

Assessment of Pulmonary Function Impairments in Treated Sputum Positive Pulmonary Tuberculosis Patients.

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Abstract

Objectives: The present study was conducted to assess patient characteristics and to determine Pulmonary Function impairments in treated sputum positive pulmonary tuberculosis patients. Also, to compare and correlate patient characteristics and pulmonary function derangements in such patients.

Materials and methods: A prospective study was conducted on 30 patients visiting a tertiary care centre for treatment of tuberculosis. Newly diagnosed sputum positive PTB cases (age > 18 years) who completed 6 months of AKT and declared cured, were included and evaluated within 1 year duration of completion of their treatment

Results: Total 30 patients were examined. 22 patients were males and 8 were females. 14 (47%) were found to have normal PFT while rest 16 (53%) had an abnormal PFT. The most common PFT abnormality was airway obstruction in 9 (30%) patients of which, 8 patients had predominantly small airway obstruction. 5 (17%) patients had restrictive lung functions, while 2 (7%) had mixed i.e. restrictive and obstructive lung functions, RV/TLC was found to be high in 11 subjects, normal in 10 subjects while rest 9 were not able to perform the test. The pulmonary function testing was also evaluating reversibility on post bronchodilator testing which showed 6 subjects to have reversible airways.

Conclusions: Microbiologically confirmed post sputum pulmonary tuberculosis cases after evaluation on pulmonary function test found that leads to Obstructive Airway disease (large, small airway), Post Tubercular Asthma, Cavitation, extensive fibrosis, bulla formation and bronchiectasis implicated in the genesis of COPD caused by the destroyed lung due to pulmonary tuberculosis. Only a few studies have been done to identify this entity, but all the studies have definitely concluded that such an entity exists. The exact abnormality that results from tuberculosis infection has to be considered in detail with future studies and a better understanding of the pathophysiology of airflow limitation may point the way to therapeutic strategies for control of symptoms in these patients (post tuberculosis sequel)

Keywords: pulmonary function test, obstruction, restriction, dyspnoea, Endobronchial.

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I. Introduction

Tuberculosis (TB) is the most common cause of infectious disease-related mortality and morbidity worldwide. Tuberculosis (TB) is a major public health problem in India. India accounts for one-fifth of the global TB incident cases. Each year nearly 2 million people in

India develop TB, of which around 0.87 million are infectious cases. Annually around 330,000 Indians die due to TB. ¹*Mycobacterium tuberculosis*, a tubercle bacillus, is the causative agent of TB. The lungs are the most common site and 85% of patients with TB present with pulmonary complaints. Cough is the most common pulmonary complaint of pulmonary tuberculosis. Inflammation of the lung parenchyma adjacent to a pleural surface may cause pleuritic chest pain. Dyspnea or breathlessness is unusual unless there is extensive disease. Tuberculosis may, however, cause severe respiratory failure.

Pulmonary tuberculosis nearly always causes abnormalities on the chest film, although an endobronchial lesion may not be associated with a radiographic finding. In primary tuberculosis, the process is generally seen as middle or lower lung zone infiltrate. Healing of the tuberculous lesions usually results in development of a scar with loss of lung parenchymal volume and, often, calcification. Diagnosis of pulmonary

tuberculosis depends on radiological, clinical and microbiological findings and each investigation is complementary, rather than diagnostic. Finding an acid fast tuberculosis bacillus in the sputum microscopy after Zeihl nelson staining is however confirmatory.

Directly Observed Treatment Short-course i.e., DOTS under NTEP is the treatment of choice for sputum positive pulmonary tuberculosis. Post tubercular impairment can manifest as obstructive airway disease, mixed defect or as pure restrictive defects. Treated pulmonary TB is a significant cause of obstructive airway disease, with an inverse relationship between FEV₁ and the extent of the disease on the original chest radiograph. Immunological mechanisms have been postulated as a cause of Post Tubercular Asthma. Cavitation, extensive fibrosis, bulla formation and bronchiectasis implicated in the genesis of COPD caused by the destroyed lung due to pulmonary tuberculosis. Only a few studies have been done to identify this entity, but all the studies have definitely concluded that such an entity exists. The exact abnormality that results from tuberculosis infection has to be considered in detail with future studies and a better understanding of the pathophysiology of airflow limitation may point the way to therapeutic strategies for control of symptoms in these patients.^{2,3} Tuberculosis can thus cause chronic impairment of lung function which increases incrementally with the number of episodes of tuberculosis. Clearly, prevention of tuberculosis and its effect on lung function is important.⁴ Patients with post tuberculous sequelae, their lung functions and functional limitation can be improved along with improved quality of life by pulmonary rehabilitation.⁴

