Original Research Article

Pattern of chest radiographic abnormalities and co-morbidities in newly detected sputum positive pulmonary tuberculosis cases

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ABSTRACT

Background: Tuberculosis (TB) is an airborne communicable disease which one of the leading causes of morbidity and deaths worldwide (ranking above AIDS).1 Probability of detecting AFB on sputum is greatly associated by the radiological findings.8 Because of the apparent widespread difficulty in recognizing the radiographic manifestations of pulmonary tuberculosis, it will be beneficial to review the spectrum of chest x-ray abnormalities in sputum positive tuberculosis patients.

Aim: To study clinical features, radiological features and comorbidities among newly detected sputum positive pulmonary tuberculosis patients.

Settings and design: The hospital based cross-sectional study was conducted from the year 2016-2018 at a tertiary care teaching hospital in Mangalore.

Methodology : Newly diagnosed smear positive pulmonary tuberculosis aged between 18-70 years attending OPD/IPD of Department of Respiratory Medicine, who fulfilled study eligibility criteria were included. Comprehensive clinical assessment was conducted and information regarding socio-demographic profile, comorbidities were noted. Chest x-ray PA view was performed for all patients.

Statistical A nalysis: Data was analyzed in SPSS V:20. Data is presented in frequency, percentages. Chi-square, was applied to test significance of association.

Results: A total of 563 (309 elderly and 254 adult) patients participated in study. Male predominance was noted (64.7%). Cough (94.1%) and expectoration (83.8%) were the most common symptoms. High bacillary load (3+) and bilateral lungs involvement were predominant among elderly patients (75.6%). Cavitary lesions were predominant among adults. Infiltration (39.6%), cavitary lesions (37.7%) and consolidation (37.5%) were most common lesions seen in chest x-ray. Cavitary lesions were found in higher percentage among patients with higher bacterial load of 2+and 3+ (36.8% and 33.0% respectively). Bilateral lesions were associated with TB patients with diabetes mellitus (69.7%).

Conclusions: Infiltration and cavitary lesions among newly diagnosed sputum positive pulmonary tuberculosis patients. Lower zone involvement among female group and Bilateral involvement and atypical lesions among PTB patients with diabetes mellitus were noted. Higher rates of co-morbid conditions like diabetes mellitus, cardiovascular disorders and COPD among elderly TB patients, higher bacillary load and atypical findings among diabetics warrant need for active screening.

1. Introduction

Tuberculosis (TB) is an airborne communicable disease which one of the leading causes of morbidity and deaths worldwide (ranking above AIDS).[1] Based on patient's immunity, tuberculosis might develop differently in each patient. The various stages include latency, primary tuberculosis, primary progressive tuberculosis and extra pulmonary tuberculosis (EPTB).

Globally, in 2019, 10 million people (56% males, 32% females and 12% children aged <15years and 8.2%

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People with HIV- PLHIV) fell ill with tuberculosis and 1.4 million died from disease (including 0.28 million among PLHIV).[2] An estimated 63million lives were saved through tuberculosis diagnosis and treatment between 2000 and 2019.[2] TB is seen increasingly in patients with medical conditions associated with immune compromised state and/or those who are receiving treatment that alters the immune system. India is one of the 8 countries accounting for 2/3rd of global disease burden. Over 95% of TB deaths occur in developing countries and it is among the top 5 cause of death for women aged 15 to 44 years.[3]

