ORIGINAL RESEARCH

Correlates of pulmonary dysfunction among cured pulmonary tuberculosis patients

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ABSTRACT
Pulmonary function tests (PFTs) is a generic term used to indicate a battery of studies or maneuvers that may be performed using standardized equipment to measure lung function. PFTs can include simple screening spirometry, formal lung volume measurement, diffusing capacity for carbon monoxide, and arterial blood gases. It is a valuable tool for evaluating the respiratory system, representing an important adjunct to the patient history, various lung imaging studies, and invasive testing such as bronchoscopy and open-lung biopsy. Patients with a history of pulmonary tuberculosis who have successfully completed treatment with complete microbiological cure and meeting the inclusion and exclusion criteria and who comes to Pulmonology outpatient department were enrolled for this study after obtaining the informed and written consent. Study was approved by the institutional ethical committee. As the severity of pulmonary dysfunction increases, there was an increase in the severity of dyspnoea and the association was found to be statistically highly significant withp – value of 0.0000. As the radiological abnormalities increased from mild to severe, there was an increase in the severity of pulmonary dysfunction. The association was found to be highly significant on statistical analysis with a p – value of <0.000.
Key words: Pulmonary dysfunction, tuberculosis, spirometry

Introduction

Although tuberculosis can affect any organ of the body, the lung is virtually always the portal of entry. Tuberculosis is the archetype of airborne-transmitted infectious diseases.[1]

Mycobacterium tuberculosis is spread by small airborne droplets, called droplet nuclei, generated by the coughing, sneezing, talking, or singing of a person with pulmonary or laryngeal tuberculosis. Usually, one bout of cough produces 3000 droplet nucleiand these can remain airborne for minutes to hours after expectoration. Droplet nuclei carrying tubercle bacilli are produced by patients with active pulmonary tuberculosis inproportion to the liquidity of the secretions and the number of bacilli excreted, i.e., they are most numerous in persons with a productive cough and positive sputum smears.The number of organisms in the airborne aerosol also depends on the expulsive force of the cough and the presence of cavitation in the lungs.[2]

Transmission of TB is influenced by the number of bacilli in the droplets, the virulence of the bacilli, exposure of the bacilli to UV light, degree of ventilation, and occasions for aerosolization.[3]

Pulmonary function tests (PFTs) is a generic term used to indicate a battery of studies or maneuvers that may be performed using standardized equipment to measure lung function. PFTs can include simple screening spirometry, formal lung volume measurement, diffusing capacity for carbon monoxide, and arterial blood gases. It is a valuable tool for evaluating the respiratory system, representing an important adjunct to the patient history, various lung imaging studies, and invasive testing such as bronchoscopy and open-lung biopsy. The percentage of predicted normal is used to grade the severity of the abnormality. A simplified and stepwise method is key to interpreting spirometry. The first step is determining the validity of the test. Next, the determination of an obstructive or restrictive

ventilatory pattern is made. If a ventilatory pattern is identified, its severity is graded. In some patients, additional tests such as static lung volumes, diffusing capacity of the lung for carbon monoxide, and bronchodilator challenge testing are needed.[4] These tests can further define lung processes but require more sophisticated equipment and expertise available only in a pulmonary function laboratory. A great deal of information can be obtained from a spirometry test; however, the results must be correlated carefully with clinical and roentgenographic data for optimal clinical application.

Methodology

Study Population

Patients with a history of pulmonary tuberculosis who have successfully completed treatment with complete microbiological cure and meeting the inclusion and exclusion criteria and who comes to Pulmonology outpatient department were enrolled for this study after obtaining the informed and written consent. Study was approved by the institutional ethical committee.

Sample size: 75

Study design: Hospital based cross sectional study

Sampling technique: Convenience sampling

Inclusion criteria

1. Adult male/female (age >18 years)
2. History of pulmonary tuberculosis with complete treatment
3. Sputum AFB negative.

Exclusion criteria

1. Smoking
2. History of prior lung disease like Bronchial Asthma, COPD and Bronchiectasis
3. Occupation posing risk to lung function
4. Interstitial lung disease
5. HIV positive status
6. Pregnancy
7. Spirometry contraindicated such as recent eye or upper abdominal surgery
8. Ischaemic heart disease
9. Lung parenchymal involvement as evidenced by clinical examination, X ray or sputum AFB positivity
10. Kyphoscoliosis or congenital chest abnormality.