The present study was conducted to assess patient characteristics and to determine Pulmonary Function impairments in treated sputum positive pulmonary tuberculosis patients. Also, to compare and correlate patient characteristics and pulmonary function derangements in such patients.

II. Materials And Methods:

A prospective study was conducted on 30 patients visiting a tertiary care centre for treatment of tuberculosis. Newly diagnosed sputum positive PTB cases (age > 18 years) who completed 6 months of AKT and declared cured, were included and evaluated within 1 year duration of completion of their treatment. Cases of post lobectomy/ pneumonectomy surgery, past history of PTB or with active respiratory infection or cases unable to perform PFT or cases who were not willing to participate, were excluded. After a proper informed consent, subjects were evaluated clinically by the preset questionnaire to enquire regarding his/her general and systemic illness.

Pulmonary function test (PFT) was performed to get measurement of basic spirometry and lung volumes. Basic spirometry was performed on the Jaeger machine, multiple readings were collected and the best three values and loops selected and the report was prepared on the average of these reports. Forced vital capacity (FVC):< 80% predicted suggests restriction. FEV₁:< 80% predicted suggests presence of obstruction. FEV₁% or FEV₁/FVC:< 70% suggests obstructive while more than 70% predicted may be seen in normal or restrictive lung disease. Maximal mid expiratory flow (MMEF):< 65% suggests small airway obstruction. Peak expiratory flow (PEF) and Maximum voluntary ventilation (MVV) were also measured. Based on above report patients were labeled as normal, obstruction, restriction, predominantly small airway obstruction or a mixed pattern.

Reversibility was defined as change in the volumes > 200ml or/and > 12% change in % predicted volumes after bronchodilator in large airways and it is defined as reversible in small airways if the percentage change in the % predicted of MMEF 25-75 is > 35%. Lung volumes were evaluated by the helium dilution method after the bronchodilator, done on Spiro-air machine on the same day. This measures the functional residual capacity, total lung capacity and the ratio of RV/TLC. The data is collected and then assessed for the statistical significance with the help of SPSS software version 19 and Microsoft Excel 2007.

III. Results:

The study included 30 subjects of which, 23 (76.7%) are below 40 years of age. Mean age of the patients was 34.57±13.85 years. 22 (73.3%) were males with male to female ratio was 2.75:1. exposure to inhaled biomass exposure (IBM) in past was found in 13 (43.3%) patients (Table 1).

The subjects were included within one year of completion of treatment and hence grouped into 2 group i.e. < 6 months and 6-12 months from completion of treatment. 20 (66.7%) patients had duration < 6 months from completion of treatment (Table 1). Average

