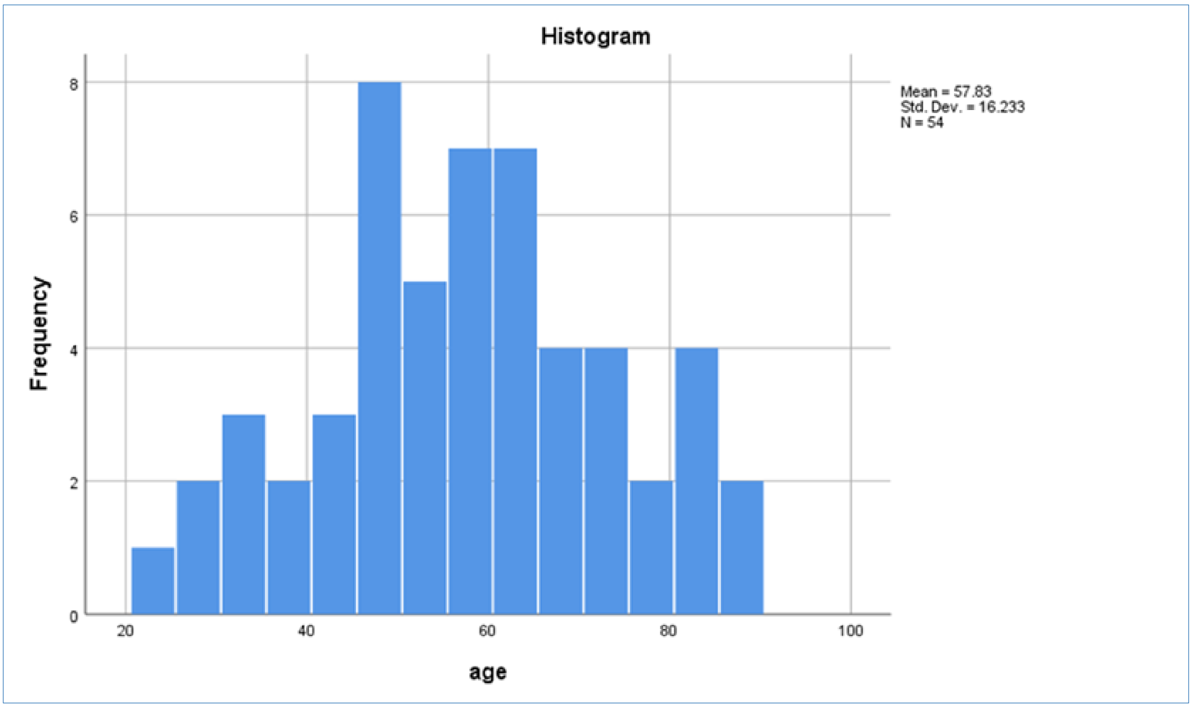

Figure 1. Age distribution of the study participants with bronchiectasis, n=54

Out of the 54 study patients, 49(90.7%) had cough. Dyspnoea was present in 39(72.2%) patients and haemoptysis was present in 21(38.9%) patients. Sputum expectoration was reported by 34(63%) patients. A history of pulmonary tuberculosis was reported by 24(44.4%) study subjects. Among the total participants, 28(51.9%) had smoked any form of tobacco at least once in their lifetime, Table 1.

The most common type of bronchiectasis observed was fibrobronchiectasis 21(38.9%), followed by cystic 15(27.8%) and cylindrical 15(27.8%) types, while the least common was varicose 3(5.5%). Regarding spirometry patterns, the most common finding was the mixed type 24(44.4%), showing features of both obstructive and restrictive ventilatory defects. No significant association was found between spirometry outcome and the type of bronchiectasis (95% CI, p=0.84), Table 2.

Out of the 54 patients, 3 (5.6%) showed bronchodilator reversibility. Specifically, 2 out of 21 (9.5%) in the fibrobronchiectasis group and 1 out of 15 (6.7%) in the cylindrical group showed bronchodilator reversibility. None of the patients in the varicose or cystic groups had bronchodilator reversibility. There was no significant association between bronchodilator reversibility and the type of bronchiectasis (p=0.632, Fisher's Exact Test), Table 3.

