Original Article

A Study of Clinical, Radiological and Spirometric Profile in Post-Pulmonary Tuberculosis Patients in Tertiary Care Center of Western U.P

Arpit Goel[1], Mazher Maqusood[2], Pradeep Nirala[3], Abhishek Kumar[4], Chinmay Jethi[5], Rajul Rastogi[6], Chayan Chaplot[1], Manisha Rajak[1], Hemax Gandhi[1]

[1]Resident, Department of Respiratory Medicine, Teerthanker Mahaveer Medical College & Research Centre, Delhi Road, Moradabad, Uttar Pradesh, India. [2]Professor & HOD, Department of Respiratory Medicine, Teerthanker Mahaveer Medical College & Research Centre, Delhi Road, Moradabad, Uttar Pradesh, India. [3]Professor, Department of Respiratory Medicine, Teerthanker Mahaveer Medical College & Research Centre, Delhi Road, Moradabad, Uttar Pradesh, India. [4]Associate Professor, Department of Respiratory Medicine, Teerthanker Mahaveer Medical College & Research Centre, Delhi Road, Moradabad, Uttar Pradesh, India. [5]Assistant Professor, Department of Respiratory Medicine, Teerthanker Mahaveer Medical College & Research Centre, Delhi Road, Moradabad, Uttar Pradesh, India. [6]Professor, Department of Radiology, Teerthanker Mahaveer Medical College & Research Centre, Delhi Road, Moradabad, Uttar Pradesh, India

Abstract

Background: Pulmonary tuberculosis (PTB) causes variations in the pulmonary parenchyma. Considerable symptoms, radiographic issues, spirometry abnormalities, and a reduced quality of life are present in cases with post-TB patients. For correct diagnosis and treatment of COPD, a comprehensive understanding of clinical, radiological, and spirometric data is essential. Therefore, more recent research on this subject is always needed in nations like India where tuberculosis is highly prevalent. Thus the present study was done assessing clinical-radiological and spirometric profile in post-pulmonary TB cases in tertiary care center of Western Uttar Pradesh. **Material and Methods:** Present cross-sectional study was conducted on 163 patients aged 18 yrs and above who have completed anti-tuberculosis treatment. Clinical history, sputum examination (AFB/CBNAAT), Chest x-ray, spirometry evaluation, severity of airflow limitation were assessed. Data was evaluated using statistical analysis with SPSS version 20.0 software (IBM Chicago). **Results:** Right and upper zone (38%) was most commonly affected. 52.8% cases had Degree 2 involvement, with 63.2% cases with reduced DLCO. A significant relation ($p<0.05$) was seen between CXR degree of involvement with mMRC grading; between post-TB period with mMRC grading; between PFT abnormalities with degree of involvement; between mean post-TB period with FEV1%; mean pack years of smoking with airflow obstruction. **Conclusion:** Since post-TB can occur at any point during or following TB treatment, it is crucial to provide PTB patients with appropriate counseling and to follow up with them on a regular basis even after anti-TB therapy is finished. To identify lung damage early in its progression, regular spirometry may be helpful. In order to reduce post-TB fibrosis, early identification and adequate treatment of PTB are crucial.

Keywords: Spirometry; Tuberculosis; Pulmonary; Radiology.

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Introduction

Tuberculosis (TB) poses a threat to public health, being one of the main reasons of mortality and morbidity, particularly in the developing nations. India reflects more than 25% of tuberculosis burden worldwide.[1] Pulmonary tuberculosis (PTB) causes variations in the pulmonary parenchyma. Respiratory failure, pulmonary impairments, and a progressive decline in lung function are all linked to reduced airway lung volume in Tuberculosis-destroyed lung (TDL) cases.[2] Smoking, malnourishment, delayed TB diagnosis, extent of lung involvement, prior treatments, and higher bacillary load at start of anti-TB t/t has all been linked to greater lung damage.[3]

Both treated and untreated patients may have a range of consequences in extra-pulmonary and pulmonary areas. Most patients have lingering pulmonary sequelae even after receiving adequate treatment. Considerable symptoms, radiographic issues, spirometry abnormalities, and a reduced life quality are present in cases with post-TB results.[4] Abnormal spirometry and repeated symptoms, which are frequently misdiagnosed as recurrent TB infection, are indicative of post-tuberculosis lung disease.[5] Although post-tuberculosis lung dysfunction is rather common and is linked to a lower quality of life, there is a dearth of information regarding altered pulmonary function in pulmonary tuberculosis survivors.[6]

Spirometry is widely used to measure the impact of lung disease on lung function, evaluate airway responsiveness, track the course of the disease, and determine a prognosis for pulmonary conditions. On spirometry, obstructive, restrictive, or mixed

Address for correspondence: Dr. Pradeep Nirala, Professor, Department of Respiratory Medicine, Teerthanker Mahaveer Medical College & Research Centre, Delhi Road, Moradabad, Uttar Pradesh, India.
E-mail: pradeep.nirala1195@gmail.com

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ventilatory abnormalities are defined by the values of FEV1, FVC, and FEV1/FVC.[7] Fibrosis, bronchiectasis, and cavitations are frequently visible on chest X-rays.[8] Coughing, dyspnea, and chest pain are unusual symptoms that can occur with a variety of various illnesses. A link between radiography, spirometry, and symptoms is more likely to provide us with a more precise diagnosis and aid in patient care.