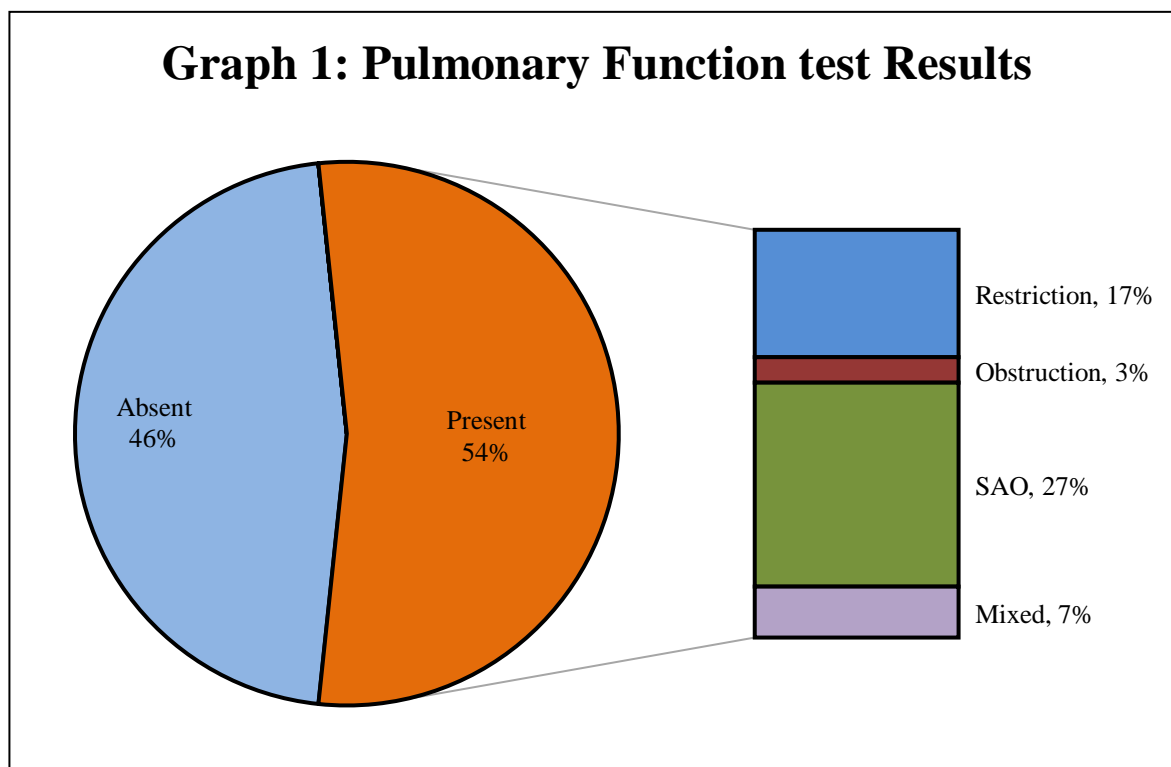
Body Mass Index (BMI) of subjects included in the study is 19.47 ±2.94Kg/m².

Table No 1: Baseline Characteristics:

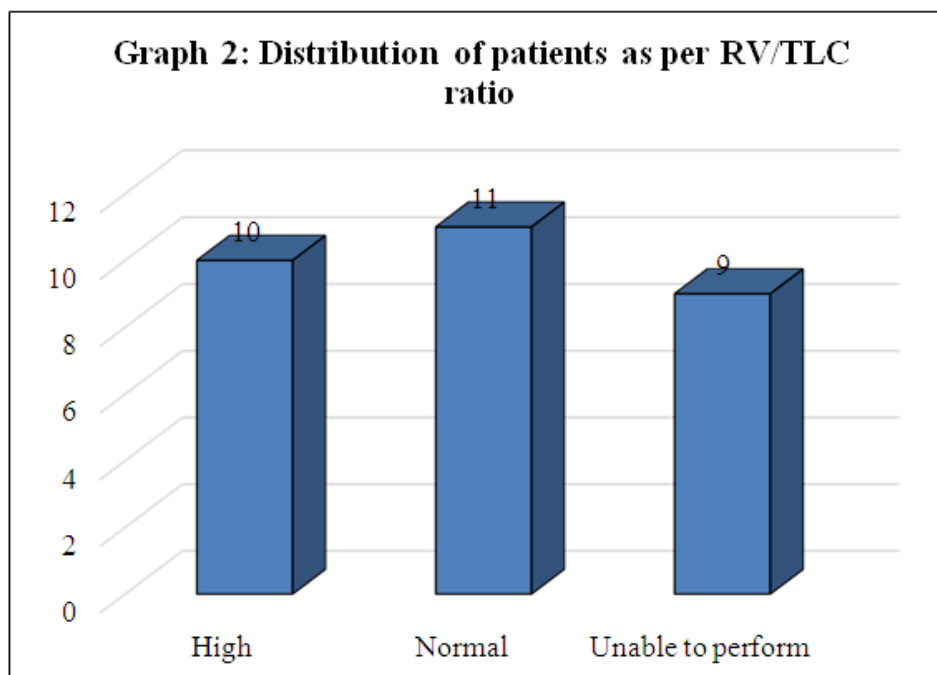
Baseline Characteristics		Frequency	Percent
Age	≤ 40 years	23	76.7
	> 40 years	7	23.3
Gender	Male	22	73.3
	Female	8	26.7
Smoking/ IBM	Yes	13	43.3
	No	17	56.7
Duration from completion of t/t	< 6 months	20	66.7
	6-12 months	10	33.3
Symptoms	Present	21	70.0
	Absent	9	30.0
Breathlessness	Yes	17	56.7
Cough	Yes	14	46.7
Chest pain	Yes	7	23.3

