

# Evaluation of Clinico-Radiological and Functional Profile of Patients with Bronchiectasis According to FACED Score

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## ABBREVIATIONS USED IN THIS ARTICLE

FEV<sub>1</sub> = Forced Expiratory Volume in First Second

HRCT = High Resolution Computed Tomography

HIV = Human Immunodeficiency Virus

mMRC = modified Medical Research Council

FRC = Functional Residual Capacity

COPD = Chronic Obstructive Pulmonary Disease

## Abstract

**Objective.** Bronchiectasis is a suppurative lung disease characterised by wide and distorted bronchi, with profuse expectoration, resulting in impaired quality-of-life. The present study evaluated the clinico-radiological and functional characteristics of patients with bronchiectasis.

**Methods.** A hospital-based, prospective, cross-sectional study was conducted for one year. Chest radiograph followed by high resolution computed tomography was done in patients with features suggestive of bronchiectasis. All patients were assessed with spirometry, sputum gram-stain and pyogenic culture-sensitivity. Severity was assessed using FACED score.

**Results.** Eighty patients (38 males) were included in the study with a mean age of 47.0±13.7 years. Average lung involvement was ≥2 lobes and cystic bronchiectasis was the most common abnormality. Shortness of breath (91%) and cough with expectoration (87%) were the most frequent complaints. The most common functional impairment was obstructive (58.7%), with a mean percent predicted forced expiratory volume in first second (FEV<sub>1</sub>) of 55.8±15.1. The patients with *Pseudomonas* spp growth in sputum culture had more severe disease in the form of more number of lobes involvement and cystic destruction (P<0.001).

**Conclusions.** Bronchiectasis is a progressive disease with significant morbidity and mortality. While radiology plays an important role in the diagnosis, microbiology is an important aspect in the management of the diseases as well as in preventing exacerbations/disease progression.

## Introduction

Bronchiectasis is defined as permanently dilated airways due to chronic bronchial inflammation caused by inappropriate clearance of various micro-organisms and recurrent or chronic infection.<sup>1</sup> The development of bronchiectasis appears dependent on declining pulmonary functions as well as airway colonisation by potential pathogens, particularly *Pseudomonas* species.<sup>2,3</sup> The relationship between bronchiectasis and bacterial colonisation appears to reflect a self-perpetuating pro-inflammatory state.

Unfortunately, bronchiectasis has received insufficient attention, considered as an “orphan disease”. With widespread availability of high-resolution computed tomography (HRCT), it is now being increasingly recognised as an important cause of respiratory impairment.<sup>4</sup> However, there were not many standardised disease severity scores. FACED score is being increasingly used to assess severity in patients with bronchiectasis.<sup>5-10</sup>

Predicting the severity of respiratory impairment and exacerbation frequency in these patients has always been difficult as radiological extent has little correlation with disease severity.<sup>3</sup> The severity assessment is essential for appropriate treatment of the patients, stratification of the risk of complications, reduction of the costs associated with the disease, as well as operational research activities.<sup>8-10</sup> It has been proposed that a combination of clinical, radiological and microbiological features can be used to assess severity.<sup>11-13</sup>

There is paucity of data on this important disease, especially in resource-limited settings, like India. The present study was conducted to assess the clinico-radiological and functional profile of patients with bronchiectasis.

## Material and Methods

A hospital-based prospective study over one year from December 2016 to December 2017 was conducted at Department of Respiratory Medicine, Institute of Respiratory Diseases, Sawai Man Singh Medical College, Jaipur, Rajasthan. Ethical clearance was taken from the Institutional Ethical Committee.

Eighty patients with newly or previously diagnosed bronchiectasis were included. All patients gave written consent to participate in the study. Patients who received antibiotic therapy in the last four weeks, human immunodeficiency virus (HIV) patients, interstitial lung disease patients and pregnant females were excluded from the study. All patients were subjected to chest radiograph followed by HRCT of the chest. All cases were assessed with spirometry and sputum pyogenic

culture. The severity was assessed by FACED scoring.

The FACED score incorporates five dichotomised variables:

F: FEV<sub>1</sub>% predicted (forced expiratory volume in first second): functional evaluation – cut-off 50% (>50%: 0 points; ≤50%: 2 points).

A: Age: physiological parameter – cut-off 70 years (≤70: 0 points; >70: 2 points).