For correct diagnosis and treatment of COPD, a comprehensive understanding of clinical, radiological, and spirometric data is essential. Therefore, more recent research on this subject is always needed in nations like India where tuberculosis is highly prevalent. Thus the present study was done assessing clinical-radiological and spirometric profile in post-pulmonary TB cases in tertiary care center of Western Uttar Pradesh.

Materials and Methods

The present observational prospective cross-sectional study was conducted in the Department of Respiratory Medicine in a tertiary hospital, Western Uttar Pradesh from June 2023 to May 2026. A total of 163 patients aged 18yrs and above who have completed anti-tuberculosis treatment as per the standard guidelines for 6 months were included in the study. Patients suffering from non-tubercular diseases of lung fibrosis; HIV-positive patients; those who were active tuberculosis cases and defaulter cases during treatment were excluded from the study. Subjects with history of obstructive airway disease or other chronic lung disease prior to TB were also excluded. All included patients were explained about the study and a written informed consent was taken. The present study was conducted after taking clearance from Institutional Ethical Committee (…….).

All included patients were interviewed using a structured questionnaire regarding present complaints; past pulmonary tuberculosis and its therapy. Extent of smoking was subsequently

assessed using 'smoking index' (SI) i.e., Number of bidi or cigarette smoked per day multiplied by duration of smoking in years. Vital signs including saturation of oxygen and detailed respiratory system examination findings were documented. Sputum examination (AFB/CBNAAT) was done to rule out active tuberculosis. Chest x-ray (posterior-anterior view) was evaluated for signs of inactive TB. Extent of lesions (pulmonary fibrosis, cavity, parenchymal calcification and bronchiectasis) in chest x-ray was assessed. Subsequently spirometry evaluation was done before and fifteen minutes after administration of 400 microgram salbutamol using pressurized metered-dose inhaler (pMDI) with small-volume spacer device. FEV1, FVC, PEFR (Peak Expiratory Flow Rate) and FEF 25-75 (Mid-expiratory flow rate), DLCO was recorded. Severity of airflow limitation was assessed using post-bronchodilator FEV1 based on latest GOLD guideline.

Statistical analysis: All quantitative variables were recorded as mean standard deviation and qualitative variables as frequency and percentage. Data was evaluated using statistical analysis with SPSS version 20.0 software (IBM Chicago).

Results

Maximum (34.97%) subjects were aged 51-60yrs, with mean age being 53.72yrs. Maximum (55.2%) subjects were males and 44.8% were females. Maximum (44.8%) subjects were housemakers, followed by 41.7% farmers, 9.8% labourers. 80.4% cases did not have any co-morbidity, whereas 12.9% had hypertension and 9.2% had DM. Most of cases (33.7%) had mMRC grade 3, followed by 30.1% with grade 2, 20.2% with grade 4 and 7.4% with grade 1. Mean duration of post-PTB period was 8.30 and mean SOB was 3.20yrs. [Table 1] Most of cases (82.8%) had cough, with mean duration of cough being 0.87years. 11.7% had Hemoptysis, whereas 88.3% cases didn't reported hemoptysis. 30.06% had chest pain, with mean duration of chest pain being 0.128yrs. 11.7% had fever, followed by 3.1% suffering from generalised weakness. 33.7% had history of smoking, from average 8.9yrs. Mean smoking index was 275 and mean pack years were 9.45yrs.

Right side was most commonly involved, followed by left side and bilateral involvement on chest xray. Upper zone (38%) was most commonly affected, followed by middle (34.4%) and lower zones (30.1%) of right side. In left side, middle zone (25.2%) was most commonly affected, followed by upper (23.9%) and lower (19.6%) zones. In bilateral, upper zone was most commonly involved (12.9%), followed by lower (6%) and middle zone (2.5%). 30.1% cases showed cavitation on CXR. Maximum 52.8% cases had Degree 2 involvement, followed by 28.2% with degree 1 and 19% with degree 3 involvement. Maximum 69.9% cases had mixed pattern on PFT, followed by 16.6% being normal and 11.7% having obstructive pattern and 1.8% restrictive pattern. Maximum 63.2% cases had reduced DLCO, and 27% being normal. 23.9% cases had Post bronchodilator reversibility. Mean FEV1% was 50.66%. Maximum 38% had severe airflow obstruction, followed by 23.9% with moderate and 17.8% with very severe obstruction.

