www.jmscr.igmpublication.org

Impact Factor 3.79
ISSN (e)-2347-176x

IGM Publication

Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Spirometry in Treated Cases of Pulmonary Tuberculosis

Authors
Doye George[1], Sethu Babu[2], P Sukumaran[3], Anu Sam Mathew[4], Salini M R[5]
[1]Associate Professor, Department of Pulmonary Medicine
[2]Associate Professor, Deaprtment of Pulmonary Medicine
[3]Professor& HOD, Department of Pulmonary Medicine
[4]Junior Resident, Department of Pulmonary Medicine
[5]TB Health Visitor, RNTCP
Pushpagiri Institute of Medical Sciences and Research Centre , Thiruvalla, Kerala. India

ABSTRACT

1. *Fifty four male patients who were cured of sputum direct smear positive pulmonary tuberculosis and were working full time were selected for the study of lung function.*
2. *Spirometry was done in all patients.*
3. *About 10% of the patients showed evidence of slight to moderate degree of restrictive ventilatory defect as judged from values of FVC and FEV_1/FVC %*
4. *About 37% showed evidence of airway obstruction mostly mild to moderate degree, except 10% who were severely obstructed.*
5. *About 24% of the patients had cough with expectoration and/or dyspnoea. These symptoms were associated with reduced FEV_1/FVC%.*
6. *It was observed that in smokers greater extent of residual lesion was associated with more severe airflow obstruction which was statistically significant.*
7. *Early detection and prompt treatment of pulmonary tuberculosis so that residual lesions will be minimal, and cessation of smoking will prevent or reduce the extent of airway obstruction, after completion of treatment.*

INTRODUCTION

Pulmonary tuberculosis involves the lung parenchyma, bronchi and bronchioles, the pleura and pulmonary vasculature (Pagel et al). For many decades it has been observed that these lesions may impair lung function depending on the extent of involvement[1,2,3].

Pulmonary tuberculosis heals by fibrosis and calcification which are likely to lead to restrictive ventilatory defect. The damaged lungs may be predisposed to complications like bronchiectasis,, Chronic bronchitis and emphysema, which may lead to secondary infection with its sequelae and impairment of lung function[4].

Some such studies on the effect of treatment with drugs on lung function have been reported [5,6]. Obstructive, restrictive and obstructive cum restrictive defects have been reported[7,8,9].

The present study is designed to investigate the state of lung function in patients in whom treatment was successfully completed following which they have been working full time for at least two years. The following aspects have been investigated.

1. Do such patients show any obstructive/ restrictive ventilatory impairment?
2. Is the impairment of lung function related to extent and type of pre-treatment lesions or post-treatment residual lesions, and smoking habits?

MATERIALS AND METHODS

Fifty four male sputum direct smear positive pulmonary tuberculosis patients who were cured of the disease by adequate chemotherapy were selected for the study two to seven years after completion of treatment. All of them were treated successfully with the Category 1 regimen.

Sputum direct smear for AFB was done in all patients to ensure that they have no relapse at the time of inclusion in the study. Chest X-ray PA view at the time of starting treatment was available in all patients. A CXR-PA view was done at the time of inclusion in the study. The radiological extent of the lesion was classified according to the Tuberculosis Association of India Classification[10].

Minimal- Only one zone of upper, middle and lower zones involved.

Moderately advanced—Two zones involved

Far advanced—More than two zones involved .

Attempt was made to correlate the functional impairment with pre and post treatment radiological extent of the lesions.

Functional impairment was studied separately in smokers and non-smokers.

CBC and ECG were done in all patients. Any patient showing evidence of cardiac disease was not included in the study.

Spirometry was done on Vitalograph Spirotrac version 1.08.0159. The predicted normal value was provided by the manufacturers. The predicted value for Indians were taken.

RESULTS

The observations on 54 patients have been analysed. The mean values of age, height, weight, and body surface area of the whole group were 37.6+-11.3 years, 161.6+-5.8 cm, 50.2+-8.4KG, and 1.51+-0.13m^2 respectively. For the purpose of analysis of the data patients were divided into different groups depending on the initial and residual radiological extent of disease as judged from the postero-anterior chest radiograph according to Tuberculosis Association of India Classification of Tuberculosis [10].

