ORIGINAL ARTICLE

Assessment of Lung Function using Spirometry and Radiological findings in Post Tuberculosis Cases

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ABSTRACT

Objective: To assess the prevalence of abnormal radiological changes and their impact on lung function in post tuberculosis cases.

Study Design: Descriptive cross-sectional study.

Place and Duration of Study: The study was conducted in medical Outpatient Department (OPD) of CMH, Quetta from 30th Nov 2018 to 30th May 2019.

Materials and Methods: A total of sixty treated cases of pulmonary tuberculosis, presenting in medical OPD of CMH Quetta for regular follow-up, were included in the study. The subjects were recruited by non-probability consecutive sampling technique according to predefined inclusion criteria. Demographic data including age, gender, post treatment duration, clinical features and history of asthma, atopy, rhinitis, biomass exposure, coalmine exposure, animal and pet exposure was collected. Their lung function was assessed using spirometry and radiological changes were assessed by either chest X-ray or high resolution CT chest.

Results: Among the 60 patients, mean age was 36.32 $\pm$ 9.95 years. The majority (70%) of subjects were males (n=42).The mean duration post treatment was 4.79 $\pm$ 4.25 years. Among the study population 51.7% (n=31) were symptomatic, 73.3% (n=44) had abnormal lung function tests. With those having abnormal lung functions tests, 23.3% (n=14) had obstructive, 43.3% (n=26) had restrictive and 6.7% (n=4) had mixed airway disease. The radiological investigations were abnormal in 80% (n=48) of the patients showing various radiological changes such as reticular shadows, nodules, pleural thickening, collapse, fibrotic bands, hilar calcifications, lung volume reduction and traction bronchiectasis.

Conclusion: Our study showed that the restrictive pattern was most common finding on spirometry while, fibrotic bands were the most common radiological findings in post tuberculosis cases in our population.

Key Words: *Lung Function Tests, Post Tuberculosis, Spirometry.*

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Introduction

Tuberculosis (TB) is a highly prevalent infectious disease, caused by Mycobacterium tuberculosis. It is a major health concern in developing countries, but re-emerged in developed countries with the rising incidence of HIV/AIDS in early 90's. In 2016, 10.4 million people had TB while about 1.6 million died from the disease including 0.3 million with HIV.[1] Pakistan is ranked 5th among 22 countries which are burdened with tuberculosis. According to the National TB (NTB) control program, the estimated incidence of TB in Pakistan in 2017 was 518,000 cases and an incidence rate of 268/100,000 people with actually notified cases of about 368,979 and mortality rates in the range of 60,000 (34/100,000 people).[2] Because of various programs worldwide and The NTB control program in Pakistan, increased numbers of patients are now getting treatment for TB, both drug-susceptible and drug resistant. In Pakistan, according to NTB control program during

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year 2017, 26% patients were cured, 67% completed their treatment, while 3% had lost to follow up.

The two most important lesions found in TB patients are the caseating granuloma and tuberculous pneumonia which can be infiltrative or exudative, resulting in liquefaction and formation of cavities.[3,4] As a result of this disease process, even patients who have undergone treatment with anti-tuberculosis drugs for recommended period of time, may have residual damage to their lungs. The residual damage involves both the parenchymal and bronchial structures resulting in bronchiectasis and emphysema.[5] These fibrotic changes can be a predictor of permanent disability following TB resulting in poor quality of life because of persistence of symptoms.[6,7] The several studies have shown poor quality of life, due to residual lung damage.[5,6,8] The studies of lung function in patients with TB showed various patterns and severity of impairment.[9] The patients can show restrictive, obstructive or mixed patterns of airway disease and are mostly permanent.[10-14] The permanent nature of these changes provides additional evidence for adoption of strategies to prevent, detect and treat TB as early as possible. The assessment for lung function abnormalities should be done after the completion of treatment. The aim of this study is to assess the prevalence of abnormal radiological changes and their impact on lung function in cases after complete treatment of pulmonary tuberculosis.