C: Chronic colonisation by *Pseudomonas aeruginosa*: microbiological parameter – dicotomic parameter: maximum value 1 point.

E: Radiological extension of the disease – number of affected lobes: radiological evaluation – cut-off 2 lobes (≤2 affected lobes: 0 points; >2 affected lobes: 1 point).

D: Dyspnoea – mMRC (modified Medical Research Council Dyspnoea Scale): clinical evaluation – cut-off grade II of the mMRC scale (≤II: 0 points; >II: 1 point).

An overall score is derived as a sum of the scores for each variable and it may range from 0 to 7 points. In this score, bronchiectasis is classified in 3 severity classes: mild (over all score 0-2 points), moderate (over all score 3-4 points) and severe (over all score 5-7 points).

## Results

Out of 80 patients with bronchiectasis, maximum (47.5%) were over 50 years of age. Mean age of the patients was 47.0±13.7 years. Most of the cases were females (52.5%). About 62.5% of the patients were smokers. Shortness of breath (91%) and cough with sputum production (87%) were the most common complaints reported by the patients, followed by chest pain (45%), fever (43%) and haemoptysis (17%).

On spirometry, most common functional impairment was obstructive (58.7%) followed by restrictive (17.5%) and mixed (15%) physiology. The mean (± SD) of FEV<sub>1</sub>, FEV<sub>1</sub>/FVC (forced vital capacity) and FVC of the study population was 55.8% (± 15.1%), 60.8% (± 16.2%) and 55.0% (± 25.9%) of predicted, respectively. Cor-pulmonale was the most common comorbidity (35%) followed by recurrent childhood infections in 20%.

*Pseudomonas* spp was the most common organism grown on sputum culture followed by *Staphylococcus* spp (Table 1). HRCT chest revealed involvement of 2 or more lobes showing evidence of bronchiectasis, and the most common pattern was bilateral lower lobe involvement (Table 1). The most common lobe involved was the right lower lobe (50%). Cystic bronchiectasis was present in 43.7% cases (Table 1). In FACED scoring, 49% of the cases were in moderate severity. The mean FACED score was 3.7±1.3 (Table 2).

**Table 1. Micro-organisms isolated on sputum cultures, extent of involvement and type of bronchiectasis**

Micro-organisms	Number of Cases in Which Organism Present (Percentage)
<i>Pseudomonas</i> spp	26 (32.5)
<i>Staphylococcus</i> spp	17 (21.5)
<i>Streptococcus</i> spp	12 (15.0)
<i>Haemophilus</i> spp	7 (8.8)
<i>Enterobacter</i>	5 (6.3)
<i>Klebsiella</i>	2 (2.5)
<i>Citrobacter</i>	1 (1.3)
Non-tuberculous mycobacteria	
<i>Mycobacteria avium</i> complex	6 (7.5)
Others	2 (2.5)
Normal commensal	2 (2.5)
<b>Lobes Involved</b>	
Right upper lobe	25 (31.4)
Right middle lobe	19 (24.0)
Right lower lobe	40 (50.0)
Left upper lobe	12 (15.0)
Left lower lobe	39 (49.0)
<b>Type of Bronchiectasis</b>	
Cystic	35 (43.8)
Varicose	34 (42.5)
Cylindrical	11 (13.8)

**Table 2. Values of the FACED score variables and FACED score**

Variable	Patients (Percentage) (N=80)
FEV <sub>1</sub> % predicted	
<50	32 (40)
>50	48 (60)
Age (years)	
>70	0
<70	80 (100)
Chronic colonisation by <i>Pseudomonas</i> spp	
Yes	26 (32.5)
No	54 (67.5)
Radiological extent (HRCT chest )	
>2 lobes affected	48 (60)
<2 lobes affected	32 (40)
mMRC dyspnoea score	
>2	74 (92.5)
<2	6 (7.5)
<b>FACED scoring#</b>	
Mild	13 (16)
Moderate	39 (49)
Severe	28 (35)

#Mean FACED scoring (±SD) 3.8±1.3

Most of the patients with severe disease were older males (57.1%). Patients with mild and moderate disease had a smoking history of 53.8% and 43.6%, respectively. Dyspnoea (92.9%) was the most common presenting complaint followed by cough with expectoration (89.3%). Crepitations were the most common clinical sign found in more than two-third of the subjects, followed by rhonchi which was more common in patients with severe disease. Clubbing was uncommon and seen mainly in patients with severe disease (14.3%) (Table 3).