Investigations

Routine investigations were done for all cases and included:

a) Hemoglobin % with ESR
b) Total WBC count, Differential WBC count.
c) Random blood sugar
d) Blood urea and Serum creatinine
e) ECG and Chest X-ray
f) Sputum for AFB
g) Pulmonary function tests
h) HIV ICTC

Results

Table 1: Association between sex and pattern of abnormality

Interpretation	Male	Female	Total
Obstruction	7 (13.2)	3 (13.6)	10913.3)
Restriction	13 (24.5)	7 (31.8)	20 (26.7)
Mixed	22 (41.5)	7 (31.8)	29 (38.7)
Normal	11 (20.8)	5 (22.7)	16 (21.3)
Total	53 (100)	22 (100)	75 (100)
Chi Square test = 0.718, p<0.869, NS			

This table shows the association between gender and pattern of PFT abnormality. It was seen that both restrictive and mixed abnormality was more commonly seen in females while males had a predominantly mixed abnormality.

The association between gender and pattern of PFT abnormality was found to be statistically not significant with a p – value of 0.869.

Table 2: Association between age group and pft interpretation

Interpretation	Age group (years)				Total
	≤30	31-45	46-60	> 60	
Obstruction	4 (16.7)	3 (15)	1 (6.7)	2 (12.5)	10913.3)
Restriction	11 (45.8)	1 (5)	5 (33.3)	3(18.8)	20 (26.7)
Mixed	2 (8.3)	10 (50)	7 (46.7)	10 (62.5)	29 (38.7)
Normal	7 (29.2)	6 (30)	2 (13.3)	1 (6.3)	16 (21.3)
Total	24 (100)	20 (100)	15 (100)	16 (100)	75 (100)
Chi Square test = 20.728, p<0.01, Significant					

This table shows the association between Age and pattern of PFT abnormality among the study group.

As the age increased there was an increase in the frequency of mixed pattern whereas Restrictive pattern was most common in young age group.

Table 3: association between dyspnoea and severity of pulmonary dysfunction

Degree of severity	Dyspnoea				Total
	Grade I	Grade II	Grade III	Absent	
Mild	3 (13.6)	0	0	1 (33.3)	4 (6.8)
Moderate	8 (36.4)	1 (4.8)	0	2(66.7)	11 (18.6)
Moderately severe	4 (18.2)	4 (19)	0	0	8 (13.6)
Severe	6 (27.3)	6 (28.6)	4 (30.8)	0	16 (27.1)
Very severe	1 (4.5)	10 (47.6)	9 (69.2)	0	20 (33.9)
Total	22 (100)	21 (100)	13 (100)	3 (100)	59(100)
Chi Square test = 30.4, df=14, p<0.000, HS					

As the severity of pulmonary dysfunction increases, there was an increase in the severity of dyspnoea and the association was found to be statistically highly significant withp – value of 0.0000

Table 4: association between severity of pulmonary dysfunction and post treatment duration

Post Treatment duration						
Degree of severity	N	Mean in years	Std. Deviation	F Value (ANOVA)	P Value	Significance
Mild	4	7.25	9.91	1.101	P <0.415	Not Significant
Moderate	11	6.55	4.91			
Moderately severe	8	6.63	6.65			
Severe	16	7.63	4.94			
Very severe	20	10.20	5.86			

With increasing post treatment duration there was an increasing trend in the severity of pulmonary dysfunction. However, the association was not found to be statistically significant.

Table 5: association of severity of dysfunction with radiological findings

Degree of severity	Radiological Abnormality			Total
	Mild	Moderate	Advance	
Mild	3(21.4)	1 (5.3)	0	4 (6.8)
Moderate	8(57.2)	3 (15.8)	0	11 (18.6)
Moderately severe	3(21.4)	4(21.1)	1 (3.8)	8 (13.6)
Severe	0	9(47.4)	7 (26.9)	16 (27.1)
Very severe	0	2 (10.5)	18(69.2)	20 (33.9)
Total	14(100)	19 (100)	26(100)	59(100)
Chi Square test = 49.606, df=8, p<0.000, HS				

As the radiological abnormalities increased from mild to severe, there was an increase in the severity of pulmonary dysfunction. The association was found to be highly significant on statistical analysis with a p – value of <0.000.

Discussion

In this study, 75 patients who had Pulmonary Tuberculosis in the past and have successfully treated for it (TB) were selected. Ofthe 75 patients, 70.7% were males and 29.3% were females. This male predominance was also noted by Di Naso *et al*[5]., where 80% of the patients were males, and Radovic *et al*[6]., who reported a male predominance of 62.5%. In the PLATINO study, however, the ratio was 0.65, which is in contrast to the finding og current study.