The definitive diagnosis of pulmonary tuberculosis lies in the isolation of the tubercle bacilli from the patient's sputum, either by direct microscopy or by culture. But the yield of sputum positive cases ranges between 40-80%.[4,5] Many non-communicable diseases such as diabetes mellitus, chronic obstructive pulmonary disease, hypertension, chronic kidney disease are risk factors for tuberculosis, especially for progression from infection to disease due to negative impact on host's defense mechanisms against Mycobacterium tuberculosis.[6] Presence of non-communicable diseases may indicate the need to actively screen for tuberculosis, especially in high-burden countries, which may help improve early and increase tuberculosis case detection.[7] Elderly patients have a higher number of co-morbidities compared to younger. Investigation, such as X-ray, which carries the major share, has been used as an important adjuvant to the diagnosis of tuberculosis. Studies have shown presence of atypical radiological features amongst pulmonary TB in the elderly. Probability of detecting AFB on sputum is greatly associated by the radiological findings.[8] Because of the apparent widespread difficulty in recognizing the radiographic manifestations of pulmonary tuberculosis, it will be beneficial to review the spectrum of chest x-ray abnormalities in sputum positive tuberculosis patients. Chest x-ray lesion such as parenchymal infiltrates, patchy consolidations, nodular opacities, fibrotic lesions (with or without volume loss), cavitations (with or without air fluid levels) and pleural effusions or thickening with parenchymal lesions were all attributed to pulmonary tuberculosis.[9] The lesions are typically seen in the apical and posterior segments of the upper lobes, as well as in the superior segments of the lower lobes.[10] Although occurrence of atypical clinical presentation and chest radiographic findings in the elderly population is known. Probably the higher morbidity and mortality reported in the elderly population is due to non-recognition of these indistinct differences in presentation thereby, delaying establishment of the diagnosis and early institution of treatment.[11] Therefore, this hospital based cross-sectional study was conducted to document and compare the co-morbidities and radiological pattern of pulmonary tuberculosis in the young adult and elderly age group. The aim and objectives of the study were:

1. To study clinical features in newly detected sputum positive pulmonary tuberculosis patients.
2. To study radiological features in newly detected sputum positive pulmonary tuberculosis patients.
3. To study comorbidities in newly detected sputum positive pulmonary tuberculosis patient.

2. Materials and Methods

The hospital based cross-sectional study was conducted from December 2016 to September, 2018 at A.J. Institute of Medical Sciences & Research Centre, Mangalore, after obtaining clearance from institutional ethics committee. Both Out-patients and In-patients who were newly diagnosed as smear positive pulmonary TB aged between 18-70 years were considered for the study. A TB patient who has never had treatment for TB or has taken Anti TB drugs for less than one month is considered as a new smear positive pulmonary tuberculosis case.[12]

Inclusion criteria consisted of all the patients of group of 18 - 70 years who were diagnosed as new smear positive pulmonary TB and gave informed consent. Patients with extra pulmonary tuberculosis, patients who were relapse/failure cases or those diagnosed as 'treatment after loss to follow-up', drug resistant tuberculosis, extra pulmonary tuberculosis, HIV patients, patients with chest abnormalities and /or pre-existing parenchymal lung diseases were excluded from the study.

All the patients who fulfilled the study criteria were included in the study, after explaining the purpose of the study and obtaining the informed consent. Thorough clinical history was taken and examination was performed. Socio-demographic profile of participants were noted in a pre-formed, semi-structured proforma, by interview method. Information regarding co-morbid conditions such as diabetes mellitus, hypertension, chronic obstructive pulmonary disease, hyponatremia, anaemia was collected along with the treatment history for these conditions, was collected. Investigations such as Sputum for Acid Fast Bacilli as per the National Tuberculosis Elimination Programme (NTEP) guidelines, fasting blood glucose, blood Urea and serum Creatinine, haemoglobin percentage, Serum Electrolytes and serology for HIV and HbsAg were performed among all the study participants. Chest X-ray PA view was performed for all the study participants.

2.1. Statistical analysis

Data was compiled in MS Office Excel spreadsheet and analyzed using SPSS V:16 (Statistical Package for Social Service). Qualitative data variables were expressed in frequency and percentages. Quantitative data variables expressed in mean and standard deviation. Pearson's Chi-square test was used to find the association between

occurrences of OSA with various risk factors (Qualitative data variables). Associations with p value of < 0.05 were considered be statistically significant.

3. Results

A total of 563 (309 elderly and 254 adult) patients of new smear positive pulmonary tuberculosis who fulfilled the eligibility criteria participated in the study (Table 1). Among the overall study population, male predominance was noted (males: 64.7%, females: 35.3%). Accordingly, among the elderly group, a higher percentage of males (56.9%) had pulmonary TB compared to adult males (43.1%) but this association was not statistically significant.

