EVALUATION OF OBSTRUCTIVE AND RESTRICTIVE SPIROMETRIC DEFECTS IN TREATED PULMONARY TUBERCULOSIS PATIENTS

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ABSTRACT

Objective: To determine frequency of obstructive and restrictive spirometric defects in treated pulmonary tuberculosis patients.

Study Design: A cross sectional study.

Place and Duration of Study: Combined Military Hospital (CMH), Kohat starting from Jan 2016 to Dec 2017.

Methodology: In our study a total 90 patients were selected. Complete history and physical examination was done on all patients and were also asked about duration of anti-tuberculosis treatment and time since completion of treatment. Documented evidence for treated pulmonary tuberculosis was obtained. Spirometry was performed and data was entered in proforma. Due respect was given to the patients as well as all cultural, traditional, social values and confidentiality.

Results: In our study mean age of selected patients was 46 ± 3.77 years. Sixty two percent of the patients were male while 38% were female. 56.66% percent patients had obstructive defect, 26.66% patients had restrictive spirometric defect, 16.66% patients had mixed spirometric defect.

Conclusion: Frequency of obstructive defect was very high followed by restrictive defects and mixed (obstructive and restrictive defect) in treated pulmonary tuberculosis patients.

Keywords: Bronchiectasis, Pulmonary tuberculosis, Restrictive spirometric defects, Spirometry.

INTRODUCTION

Some close related species are main etiologies of Tuberculosis, which include the Mycobacterium TB complex. Mycobacterium tuberculosis, Mycobacterium bovis, and M. Africanu, are recognized as tubercle bacilli and develop disease in humans which is histopathologically and clinically difficult to distinguish. Worldwide, large numbers of TB cases are caused by M. Tuberculosis (Koch's bacillus). Acid fastness is a peculiar property which characteristically defines the genus Mycobacterium and when carbolfuchsin or auramine-rhodamine staining is done, this acid fastness causes it to withstand decolorization after a mixture of acid alcohol. Mycobacteria have slow rates of growth, are obligate aerobes, non spore forming and immotile intracellular bacilli M. Tuberculosis needs oxygen for its growth. It has a large amount of lipid content in its cell wall and it is the reason why it does not retain any sort of bacteriological stain , and also it is none of gram +ve or gram -ve; that is why Zeihl nelson stain or acid fast stain is particularly done[1].

When M. Tuberculosis is cultured, it does not produce any significant amount of pigment and has apparently smooth surface, and niacin is the biochemical end product. These characteristics are significant while differentiating between M. Tuberculosis and nontuberculous mycobacteria. Division time of M. Tuberculosis is about every fifteen to twenty hours, that is much slower than so many other types of bacteria, which usually show division intervals approximately in minutes M. Tuberculosis is a resistant strain and its different cell wall, containing huge amount of lipids (e.g., mycolic acid), is very important for this property[2].

Pulmonary tuberculosis (TB), an important public health problem, may cause lung parenchymal damage by upregulation of various

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proteases and dysregulation of protease control. In treated Pulmonary TB patients various histopathological changes include bronchiectasis, fibrosis and bronchial stenosis, all of which resulting in pulmonary function abnormalities[3]. Poor ventilation and gas exchange in Tuberculosis destroyed lungs results in progressive dyspnoea, deconditioning and overall decline in functional status of individuals[4]. The clinical presentation of pulmonary TB includes general signs along with chronic respiratory signs, mainly cough and sputum production According to WHO Global Health Observatory Database, Tuberculosis accounts for 342 cases per 100,000 population in Pakistan[5,6].

Spirometry is a valuable investigation to detect ventilatory defects in treated patients of pulmonary tuberculosis. Only a few studies have been done so far and keeping in view the overall burden of the disease, more work needs to be done in this regard. The purpose of our study was to recognize pulmonary function problems post tuberculosis for better understanding and management of patients with these problems.

