

A Comparative Analysis of Clinical, Radiological Spectrum and Sputum Conversion Rates in Smokers and Non-Smokers in Newly Diagnosed Cases of Pulmonary Tuberculosis on Treatment

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ABSTRACT

BACKGROUND

Tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis* which spreads by inhalation of infected droplet nuclei. Prevalence of TB is three times higher among ever-smokers as compared to that of never smokers. Mortality from TB is three to four times higher among ever-smokers as compared to never smokers. Smoking contributes to 50% of male deaths from TB in India in the 25-69 years age group. We performed a prospective study over one and half year period with objective of comparing the sputum conversion, clinical and radiological presentation, in smokers and non-smokers in newly diagnosed sputum positive pulmonary tuberculosis patients started on anti-tuberculosis treatment.

METHODS

This prospective observational study was done on the adult newly diagnosed sputum positive (micro biologically confirmed) pulmonary tuberculosis patients started on anti-tuberculosis therapy in the Department of Pulmonary Medicine, Gandhi Hospital, Secunderabad. This study was performed over a period of 18 months. A comparative analysis of sputum conversion, clinical and radiological presentation between smokers and non-smokers in newly diagnosed sputum positive pulmonary tuberculosis patients who were on anti-tuberculosis treatment was carried out.

RESULTS

In the present study, 100 patients were seen during the study period, and divided into 2 groups comprising of 50 smokers and 50 non-smokers who were diagnosed as newly sputum positive pulmonary tuberculosis. Overall mean age in the present study was 40.34 years and in smokers groups mean age is 49.44 years and among non-smokers it is 31.21 years. Among non-smokers, females contribute 46% and male accounted for 54%.

CONCLUSIONS

Smoking is associated with delayed sputum conversion, more complications like hemoptysis, more advanced and extensive lesions radiologically. Hence, smokers pose an epidemiological threat by remaining infective as they remain a source of infection for longer period of time. Hence smoking should be enquired into and discouraged in all patients. This study can be made extensive by increasing the size of the sample, by examining the sputum smear for AFB at 15 days intervals, and by following up the patients to look for relapse in patients who have quit smoking and in patients who have continued to do so.

KEY WORDS

Smoker, Non-Smoker, Tobacco, *Mycobacterium Tuberculosis*, Anti-Tubercular Drugs, Droplet Nuclei, Post Primary Tuberculosis TB, Latent TB infection

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BACKGROUND

Tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis* which spreads by inhalation of infected droplet nuclei¹. Tuberculosis usually affects the lungs but can affect any part of human body²¹. All those who are infected do not necessarily progress to the disease.³ Life time risk of breaking down to disease is 10 to 15% and the risk is higher in people living with HIV, patients with Diabetes Mellitus, patients on immune suppressant therapy, alcoholics, malnourished and people who smoke tobacco products.^{4,5} Chemotherapy strategy for TB control represents one of the major public health strategies of the recent times which have resulted in important therapeutic breakthrough all over the world.⁶ The incidence (New TB cases per year) is 204 per 1 lakh population in 2017 and the estimated mortality due to TB is 31 per 1 lakh population in INDIA – according to GLOBAL TB report 2018.⁷ Over 95% of TB deaths occur in low and middle-income countries and India bears one fourth of global burden of tuberculosis.⁸ In March 1993, the World Health Organisation (WHO) took an unprecedented step & declared TB as a “Global Emergency”^{9,10}.

India is the third largest producer and second largest consumer of tobacco in the world.¹¹ As per GATS 2010, there are 275 million adult tobacco users in India¹². According to which more than one third (35%) adults in India use tobacco in some form or the other⁸. Prevalence of tobacco use is higher in rural areas as compared to urban areas¹³ and Women use mainly the chewing forms of tobacco.¹⁴

Prevalence of TB is three times higher among ever-smokers as compared to that of never smokers.¹⁵ Mortality from TB is three to four times higher among ever-smokers as compared to never smokers.¹⁶ Smoking contributes to 50% of male deaths in the 25-69 years age groups from TB in India.¹⁶ Exposure to tobacco smoke has been found to affect TB - by increasing risk of infection and developing disease¹⁷; affecting clinical manifestations and increasing risk of relapse among TB patients; affecting bacteriological conversion (sputum smear or culture) and outcome of treatment and increasing TB mortality and resistance to anti-tubercular drugs.¹⁸ Cigarette smoking was an important risk factor associated with a higher prevalence of Latent TB Infection (LTBI).¹⁹ Current and former smokers should be considered as a high-risk population for LTBI and potential candidates for LTBI prophylaxis treatment.²⁰