Cough (94.1%) and expectoration (83.8%) were the most common symptoms in patients with sputum positive pulmonary tuberculosis. (Figure 1) Breathlessness (85.9%) and fever (52.5%) were reported in significantly higher percentages by elderly patients group compared to adult patients group (14.1% and 47.5% respectively), whereas haemoptysis was reported in significantly higher percentage among adult group (56.8%) compared to elderly group (43.2%). Loss of appetite and loss of weight did not significantly differ between the two study groups.

It was observed that the high bacillary load (3+) was found in higher percentage among elderly patient group (75.6%) when compared with adult patient group (24.4%) and this association was found to be statistically significant (Table 1)

Table 2 compares the radiological characteristics of both the study groups. Bilateral involvement of lungs was found in higher percentages among elderly group (66.7%) compared to adult group (33.3%) and this association was found to be statistically significant (p < 0.05). Cavitary lesions were found in significantly higher percentages among adult patient group (56.6%) compared to elderly group (43.4%). Whereas alveolar opacities (69.1%) consolidation (61.6%) and infiltration 57.0%) were found in higher percentages among elderly patient group compared to adult patient group (30.9%, 38.4%, 43.0% respectively).

All patients underwent chest X-Ray. Infiltration (39.6%), cavitary lesions (37.7%) and consolidation (37.5%) were the most common lesions seen in chest x-ray among these new smear positive pulmonary tuberculosis patients. (Figure 2)

Table 3 Compares the X-ray lesions and comorbidities with bacterial load. Cavitary lesions were found in higher percentage among patients with higher bacterial load of 2+and 3+ (36.8% and 33.0% respectively) when compared with the patients with bacterial load of scanty and 1+ (4.7% and 25.5% respectively). This association was found to be statistically significant. Pleural effusion was present in majority of patients with high bacterial load of 3+ (54.5%) when compared with those patients with relatively lesser bacterial load, which was statistically significant (p<0.05). High bacterial load (3+) was found among majority of

patients with diabetes mellitus, which was statistically significant (p<0.05).

Table 4 Shows that bilateral lesions were more frequently found in TB patients with diabetes mellitus (69.7%) which was statistically significant. Although, relatively higher percentage of TB patients with comorbid conditions such as hypertension (23.5%) and anaemia (41.7%) had bilateral chest X-ray lesions, these associations were not significant. Table 5 compares the lower zone involvement among male and female group. Our study shows that lower zone involvement was more common in females than in males.
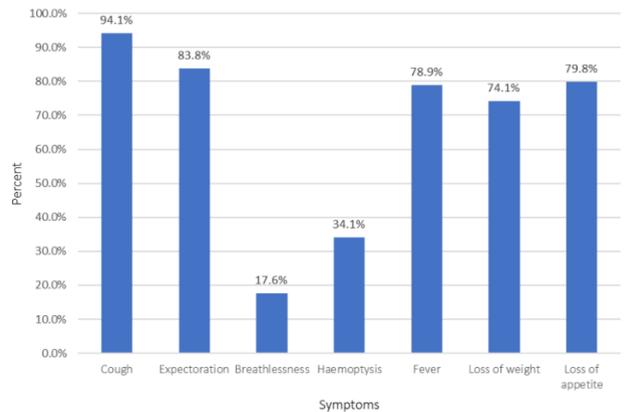

Fig. 1: Chest X-ray lesions is sputum positive pulmonary tuberculosis

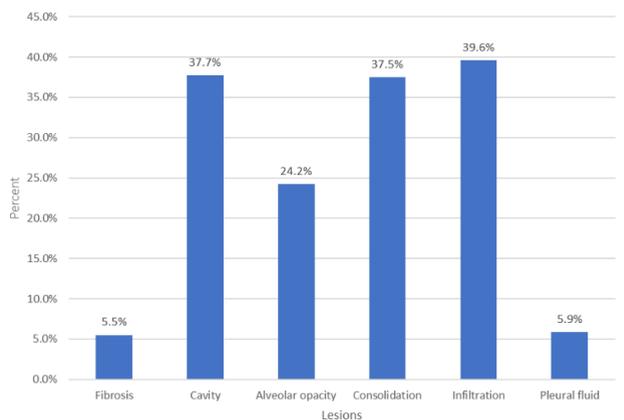**Fig. 2:** Radiological features of new smear positive TB patients

