Assessment of Symptomatic Post Tuberculosis Patients by Spirometry and Chest X Ray

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ABSTRACT

Introduction: TB is an infectious disease caused by the bacillus Mycobacterium tuberculosis which typically affects the lungs. The disease is spread by the people who are sick with active pulmonary TB. Up to half of TB survivors have some form of persistent pulmonary symptom despite microbiologic cure. The aim of the study was to assess the symptomatic post tuberculosis patients by using spirometry and chest x ray.

Material and methods: The study was conducted in the Department of Respiratory Medicine, Rohilkhand Medical College and Hospital after seeking clearance from the Institutional Ethical Committee. The aim of the study was to assess the symptomatic post tuberculosis patients by using spirometry and chest x ray. The study duration was from 1st November 2018 to 31st October 2019 and 100 patients were enrolled in the study. Data was collected from patients who presented with symptoms within 6 months of completing their treatment for tuberculosis.

Results: All the patients (post tubercular) enrolled in the study had symptoms (in some form) even after full course of antitubercular treatment and bacteriological cure and among these breathlessness was the most common presenting symptom (96%) followed by cough (58%). Maximum patients had abnormal findings on chest examination (80%). Fibrosis followed by cavitary lesions were the most common findings on chest x ray in post tuberculosis patients. Maximum patients had restriction (56%) in their spirometry followed by mixed pattern (23%).

Conclusion: In patients with restriction on spirometry and having symptom of breathlessness and cough, reassurance and pulmonary rehabilitation may play a major role in relieving their symptoms whereas in patients with mixed or obstructive pattern on spirometry, bronchodilator therapy along with pulmonary rehabilitation may be helpful in relieving their symptoms post tuberculosis treatment.

Keywords: Tuberculosis; Pulmonary Function; Post Tubercular Symptoms; Ventilatory Defects.

INTRODUCTION

Mycobacterium Tuberculosis is the causative organism for developing tuberculosis throughout the world. It mainly infects the lungs but can also involve other parts of the body (extrapulmonary TB). The disease is spread when people who are infected with pulmonary TB expel bacteria into the air, for example by coughing, sneezing, singing and talking. About 1/3rd of the world's population is infected with tuberculosis in its pulmonary or extrapulmonary forms, and over 9 million new cases of tuberculosis (TB) are reported annually.[1] Treatment of drug-susceptible pulmonary TB is highly effective, with 85% (66 million cases) of reported cases estimated to have been successfully treated between 1995 and 2015.[1] However, up to half of pulmonary TB survivors have some form of persistent lung function defects despite bacteriological cure.[2-5] Pulmonary function impairment ranging from minor defects to severe forms can increase the risk of mortality from respiratory cause.[6-9] Moreover post tuberculosis treatment, patients appear to contribute substantially to the growing worldwide burden of chronic obstructive pulmonary disease (COPD).[10-12]A notable feature of lung involvement in TB is its striking heterogeneity. This is observed on formal lung function testing in terms of the variability of pulmonary function, ranging from no impairment to severe dysfunction[3,7,8] and the specific types of lung function defects.[3,11,13] Post tuberculosis patients may present with residual lesion like cavities, fibrosed lung parenchyma or nodular infiltrates, or have a mix of these pulmonary pathologies.[14,15] This immense variability in the post tuberculosis lung function impairment may relate to host–pathogen interactions and the multiple immunological events that can follow.

Studies of pulmonary function in individuals with PTB demonstrated variable patterns and severity of impairment.[2,13,15,16-18] Pulmonary function studies[2,13,15-18] can show restrictive, obstructive, or mixed patterns and range from normal to severe impairment. These findings are currently incompletely characterized. The studies performed to date[2,13,15-18] have been of highly selected populations, as follows: patients receiving only inpatient TB treatment; patients who have been referred for a symptom or preoperative evaluation; patients with an absence of other lung diseases; and persons sufficiently well to be currently employed in mining.[2,3,15-18] These patients do not completely represent the populations affected by TB. PFTs objectively

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quantify lung function and impairment and are used to evaluate persons with chronic lung disease.[19]

Spirometry is a physiological test that measures how an individual exhales or inhales volumes of air as a function of time. It primarily measures the volume or flow. The values of FVC, FEV1 and FEV1/FVC are used in defining the obstructive, restrictive or mixed ventilatory defects on spirometry.