Smoking causes various pathophysiological changes in the respiratory tract ranging from local anatomical destruction to complex immunological changes^{21,22}. Therefore, naturally the lung defense mechanisms against mycobacterium or its elimination are affected. Smoking is a known risk factor for development of active tuberculosis.²³ Factors influencing sputum smear conversion have been studied extensively, but the effect of smoking has not been evaluated well.²⁴ Pulmonary TB comprises of about 85% of all new TB cases in India which are responsible for the spread of the infection²⁵ in the community. In the light of sparse data, this study looks into the effect of cigarette smoking on sputum smear conversion following Anti-Tuberculosis Therapy, the clinical presentation and radiological presentation in patients who are newly diagnosed with pulmonary tuberculosis by sputum smear examination.

Objectives

1. To compare the time required for sputum smear conversion to negative at 0, 1st, 2nd monthly intervals in smokers when compared to non-smokers in newly diagnosed sputum positive pulmonary tuberculosis patients started on anti-tuberculosis treatment and to know whether the sputum conversion rates are affected by smoking status or not.
2. To assess the time for which a particular case remains infective.
3. To assess the difference between the clinical presentation between smokers and non-smokers in newly diagnosed sputum positive pulmonary tuberculosis patients started on anti-tuberculosis treatment.
4. To evaluate the difference between the radiological presentation between smokers and non-smokers in newly diagnosed sputum positive pulmonary tuberculosis patients started on anti-tuberculosis treatment.

METHODS

This was prospective observational study conducted in the Department of Pulmonary Medicine Gandhi Hospital, Secunderabad, Telangana State over a period of 18 months. Patients were randomly selected in the Outpatient Department of Pulmonary Medicine Gandhi Hospital and divided in two groups each of 50 with smoking nonsmoking history respectively with newly diagnosed sputum positive (microbiologically confirmed) pulmonary tuberculosis patients started on anti-tubercular therapy. As it is compared to analysis equal numbers of patients in each group were selected for easy Statistical analysis.

Inclusion Criteria

Group 1 - New sputum positive pulmonary tuberculosis patients – smokers (an adult who has smoked 100 cigarettes or more in his or her lifetime and who currently smokes cigarettes) - According to CDC-NHIS 2017 definition of current smoker^{26,27} **Group 2** - new sputum positive pulmonary tuberculosis patient – non-smokers (an adult who has never smoked, or who has smoked less than 100 cigarettes in his or her lifetime) - According to CDC-NHIS 2017 definition of non-smoker²⁸.

Various Forms of Smoking²⁷

1. Bidi: Small, thin, hand-rolled cigarettes imported to the United States primarily from India and other Southeast Asian countries. Bidis contain tobacco and can be flavoured. When smoked, bidis have higher concentrations of nicotine, tar, and carbon monoxide than conventional cigarettes.
2. Cigarette: A thin cylinder of ground or shredded tobacco that is wrapped in paper, lit, and smoked.
3. Cigar: A tube of tobacco that is thicker than a cigarette, wrapped in tobacco leaf, lit, and smoked. Cigars include regular cigars, cigarillos, and little filtered cigars.
4. Hookah: Hookahs are water pipes that are used to smoke specially made tobacco that comes in different flavours, such as apple, mint, cherry, chocolate, coconut, liquorice, cappuccino, and watermelon. Also called water pipes.
5. Pipe: A tube with a small bowl at one end that is filled with tobacco - lit and smoked.

Exclusion Criteria

Severely moribund cases, MDR cases, patients lost to follow up, patients with retroviral disease, elderly patients > 70 yrs., age, patients <20 yrs. of age, and diabetics were excluded from the study.

Investigations

Plain chest radiograph, sputum fluorescent stain for AFB, complete blood picture, liver function test, renal function tests, random blood sugar, ECG, HIV screening (after informed written consent from the patient) and other investigations as per requirement.