4. Discussion

The present study consisted of a total of 563 newly diagnosed smear positive pulmonary TB patients aged between 18-70 years who fulfilled the eligibility criteria. 309 (54.9%) patients were older than 50 years and 254 (45.1%) patients were aged between 18 and 50 years (Table 1). As the most important role in specific defense of

Table 1: The Distributionof study patients according to gender, symptoms, co-morbidities and bacillary load

Characteristics	Parameters	Adult(18-50 years) n (%)	Elderly(>50 years) n (%)	Total N (%)	Chi square and p value
Sex	Female	97 (48.7%)	102(51.3%)	199 (100.0%)	χ^2 = 1.636 p = 0.2008
	Male	157 (43.1%)	207 (56.9%)	364(100.0%)	
Symptoms	Cough	239 (45.1%)	291 (54.9%)	530(100.0%)	χ^2 = 0.0016 p = 0.967
	Expectoration	206 (43.6%)	266 (56.4%)	472(100.0%)	χ^2 = 2.55 p = 0.110
	Breathlessness	14 (14.1%)	85 (85.9%)	99(100.0%)	χ^2 = 46.54 p = 0.001
	Hemoptysis	109 (56.8%)	83 (43.2%)	192(100.0%)	χ^2 = 15.985 p = 0.001
	Fever	211 (47.5%)	233 (52.5%)	444(100.0%)	χ^2 = 4.915 p = 0.0266
	Loss of weight	185 (44.4%)	232 (55.6%)	417(100.0%)	χ^2 = 0.3662 p = 0.5451
	Loss of appetite	201 (44.8%)	248 (55.2%)	449(100.0%)	χ^2 = 0.109 p =0.7409
Co-morbidities	Diabetes	64 (30.0%)	149 (70.0%)	213(100.0%)	χ^2 = 31.418 p = 0.001
	Hypertension	38 (31.9%)	81 (68.1%)	119(100.0%)	χ^2 = 10.590 p = 0.001
	Chronic Kidney Disease	4 (25.0%)	12 (75.0%)	16(100.0%)	χ^2 = 1.278 p > 0.05
	Hyponatremia	10 (45.5%)	12 (54.5%)	22(100.0%)	χ^2 = 0.0011 p = 0.9739
	Anemia	98 (50.0%)	98 (50.0%)	196(100.0%)	χ^2 = 2.897 p =0.088
	COPD	9 (11.0%)	73 (89.0%)	82(100.0%)	χ^2 = 5.1778 p = 0.001
Bacillary load	Scanty	27 (60.0%)	18 (40.0%)	45(100.0%)	
	1+	89 (50.6%)	87 (49.4%)	176(100.0%)	
	2+	99 (54.4%)	83 (45.6%)	182(100.0%)	χ^2 = 40.265 p = 0.001
	3+	39 (24.4%)	121 (75.6%)	160(100.0%)	
	Total	254 (45.1%)	309 (54.9%)	563(100.0%)	

Table 2: Comparison of patients based on the radiological features (Chest X-Ray)

Radiological features	Parameters	Adult Group	Elderly Group	Total	Chi square value and p value
Bi-lateral involvement	Present	44(33.3%)	88(66.7%)	132(100.0%)	χ^2 = 9.06 p = 0.003
	Absent	210(48.7%)	221(51.3%)	431(100.0%)	
Lesions	Fibrosis	12(38.7%)	19(61.3%)	31 (100.0%)	χ^2 = 0.3 p = 0.584
	Cavity	120(56.6%)	92(43.4%)	212(100.0%)	χ^2 = 17.39 p =0.001
	Alveolar opacity	42(30.9%)	94(69.1%)	136(100.0%)	χ^2 = 13.92 p =0.001
	Consolidation	81(38.4%)	130(61.6%)	211(100.0%)	χ^2 = 18.68 p =0.001
	Infiltration	96(43.0%)	127(57.0%)	223(100.0%)	χ^2 = 7.19 p = 0.007
	Pleural fluid	12(36.4%)	21(63.6%)	33(100.0%)	χ^2 = 2.07 p =0.150
Lung zone involvement	Right Upper Zone	148(42.0%)	204(58.0%)	352(100.0%)	χ^2 = 3.25 p =0.071
	Right Middle Zone	85(42.7%)	114(57.3%)	199(100.0%)	χ^2 = 0.57 p =0.45
	Right Lower Zone	30(40.5%)	44(59.5%)	74(100.0%)	χ^2 = 0.52 p =0.47
	Left Upper Zone	66(41.3%)	94(58.8%)	160(100.0%)	χ^2 = 1.14 p = 0.285
	Left Middle Zone	28(48.3%)	30(51.7%)	58(100.0%)	χ^2 = 0.14 p = 0.708
	Left Lower Zone	18(47.4%)	20(52.6%)	38(100.0%)	χ^2 = 0.01 p =0.920
Total		254 (45.1%)	309 (54.9)	563 (100.0%)	