Extent of the disease

1.Minimal- lesions involving a small part of one lung or both lungs the total extent- regardless of distribution-not exceeding the volume of one lung upto the level of the lowest point of the second costochondral junction.

2.Moderately Advanced- Lesions involving one lung or both lungs but not exceeding volume of

one lung upto the level of the lowest point of the costochondral junction.

3.Far Advanced- Lesions more extensive than moderately advanced lesions.

4. Complete Clearing- The patients who showed almost complete clearing of lesions after treatment were classified as Complete Clearing.

In each of the above groups, patients were further subdivided into smokers and non-smokers.

Distribution of patients according to age groups,smoking habits, initial as well as residual extent of lesions and respiratory symptoms are shown in tables 1 and 2. It can be seen that 40(74%) out of the 54 patients were smokers. They smoked an average of 22.7+-2.6 pack years. On the basis of initial extent of disease, the lesions were minimal in 22.2%, moderately advanced in 40.7% and far advanced in 37.1% of patients. On the basis of residual extent of disease, 14.8% showed complete clearing, 63% showed minimal, 18.5% moderately advanced and 3.7% far advanced lesions.

Forty one (75.9%) were symptom-free, while 4 (7.4%)had cough with expectoration,1(1.9%) had dyspnoea on exertion, and 8 (14.8%) had both cough and dyspnoea at the time of inclusion in the study.

The influence of treatment on the initial extent of lesions is shown in table 2. It can be seen that all patients showed regression of lesions and none showed worsening.

Physical examination showed no abnormality in 48 (88.9%) patients, medium crepitations in both infrascapular areas in one patient, and rhonchi on forced expiration in all areas in 5 patients. None of the patients showed any evidence of cardiovascular disease.

Sputum direct smear for AFB (2 samples) were negative in all patients. Total and differential leucocyte counts were within normal limits in all patients. Haemoglobin values ranged between 9 and 16 g% with a mean of 12.1g%.

Routine urinalysis showed no abnormality in 52 patients. Two patients showed presence of sugar. They were not known diabetics. 12 lead ECG showed no abnormality in all 54 patients.

Forced Vital Capacity-

Table 3 shows that greater the extent of initial and residual lesion, grater the reduction in FVC, the association being more marked in the latter (residual) than in the case of the former. Whereas the decrease in FVC with more extensive initial lesions was not stastistically significant both in smokers and non-smokers, it was found to be stastistically significant in smokers ($F=4.47$ and 3 and 36 df. $p < 0.05$) in relation to the extent of residual lesions. Due to the small number of non-smokers, cases with complete radiological clearing and minimal residual lesions were pooled together and compared with those having moderately advanced residual lesion. The difference although appreciable failed to attain statistical significance.

FEV_1/ FVC, and $FEF_{25-75\%}$

FEV_1/FVC, and $FEF_{25-75\%}$ decreased as the extent of lesions (both initial and residual) increased. The decrease in both parameters with greater extent of residual lesion was statistically

significant in smokers. (FEV_1/FVC- F=4.11 for 3 and 36df $p < 0.05$; $FEF_{25-75\%}$-F=4.46 for 3 and 36 df $p < 0.05$).

PEFR, FEF_{25}, FEF_{50}, and FEF_{75}

The results of PEFR, FEF_{25}, FEF_{50} and FEF_{75} are shown in table 6. The maximal expiratory flow rates in smokers showed a downward trend with greater extent of initial disease. However, nonsmokers with far advanced initial lesions showed higher flow rates than nonsmokers with moderately advanced initial lesions. None of the differences were statistically significant.

In smokers the maximal expiratory flow rates showed a definite downward trend with more extensive residual lesions. The difference in all flow rates were statistically significant (PEFR-F=12.92 for 3and 19 df, $p < 0.05$; FEF_{25} F=7.43 for 3 and 19 df, $p < 0.05$; FEF_{50} F=5.47 for 3 and 19 df, $p < 0.05$; and FEF_{75} F=2.60 for 3 and 19 df, $p < 0.05$.