Sputum Collection Method

Two sputum samples were collected- spot and early morning. Sputum induction can also be performed with 3% NaCl nebulisation. Collection is done ideally in a container of 28 ml, screw capped bottle with watertight seal, is easy to label, and is reusable after thorough cleaning and sterilization. Mouth is rinsed before sputum collection. Two deep breaths taken before coughing out. Sputum collected in open surroundings. Specimens collected should reach the lab as soon as possible. Sputum samples collected in the early morning is processed the same day or late in the same day are processed the next morning. Any delay, can be stored at 2 – 80 C temperature and delivery should not be delayed for more than 48 hrs.

AFB Staining- Fluorescent Staining with LED Microscopy

1. Mark a new, clean, grease free slide with laboratory number.
2. Pick the purulent portion of the sputum using the crushed end of the broom stick and prepare smear in an oval shape in the centre of the slide (3 x 2 cms), for good spreading of sputum firmly press the stick perpendicular to the slide and move in small concentric circles. Thorough spreading of sputum is very important; it should be neither too thick nor too thin. Prior to staining, hold the smear about 4-5 cm over a piece of printed paper, if letters cannot be read, it is too thick.
3. Allow smear to air dry at room temperature
4. Heat fix by passing the slide over flame 2-3 times for about 2-3 seconds each time. (do not heat or keep the slide stationary over the flame or for too long or else it will be scorched).

Arrange slides in serial order on staining bridge, with smear side up, at a distance of at least 1 cm between every slide-

1. Flood the slide with filtered 0.1% Auramine solution.
2. Do not heat.
3. Keep the staining reagent for at least 20 min; make sure that the smear area is continuously covered with Auramine by adding more if needed.
4. Rinse with water and drain.
5. Apply de-colourising solution, 0.5% acid alcohol for 3 minutes.
6. Gently rinse with water until the macroscopically visible stain has been washed away and drained.
7. Flood smear with 0.5% potassium permanganate solution for 1 minute. Time is critical because counter staining for longer time may quench the acid-fast bacilli fluorescence.
8. Gently rinse with water and drain
9. Air dry on a slide rack away from sunlight. If they are not

read immediately Place them in slide box.

Reading²⁹

1. Keep stained smears in the dark (box or folder), and read on the same day of staining as the fluorescence is prone to fading with time.
2. To be able to focus with ease, better to read first a positive control smear stained by auramine O.
3. Use the objective 20X for focusing and read to the slide use 40X objective (avoid using oil immersion 100X objective, inexperienced readers should ask confirmation from a supervisor)
4. Scan the stained smear systematically from one side to the other, for one length of the smear
5. Acid-fast bacilli appear bright yellow against the dark background material.
6. Sputum grading according to RNTCP guidelines.

Chest X Ray

It is an invaluable tool in the management of pulmonary tuberculosis patients. This can be used both in the diagnosis and follow up in tuberculosis patients.³⁰ A horizontal line passing through the tracheal bifurcation bounds the upper and middle lung zone. Similarly, a horizontal line passing through the lower pulmonary vein separates the middle and lower lung zones. In total, both lungs are divided into 6 zones; each zone is addressed as 1 to 6.

Statistical Analysis

Statistical Analysis were performed using Statistical Package for Social Sciences (SPSS Version) and Numerical Data was entered as such. Inferential Statistics obtained included Chi Square Test and p Values.

RESULTS

In the present study total 100 patients were included in 2 groups Smokers and Non-smokers. Majority of the patients in group 1 (smokers with pulmonary tuberculosis) belonged to 51 to 70 years age group and majority of group 2 (non-smokers with pulmonary tuberculosis) belonged to age group of 21 to 30 years in the present study. In the present study out of 100 patients in 2 groups 29 % of them are females and 71 % of them are males. The smokers (Group 1) had 12% of females and 88% of males which is expected according to the smoking habits in the community. Females accounted for 46% of non-smokers (Group 2) and males accounted for 54% of non-smokers.

In the present study out of 50 patients in group 1 (Smokers with Pulmonary Tuberculosis), 30% (15) of the patients showed sputum grade +3, 44% (22) had sputum grade +2 and 14% (7) had sputum grade +1 whereas 12% (6) had sputum grade scanty. Out of 50 patients in group 2 (non-smokers with Pulmonary Tuberculosis), 10% (5) of the patients showed sputum grade +3, 24% (12) had sputum grade +2 and 34% (17) had sputum grade +1 whereas 32% (16) had sputum grade scanty.