The aim of the study was to assess the symptomatic post tuberculosis patients by using spirometry and chest x ray with the objectives to investigate the trends of the changes in pulmonary functions in patients (which may be the cause of symptoms) after completion of treatment for tuberculosis and to know the prevalence of obstructive, restrictive or mixed patterns in spirometry, that contribute to long term disability and decreased quality of life in new pulmonary tuberculosis patients.

MATERIAL AND METHODS

A prospective observational study was conducted in the Department of Respiratory Medicine, Rohilkhand Medical College & Hospital, Bareilly International University, Bareilly. Institutional Ethical Committee clearance was taken before commencing the study. Written informed consent were taken from all the patients included in the study. The period of the study was twelve months i.e. 1st November 2018- 31st October 2019 which was used for the development of study tools, collection of data, evaluation and presentation of findings.

Sample Size and Sampling Technique: Patients attending the Department of Respiratory Medicine in one year who were newly diagnosed cases of pulmonary tuberculosis and fulfill the inclusion criteria were enrolled in the study.

Study Population: Patients of all age group and of both genders who were diagnosed as a case of new pulmonary tuberculosis based on the RNTCP guidelines (history, clinical examination, microbiological and radiological investigation) were included in the study.

Inclusion Criteria

- Patient willing to give informed consent.
- All the patients diagnosed and treated as a case of new pulmonary tuberculosis according to RNTCP guidelines. Patient who completed their treatment and become sputum smear negative at the end of treatment, presenting to OPD/IPD with symptoms within 6 months of completing treatment were included in the study.

Exclusion Criteria

- Pregnant and lactating women.
- History of Asthma, ILD, immunosuppressive disorders, diabetes, cardiac, renal and hepatic insufficiency.
- Patients with history of smoking.
- History of Recurrent pulmonary tuberculosis, EPTB and MDR-TB patients.
- Patients with history of dyspnea for >1year.

Data Collection Technique and Tools: Data was collected from patients who presented with symptoms within 6 months of completing their treatment for tuberculosis.

Pulmonary function Test: The pulmonary function tests according to ATS/ERS guidelines using computerized spirometer, MIR Spirolab 3 (made in Italy) with flow transducer. The entire FVC procedure was demonstrated satisfactorily to the subjects. Nose clips were attached before the test. The subjects were asked to take maximal inspiration and blow into the mouthpiece as rapidly, forcefully and completely as possible for about 6 seconds. The subjects were verbally encouraged to continue to exhale the air at the end of maneuver to obtain optimal effort. A minimum of 3 acceptable Forced vital capacity (FVC) maneuvers were performed in the standing position with nose pinched and the best maneuver were selected and accepted. The parameters measured were Forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), FEV1/FVC ratio, Peak expiratory flow rate (PEFR) and forced expiratory flow rate (FEF25-75%.)

PFT was done in those patients who presented with symptoms within 6 months of completing their treatment for tuberculosis.

STATISTICAL ANALYSIS

The data were entered on a Microsoft Excel spreadsheet and imported into Statistical Package for Social Sciences (SPSS) version 22 for statistical analysis. Frequency distribution tables were produced, and the chi square test was used to assess associations of variables. A *P*-value less than 0.05 was considered statistically significant.

RESULTS

In the present study maximum number of patients were in the active age group i.e. 21-60 years (45% of patients in the age group of 41-60 years followed by 32% in 21-40 years group)

Mean Age in years(mean ± S.D)	42.84 ± 16.50
Male : Female	1:0.75
Mean BMI in Kg/m^2(mean ± S.D)	20.24 ± 4.44
Employment	42% employed
Literacy	59% litterate

Table-1: Socio-demographic profile

Findings	%
Normal	20
Abnormal	80

Table-2: Chest examination findings

Findings	N	%
Normal	12	12
Fibrosis	49	49
Cavity	18	18
Fibro-cavitary	11	11
Bronchiectasis	9	9
Destroyed lung	1	1