METHODOLOGY

This cross sectional study was organized in General Medicine department of Combined Military Hospital Kohat from January 2016 to December 2017. With the help of WHO recommended calculator for health studies, confidence level=95%, anticipated population proportion= 17%[7], absolute precision=8%, sample size was calculated to be 90 patients. Sampling technique used was non-probability consecutive sampling. Patients of either gender aged 18 to 65 years with pulmonary tuberculosis either smear positive or smear negative who took anti-tuberculous treatment minimum for six months and were declared cured and patients reporting minimum after two years of anti-tuberculous treatment completion were included in the study. Patients excluded from the study were those having history of asthma, COPD, ischemic heart disease, congestive heart failure, interstitial lung disease and bronchiectasis, patients with malignancy, kyphoscoliosis or chest wall deformity, patients with history of lung resection, major abdominal surgery or respiratory failure requiring mechanical ventilation and chronic smoker of 15-20 pack years. The following operational definitions were used.

Treated Tuberculosis: A smear positive tuberculosis patient treated for minimum six months and became smear negative and a smear negative tuberculosis patient becoming afebrile, gaining weight, resolution of any haemoptysis together with healed apical fibrosis or other pulmonary lesion on chest x-ray after completion of minimum six months of anti-tuberculous treatment.

Obstructive Defect: It was defined as forced expiratory volume in 1 s (FEV1) ratio forced vital capacity (FVC) (FEV1/FVC ratio) below 70% as measured by spirometry. Reversibility testing with Beta 2 agonist was done and FEVl <80% of the predicted value was taken as obstructive lesion.

Restrictive Defect: It was defined as reduction of both FEV1 and FVC but normal FEV1/FVC ratio.

Data was collected on a specially designed proforma. After getting approval of the hospital's ethical and research committee, informed consent was obtained from the patient or his next of kin, after explaining the cause and beneficial effects of this study, from those fulfilling the inclusion and exclusion criteria. All indoor and outdoor patients who met the inclusion criteria were selected in the study. Treated pulmonary tuberculosis patients was based on negativity of sputum smear on culture or by gene expert if smear positive previously and healed pulmonary lesion on chest x-ray along with resolution of symptoms if smear negative previously.

Complete physical examination and through history was taken from all patients including duration of anti tuberculosis treatment and time since completion of treatment. Documented evidence for treated pulmonary tuberculosis was obtained. Spirometry was performed and data

was entered in proforma. Exclusion criteria had strictly followed for controlling confounders and avoiding bias in the study. Due respect was given to the patients and all cultural, traditional and social values were kept in mind. Confidentiality was given due importance. The patients or the next of kin were asked to give informed written consent after explaining the pros and cons of the test.

Data collected was entered in SPSS-16. Continuous variable like age and duration were measured by mean and standard deviation. Qualitative variables including gender, obstructive and restrictive defects were measured as frequency and percentages. After stratification chi-square test was applied. *p*-value of less than or equal to 0.05 was meant significant.

RESULTS

General Medicine Department of Combined Military Hospital Kohat in which a total of 90 patients were studied to find the frequency of obstructive and restrictive spirometric defects in treated pulmonary tuberculosis and after that analyzed results. Distribution of age in these 90 patients was anlayzed as 18 (20%) patients were in the age range of 18-30 years, 27 (30%) patients were among the age range 31-40, 29 (32%) patients were having age range of 41-50 years and 16 (18%) patients were of the age in between 51-65 years. Mean age found was 46 ± 3.77 years. Gender distribution of these 90 patients was anlayzed as 56 (62%) patients were male and 34 (38%) patients were female. Duration since treatment completion among 90 patients was anlayzed as 30 (33%) patients had duration since treatment completion ≤10 years and 60 (67%) patients had duration since treatment completion >10 years. Mean duration was 12 ± 3.11 years. Obstructive and restrictive spirometric defect among 90 patients was anlayzed as 51 (56.66%) patients had obstructive defect, 24 (26.66%) patients had restrictive spirometric defect, 15 (16.66%) patients had obstructive and restrictive spirometric defect.