Among smokers 30% (15) sputum grade is +3, 44% (22) sputum grade is +2 and 14% (7) sputum grade is +1 and 12%

(6) had sputum grade scanty. Among non-Smokers 10% (5) sputum grade is +3, 24% (12) sputum grade is +2 and 34% (17) sputum grade is +1 and 32% (16) had sputum grade scanty. Among smokers 20 patients (40%) had sputum conversion to negative at the end of 1st month of treatment with Anti-Tuberculosis Treatment and 27 patients (54%) had sputum conversion at the end of 2nd month of treatment, in non-Smokers 39 patients (78%) had sputum conversion to negative at the end of 1st month of treatment and 8 patients (16%) had sputum conversion at the end of 2nd month of treatment. In the present study patient who smoke had high chance of developing hemoptysis 36% when compared to non-smokers (26%). Overall sputum conversion in smoker and non-Smoker was found to be same i.e., 97%.

Sputum Conversion Rates in Smokers					Sputum Conversion Rates in Non-Smokers				
Grade	Total	Conversion 1 m	Conversion 2 m	Not converted	Grade	Total	Converted 1 m	Converted 2 m	Not converted
+3	15	2(13.3%)	10(66.6%)	3(20%)	+3	5	2(40%)	2(40%)	1(20%)
+2	22	6(27.2%)	16(72.8%)	0	+2	12	7(58.33%)	5(41.66%)	0
+1	7	6(85.7%)	1(14.3%)	0	+1	17	15(88.23%)	0	2(11.76%)
Scanty	6	6(100%)	0	0	Scanty	16	15(93.75%)	1(6.25%)	0
Total	50	20(40%)	27(54%)	3(6%)	Total	50	39(78%)	8(16%)	3(6%)
Chi square value 16.31 p value <0.01*					Chi square value 6.38 p value 0.38				

Table 1. Sputum Conversion Rates in Smokers and Non-Smokers

Table 1 shows, the results show that out of 50 patients in group 1 (Smokers with pulmonary tuberculosis), 20 patients (40%) had sputum conversion to negative at the end of 1st month of treatment with ATT and 27 patients (54%) had sputum conversion at 2nd month. Whereas in group 2 (non-smokers with pulmonary tuberculosis) 39 patients (78%) had sputum conversion to negative at 1st month and 8 patients (16%) had sputum conversion at the end of 2nd month of treatment.

Beginning of the Treatment	Smokers		Non-smokers		Chi-square value = 9.60
	Frequency	Percent	Frequency	Percent	
Bronchiectasis	1	2.0	0	0.0	P-value 0.04*
Cavity	22	44.0	16	32.0	
Consolidation	6	12	4	8.0	
Infiltrates	14	28.0	29	58.0	
Pneumothorax	5	10.0	1	2.0	
Lung abscess	2	4.0	0	0.0	
Total	50	100.0	50	100.0	
At the end of 2 months of treatment	Smokers		Non-smokers		Chi-square value = 5.79
	Frequency	Percent	Frequency	Percent	
Bronchiectasis	1	2.0	3	4.0	
Cavity	13	26.0	9	18.0	
Clear	18	36.0	27	54.0	
Consolidation	2	4.0	2	4.0	
Fibrosis	9	18.0	6	12.0	
Infiltrates	4	8.0	2	4.0	
Pneumothorax	3	6.0	1	2.0	
Total	50	100.0	50	100.0	

Table 2. Radiological Presentation of TB among Smokers and Non-Smokers at the Beginning and at the End of 2 Months of Treatment

Table 2 shows in the present study the chest X-ray of smokers and non-smokers were compared at the beginning of treatment and in smokers the incidence of bronchiectasis was found to be 1(2%) whereas in non-smokers none of the cases had bronchiectasis on chest X-ray. The chest X-ray of smokers initially showed 22(44%) cavities whereas in non-smokers the incidence of cavities was found to be 16(32%), in smokers the incidence of consolidation was found to be

6(12%) whereas in non-smokers the incidence of consolidation was found to be 4(8%). The chest X-ray in smokers showed 5(10%) pneumothorax whereas only 1(2%) of non-smokers had pneumothorax. 28% (14) Smokers showed infiltrates radiologically on a chest X ray while 58% (29) of non-smokers showed infiltrates on a chest x ray and the infiltrates on chest x ray were higher among non-smokers than smokers. It was observed in the present study that 2(4%) of smokers had lung abscess on a chest x ray initially whereas none of the non-smokers presented with lung abscess. Statistically the above difference in the chest x-ray findings in smokers and non-smokers has found to be significant (p value 0.04).