Out of 46 cases with in degree 1, maximum Cases (30.4%) had mMRC grade 2, followed by grade 3 (26%). Out of 86 cases with degree 2, maximum 32.56% had mMRC grade 2, followed by grade 3 (31.39%). Out of 31 cases with degree 3, maximum 51.6% had mMRC grade 3, followed by grade 2 and grade 4 (22.58%). A significant relation ($p<.05$) was seen between CXR degree of involvement and mMRC grading. [Table 2] Mean post-TB period was highest in mMRC grade 4 (10.09years), followed by grade 3 (9.07years), grade 1 (7.75years). A significant relation ($p<0.05$) was seen between post-TB period and mMRC grading. [Table 3] Out of 46 cases with in degree 1, maximum Cases (41.3%) had normal PFT, followed by (28.3%) with obstructive abnormality. Out of 86 cases with degree 2, maximum 84.9% had mixed PFT, followed by 8.1% with normal findings. Out of 31 cases with degree 3, maximum 93.5% had mixed pattern on PFT, followed by obstructive abnormality (6.5%). A significant relation ($p<.05$) was seen between PFT abnormalities degree of involvement. [Table 4]

Mean post-TB period was found to be significantly ($p<.05$) correlated with FEV1%. [Table 5] Mean pack years of smoking were highest in very severe obstruction (16.37 pack years), followed by moderate (9.71 pack years), severe (7.43 pack years)

airflow obstruction. A significant relation (p<.05) was seen between pack years of smoking and airflow obstruction. [Table 6]

Table 1: Demographic profile

Parameters		Frequency (n)	Percentage (%)
Age groups (yrs)	<20	4	2.454
	20-30	9	5.521
	31-40	14	8.589
	41-50	26	15.951
	51-60	57	34.969
	>60	53	32.515
Gender	Female	73	44.8
	Male	90	55.2
Occupation	Cotton industry worker	1	.6
	Farmer	68	41.7
	Housemaker	73	44.8
	Labour	16	9.8
	Painter	1	.6
	Polish industry worker	1	.6
	Student	3	1.8
mMRC grade	Grade 0	14	8.6
	Grade 1	12	7.4
	Grade 2	49	30.1
	Grade 3	55	33.7
	Grade 4	33	20.2

Table 2: Degree of involvement on CXR with mMRCgrading

mMRCgrading	Degree 1 (n=46)		Degree 2 (n=86)		Degree 3 (n=31)	
	Freq. (n)	Perc. (%)	Freq. (n)	Perc. (%)	Freq. (n)	Perc. (%)
Grade 0	9	19.565	4	4.651	1	3.226
Grade 1	5	10.869	7	8.139	0	0
Grade 2	14	30.435	28	32.558	7	22.581
Grade 3	12	26.087	27	31.395	16	51.613
Grade 4	6	13.043	20	23.256	7	22.581
Total	46	100	86	100	31	100
Chi square	1.778					
p-value	0.002*					

*p<0.05 is significant.

Table 3: Duration of post-TB period(in years) with mMRCgrading

MMRC grading	Post-TB period(inyears)	
	Mean	SD
Grade 0	8.000	7.093
Grade 1	7.750	7.641
Grade 2	6.452	7.845
Grade 3	9.077	8.873
Grade 4	10.099	10.545
ANOVA	3.819	
p-value	0.045*	

*p<.05 is significant.

Table 4: Degree of involvement on CXR with PFT abnormalities

PFT abnormalities	Degree 1 (n=46)		Degree 2 (n=86)		Degree 3 (n=31)	
	Freq. (n)	Perc. (%)	Freq. (n)	Perc. (%)	Freq. (n)	Perc. (%)
Mixed	12	26.1	73	84.9	29	93.5
Normal	19	41.3	7	8.1	0	0
Obstructive	13	28.3	5	5.8	2	6.5
Restrictive	2	4.3	1	1.2	0	0
Total	46	100.0	86	100.0	31	100.0
Chi square	2.008					
p-value	0.032*					

*p<0.05 is significant.

Table 5: Duration of post-TB period (in yrs) with FEV1

	Post-TB period	FEV1
Mean	8.3047	50.6564
Std. Deviation	8.73914	23.40027
Std. Error Mean	.68450	1.83285
Mean difference	-42.35172	

Std. Deviation		25.43080
Std. Error Mean		1.99189
95% CI	Lower	-46.285
	Upper	-38.418
t-test		-21.262
df		162
p-value		0.0001*

*p<0.05 is significant.