Obstructive and restrictive spirometric defect with age, gender and duration since treatment completion were given in (table-I,II,III).

Table-I: Spirometric defects with respect to age distribution (n=90).

Spirometric Defects	10-30 years n (%)	31-40 years n (%)	41-50 years n (%)	51-65 years n (%)	*p*-value
Obstructive	10 (11.11)	16 (17.77)	16 (17.77)	9 (10.00)	<0.001
Restrictive	5 (5.55)	6 (6.66)	8 (8.88)	5 (5.55)	
Mixed	3 (3.33)	5 (5.55)	5 (5.55)	2 (2.22)	

Table-II: Spirometric defects with respect to gender distribution (n=90).

Spirometric Defects	Male n (%)	Female n (%)	*p*-value
Obstructive	32 (35.55)	19 (21.11)	0.981
Restrictive	15 (16.66)	9 (10.00)	
Mixed	9 (10.00)	6 (6.66)	

Table-III: Spirometric defect with respects to duration since treatment completion (n=90).

Spirometric Defects	≤10 years n (%)	>10 year n (%)	*p*-value
Obstructive	17 (18.88)	34 (37.77)	<0.001
Restrictive	8 (8.88)	16 (17.77)	
Mixed	5 (5.55)	10 (11.11)	

DISCUSSION

Spirometry is a pulmonary function test (PFTs) and is one of the most frequently done test. Lung function of patients especially the amount (volume) and/or speed (flow) of air to be taken in and also taken out is measured by spirometry. It is also helpful to assess various types of breathing patterns which usually recosgnize conditions including asthma, pulmonary fibrosis, chronic obstructive pulmonary disease and cystic fibrosis. Spirometry makes very important part of health surveillance system, in which different types of respiration over time are commonly determined[8]. Spirometry produces charts called pneumotachographs, and on these charts the flow and volume of air coming inside and moving outside of the lungs from stepwise inspiration to expiration is to be plotted.

The various common parameters which are measured in spirometry include Vital capacity (VC), Forced vital capacity (FVC), Forced expiratory volume (FEV) at specific intervals of 0.5, 1.0 (FEV1), 2.0, and 3.0 seconds, forced expiratory flow 25–75% (FEF 25 to 75) and maximal voluntary ventilation (MVV). Other investigations can also be done in different situations[9].

The number of reported cases of TB which were identified in 2014 was 6.3 million and among these 81% were having lung TB[8]. Based on available treatment options recently, about 86% of new and relapsed subjects of Pulmonary TB which were notified in 2014 were managed successfully. However, various studies done in successfully managed Pulmonary TB patients, it was found that symptoms remain persistent with lesser life comforts, abnormal chest X-ray reports and impairment of spirometric findings in some individuals[9]. Pulmonary TB poses long term risk of respiratory complications which include fibrosis of the lungs, bronchiectatic changes, stenosis of airway, Aspergillosis and Obstructive airway disease. One more thing found was that it may also be responsible for a significant risk of malignancy of the lungs[10]. There seems to be a too little data which is found on the whole mechanism of above mentioned complications in various cohort studies of patients who were successfully managed for Tuberculosis. For most of those diseases the available studies are more often based on case report studies and case series. In one of these types of studies, Neeta Singh *et al* reported about 51 successfully treated patients who were having multidrug resistant Tuberculosis. Of these patients, 78% had persistent respiratory complaints, 98% had remaining chest X-ray changes, 96% had ventilation problems with 66% of ventilatory problem patients showed a mixed variety of ventilation problem and 19% were found to have pure restrictive defect and 11% showed pure obstructive defect after completion of their anti TB drug treatment. In a similar type of small prospective study having 25 drug sensitive TB patients, the investigators found that exudative changes were healed and lymph nodes regressed after treatment was completed although it did left some permanent characteristics including emphysema (36%), fibrotic bands (64%), bronchiectatic changes (40%) and distorted bronchial as well as vascular markings (56%). Patients with cavitating lung disease were found to have more evidence of Structural as well as functional problems than those having non cavitating lung disease[11]. When the era of treating pulmonary TB patients with sanatorium came to an end, obstructive airway problems were more frequently found in those who left sanatorium. It was determined in a study that as high as 62% of white male patients who left sanatorium were observed to be having lung function finding of obstructive airway problem[12]. There have also been more studies showing similar type of results. In such studies it was found some patients had restriction while others had combined restriction and obstruction and some had only obstructive airway problems. It was also noted that those subjects who were repeatedly affected by TB had a relatively more evidence of spirometric problems[13]. A similar study was done in South African patients of tuberculosis, problems of lung function were observed in 18%, 27%, and 35% of patients after single, double, or three times affected subjects of Pulmoary TB[14]. In an-other case-control study, spirometry was done in those patients who had positive culture for Pulmonary TB and were compared with patients who were infected with latent tuberculosis. It was observed that those group of patients who had Pulmonary TB, they were 5.4 times more often susceptible in developing a reduction in Forced Expiratory Volume in 1s (FEV1) and Forced Vital Capacity (FVC) as compared to those having Latent Tuberculosis Infection (LTBI) after making adjustment of the risk factors including age, BMI, place of origin, sex, and cigarette smokers[15]. One other study was done in Latin America which observed obstructive airway problems in the population. It was noted that 30.7% of those patients having history of Pulmonary TB had obstructive airway disease