At Beginning of Treatment	Smokers		Non-Smokers		Chi-square value = 9.54
	Frequency	Percent	Frequency	Percent	
Bilateral	45	90.0	33	66.0	p-value <0.01*
Unilateral	5	10.0	17	34.0	
Total	50	100.0	50	100.0	
At the End of 2 Months of Treatment	Smokers		Non-smokers		Chi-square value = 4.44
	Frequency	Percent	Frequency	Percent	
Bilateral	14	28.0	8	16.0	p-value = 0.11
Unilateral	18	36.0	15	30.0	
Cleared	18	36.0	27	54.0	
Total	50	100.0	50	100.0	

Table 3. Radiological Extent of TB among Smokers and Non-Smokers at the Beginning and at the End of 2 Months of Treatment

Table 3 shows in the present study the chest x rays of 45 (90%) of patients who smoked showed bilateral lesions on chest x- ray whereas only 33(66%) of patients who were non-smokers showed bilateral lesions on chest x-ray at presentation. This difference in the extent of radiological lesion was found to be statistically significant. In the present study the x rays at the end of 2 months were compared and the lesions were found to be bilateral in more number of smokers 14(28%) than non-smokers 8(16%).

Beginning of the Treatment	Smokers		Non-Smokers		Chi-square value = 16.37
	Frequency	Percent	Frequency	Percent	
1	3	6.0	7	14.0	p-value <0.01*
2	6	12.0	19	38.0	
3	11	22.0	8	16.0	
4	14	28.0	7	14.0	
5	5	10.0	0	0.0	
6	11	22.0	9	18.0	
Total	50	100.0	50	100.0	
At the End of 2 Months of Treatment	Smokers		Non-smokers		Chi-square Value = 8.07
	Frequency	Percent	frequency	Percent	
1	12	24.0	13	26.0	p-value 0.15
2	11	22.0	3	6.0	
3	3	6.0	3	6.0	
4	5	10.0	3	6.0	
6	1	2.0	1	2.0	
Cleared	18	36.0	27	54.0	
Total	50	100.0	50	100.0	

Table 4. Radiological Zones Affected by TB among Smokers and Non-Smokers at the Beginning and at the End of 2 Months of Treatment

Table 4 shows in the present study it was found that in smokers all 6 zones were involved in 11 (22%) of patients whereas 6 zones were involved in 9 (18%) in non-smokers. 5 zones on chest x ray was involved in 5 (10%) of smokers and none of the non-smokers had the same findings. Similarly, 4 zone involvement was seen in 14 (28%) of smokers and 7 (14%) of non-smokers. 11 (22%) of smokers and 8 (16%) of non-smokers showed involvement of 3 zones on chest x ray. 6 (12%) of smokers and 19 (38%) of non-smokers showed 2 zones involvement on chest X ray. Only 1 zone involvement

was seen in 3(6%) of smokers and 7 (14%) of non-smokers. In the present study it was found that the clearance of chest X-ray was found to be less in smokers 18 (36%) than in non-smokers 27 (54%). The x rays at the end of 2 months were compared and the lesions were found to be bilateral in more number of smokers (28%) than non-smokers (16%).

DISCUSSION

In the present study 100 patients were enrolled comprising of 50 smokers and 50 non-smokers who were diagnosed as sputum positive pulmonary tuberculosis (microbiologically confirmed by sputum smear microscopy). These patients were followed up in Gandhi Hospital, Secunderabad till the end of intensive phase of anti- tubercular treatment.

Age Distribution

The mean age in the present study was 40.34 years. In smokers it is 49.44 years and among non-smokers it is 31.24 yrs. The mean age of Deepthi Ratheet al.³¹ Study was 31.22 years. The mean age of Dr. Agarwal A et al.³² Study was 41.21 years and among non-smokers it was 36 years and in smokers it was 46.42 years. The average age in the present study is lower when compared to the above 2 studies.

Sputum Grading

Hence the above data suggests that in smokers with Pulmonary Tuberculosis the incidence of sputum grade +3 was higher by 20% when compared with non- smokers. While 32 % of patients who were non-smokers had scanty sputum grade while only 6% of smokers in the study had scanty sputum grade. This suggests higher bacillary load in sputum of smokers when compared to non- smokers at the time of diagnosis.