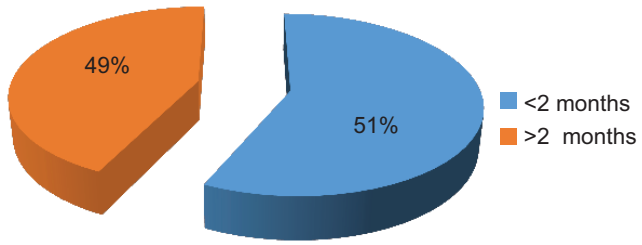
Table-3- Chest x ray findings

Findings	%
Normal	18
Obstruction	3
Restriction	56
Mixed defect	23

Table-4: Post tubercular treatment spirometric findings

CXR Findings	BLN	Cough	Sputum	Hemoptysis
Normal	12	5	2	3
Fibrosis	46	31	8	4
Cavity	17	10	4	0
Fibro-cavitary	11	5	2	0
Bronchiectasis	9	6	2	2
Destroyed lung	1	1	0	0
Total	96	58	18	9

Table-5: Post tubercular symptom corelation with chest x ray findings.



*ATT - Antitubercular treatment

Figure-1: Duration of illness before initiation of ATT

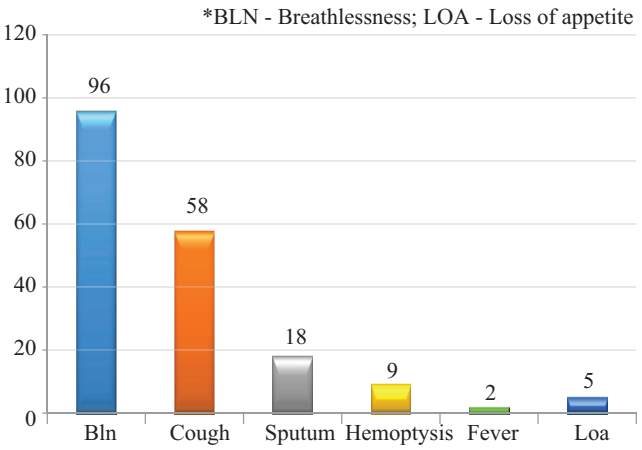


Figure-2: Post tubercular treatment symptoms

(table-1). It was observed in that, 80% patients had abnormal chest examination findings (table-2). Post tuberculosis 49% patients had fibrosis on their chest x ray followed by cavity in 18%, fibro-cavitary lesions in 11%, bronchiectasis in 9% and destroyed lung in 1% of the patients. 12% patients had a normal chest radiograph post tuberculosis treatment (table-3). About half of the patients had duration of symptoms of >2months before the diagnosis of tuberculosis (fig-1). In present study we observed that 56% patients had restrictive pattern in their spirometry post tuberculosis followed by mixed pattern in 23% of the patients and obstruction in 3% of the patients. 18% patients had normal spirometric results (table-4).

DISCUSSION

Demographic Profile

In our study we selected a wide range of patients, the study observed that maximum number of patients were in the active age group i.e. 21-60 years (45% of patients in the age group of 41-60 years followed by 32% in 21-40 years group). The study also observed that there were only 11% of patients in the age group of >60 years. The mean age of the patients was found to be 42.84 ± 16.50.

A study conducted by Choi, CJ et al.[20] in South Korea had similar age distribution among the respondents aged >40 years in study of 13522 patients.

This is because people in this age group (21-60 years) are more physically active and carry out outdoor activity than people in age group >60 years and therefore, are having more chances exposure for TB.

It was observed that 57% patients were male while 43% were female. The observed results were found in accordance with a study done by Bertrand Hugo Mbatchou Ngahane et al.[21] As per the study out of the 269 participants included in the study, 146 (54.3%) were male.

The BMI findings of the study suggest that majority of patients were having abnormal BMI i.e. 54%. The mean BMI was found to be 20.24 ± 4.44. The finding of the present study correlates with a study conducted by Tatenda M Nyaguraet al.[22] and as per the study the patients with history of TB were having mean BMI of 21.7 ± 4.1.

According to the socioeconomic status, it was found that there were no patient in the upper class, majority of patients belongs to the upper lower class (39%), followed by lower middle class (25%), and 23% of patients were in the lower category. Most of the patients were in the lower middle and lower class of socioeconomic status and tuberculosis is most prevalent in the lower socioeconomic group.