Materials and Methods

Sample Selection

- **Inclusion Criteria**

a. TB patients of both genders who completed the treatment with anti TB drugs as per National/WHO guidelines and were declared cured.

- **Exclusion Criteria**

a. Extra pulmonary TB cases
b. Cases lost follow up during treatment
c. History of irregular treatment
d. Cases with history of smoking (active or past)
e. Cases with Asthma, diabetes mellitus, hypertension and ischemic heart disease
f. Patients with COPD and bronchiectasis without previous history of TB
g. Patient with interstitial lung disease
h. Cases unable to cooperate during Spirometry procedure or those who did not wish to enroll in the study

Data Collection

The cases satisfying the selection criteria were selected from medical OPD by non-probability consecutive sampling. An informed verbal consent was obtained from every patient. Demographic data including age, gender, post treatment duration, present symptoms, history of asthma, atopy, rhinitis, biomass exposure, coalmine exposure, animal and pet exposure were collected. Lung function was assessed using a portable Spirometer Spiro lab II manufactured by MIR010 from Italy.

The spirometry results were analyzed and divided in following four categories:

a. The patients with ratio of FEV_1 (forced expiratory volume in the first second) to FVC (forced vital capacity) of more than 70% and with a FVC of more than 80% predicted were classified as NORMAL.
b. The patients with ratio of FEV_1 to FVC less than 70% were classified as having obstructive pattern of lung disease.
c. The patients with ratio of FEV1 to FVC of more than 70% were classified as having restrictive pattern of lung disease.
d. The patients with ratio of FEV_1 to FVC of less than 70% and with FVC of less than 80% predicted were classified as having Mixed pattern of lung disease.

For the radiological study either chest X-ray or high-resolution CT Scan (HRCT) chest was performed. Chest X-ray was done in every patient. If there was any ambiguity in the findings of chest X-ray or when there was discrepancy between lung functions test and chest X-ray findings, then HRCT chest was performed. This occurred in 55% (n=33) of cases in our study.

Data Analysis

Data was analyzed using SPSS-17. The mean and standard deviations for age and post treatment duration and frequency and percentages were calculated for gender, symptomatic and asymptomatic patients, normal and abnormal spirometry and imaging studies. The abnormal lung function tests were classified into different types and frequency and percentages for each type were

calculated.

Results

A total of sixty patients of both genders were included in the study. The mean age was 36.32 ± 9.95 years. The mean duration post treatment was 4.79 ± 4.25 years (Table 1). Out of these 60 patients, eight patients had relapse of pulmonary TB, while three had MDR TB.

Table No 1: Descriptive studies

Parameter (years)	n	Mean ± SD	Maximum	Minimum
Age	60	36.3 ± 9.95	65	24
Duration post treatment	60	4.79 ± 4.25	18	1

The 70% (n= 42) were males, while 30% (n=18) were female. Out of 60 patients, 28.3% (n=29) were asymptomatic while 51.7% (n=31) were having symptoms. Out of 60, 73.3% (n=44) subjects had an abnormal lung function test with 25% had obstructive, 43.3% had restrictive and 6.7% had mixed airway disease (Table 2).

Table No 2: Pattern of airway disease

S. No	Type of Airway Disease	Frequency	Percentage
1	Obstructive Pattern	15	25.0%
2	Restrictive Pattern	26	43.3%
3	Mixed Pattern	4	6.7%
4	Normal	15	25.0%

Among those who were asymptomatic (n=29), 58.6% had an abnormal lung function test, 20.6% (n=6) with obstructive and 37.9% (n=11) with restrictive pattern. Those who were symptomatic (n=31), 90.3% (n=28) had an abnormal lung function test, 29% (n=9) had obstructive, 48.3% (n=15) had restrictive and 12.9% (n=4) had mixed pattern while only 9.6% (n=3) had normal lung function tests.