Among non-smokers, those with moderately advanced residual lesions showed lower FEF_{50} and FEF_{75} than those with minimal residual lesions. The difference was not statistically significant.

Coparison between pulmonary functions of smokers and non-smokers showing the same extent of residual lesion.

There were no non-smokers in the group with far advanced residual lesion. In the other groups smokers generally showed a lower mean value of FVC, FEV_1/FVC, FEF_{25-75}, PEFR, FEF_{25}, FEF_{50}, and FEF_{75}

For statistical analysis, patients with complete clearing and minimal lesions in the post-treatment skiagrams were clubbed together. The lower FEF_{50} and FEF_{75} in smokers as compared to non smokers were found to be statistically significant-(FEF_{50} – $0.01>p<0.02$; FEF_{75} $0.001<p<0.01$.

Table – 1 Distribution of patients according to age, smoking habits, extent of disease and symptoms.

		AGE GROUPS				
		20 - 29	30 - 39	40 - 49	50 - 59	**TOTAL**
Smoking Habits	Smokers	10	12	7	11	40 (74.1%)
	No Smokers	9	5	2	0	14 (25.9%)
Initial Extent of Disease (I E D)	Minimal	3	3	4	2	12 (22.2%)
	Mod. Advanced	8	8	3	3	22 (40.7%)
	Far advanced	8	4	2	6	20 (37.0%)
Residual Extent of Disease (RED)	Complete Clearing	4	2	2	0	8 (14.8%)
	Minimal	11	11	6	6	34 (63.0%)
	Mod. Advanced	3	2	1	4	10 (18.5%)
	Far Advanced	1	0	0	1	2 (3.7%)

Symptoms	Asymptomatic	17	13	6	5	41 (75.9%)
	Symptomatic					
	Cough with expectoration	1	2	0	1	4 (7.4%)
	Dyspnoea on exertion	0	0	1	0	1 (1.9%)
	Cough with expectoration and dyspnoea on exertion.	1	0	2	5	8 (14.8%)
	Total	19	15	9	11	54

Table – 2 Distribution of patients according to pre treatment and post treatment extent of disease.

Initial extent of disease (Pre Treatment)	No. of Patients.	**Post – treatment extent of disease**			
		Complete clearing	Minimal	Mod. Advanced	Far advanced
Minimal	12	3	9	0	0
Mod. Advanced	22	5	14	3	0
Far Advanced	20	0	11	7	2
Total	54	8	34	10	2

Table – 3 Mean values ± SD of FVC in patients according to the extent of disease.

Extent of Disease	**Smoking Habit**	**No. of Patients**	**FVC % Predicted.**
Initial Extent			
Minimal	Smokers	11	91.44±8.35
	Non Smokers	1	87.80
	Total	12	91.13±8.03
Mod. Advanced	Smokers	16	87.28±13.44
	Non Smokers	6	92.18±16.91
	Total	22	86.61±14.21
Far Advanced	Smokers	13	80.41±14.27
	Non Smokers	7	89.17±10.85
	Total	20	83.48±13.57
Residual Iesion			
Complete Clearing	Smokers	6	87.73±10.33
	Non Smokers	2	91.40±5.09
	Total	8	88.65±9.10
Minimal	Smokers	27	89.59±12.36
	Non Smokers	7	93.79±9.23
	Total	34	90.46±11.79
Mod. Advanced	Smokers	5	72.14±4.69
	Non Smokers	5	85.16±18.81

	Total	10	78.65±14.63
Far Advanced	Smokers	2	70.70±14.71
	Non Smokers	0	70.70±14.71
	Total	2	87.27±13.00
Total		54	87.27±13.00

Table – 4 Mean values ± SD of FEV_1, and forced mid – expiratory flow rate $FEF_{25-75\%}$ in patients according to extent of disease.