It was observed in the study that majority of patients i.e. 58% were unemployed and only 42% patients were employed.

The results reflects that according to educational status 41% were illiterate, 8% have primary school certificate, 28% have high school certificate, 19% have intermediate or diploma and there are only 4% patients with graduation degree. This result signifies that literacy is one of the important factor which can help the patient to understand the disease process and its outcome. It can also help them to recognize their symptoms and seek consultation for their symptoms as early as possible.

Post tuberculosis respiratory function impairment

Total of seven TB guidelines have addressed regarding patient follow up after TB treatment but only three have mentioned the problem regarding TB sequelae while four others have stated about the risk of relapse or recurrence of tuberculosis.[33-35] In an international guideline it was indicated that early diagnosis of TB may lead to fewer post tuberculosis sequelae.[36] Two other guidelines explained about the problem of long term TB sequalae but both were written for low-burden TB countries. One of the guidelines emphasized on the need of post-Tb management and support

to address TB sequalae and the other indicated no need for clinical monitoring after TB cure.[37,38] None of these guidelines mentioned that how potential TB sequalae should be identified or managed.

Duration of symptom before the initiation of antitubercular treatment

Defining restrictive pathology based on duration of symptoms: In patients with duration of illness of <2month duration, 35% had restrictive pathology on their spirometry and patients with duration of illness >2 month duration, 44% had restrictive pathology on their spirometry.

Defining obstructive (FEV1/FVC <0.7) pathology based on duration of symptoms: In our study the patients with symptoms of less than 2 month duration, only 4% had FEV1/FVC ratio <0.7 in their spirometry but a majority of patients i.e. 22% patients with more than 2 months of duration of symptoms had FEV1/FVC ratio <0.7 in their spirometry. The P value for this data is 0.001 which is highly significant.

The above data signifies that delay in diagnosis of pulmonary tuberculosis can lead to significant damage of the lung parenchyma thereby leading to various functional abnormalities.

A study conducted by SK Verma et al.[23] found that only 15(16.3%) patients had obstructive airway disease by spirometry criteria. 21(22.80%) patients had mixed obstructive with restrictive disorder. Restrictive pathology was seen in 37(40.21%) patients. This study corelates with the findings of our study.

Another study conducted by Patil, et al.[24] showed that in 500 symptomatic individuals 150 (30%) had normal spirometry, 210 (42%) had obstructive pattern, 90 (18%) had mixed pattern and 50 (10%) had restrictive pattern in their spirometry. The findings of this study goes against our study as obstructive pattern was more common in this study.

In another study conducted by Milan radovicet al.[25] 40 patients were selected for the study and 15 (37.5%) had restrictive ventilatory defect in their spirometry.

Post-tubercular treatment symptoms

A previous study conducted by Patilet al.[24] showed that among 500 symptomatic subjects who were included in the study, the most common post tubercular symptom was of breathlessness in 79% cases, followed by cough in 48% cases, and sputum production in 39% cases.

Another study conducted by Mohamed W. Zakaria et al.[26,] who enrolled 50 post tubercular patients in their study. A total of 39 patients complained of breathlessness followed by 22 patients who complained of cough, and 16 patients had both breathlessness and cough after treatment completion.

In our study the most common post tubercular symptom was of breathlessness in 96% of the patients followed by cough in 58%, sputum production in 18% and hemoptysis in 9% of the patients. The most common chest x ray findings associated with these symptom was fibrosis followed by cavity, fibro-cavitary, bronchiectasis and destroyed lung (fig-2, table-5).

Radiological changes after tuberculosis

Most studies on post-TB chest X-ray abnormalities and respiratory symptoms were conducted in India and Pakistan and almost exclusively reported on the proportion of these conditions. One systematic review assessed pulmonary abnormalities with radiological imaging among people with a history of TB and found proportions of between 8.3%–83.7% for cavitation, 4.3%–11.2% for bronchiectasis and 25.0%–70.4% for fibrosis.[27] A similar result was found in our study (table-3).