Table 1. Distribution of symptoms among patients with bronchiectasis, n=54

Symptom	Present, n(%)	Absent, n(%)
Cough	49(90.7)	5(9.3)
Expectoration	34(63)	20(37)
Dyspnoea	39(72.2)	15(27.8)
Haemoptysis	21(38.9)	33(61.1)
PTB	24(44.4)	30(55.6)
Smoking	28(51.9)	26(48.1)

Table 2. Association between spirometry outcome and type of bronchiectasis on HRCT, n=54

Type of Bronchiectasis / Spirometry outcome	Cystic	Varicose	Cylindrical	Fibrobronchiectasis	Total	p-value
Normal	4	1	2	3	10	0.84
Obstructive	1	1	3	5	10	
Restrictive	4	0	2	4	10	
Mixed	6	1	8	9	24	
Total	15	3	15	21	54	

Table 3. Association between bronchodilator reversibility and type of bronchiectasis, n=54

Type of bronchiectasis	Reversibility			p-value
	No, n(%)	Yes, n(%)	Total	
Cystic	15(100)	0	15	0.632
Varicose	3(100)	0	3	
Cylindrical	14(93.3)	1(6.7)	15	
Fibrobronchiectasis	19(90.5)	2(9.5)	21	
Total	51(94.4)	3(5.6)	54	

p-value Fisher's exact test

Discussion

This study evaluated the association between chest CT features and spirometry findings in patients with bronchiectasis. No significant association was found between the morphological type of bronchiectasis on HRCT and spirometry patterns, with a mixed ventilatory defect being the most common functional abnormality.

The high prevalence of fibrobronchiectasis in our study likely reflects the regional burden of post-tuberculosis lung disease.[13] This differs from studies in other settings where different aetiologies predominate and where cylindrical bronchiectasis is more frequently reported.[14]

In our study, a mixed spirometry pattern was most common. While many studies have found obstructive defects to be predominant, other research indicates that pulmonary function changes depend on the underlying aetiology.[14] Studies of post-tubercular bronchiectasis have reported a mixed pattern, which may be due to greater combined bronchial and parenchymal damage.[15]

The absence of a significant association between CT type and spirometry pattern in our study is consistent with previous findings.[14] However, factors such as the older age of our cohort and a significant history of tobacco smoking may influence spirometry results. Research suggests that the overall severity and extent of disease correlate more strongly with lung function impairment than specific radiographic subtypes.[14]

Bronchodilator reversibility was observed in only 5.5% of patients and showed no association with CT type. This contrasts with some studies that have linked reversibility to more severe obstruction.[16]

Some of the limitations of this study may be a cross-sectional design which prevents causal inferences; single-centre data may limit the generalizability. Confounders, such as detailed smoking history and concurrent respiratory comorbidities, were not fully captured. Additionally, reliance on standard radiology reports for CT classification, rather than a centralized review, may introduce variability.

In our setting, bronchiectasis presented most commonly with a mixed ventilatory defect on spirometry. The lack of association between specific HRCT morphological types and lung function patterns reflects the functional heterogeneity of the disease and the need for comprehensive functional assessment. Further research focused on non-cystic fibrosis bronchiectasis may be needed, which is the predominant form in our region.

Conclusion

The mixed obstructive-restrictive pattern was the most common spirometry abnormality among patients with bronchiectasis at our centre. There was no significant association between specific morphological types of bronchiectasis on HRCT and patterns of impairment on spirometry. This reflects the functional heterogeneity of bronchiectasis and suggests that lung function assessment provides complementary information that is not reliably predicted by structural appearance alone. Further research is warranted to better understand the causes of functional decline in regionally prevalent disease, such as post-tuberculosis bronchiectasis.

Author contribution

Concept design: SA, PS; Literature search: PS; Data collection: PS; Data analysis: PS; Draft manuscript: PS; Final manuscript and accountability: SA, PS

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Conflict of Interest

None

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Supplementary material

The data and supplementary material that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. Tino G. Bronchiectasis. In: Grippi MA, Antin-Ozerkis DE, Dela Cruz CS, Kotloff RM, Kotton CN, Pack AI, editors. Fishman's Pulmonary Diseases

and Disorders. 6th ed. New York: McGraw-Hill Education; 2023. Link: accessmedicine.mhmedical.com/content.aspx?bookid=3242&sectionid=270514086