Extent of Disease	**Smoking Habit**	**No. of Patients**	**FEV_1 / FVC**	**$FEF_{25-75\%}$ Predicted.**
Initial Extent				
Minimal	Smokers	11	77.15±5.62	85.19±27.96
	Non Smokers	1	77.4	77.6
	Total	12	76.99±5.47	84.56±26.74
Mod. Advanced	Smokers	16	72.6±11.31	70.28±25.37
	Non Smokers	6	78.0±5.03	86.68±29.92
	Total	22	73.77±10.03	74.75±27.0
Far Advanced	Smokers	13	66.98±13.07	58.59±38.53
	Non Smokers	7	73.17±17.36	71.41±50.08
	Total	20	69.53±14.71	63.08±42.06
Residual Iesion				
Complete Clearing	Smokers	6	80.48±4.33	93.25±30.36
	Non Smokers	2	81.6±5.94	89.65±17.04
	Total	8	80.7±4.27	92.35±26.51
Minimal	Smokers	27	72.59±11.08	73.50±30.15
	Non Smokers	7	76.71±14.57	88.41±42.09
	Total	34	73.42±11.7	76.57±32.8
Mod. Advanced	Smokers	5	65.92±9.65	46.62±11.11
	Non Smokers	5	71.48±11.63	59.88±40.88
	Total	10	68.7±10.49	53.25±29.09
Far Advanced	Smokers	2	54.3±1.27	23.0±6.93
	Non Smokers	0		
	Total	2	54.3±1.27	23.0±6.93
Total		54	72.94±11.54	72.61±33.76

Table – 5 Mean values ± SD of Peak Expiratory flow rate (PEFR) and maximal expiratory flow rate (FEF) at 75%, 50%, and 25% of forced vital capacity.

Extent of Disease	Smoking Habit	No. of Patients	PEFR L/min	FEF_{25} L/min	FEF_{50} L/min	FEF_{75} L/min
Initial Extent						
Minimal	Smokers	12	386±41	357±51	186±46	59±20
	Non Smokers	0				
	Total	12	386±41	357±51	186±46	59±20
Mod. Advanced	Smokers	16	384±118	319±139	170±70	63±21
	Non Smokers	4	368±40	349±40	247	100±38
	Total	20	381±107	325±126	184±70	70±27
Far Advanced	Smokers	14	333±108	251±111	122±67	47±38
	Non Smokers	8	573±218	495±277	266±108	116±85
	Total	22	413±185	332±208	170±105	70±64
Residual Iesion						
Complete Clearing	Smokers	10	468±94	411±107	213±60	74±25
	Non Smokers	1	396	377	247	127
	Total	11	456±89	405±97	219±55	83±31
Minimal	Smokers	25	379±53	317±84	165±55	59±27
	Non Smokers	2	473±187	454±189	295±68	149±107
	Total	27	391±77	335±104	182±71	71±49
Mod. Advanced	Smokers	6	251±29	204±38	100±27	40±16
	Non Smokers	6	562±266	465±331	241±177	80±56
	Total	12	407±240	335±255	170±108	60±43
Far Advanced	Smokers	4	206±15	116±47	60±27	22±6
	Non Smokers	0				
	Total	4	206±15	116±47	60±27	22±6
Total		54	395±134	334±153	179±81	68±44

Table – 6 Distribution of FEV/ FVC predicted in patients.

Test	Age Group	80%	70 – 79%	60 – 69%	50 – 59%	50%
FEV / FVC	20 - 29	9	9	0	1	0
	30 - 39	3	8	1	2	1
	40 - 49	3	4	1	1	0
	50 - 59	0	3	4	3	1
	Total	15	24	6	7	2

DISCUSSION

A few reports are available on lung function after treatment and rehabilitation of patients11,12. Most of these reports are in patients who had completed treatment less then one year before the study. The present study deals with patients who had not only been cured of their disease, but were successfully rehabilitated and were working full time for a period of several years after conclusion of treatment.

As the pathology of tuberculosis involves mainly the parenchyma and pleura, it is not surprising that the lung volumes in the active phase of the disease are reduced according to the extent of disease. Approximately 75% of the patients in the present study had FVC which was more than 80% of predicted normal values. a further 17% had their FVC between 70-80% of predicted normal. Only 8% had FVC less than 70% and none lower than60% predicted normal value. It may be noted that amongst the patients included in the present study nearly 41% had moderately advanced and 37% far advanced disease in the initial active stage. It therefore seems that treatment with chemotherapeutic drugs successfully resolved most lesions to restore distensibility of the alveoli.