Smokers Sputum Grade

In the present study among smokers 30% of patients has sputum grade +3 when compared to Deepthi Rathe et al. Study which had 28% and Dr. Agarwal. A et al. Study which had 46.7% of smokers with high sputum grade. In the present study among non-smokers 10% of patients has sputum grade +3 when compared to Deepthi Rathe et al Study which had 40% and Dr. Agarwal. A et al. Study which had 24% of smokers with high sputum grade.

Sputum Conversion Rates in Group 1

Among smokers 15 patients who had high sputum grade+3 on evaluation 2 (13.3%) of them were found to be sputum negative at 1st month and 10 (66.6 %) of them had sputum conversion at 2 months and 3 (20%) of them are sputum positive even after 2 months of treatment. Among smokers 22 patients who had sputum grade +2 on evaluation, 6 (27.2%) of them were found to be sputum negative at 1st month and 16 patients had sputum conversion to negative after 2 months of treatment. Among smokers 7 patients who had low sputum grade +1 on evaluation 6 (85.7%) of them were found to be sputum negative at 1st month and the remaining 1 patient had sputum conversion at 2 months of treatment. Among smokers 6 patients who had sputum grade

scanty on evaluation at 1st month all of them were found to be sputum negative. The above data was found to be statistically significant.

Smokers Sputum Grade						
Grading	Present Study	Percent	Deepthi et al. Study ³²	Percent	Dr. Agarwal A et al. Study ³³	Percent
+3	15	30	28	60	36	46.7
+2	22	44	-	-	11	14.2
+1	7	14	-	-	26	33.7
Scanty	6	12	-	-	4	5.1
Total	50	100	-	-	77	100
Non-Smokers Sputum Grade						
Sputum Grading	Present Study	Percent	Deepthi et al. Study ³²	Percent	Dr Agarwal A et al. Study ³³	Percent
+3	5	10	-	40	6	24
+2	12	24	-	-	2	8
+1	17	34	-	-	14	56
Scanty	16	32	-	-	3	12
Total	50	100	-	-	25	100

Table 5. Smokers and Non-Smokers Sputum Grade in Comparison with Other Studies

Sputum Conversion Rates in Group 2

Among non-smoker 12 patients who had sputum grade +2 on evaluation, 7 patients (58%) of them were found to be sputum negative at 1st month and 5 (42%) of the remaining patients had sputum conversion at 2 months. Among non-smoker 17 patients who had low sputum grade +1 on evaluation, 15 patients (88%) of them were found to be sputum negative at 1st month and 2 of the remaining was sputum positive even after 2 months of treatment. Among non-smoker 16 patients who had sputum grade scanty on evaluation, 15 (93.7%) of them were found to be sputum negative at 1st month and one of the remaining had sputum conversion at 2 months. The above data suggests that high sputum grading increases the time for sputum conversion. Hence smokers which has significantly high percentage of patients with +3 and +2 sputum grading required more time to convert negative than their counterparts who were non-smokers. The group 1 patients remained infective for longer time than group 2. In Deepthi Ratheet al.³¹ Study by the end of intensive phase (IP), 11 patients were lost to follow-up (Defaulters) which included 9 smokers and 2 non-smokers. Maximum conversion rate at end of IP was found among non-smokers (56.50%) and among smokers 36.40% could achieve negative sputum status by this time (p= 0.137). The above data from Deepthi Rathe et al. Study correlates with the results obtained in the present study.

Effect of Smoking on Sputum Conversion

The present study also assesses the impact of smoking on sputum conversion rates depending on the smoking habits. Patients with more than 100 pack years (heavy smokers) of smoking history had 20% conversion rates while patients with 51 to 100 pack years history of smoking had 30.7% conversion rates and patients with less than 50 pack years (light smokers) of smoking had 46.8 % sputum conversion rates at the end of 1 month. The overall conversion rates in smokers at the end of 1 month was 40% and non- smokers had the sputum conversion rates of 78% at the end of 1 month. This suggests that the smoking status and the number of pack years have affected the sputum conversion and lead to delayed sputum conversion in heavy smokers. In Deepthi