2. Chalmers JD, Chang AB, Chotirmall SH, Dhar R, McShane PJ. Bronchiectasis. Nat Rev Dis Primers. 2018;4(1):45. DOI: 10.1038/s41572-018-0042-3 PubMed Google Scholar Full Text
3. Habesoglu MA, Ugurlu AO, Eyuboglu FO. Clinical, radiologic, and functional evaluation of 304 patients with bronchiectasis. Ann Thorac Med. 2011;6(3):131-6. DOI: 10.4103/1817-1737.82443 PubMed Google Scholar Full Text
4. Pande JN. Respiratory Medicine in the Tropics. Oxford University Press; 2000. Google Scholar: scholar.google.com/scholar?q=Respiratory+Medicine+in+the+Tropics+Pande Full Text
5. Bhatta N, Dhakal SS, Rizal S, Kralingen KW, Niessen L. Clinical spectrum of patients presenting with bronchiectasis in Nepal: evidence of linkage between tuberculosis, tobacco smoking and toxic exposure to biomass smoke. Kathmandu Univ Med J. 2008;6(2):195-203. PubMed: pubmed.ncbi.nlm.nih.gov/18769086 Google Scholar Full Text
6. Edwards EA, Metcalfe R, Milne DG, Thompson J, Byrnes CA. Retrospective review of children presenting with non cystic fibrosis bronchiectasis: HRCT features and clinical relationships. Pediatr Pulmonol. 2003;36(2):87-93. DOI: 10.1002/ppul.10339 PubMed Google Scholar Full Text
7. Rifai D, Hadid W, Rodgers DE, Sadikot RT. Bronchiectasis: A Correlation Between Chest CT Scan Findings and Pulmonary Function Test. Chest. 2010;138(4):506A. DOI: 10.1378/chest.10569 Google Scholar Full Text
8. Goeminne PC, Scheers H, Decraene A, Seys S, Dupont LJ. Risk factors for morbidity and death in non-cystic fibrosis bronchiectasis: A retrospective cross-sectional analysis of CT diagnosed bronchiectatic patients. Respir Res. 2012;13(1):21. DOI: 10.1186/1465-9921-13-21 PubMed Google Scholar Full Text
9. Onen ZP, Gulbay BE, Sen E, Yildiz OA, Saryal S, Acican T, et al. Analysis of the factors related to mortality in patients with bronchiectasis. Respir Med. 2007;101(7):1390-7. DOI: 10.1016/j.rmed.2007.02.002 PubMed Google Scholar Full Text
10. Bulcun E, Arslan M, Ekici A, Ekici M. Quality of Life and Bronchial Hyper-Responsiveness in Subjects With Bronchiectasis: Validation of the Seattle Obstructive Lung Disease Questionnaire in Bronchiectasis. Respir Care. 2015;60(11):1616-23. DOI: 10.4187/respcare.04056 PubMed Google Scholar Full Text
11. Guan WJ, Gao YH, Xu G, Li HM, Yuan JJ, Zheng JP, et al. Bronchodilator response in adults with bronchiectasis: correlation with clinical parameters and prognostic implications. J Thorac Dis. 2016;8(1):14-23. DOI: 10.3978/j.issn.2072-1439.2016.01.15 PubMed Google Scholar Full Text
12. Pellegrino R, Viegi G, Brusasco V, Crapo RO, Burgos F, Casaburi R, et al. Interpretative strategies for lung function tests. Eur Respir J. 2005;26(5):948-68. DOI: 10.1183/09031936.05.00035205 PubMed Google Scholar Full Text
13. Habesoglu MA, Ugurlu AO, Eyuboglu FO. Clinical, radiologic, and functional evaluation of 304 patients with bronchiectasis. Ann Thorac Med. 2011;6(3):131-6. DOI: 10.4103/1817-1737.82443 PubMed Google Scholar Full Text
14. Kim SH, Yang B, Yoo JY, Cho JY, Kang H, Shin YM, et al. Clinical characteristics, radiological features, and disease severity of bronchiectasis according to the spirometric pattern. Sci Rep. 2022;12(1):13167. DOI: 10.1038/s41598-022-17448-6 PubMed Google Scholar Full Text
15. Lopes AJ, Camilo GB, de Menezes SLS, Guimarães FS. Impact of different etiologies of bronchiectasis on the pulmonary function tests. Clin Med Res. 2015;13(1):12-9. DOI: 10.3121/cmr.2014.1234 PubMed Google Scholar Full Text
16. Radovanovic D, Santus P, Blasi F, Sotgiu G, D'Arcangelo F, Simonetta E, et al. A comprehensive approach to lung function in bronchiectasis. Respir Med. 2018;145:120-9. DOI: 10.1016/j.rmed.2018.11.007 PubMed Google Scholar Full Text