The mean age of study population was 43.32 years with a minimum age of 18 years and maximum age of 85 years.Among the males, the mean age was 47.79 years while it was 39.36 years in the female group, having older males than female.

Approximately three fourth of the patients, 77.3% patients had dyspnoea at the time of enrolment in the study. Most of the patients had either grade I or grade II dyspnoea. The mean duration dyspnea in this was 4.83 months. As the severity of dyspnoea increased, there was an increase in the mean duration of dyspnoea as well. Studies have documented that cured PTB patients continue to have respiratory symptoms.[10,146] similarly in one study 14% of treated PTB patients continued to attend the OP department for more than five years for respiratory complaints.[146]There is a need to educate the patients

that persistence of respiratory symptoms is not synonymous with reactivation of the disease.As all patients enrolled for the study had completed their anti – tubercular treatment and were sputum negative, the cause of their dyspnoea should be ascribed to post tubercular pulmonary changes. This study highlights the presence of respiratory system related morbidity among the microbiologically cured pulmonary tuberculosis patients.

This study also shows that there was a direct association between severity of radiological changes and severity of pulmonary dysfunction as evident by PFT. Out of 26 patients who showed advance radiological changes 25(96.1%) patients had severe and very severe pulmonary impairment while out of 14 patients who has mild radiological changes 78.6% patients had mild to moderate impairment.

In the present study, the prevalence of pulmonary function abnormalities showed an increasing trend with rising age. Among patients less than 30 years, 29.7% of the patients had a normal PFT while only one of the patients above 60 years of age had a normal PFT (see table no. 8). This may be due to age related changes in the pulmonary parenchyma. With increasing age, there is a loss of lung elasticity resulting in alveolar dilatation, lung hyperinflation and inadequate deflation. These anatomical and physiological alterations which take place with age, affect the normal functioning of respiratory system leading to increased pulmonary impairment with ageing.

But, in the present study; Among the patients of less than 30 years age group, 12.5% patients had advanced radiological changes whereas 62.5% patients above 60 years of age had advanced changes (see Table no. 26). So increase in age was associated with a higher prevalence of advanced radiological changes. Thus advanced radiological changes may be considered as the underlying factor in the increased severity and frequency of pulmonary dysfunction with increasing age.

Similar observations have been made in various other studies done till date. In all these studies, the decline in pulmonary function with age was related to the extent of radiological shadowing.[7]

In our study, patients of younger age group were associated with a higher prevalence of restrictive defect on PFT, with 45.8% patients less than 30 years of age having restrictive impairment, and combination of obstruction and restriction that is mixed abnormality was more commonly seen in the elderly patients with 62.5% of the patients above 60 years having obstruction. This finding may also be explained by the association of obstructive abnormality and advanced tissue destruction and scarring seen with increasing age.

The severity of pulmonary dysfunction was also found to be higher in the elderly age group, however the difference between the elderly and younger age group was not found to be statistically significant.

Severity of PFT appeared to be related to post treatment duration. With increasing post treatment duration there was an increasing trend in the severity of pulmonary dysfunction.However the difference was not found to be statistically significant.

Variable observations have been made with respect to the association of severity of pulmonary dysfunction with the post treatment duration. Plit *et al*. and Chung *et al*. in study found out that PTB patients usually develop maximum loss of lung function within 6 months of the diagnosis of TB and which stabilized 18 months after completion of treatment.[8,9] In another study, decline of FVC of 27.7 - 54.3 ml/year and FEV_1 of 28.8-35.3 ml/year over a period of 15 years was reported.[7] A study of 46 patients in Saudi Arabia showed an improvement in lung function with increase in post treatment duration.[10] These changes can be explained by the fact that in the first few years after tuberculosis, healing does continue even after stopping all anti tubercularthерapy leading to further improvement of lung parenchymal structure and better lung function measurements. Thereafter, depending on the extent of the lung residual damage, decline in the pulmonary functions may be documented.

Conclusion

- Restrictive and mixed abnormality was more commonly seen in females while mixed pattern was more commonly seen in males. The association was not found to be statistically significant.
- With increasing age, an increased prevalence of obstructive abnormality was seen while restriction was more common in the younger age group. Severity of pulmonary impairment also showed an increase with increasing age but the difference was not found to be statistically significant.
- All patients were subjected to radiological examination and based on the findings were divided into mild, moderate and advanced group.40% patients had mild changes, 25% had moderate parenchymal involvement on chest radiology while 35% had advanced radiological findings.
- A direct correlation between increased pulmonary impairment and radiological changes on chest radiograph was found in this study.

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