the organism against tuberculosis is played by macrophages and T-lymphocytes. [13] These differences in the prevalence of pulmonary tuberculosis among young and elderly persons may be related to weaker immune status among older aged population.

In our study, males were predominantly affected population (364 out of 563 patients- 64.7%), which comparable with studies conducted elsewhere. [14–16] Males have higher rates of TB because they tend to have greater chance of exposure to disease due to greater outdoor activities and also occupational exposure. Whereas social stigma related to TB in the lower and middle income countries like India, has led to reduced health seeking behavior among females.

High bacillary load (3+) was found frequently in elderly (75.6%) as compared to adults (24.4%), possibly making them more infectious that warrants early diagnosis and management. (Table 1) similar results are documented elsewhere. This high bacteriological burden among elderly could be due to more presence of more comorbid conditions and reduced immunity. [7]

In the present study, the most common presenting complaints in both the groups were cough (94.1%) with (or) without expectoration (83.8%) (Figure 1). Similar

Table 3: Association between bacterial load with chest X-ray lesions and co-morbidities

Chest X-ray Lesion	Bacterial Load					Chi square value and p value
	Scanty	**1+**	**2+**	**3+**	**Total**	
Fibrosis	3 (9.7%)	7(2.6%)	8(25.8%)	13(41.9%)	31 (100.0%)	χ^2 =0.14 p = 0.708
Cavity	10(4.7%)	54(25.5%)	78(36.8%)	70(33.0%)	212(100.0%)	χ^2 = 12.84 p = 0.005
Alveolar opacity	8(5.9%)	38(27.9%)	41(30.1%)	49(36.0%)	136(100.0%)	χ^2 = 5.55 p =0.1357
Consolidation	8(3.8%)	59(28.0%)	75(35.5%)	69(32.7%)	211(100.0%)	χ^2 = 11.89 p =0.0078
Infiltration	24(10.8%)	75(33.6%)	58(26.0%)	66(29.6%)	223(100.0%)	χ^2 = 8.95 p =0.03
Pleural effusion	1(3.0%)	1(3.0%)	13(39.4%)	18(54.5%)	33(100.0%)	χ^2 = 18.8 p =0.0001
Diabetes	11(5.2%)	62(29.1%)	58(27.2%)	82(38.5%)	213(100.0%)	χ^2 = 18.94 p =0.0003
HTN	7(5.9%)	38(31.9%)	39(32.8%)	35(29.4%)	119(100.0%)	χ^2 = 0.92 p =0.8206
CKD	0(0.0%)	3(18.8%)	6(37.5%)	7(43.8%)	16(100.0%)	χ^2 = 3.64 p =0.3031
COPD	7(8.5%)	24(29.3%)	24(29.3%)	27(32.9%)	82(100.0%)	χ^2 = 1.12 p =0.7722
ANEMIA	10 (5.1%)	66(33.7%)	66(33.7%)	54(27.6%)	196(100.0%)	χ^2 = 3.95 p =0.2669
Hyponatremia	2(9.1%)	7(31.8%)	7(31.8%)	6(27.3%)	22(100.0%)	χ^2 = 0.05 p =0.9971
Total	45 (8.0%)	176(31.3%)	182(32.3%)	160(28.4%)	563 (100.0%)	