Ratheet al.³¹ Study Assessment of bacillary load showed that out of total 47 patients who had 3+ smear grading, 49% were smokers, 40% non-smokers, and 11% former smokers. As smoking index increased from <100 to 100–299 and >300, 3+ smear grade increased from 12.5% to 68.18% and 66.66%, respectively, ($p < 0.05$). The data indicates a positive correlation of sputum bacillary load among pulmonary TB patients with higher smoking index. According to Dr. Agarwal et al.³² Study the Bedford-England, Smokerlyzer was used to qualify smokers into light and heavy smokers. In this study it was found that light smokers (65.69%) were more affected than heavy smokers (24.61%), but sputum grade +3 was high among heavy smokers group. +3 Sputum in smokers was 57.9% rather in non-smokers 24% ($p < 0.01$). The data that was obtained from the present study was found to be similar to the above 2 studies emphasizing the fact that smokers have high bacillary load and that the smokers remain infective for longer periods of time than non-smokers.

Various Tobacco Products and Their Effect on Sputum Conversion

In the present study it was noted that majority of patients smoked beedis (66%), Chuttas were smoked the least (4%) and cigarettes were smoked by 30% of the patients. In Deepthi Ratheet al.³¹ Study number of patients smoking Beedi were 42 (41.58%) and Cigarette were 11 (10.9) rest were smoking chuttas. In the present study it was found that the patients who smoked beedis had delayed sputum conversion (33.33%) as compared to patients smoking cigarettes and chuttas i.e. 53.3% and 50% respectively at 1 month of treatment.

Clinical Spectrum in Smokers and Non-Smokers

BMI- In the present study the average BMI in smokers and non-smokers was found to be 19.38 and 19.56 respectively and the difference was not statistically significant.

Haemoptysis- In the present study Smokers with pulmonary tuberculosis had 36% incidence of hemoptysis and non-smokers had 26% incidence of hemoptysis. This shows that the smokers who had pulmonary tuberculosis have higher chance of complications like hemoptysis than non-smokers. In the Dr. Agarwal et al.³² Study the incidence of hemoptysis was 18% in non-smokers and 19% in smokers and the study showed that the difference was not significantly different. In the present study the data analysed from the smokers showed that patients with high pack years (>101 Pack Years) of smoking had more incidence of hemoptysis (40%) as compared to the patients with history of smoking for less than 50 pack years (31.25%). Hemoptysis in patients with history of smoking of 51 to 100 pack years had the incidence of 46.15%. This data suggests that heavy smoking also increases the risk of hemoptysis in patients of pulmonary Tuberculosis.

SpO₂- The saturation of oxygen was measured with finger pulse oximetry and the mean SPO₂ in smokers was found to be 85.24% and 93.12% in non-smokers. This showed that patients with pulmonary tuberculosis and with a smoking history had a lower saturation of oxygen than their counterparts who did not smoke. This difference was found to be statistically significant.

Cough- It was found in the present study that cough was the most common symptom and all patients in the study in both the groups had this symptom with various durations. The frequency was found to be 100%. In the present study cough is the predominant symptom in both the groups i.e., 50(100%), Patients in smokers group 45 patients have dyspnea which is accounting to 90% and nonsmokers group 36 patients have dyspnea which is accounting to 78% and in case of Hemoptysis in smokers group 18 patients have hemoptysis (36%) and in nonsmokers group 13 patients have hemoptysis (26%).

SOB- Upon analysis of patients it was found that 90% of smokers and 78% of non-smokers had dyspnea. These results suggest that the incidence of dyspnea was higher in smokers than non-smokers.