while only 13.9% had such problem without having Pulmonary TB[16].

Our study shows that mean age found was 46 years with SD ± 3.77. Sixty two percent of the patients were male while 38% patients were female. Thirty three percent patients had duration since treatment completion ≤10 years and 67% patients had duration since treatment completion >10 years. Mean duration was 12 ± 3.11 years. Fifty six percent patients had obstructive defect, 27% patients had restrictive spirometric defect, 17% patients had obstructive and restrictive spirometric defect.

Lee *et al*[17] in a study to estimate extent of Tuberculosis destroyed lung performed pulmonary function tests on 25 selected patients and found that sixteen patients (64%) had obstructive pattern while nine patients (36%) had restrictive pulmonary function problem. Baez-Saldana *et al*[7] in a study to measure radiographic abnormalities and related spirometric values in cured pulmonary tuberculosis found that 30 patients out of 127 (24%) showed obstructive pattern and 22 patients out of 127 (17%) exhibited restrictive pulmonary function abnormality.

Similarly, Baig *et al*[1] in a study to determine frequency of chronic obstructive pulmonary disease following treated pulmonary tuberculosis found that there were 36 (76.5%) males. Mean age was found 56.4 years in male patients and 44.2 years in female patients. Obstructive airway problems were observed in 26 (55.3%) patients. Obstruction was severe in 18 (69.2%) patients, moderate in 6 (23%) and mild in 2 (5.9%). 14 (29.7%) were observed to have restriction and 7 (14.8%) showed both obstruction as well as restriction on spirometry.

Manji *et al*[18] also reported in his study as abnormal spirometric problems were found in 371 (74%) subjects. Obstructive lung problem was found in 210 (42%) patients, restriction was observed in 65 (13%) patients and 96 (19%) patients were observed with both types of spirometric defects. Important etiology found in patients with significant airway problems repeated episodes of Pulmonary TB (Adj OR 2.8, CI 1.274-6.106), individuals with –ve Human Immunodeficiency Virus (HIV) results (Adj OR 1.7, CI 1.055-2.583), over 40 years old (Adj OR 1.7, CI 1.080-2.804) and male gender (Adj OR 1.7, CI 1.123-2.614).

CONCLUSION

Treated patients of pulmonary tuberculosis should be followed up for residual lung defects. The frequency of obstructive lung defect is more than restrictive lung defects in treated patients of pulmonary tuberculosis. Some patients may have both obstructive and restrictive lesions.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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