Table 4: Relation between comorbidities and extent of chest X-ray lesion

Comorbid conditions	Extent of Chest X-ray lesions		Chi square p value
	Bilateral	**Unilateral**	
Diabetes	92(69.7%)	121(28.1%)	χ^2 = 12.33 p = 0.001
HTN	31(23.5%)	88(20.4%)	χ^2 =3.36 p =0.067
CKD	6(4.5%)	10(2.3%)	χ^2 = 0 p =1
COPD	28(21.2%)	54(12.5%)	χ^2 = 0 p =1
ANEMIA	55(41.7%)	141(32.7%)	χ^2 = 3.57 p =0.059
Hyponatremia	6(4.5%)	16(3.7%)	χ^2 = 0.17 p =0.680
Total	218 (100.0%)	430 (100.0%)	

Table 5: Lower zone involvement amongst male and female

Lower Zone		Sex of the patients		Total	Chi square p value
	Involvement	Female	Male		
Right lower zone involvement	Present	39 (19.6%)	35 (9.6%)	74 (13.1%)	χ^2 = 10.37 p = 0.001
	Absent	160(80.4%)	329 (90.4%)	489(86.9%)	
left lower zone involvement	Present	16(8.0%)	22 (6.0%)	38(6.7%)	χ^2 = 0.53 p = 0.467
	Absent	183 (92.0%)	342 (94.0%)	525 (93.3%)	
Overall Lower Zone involvement (Right and/or Left Lower Zone)	Present	55 (27.6%)	57	112 (19.9%)	χ^2 13.21 p = 0.001
	Absent	144 (72.4%)	329	451 (80.1%)	
Total		199 (100.0%)	364 (100.0%)	563 (100.0%)	

results are found in various other studies.[1,16] (Table 1) Comorbid conditions like diabetes, hypertension and Chronic Obstructive Pulmonary Disease (COPD) were found significantly higher among elderly as compared to adults (Table 1). However, anemia, hyponatremia, CKD did not significantly differ between the groups.[16,17] Due to atypical symptom characteristics in pulmonary TB, high index of suspicion is essential to early diagnosis and management. Previous studies shown that the use of high daily doses of inhaled or oral corticosteroids daily for severe COPD, may be associated with an increased risk of pulmonary tuberculosis.[16–19]

In the present study, among the total study population, the predominant pulmonary lesions evident on Chest X-ray were infiltration (39.6%) and cavitary lesions (37.7%) (Table 2,Figure 2). Similar results are found in studies conducted elsewhere.[10,14] Upon comparison of lesions among the two study groups, cavitary lesions were found to be significantly higher among adults (56.6%) compared to elderly (43.4%), while alveolar opacities, consolidation and infiltrations were seen significantly higher in elderly (69.1%, 61.6% and 57.0% respectively) compared to adults (30.9%, 38.4% and 43.0% respectively). (Table 2). Similar results are found in studies conducted by others.[17,20,21] Cavitation develops as part of host defense mechanism. Elderly population, due to their weakened immune system have lesser evidence of cavitary lesions. Accordingly, among the immunocompromised TB patients, evidence of cavernous tuberculosis is lesser.[22] The non-specific radiographic presentations in older patients delays diagnosis and treatment.[23]

In the present study, bilateral lung involvement (66.7%), lower zone predominance (58.8% Left upper zone, 51.7% Left middle and 52.6% Left lower Zones) and far advanced lesions were more prevalent in elderly as compared to adults (Table 2). The findings are comparable with studies conducted by Babu et al[10]., Rawat et al.,[16,20].

Cavity and pleural effusion were found more frequently in patient with high bacterial load (3+), which was statistically significant (33.3% and 54.5% respectively) (Table 3). Cavitary lesions were found to be significantly associated with higher bacterial load (3+). The presence of cavitary lesions is a strong indicator for initiating early treatment. Whereas, in a study conducted by Murthy et al·reported that the radiological severity of disease on chest X-ray prior to treatment in smear positive pulmonary TB patients was weakly associated with the bacterial burden.[24] In our study, bilateral lesions were significantly more predominant among PTB patients with diabetes mellitus (69.7%) (Table 4). Also, majority of PTB patients with DM (38.5%) had high bacillary load of 3+. Associated DM may have contributed to advanced lesions and extensive pulmonary involvement. Suyyora et al., have documented in their study that extensive parenchymal lesions, multiple

cavities, large cavities are frequently found in diabetes patients.[25]