*Pseudomonas* spp on sputum culture was most common in those with severe disease (50%) as compared to those with moderate disease (30.8%). No patient with mild disease grew *Pseudomonas* on sputum culture. This difference in *Pseudomonas* in relation to severity of the disease was found to be statistically significant (P=0.006) (Table 4).

**Table 3. Baseline characteristics of the study patients according to severity of the disease (n=80)**

Characteristics	Mild	Moderate	Severe	P value (ANOVA)
Age (in years) (Mean±SD)	42.7±15.1	47.6±13.5	48.0±13.6	0.473
Gender, Male [No. (%)]	5 (38.5)	19 (48.3)	16 (57.1)	0.52
<b>Smoking habit</b>				0.07
Smokers, No. (%)	6 (46.1)	22 (56.4)	22 (%)	
Non-smokers, No. (%)	7 (53.8)	17 (43.6)	6 (21.4)	
<b>Respiratory symptoms</b>				
Dyspnoea, No. (%)	10 (76.9)	37 (94.9)	26 (92.9)	0.18
Cough, No. (%)	1 (7.7)	5 (12.8)	2 (7.1)	0.45
Expectoration, No. (%)	12 (92.3)	33 (84.6)	25 (89.3)	0.81
Haemoptysis, No. (%)	4 (30.8)	6 (15.4)	4 (14.3)	0.34
Fatigue, No. (%)	6 (46.2)	19 (48.7)	11 (39.3)	0.74
Chest pain, No. (%)	5 (38.5)	17 (43.6)	14 (50)	0.14
Fever, No. (%)	9 (69.2)	17 (43.6)	9 (32.1)	0.65
<b>Clinical sign</b>				
Clubbing, No. (%)	0	01 (2.6)	04 (14.3)	0.14
Crepitations, No. (%)	10 (76.9)	31 (79.6)	22 (78.6)	0.981
Rhonchi, No. (%)	3 (23.1)	17 (43.6)	17 (60.7)	0.072
<b>Duration of illness</b>				
Mean± SD			Minimum	Maximum
	7.0±2.9		2	15

P value &lt;0.05 is statistically significant

**Table 4. Organisms cultured on sputum according to severity of the disease**

Organisms	Mild N (%)	Moderate N (%)	Severe N (%)	P value
<i>Pseudomonas</i>	0	12 (30.8)	14 (50)	0.006 (S)
<i>Haemophilus</i>	2 (15.4)	4 (10.3)	1 (3.6)	0.413
<i>Staphylococci</i>	6 (46.1)	6 (15.3)	5 (17.8)	0.055
<i>Streptococci</i>	2 (15.4)	6 (15.3)	4 (14.3)	0.991
<i>Enterobacter</i>	0	4 (10.3)	1 (3.6)	0.320
<i>Citrobacter</i>	0	2 (5.1)	0	0.340
<i>Klebsiella</i>	1 (7.7)	0	1 (3.6)	0.277
<i>Mycobacteria avium</i> complex	1 (7.7)	1 (2.6)	0	0.340
Others	0	4 (10.3)	2 (7.1)	0.476
Normal commensal	1 (7.7)	0	0	0.074

On spirometry, obstructive and mixed type of pattern was most common in patients with severe disease (64.3% and 28.6%). All patients with mild disease had FEV<sub>1</sub> >50%. Multiple lobes (≥2 lobes) involvement was more common in patients with severe disease (64.3%). The mMRC score ≥2 was seen in all the patients with severe disease (Table 5). The type of bronchiectasis was correlated with multiple variables; however, only cor-pulmonale was found to have a statistically significant association. Similarly, haemoptysis was found to have a significant association with number of lobes involved (Table 5).