Table 6: Pack years of Smoking with Severity of airflow obstruction

Severity of airflow obstruction	Pack years of Smoking	
	Mean	SD
Normal	6.8966	12.91551
Mild	6.2500	12.50000
Moderate	9.7179	15.73456
Severe	7.4355	13.13688
Very severe	16.3793	18.89334
ANOVA	4.446	
p-value	0.008*	

*p<0.05 is significant.

Discussion

A major and expanding public health concern is Post-Tuberculosis Lung Disease (PTLD), a chronic after effect of tuberculosis (TB) in which patients continue to have respiratory symptoms and reduced lung function following microbiological cure. Due to variations in treatment effectiveness, comorbidities, and environmental exposures, its prevalence varies greatly and is more common in nations with high rates of tuberculosis.[9]

In present study, mean age of patients was 53.72yrs, with male predominance (55.2%). Maximum (44.8%) subjects were housemakers. In accordance with our study, Santra A et al,[10] found that in cases having post-PTB, male predominance (84.06%) was observed, with average age of 53.39yrs. Dash M et al,[11] observed that mean age of cases having post PTB was 51.39±13.73 years., with male predilection (71%) and maximum (29%) were farmers.

In our study, maximum 33.7% cases had mMRC grade 3, and minimum 7.4% with grade 1. As in our research, Adwani S et al,[12] found that maximum (40%) had mMRC dyspnea Grade III; and 9.7% had Grade I. In our study, most of cases (82.8%) had cough, with mean duration of cough being 0.87years. 11.7% had Hemoptysis, 30.06% had chest pain, with mean duration being 0.128yrs. In accordance with our study, Santra A et al,[10] found that the most common symptom (95.65%) was Dyspnoea, followed by cough (89.85%) and expectoration (75.36%). %). Dash M et al,[11] observed that 54% had cough, 40% breathlessness and 28% had Haemoptysis. As in our research, Adwani S et al,[12] found that maximum (98%) cases had breathlessness (98%), 80% had cough, 69% had expectoration, 32% had chest pain, 29% had weight loss and 23% had fever.

We found that 30.1% cases showed cavitation on CXR, with maximum 38% cases had right upper zone involvement. Dash M et al,[11] observed that maximum cases (56%) had fibrosis and 38% had emphysema. As in our research, Adwani S et al,[12] found that maximum 56% cases had emphysema. In our study, maximum 52.8% cases had Degree 2 involvement. Similarly, Santra A et al,[10] found that the most common radiological extent was Degree II (52.17%), Degree I (24.64%) and Degree III (17.39%).

We found that maximum 69.9% cases had mixed PFT. In accordance with our study, Dash M et al,[11] observed that most of the cases (52%) had mixed pattern. The widespread fibrosis that coexists with airflow obstruction can account for the high occurrence of mixed patterns. Due to low socioeconomic conditions, persons in India frequently present to medical facilities late in the course of their tuberculosis is treatment, making this type of fibrotic sequelae rather common. In our study, maximum 63.2% cases had reduced DLCO. Byrne A et al,[13] found that maximum 33% cases had Abnormal DLCO > 60%.

Our study revealed that with higher mMRC grades, degree of involvement also increased significantly on radiographs. A significant relation (p<0.05) was seen between PFT abnormalities and degree of involvement. Our study results signify that FEV1% significantly depends on post-TB duration. Our study results signify that degree of obstruction is significantly associated with pack years of smoking. In accordance with our study, Santra A et al,[10] found that with higher degree of radiological lesion, more severe obstruction of airflow was associated. Severity of limitation of airflow was observed - based on extension of r/g lesion. As seen in our study, correlation between radiological extent and level of airway obstruction was considerably significant. Since post-TB can occur at any point during or following TB treatment,[14,15] it is crucial to provide PTB patients with appropriate counseling and to follow up with them on a regular basis even after anti-TB therapy is finished.

Limitations of study

1. The outcomes of this study may not be applicable to other centers due to its single-center experience.
2. The very small sample size of 163 patients is another significant drawback that may reduce the statistical ability to identify subtler but possibly clinically significant changes, especially in secondary outcomes. The research may not have been sufficiently powered for all evaluated outcomes. Therefore, larger, multi-center trials are required to confirm these results, enhance generalizability.

Conclusion

Even when tuberculosis treatment is successfully completed, aberrant spirometric readings continue to exist. Various radiological abnormalities have been found as complications and sequelae to tuberculosis healings that affect quality of life. The kind of defect varies depending on the degree of the disease, with obstructive patterns being the most common. Even after the microbiological infection has been treated with Anti tubercular therapy, long-term monitoring is crucial. We suggest that further prospective studies and clinical trials should be conducted on a larger sample covering large Indian population, so that results could be generalised.

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Conflicts of interest

There are no conflicts of interest.

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