Several workers have observed the presence of airway obstruction in patients with pulmonary tuberculosis during the active stage of the disease, proportional to the extent of the disease13. Presumably the airway obstruction in pulmonary tuberculosis results from endobronchial disease14, peribronchial fibrosis and emphysema. In the present study the presence and severity of airway obstruction was judged on the basis of FEV1/FVC %, $FEF_{25-75\%,}$ and maximum airflow rates at low lung volumes. Twenty (37%) of the 54 patients showed evidence of airway obstruction. Of these twenty patients, 2 had severe, 11 moderately severe and 7 minimal obstruction of the airways. The minimal airway obstruction was judged mostly on the basis of reduced flow rates at low lung volumes. It must be kept in mind that in the present series a large number of patients were smokers, and smoking must have contributed to the airway obstruction in them. However, there were statistically significant reduction in all flow rates as the extent of residual lesion increased. In other words a smoker with a larger residual lesion showed significantly reduced flow rates.

The persistence of symptoms of cough with expectoration and/or dyspnoea was clearly related to reduced FEV_1/FVC% (mean 58+- 10%). 85% of the symptomatic group were smokers.

CONCLUSION

Successful treatment with antituberculous drugs can restore lung function to near normal levels in a large number of patients. Smokers with larger residual lesions showed significantly more airway obstruction, as shown by reduced flow rates.

When treating pulmonary tuberculosis, the treating physician should make every effort to make the patient quit smoking. Early diagnosis and prompt treatment also helps in preventing airway obstruction after completion of treatment.

REFERENCES

1. Birath G, Caro J, Malmberg R, and Simonsson B G, Airways obstruction in

pulmonary tuberculosis. Scand J Respir Dis 1966,47,27.

2. Hnizdo E, Singh T,Churchyard G, Chronic pulmonary function impairment caused by initial and recurrent pulmonary tuberculosis following treatment, Thorax 2000, 55:32-38
3. Pasipanodya J G, Miller T L, Munguia G, Pulmonary impairment after tuberculosis, Chest 2007 131(6) 1817-1824
4. Malik S K, Martin C J, Tuberculosis, corticosteroid treatment and pulmonary function, Am Rev Respir Dis 1969, 100, 13.
5. Plit M L, Anderson R, Van Rosenburg C E, Influence of antimicrobial therapy on spirometric parameters and proinflammatory indices in severe pulmonary tuberculosis European Respir J, August 1998,vol 12, no.2, 351-356.
6. Long R, Maycher B, Dhar A, Manfreda J, Hershfield E, Anthonisen N, Pulmonary tuberculosis treated with directly observed therapy; serial changes in lung structure and function, Chest April 1998 113(4) 933-943
7. Maguire G P, Anstey N M, Adrian M, Pulmonary tuberculosis, impaired lung function, disability and quality of life in a high burden setting, International J TB and Chest Dis 2009, 13,12, pp 1500-1506.
8. De Valliere S, Barker R D. Impaired lung function after treatment for MDR-TB, Int J TB and LD 2004 June No.6 pp767-771
9. Menezes M B, Hallal P C, Perez-Padilla R, Tuberculosis and airfow obstruction: evidence from PLATINO study in Latin America, European Resp J,vol 30 no. 6 1180-1185
10. Tuberculosis association of India (1969); Classification of tuberculosis
11. Vecino M, Pasipanodya J G, Slocum P, Bae S, Evidence of chronic lung impairment in patients treated for pulmonary tuberculosis, Journal of Infection and Public Health, 2011 Nov. vol 4(5) 244-252
12. Verma S K, Kumar S, Narayan K V, Sodhi R, Indian J Allergy Asthma Immunol 2009 23(2) 95-99
13. Amin S K, Pande R S, Ventilatory function in chronic pulmonary tuberculosis, Indian J Chest Dis Allied Sci, 1978, 20,173
14. Williams D J, York E L, Nobert E, Sproule B J, Endobronchial tuberculosis presenting as asthma, Chest, 1988, 93(4), 836-838