Studying the physiological impairments with the help of symptoms and pulmonary function in treated sputum positive pulmonary tuberculosis. Patients were evaluated for respiratory symptoms and found that 21 (70%) subjects were symptomatic, of which the predominant complaint was breathlessness present in 17 (56.7%) subjects. (Table 1)

14 (47%) were found to have normal PFT while rest 16 (53%) had an abnormal PFT. The most common PFT abnormality was airway obstruction in 9 (3%) patients of which, 8 patients had predominantly small airway obstruction. 5 (17%) patients had restrictive lung functions, while 2 (7%) had mixed i.e. restrictive and obstructive lung functions. (Graph 1)



RV/TLC was found to be high in 11 subjects, normal in 10 subjects while rest 9 were not able to perform the test. The pulmonary function testing was also evaluating reversibility on post bronchodilator testing which showed 6 subjects to have reversible airways. (Graph 2)



Cross-tabulating PFT abnormality with patient characteristics shown in table 2. The age of the subjects shows 11 subjects (47.8%) had abnormal PFT out of 23 subjects below 40 years of age, while 5 subjects (71.4%) had abnormal PFT out of 7 subjects above 40 years of age. 13 males (59%) out of 22 males had abnormal PFT, while 3 females (37.5%) out of 8 females had abnormal PFT. 9 subjects (69.2%) out of 13 subjects having exposure to smoking/IBM had abnormal PFT, while 7 subjects (41.1%) out of 17 subjects not having exposure to smoking/IBM had abnormal PFT. 11 subjects (55%) of 20 subjects studied within first 6 months of completion of treatment had abnormal PFT, while 5 subjects (50%) of 10 subjects studied between 6 to 12 months of completion of treatment had abnormal PFT. (Table 2) All these correlations were not significant.

Table 2: PFT Abnormality correlated with patient characteristics:

Baseline Characteristics		PFT Abnormality		Total	p value
		Present	Absent		
Age	≤ 40 years	11	12	23	0.273
	> 40 years	5	2	7	(NS)
Gender	Male	13	9	22	0.295 (NS)
	Female	3	5	8	
Smoking/ IBM	Yes	9	4	13	0.127 (NS)
	No	7	10	17	
Duration from completion of t/t	< 6 months	11	9	20	0.796 (NS)
	6-12 months	5	5	10	
Symptoms	Present	15	6	21	0.002 (S)
	Absent	1	8	9	
Breathlessness	Yes	13	4	17	0.004 (S)
	No	3	10	13	
Body Mass Index	< 18.5	6	5	11	0.618 (NS)
	18.5 to 24.9	9	9	18	
	> 24.9	1	0	1	
Total		16	14	30	

Cross-tabulating the PFT abnormality with the presence or absence of symptoms resulted in statistically significant results and shows a positive correlation between the two. 15 symptomatic subjects (71.4%) of 21 symptomatic subjects included in the study had abnormal PFT, while only 1 asymptomatic subject (11.1%) of 9 asymptomatic subjects included in the study had abnormal PFT. A statistically significant results and a positive correlation of presence of PFT abnormality with the presence of complaints of breathlessness, while no significant correlation seen with the complaints of cough and chest pain. PFT abnormality with BMI showed no statistical significance.