**Table 5. Spirometric pattern, FEV1, number of lobes involved and mMRC score according to the severity of bronchiectasis**

Spirometry Pattern	Mild N (%)	Moderate N (%)	Severe N (%)	Total N (%)	P value
Normal	5 (38.5)	2 (5.1)	0	7 (8.7)	<b>0.002</b>
Obstructive	6 (46.1)	21 (53.8)	18 (64.3)	45 (56.3)	Chi-square=4.281 with 2 degrees of freedom
Restrictive	1 (7.7)	11 (28.3)	2 (7.1)	14 (17.5)	P=0.41
Mixed	1 (7.7)	5 (12.8)	8 (28.6)	14 (17.5)	
<b>FEV<sub>1</sub> %</b>					Chi-square=51.108 with 2 degrees of freedom
>50	13 (100)	33 (84.6)	2 (92.9)	48 (60)	P <0.001
≤50	0	6 (15.4)	26 (7.1)	32 (40)	
<b>No. of Lobe</b>					Chi-square=1.291 with 2 degrees of freedom
<2	8 (61.5)	15 (38.5)	10 (35.7)	32 (40)	P=0.045
≥2	5 (38.5)	24 (61.5)	18 (64.3)	48 (60)	
<b>mMRC SCORE</b>					Chi-square= 12.733 with 2 degrees of freedom
<2	4 (30.8)	2 (5.1)	0	6 (7.5)	P=0.004
≥2	9 (69.2)	37 (94.9)	28 (100)	74 (92.5)	

P<0.05 is statistically significant

## Discussion

In the present study, bronchiectasis was present in patients with advanced age and predominantly in females. These results were similar to the study done by Gavazzi and Krause *et al*<sup>14</sup> and Martinez-Garcia *et al*<sup>3</sup>. However, in our study, age had least weightage in FACED score, as all the cases were less than 70 years. The immune system and the microbiome undergoes its own change with age, a process incompletely understood and is called 'immunosenescence'.<sup>15,16</sup> It is hypothesised that global shift in ageing will continue to influence the burden of bronchiectasis and consequent implications on the health-care system.

In our study, most patients were smokers. Smoking causes chronic obstructive pulmonary disease (COPD) but is probably not an aetiology for bronchiectasis. It is important to understand that there is an overlap in clinical characteristics of COPD and bronchiectasis which have prognostic and management implications. The bronchiectasis severity was assessed by FACED score in our study, and mostly moderate and severe cases were found. Shortness of breath (91.2%) was the most common symptom followed by cough with expectoration. These observations were similar to the study by Dimakou *et al*.<sup>17</sup> The severity of dyspnoea is the major determinant of severity of bronchiectasis, independent of lung function.

Another variable of FACED score was colonisation where *Pseudomonas* spp was the most common bacteria cultured in sputum followed by *Staphylococcus* spp. In



the study by Edmundo Rosales-Mayor, it was observed that *Pseudomonas* spp impaired lung function severely and had high rate of hospitalisation; whereas in other studies *Haemophilus influenzae* was the most commonly isolated bacteria.<sup>18-20</sup> *Haemophilus* was cultured in less number of patients in our study. One of the limitations could possibly be that *Haemophilus* spp needs to be cultured within three hours of sample collection; which was not logistically feasible in the present study.

Next variable in FACED score is the extent of disease determined by HRCT which has been the gold standard diagnostic method for bronchiectasis. In our study, cystic bronchiectasis, involvement of more than one lobe and bilateral lung fields were predominant in severe cases. Lynch *et al*<sup>21</sup> pointed out that the type of bronchiectasis might be a predictor of the severity of the disease; the distortion and inflammation of the airways can be more serious with cystic component which is also reflected in clinical severity, as observed in our study also. We observed that there was no significant difference between right lower lobe and left lower lobe involvement similar to the study by King *et al*.<sup>22</sup>

Another important variable in FACED stands for FEV<sub>1</sub> which determines the severity of airflow obstruction. Our results were similar with the other studies.<sup>22,23</sup> The most common co-morbidity associated with bronchiectasis observed in our study was cor-pulmonale, similar to be reported by Gale *et al*.<sup>24</sup> Haemoptysis was more common in those patients who had only one lobe involvement and those presented with shorter duration of illness. It is hypothesised that patients with haemoptysis were higher than other studies probably due to tubercular aetiology.

On physical examination, crepitations was the most frequent finding followed by rhonchi but in severe cases rhonchi was predominantly present, as also observed in another study.<sup>23</sup>

## Conclusions

The FACED score is a useful tool to assess morbidity and mortality in patients with bronchiectasis, as it incorporates various clinical, functional, radiological and microbiological aspects of the disease.

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