Radiological Spectrum in Smokers and Non-Smokers

Chest X-Ray Initially- In the present study after analysis of the data it was found that bronchiectasis, consolidation, pneumothorax, cavitary lesions and lung abscess were found to be more in smokers group when compare to nonsmokers. To compare the extent of the radiological lesions even more precisely the chest X ray was divided in 6 zones and it was found that in smokers all 6 zones were involved in 22% of patients whereas 6 zones were involved in 18% in non-smokers. 5 zones on chest X ray was involved in 10% of smokers and none of the non-smokers had the same findings. Similarly, 4 zone involvement was seen in 28% of smokers and 14% of non-smokers. 22% of smokers and 16% of non-smokers showed involvement of 3 zones on chest x ray. 12% of smokers and 38% of non-smokers showed 2 zones involvement on chest x ray. Only 1 zone involvement was seen in 6% of smokers and 14% of non-smokers. The difference in the involvement of zones on X ray chest between smokers and non-smokers was found to be statistically significant (p value < 0.01). Radiological findings in Dr Agarwal A et al study are as follows - here the patients with pulmonary Tuberculosis are divided into the cases (Smoker) and controls (non-smokers). In Dr. Agarwal A et al.³² Study radiologically cavitation (98.07%) and fibrosis (98.07%) frequently appear in study group i.e. smokers. In Deepthi Ratheet al.³¹ Study Among nonsmokers, 18.8% had cavitation while among smokers and former smokers 40.4% and 45.5% respectively had the cavitary disease ($p > 0.05$). The results of the above 2 studies are similar to that of the present study. The above studies suggest that the smokers have more radiologically advanced disease than the non-smokers and that the incidence of complications like pneumothorax was also higher. Whereas non-smokers mostly presented with infiltrates which are early lesions in tuberculosis. Smoking has widespread effects on lung structure and function and affects host defenses both in the lung and systemically; therefore, it could plausibly act to increase incidence or worsen the prognosis of tuberculosis. Postulated mechanisms include effects on clearance mechanisms and immunologic responses to inhaled pathogens, as well as the structural changes in the lung caused by smoking³³. The analysis shows that cavitation in smokers was higher than in non-smokers in all the studies.

Chest X-Ray after 2 Months- The chest X ray of smokers was compared with non-smokers at the end of intensive phase and it was found that smokers had higher persistence of cavities (26%) than non-smokers (18%). The persistence of pneumothorax was found to be 6% in smokers and 2% in non-smokers. In 18% of smokers, fibrotic changes were observed whereas 12% patients developed fibrosis in non-smokers. The clearance of chest X-ray was found to be less in smokers (36%) than in non-smokers (54%). The x rays at the end of 2 months were compared and the lesions were found to be bilateral in more number of smokers (28%) than non-smokers (16%). The x rays of the patients who smoked had more extensive changes at the end of 2 months in terms of number of zones involved but the results were not statistically significant. In Deepthi Ratheet al.³¹ study, at the end of treatment, 93.30% of non-smokers showed complete clearance of infiltrates on chest X-ray while only 80% and 90% smokers and former smokers, respectively, showed complete clearance ($p > 0.05$). Among non-smokers, 6.70% still had minimal infiltrates as compared to 13.30% of smokers and 10% of former smokers. At the end of treatment, 91.1% non-smokers showed clearance of cavity as against 80% of the smokers and 70% of the former smokers. This data suggests that smokers and former smokers demonstrate more persistence of cavitation (as sequel) on X-ray at end of treatment as compared to non-smokers ($p < 0.05$). The above data shows that the even the radiological resolution on chest X rays was slower in smokers when compared to non-smokers.

CONCLUSIONS

Sputum conversion rates in smokers and non-smokers at the end of 1 month were 40% and 78% respectively. This difference is statistically significant. Overall sputum conversion rates in smokers and non-smokers was found to be similar i.e. 97%. In patients with high sputum grade (+3), the sputum conversion rates in smokers was 13.3% and in non-smokers, it was 40% at the end of 1 month. Patients with more than 50 pack years of smoking showed delayed sputum conversion than patients with less than 50 pack years of smoking. Among various tobacco products it was found that beedi smoking affected the sputum conversions more than that of other products. It was found in the present study that the patients who smoked had higher chances of developing haemoptysis (36%) than non-smokers (26%). The mean saturation of oxygen was less in smokers when compared to non-smokers and this difference was found to be statistically significant. Radiologically, smokers had more advanced lesions like bronchiectasis, cavitation, and pneumothorax; whereas, in non-smokers, majority of the patients had infiltrates on chest x ray which are lesions of tuberculosis in the early stage. This difference in radiological presentation was found to be statistically significant. The radiological extent of the disease was found to be more in smokers in comparison to non-smokers as smokers with pulmonary tuberculosis had high number of bilateral lesions. This data was found to be statistically significant. Hence, it is concluded from the present study that smoking is associated with delayed sputum conversion, more complications like haemoptysis and radiologically more advanced and extensive

lesions. Smokers pose an epidemiological threat by remaining infective and hence being a source of infection for longer period of time. Hence smoking should be enquired into and discouraged in all patients. Adequate help should be given to help the patients to quit smoking. This study can be made extensive by increasing the size of the sample, by examining the sputum smear for AFB at 15 days interval and by following up the patients to look for relapse in patients who have quit smoking and in patients who have continued to do so.

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