IV. Discussion

Tuberculosis (TB), a multi-systemic disease with myriad presentations and manifestations. We evaluated the cases with pulmonary function testing which were abnormal in 16 cases (53.3%) with predominant finding being obstructive (mostly small airway obstruction) ventilatory defect in 9 cases (30%), mixed obstruction in 2 cases (6.7%) and restrictive ventilatory defects in 5 cases (16.7%). Baig IM⁵ studied a small population of post tuberculosis treated patients and analyzed for pulmonary function defects and interpreted that chronic obstructive pulmonary disease can occur as one of the chronic complications of pulmonary tuberculosis and the obstructive ventilatory defect appears more common among various pulmonary function derangements.⁵

In the executive summary of the 2006 update of the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines⁶, the authors state that it is difficult to differentiate between chronic obstructive pulmonary disease (COPD) and treated pulmonary tuberculosis (TB) in some subjects due to similar respiratory symptoms and chronic airflow limitation, and they suggest that a possible diagnosis of pulmonary TB should be considered in developing countries where these two diseases are common. Treated pulmonary TB is a significant cause of obstructive airway disease, with an inverse relationship between FEV₁ and the extent of the disease on the original chest radiograph. Moreover, this relationship is valid even with minimal involvement without cavitations on chest radiograph at presentation. Interestingly, the degree of obstructive airway changes in subjects treated for TB increases with age, the number of cigarettes smoked, and the extent of the initial TB disease.⁶

We found in our study that, 5 subjects (71.4%) of 7 subjects of age > 40 years had an abnormal PFT. We also found that, among subjects having history of smoking or IBM exposure, 9 subjects (69.2%) of 13 subjects had an abnormal PFT. An article by Eva Hnizdo Et Al⁷ conducted a study to establish the chronic effect of initial and recurrent treated pulmonary tuberculosis on impairment of lung function. The average time between the diagnosis of the last episode of tuberculosis and the lung function test was 4.6 years (range one month to 31years). The loss of lung function was highest within six months of the diagnosis of tuberculosis and stabilized after 12 months when the loss was considered to be chronic. Tuberculosis can thus cause chronic impairment of lung function which increases incrementally with the number of episodes of tuberculosis.

In our study however, 11 subjects (55%) had an abnormal PFT within 6 months of completion of treatment. V. V. Banu Rekha et al⁸, in their study found that the mean period after treatment completion for 363 eligible participants was 16.5 years (range 14 to 18 years,

84% coverage) ; 25 (7%) had been re-treated and 52 (14%) died. Among the investigated, 58 (29%) had persistent respiratory symptoms, abnormal PFT was observed in 96 (65%) with predominantly restrictive type of disease in 66 (45%). Assessment of long term status of cured PTB patients showed an impairment of lung functions and health related quality of life highlighting the need to address these issues in the management of TB that may provide added value to patient care.⁸

We also performed lung volume estimation by helium dilution method and evaluated the RV/TLC ratio, but showed equivocal results as 11 cases (36.7%) had normal ratio, 10 cases (33.3%) had high ratio, while 9 cases (30%) were not able to perform the test. P-R. Burgel PR⁹ and Sorkness et al¹⁰. have recently shown that RV/TLC ratio (% predicted) was markedly increased in severe compared to non-severe asthmatics.

In our study, 9 subjects (90%) of 10 subjects having high RV/TLC ratio and 3 subjects (27.2%) of 11 subjects having normal RV/TLC ratio had an abnormal PFT. The study showed a positive correlation and significant association between symptoms of breathlessness and PFT being abnormal in post sputum positive treated pulmonary tuberculosis cases (p- <0.005).

V. Conclusion:

The pulmonary function test was abnormal in 16 cases (53.3%), with predominant defect being small airway obstruction. RV/TLC is high in 9 cases (90%) with abnormal PFT. The study showed a positive correlation and significant association between symptoms of breathlessness and PFT being abnormal in post sputum positive treated pulmonary tuberculosis cases.

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Conflicts of Interest: There are no conflicts of interest.

Ethical approval: The study was approved by the Institutional Ethics Committee.

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