In our study, while comparing male and female groups, we observed that lower zone involvement was more common among females compared to males (Table 5). Mahabalshetty et al.,[26] reported that a higher involvement of lower zone in females. Existence of costal type of respiration among females that leads to poor ventilation might have resulted in higher chances of lower lung field tuberculosis among them. Other conditions associated with lower lung zone involvement in PTB are diabetes, bronchial asthma, chronic renal failure, pregnancy, epilepsy, malignancy that lead to immune compromised states.[26]

A majority of smear positive pulmonary tuberculosis patients with diabetes mellitus had bilateral pulmonary lesion (56.8%) on chest X-ray, whereas bilateral chest x-ray lesions were found among 43.2% of these patients. This association of comorbidity of diabetes mellitus and Pulmonary TB with the extent of chest X-ray lesion was found to be statistically significant. Accordingly, patients with other associated co-morbid conditions like hypertension and anaemia were also found to have unilateral chest X-ray lesions (73.9% and 71.9% respectively) whereas bilateral chest X-ray lesions were found among 26.1% and 28.1% of hypertensive and anaemic comorbid condition patients. Although a higher percentage of hypertensive and anaemic patients had unilateral chest x-ray lesions, these associations were not significant.

In our study, Bilateral lesions were found more frequently in patients with diabetes mellitus, which was statistically significant (p<0.05) (Table 17). We also found that atypical lesions were higher in diabetes mellitus (Table 18). Huang et al[26]., conducted a study to evaluate influence of glycemic status on radiological manifestations in pulmonary TB. They found that atypical radiological presentations of PTB were more common in DM patients.[27]

It is evident from various studies that atypical presentation of chest radiography among PTB is more prevalent among diabetic PTB patients. Hence, cautious has to be exercised while interpreting atypical presentations in Chest X-ray among such patients due to possibility of atypical and extensive pulmonary lesions.[23]

5. Conclusions

Infiltration and cavitary lesions were found in majority of newly diagnosed sputum positive pulmonary tuberculosis patients. Lower zone involvement was found more frequently in female group and bilateral involvement and atypical lesions were seen more frequently in pulmonary TB patients with diabetes mellitus. Higher rates of co-morbid conditions like diabetes mellitus, cardiovascular disorders and chronic obstructive pulmonary disease among elderly TB patients were noted. PTB with diabetes patients had higher bacillary load. Atypical presentation and high

bacterial load at time of diagnosis was commonly seen in the elderly. Thus, atypical clinico-radiological manifestation of tuberculosis in older persons can result in delay in diagnosis and initiation of treatment. Hence high index of suspicion is essential to early diagnosis and management, thereby reducing morbidity and mortality amongst the patients and diminish the spread of tuberculosis in the community.

6. Recommendations

Higher rates of co-morbid conditions like diabetes mellitus, cardiovascular disorders and chronic obstructive pulmonary disease among elderly TB patients highlights the need for actively screen for common co morbidities in patient with pulmonary tuberculosis, which may otherwise go undiagnosed, especially in developing countries where services for non-communicable diseases are vastly under developed. Especially in developing countries where services for non-communicable diseases are vastly under developed. Evidence of significant association of higher bacillary load and atypical presentation among diabetic as well as elderly pulmonary TB patients, highlight the importance of having high index of suspicion for early diagnosis and management, thereby reducing morbidity and mortality amongst the patients and diminish the spread of tuberculosis in the community.

7. Strengths of the study

The study has provided valuable information about the prevalence of OSA in metabolic syndrome. The study has shown the levels of metabolic dysfunctions that exist in the various grades of severity of OSA.

8. Limitations

Study are that generalization of results cannot be made from this hospital based cross-sectional study. Study also excluded HIV patients which may be one of the common co-morbidity among pulmonary tuberculosis patients

9. Acknowledgement

10. Source of Funding

11. Conflict of Interest

The authors declare that they have no conflict of interest.

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