International TB guidelines universally fail to address the importance of lung function impairment after tuberculosis, particularly omitting guidance on identification and management. This is alarming given the global rise in mortality and morbidity from non-communicable diseases, including post tubercular sequalae.[28,29] Consequently, national TB policies do not address the issue and national TB control programmes are not designed to adequately deal with the problem.

As the national programme in our country is focused on treating active disease, almost all the patient are sent home after bacteriological conformation of cure at the end of the treatment. If these patients return to the health care facility with complain of cough and shortness of breath, they are misdiagnosed as a case of recurrent tuberculosis or multi drug resistant tuberculosis by the health care provider despite negative laboratory results. This results in improper treatment of the patient.

In a resource limited country like ours, patients with symptoms due to post TB sequalae after full treatment (sputum negative) are often treated as smear negative recurrent PTB. This leads to commencement of re-treatment with ATT which are unnecessary and patients may be exposed to unwanted toxicity of the drugs. Also, in many countries, people with continuous respiratory symptoms after TB cure may be believed to be infectious and can be stigmatized.[39] Therefore there is a need for producing awareness regarding post tuberculosis sequalae and lung function impairment among policy makers, practitioners and patients. As a minimum, healthcare staff should be made aware of the increased risk of symptoms due to post tubercular lung function impairment, so that they can educate the health implications of residual lung damage with patients and their relatives. Ideally, those at risk should be referred to higher centers as early as possible to receive appropriate diagnosis. Unfortunately, the mechanisms of early referral are yet to be assessed and determined and, importantly, post TB lung function assessment services are often not yet established in high TB burden countries.[30] As there is no proper guidelines to follow up patients with post tubercular lung function impairment most of the patient either suffer in silence or continue to receive irrelevant treatment. Therefore proper guidelines must be made to keep follow up of the patients post tuberculosis treatment to assess their lung functions and to review their chest x rays.

An international study called TB Sequel, initiated in Gambia, Tanzania, Mozambique and South Africa to assess predictors

and progression of PTBLD (post tuberculosis chronic lung disease) among a cohort of patients with TB, which could provide valuable information on how to best follow-up post tuberculosis patients.[31] General education on lung health may be more suitable for high-TB burden countries and pulmonary rehabilitation offers a new way to improve health status in patients with post tubercular lung function impairment.[32]

The key to prevention and reducing the incidence of post tubercular respiratory function impairment is early diagnosis and adequate and regular treatment of TB in order to minimize residual lung damage. However, while the incidence of TB may be decreasing (although at a slow rate), there are a considerable number of people in this world with a history of TB (approaching 100 million over the last decade) who are at increased risk of developing lung function impairment (drug-susceptible and drug-resistant TB disease, and those with comorbidities such as HIV infection and diabetes mellitus) should be managed appropriately.

CONCLUSION

From the study we concluded that most of the patients were in the active age group and therefore were more exposed to develop tuberculosis. A significant number of patients were illiterate and belonged to lower socioeconomic class, which may be the cause of their late presentation to the healthcare facility leading to delay in their diagnosis and treatment thereby producing high percentage of post tubercular symptoms and sequalae. As our study was conducted in the tertiary care center, usually most of the patients present at later stage with advanced disease which may be the cause of symptoms (in some form) post tuberculosis treatment. Despite of bacteriological cure maximum patients had some form of residual opacity on chest x ray which is due to the structural damage caused by tuberculosis infection. In our study fibrosis followed by cavitary lesion were the most common findings on chest x ray. Post TB treatment breathlessness followed by cough was the most common presenting symptom and spirometric results showed that restriction was the most common abnormality followed by mixed pattern (restriction and obstruction). In patients with restriction and having symptom of breathlessness and cough, reassurance and pulmonary rehabilitation may play a major role in relieving their symptoms whereas in patients with mixed or obstructive pattern, bronchodilator therapy along with pulmonary rehabilitation may be helpful in relieving their symptoms post tuberculosis treatment.

Patients who are symptomatic post TB treatment, most of the time they receive re-treatment with antitubercular drugs due to lack of proper assessment tools for their symptom evaluation. So proper guidelines and assessment tools should be developed for assessment of symptoms in this group of patients so that accurate management can be given to them at an early stage so as to improve their quality of life.

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