Among those cases, with normal lung function tests (n=15), only 20% (n=3) had symptoms.

The radiological investigations were abnormal in 80% (n=48) of the patients. In cases who were asymptomatic, 31% (n=9) had abnormal radiological findings, with the most common radiological abnormality 17.2% (n=5) being reticulonodular shadowing followed by pleural effusion or blunting of costophrenic angle seen in 13.7% (n=4) of cases. The prevalence of various radiological changes such as reticular shadows, nodules, pleural thickening, collapse, fibrotic bands, hilar calcifications, lung volume reduction and traction bronchiectasis shown in Table 3.

Table No 3: Pattern of radiological findings

S No	Radiological Finding	Frequency	Normal
1	Normal	12	20%
2	Reticular Shadowing	6	10%
3	Nodules	11	18.3%
4	Pleural thickening	13	21.7%
5	Collapse	7	11.7%
6	Fibrotic Bands	22	36.7%
7	Hilar Calcifications	6	10%
8	Lung volume Reduction	3	5%
9	Traction Bronchiectasis	17	28.3%

Discussion

Although treatment with anti-tuberculosis drugs improves lung function in many patients, residual pulmonary dysfunction can occur. Approximately 30–40% patients of pulmonary tuberculosis have lung function issues despite successful treatment with antibiotics. A study conducted in the United States by Pasipanodya et al. showed that 59% of TB patients had abnormal pulmonary function test post treatment. In our study, 73.3 % of patients had abnormal lung functions.[16] Similarly in a study conducted by Naghahne et al, 45.4% had lung function impairment.[6]

Agarwala et al in India showed 52.7% of treated TB patients had an obstructive pattern on spirometry.[17] In our study, 23.3% (n=14) had obstructive pattern of airway disease. Manji et al. documented 74% prevalence of lung dysfunction, 68% with obstructive pattern (68%) and 43.3% with restrictive airway disease.[18] Most of the earlier studies have reported obstructive type as most prevalent defect in post TB patients.[19, 20] Few have reported other patterns of airway lung disease on spirometry similar to our study.[21] In our study all three types of lung function dysfunction were reported.

A history of tuberculosis is an important risk factor for COPD as its prevalence in the general population increases to 3.7-5% with inclusion of subjects with prior history of TB.[22] Another study found that there was greater reduction in FVC as compared to FEV_1, when TB patients were followed for 15 years.[23]

In post TB patients various changes occur in the lung

such as fibrosis in lung parenchyma, cavitations, bronchiectasis and pleural thickening. The residual X-ray changes in an Indian study were 40.36%, with 67.4% parenchymal, 23.59% pleural lesions and 8.99% mediastinal lesions.[24] In our study 53.3% had parenchymal lesions, 21.7% had pleural lesions and 6% had mediastinal lesions.

TB increases activity of matrix metalloproteinase enzymes which causes increased lung damage similar to what happens in smokers.[25] In a study, by Nefadov and Simirnova, various functional changes in lung tissue such as hyperinflation, abnormalities in elasticity, bronchial obstruction and disorders associated with gas exchange lead to impairment in lung function tests.[26] The structural changes persist in lungs even after successful anti mycobacterial treatment, which can be symptomatic or asymptomatic. In our study, lung function abnormalities were detected in both symptomatic as well as asymptomatic patients. Thus, the absence of symptoms is not a reliable marker for normal lung function.[27]

The limitations in our study were small sample size and the recruitment of only those patients who attended the pulmonology department. It does not reflect the total number of treated patients present in the community. The radiological findings seen do not correlate with original findings in chest radiograph at the time of initial diagnosis.

Conclusion

Our study showed that the restrictive pattern of airways disease was most common finding on spirometry and fibrotic bands were the most common radiological finding in our study population. Early diagnosis and treatment are recommended as it reduces post TB lung dysfunction.

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