Analysis of Radiographic Patterns and Associated Co-Morbidities in Newly Diagnosed Sputum-Positive Pulmonary Tuberculosis in Adult Population of Either Gender in a Tertiary Care Centre Hapur Uttar Pradesh

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Abstract:-

➤ *Background*

Pulmonary tuberculosis often results in notable chest radiographic abnormalities. Older adults and individuals with existing co-morbid conditions are especially susceptible to developing more severe forms of TB. This study explores the impact of age and co-morbidities on the radiographic presentation of pulmonary tuberculosis.

➤ *Objective*

To evaluate the chest radiographic features and associated co-morbidities in adults over 18 years of age who have recently been diagnosed with sputum-positive pulmonary tuberculosis.

➤ *Materials & Method:*

An observational study was carried out involving 70 adults newly diagnosed with sputum-positive pulmonary tuberculosis. The study documented both chest radiographic abnormalities and associated co-morbidities.

➤ *Results:*

The study comprised 70 individuals who had recently received a diagnosis of sputum-positive pulmonary tuberculosis. The mean age of study population was 49.64 years and majority of patients were male (61.4%) and rest (38.6%) were female. Of the radiological lesion seen on chest x-rays, the most prevalent ones were patchy infiltrates (82.9%). Radiological findings of infiltration and cavitation were found to be the most in recently diagnosed sputum-positive pulmonary tuberculosis. Most common comorbidity associated with pulmonary tuberculosis was Diabetes Mellitus. Bilateral lesion on chest radiology in sputum positive PTB was commonly seen in patients with Diabetes Mellitus.

➤ *Conclusion:*

Our investigation revealed that newly diagnosed sputum positive PTB patients often exhibited chest X-ray abnormalities such as infiltration, cavitary lesions, and comorbidities such diabetes and anemia.

This study also demonstrates that elderly patients with pulmonary tuberculosis had a greater incidence of comorbidities and unusual radiological findings. Therefore, it is completely justified to maintain a high level of suspicion for tuberculosis in the aged population.

Keywords:- Radiographic Abnormalities; Diabetes Mellitus; Bacterial Load; Mycobacterium Tuberculosis.

I. INTRODUCTION

Tuberculosis (TB) is a significant contributor to morbidity and mortality worldwide. Tuberculosis, a disease caused by the bacteria Mycobacterium tuberculosis (MTB), is the subject of discussion. Although there are indications of the presence of this illness in ancient times, notable progress was made in 1888 when Robert Koch identified Mycobacterium tuberculosis, the bacteria responsible for the disease. [1]

The development of tuberculosis can vary in each patient depending on their immunological condition. Tuberculosis (TB) ranks among the top 10 leading causes of mortality globally. In 2022, tuberculosis affected 10.6 million individuals, resulting in 1.6 million fatalities, which included 0.3 million deaths among those with HIV [2].

Many cases of tuberculosis can be linked to many non-communicable diseases, such as diabetes mellitus, alcohol use disorders, and smoking-related illnesses. Presently, tuberculosis (TB) remains the leading cause of mortality globally attributable to a solitary communicable ailment . Non-communicable illnesses, such as diabetes mellitus,

chronic obstructive disease, hypertension, and chronic renal disease, elevate the susceptibility to tuberculosis. These disorders significantly contribute to the transition from infection to disease by negatively influencing the host's defense mechanisms. Antimicrobial mechanisms aimed for combating Mycobacterium tuberculosis. [3]

Radiology, which plays a significant role, is a crucial tool used alongside other methods to diagnose tuberculosis. There is a suggestion that older individuals with pulmonary tuberculosis may exhibit radiological characteristics that are quite unusual. [4]

The presence of many abnormalities on a chest X-ray, including infiltrates within the lung tissue, areas of consolidated lung tissue, small rounded shadows, areas of scar tissue (with or without loss of lung volume), hollow spaces inside the lung (with or without fluid levels), and the accumulation of fluid or thickening of the lining around the lungs, were all determined to be caused by PTB. [5]

The lesions are usually detected in the apical and posterior segments of the upper lobes, as well as in the superior segments of the lower lobes.[6] While it is recognized that aberrant clinical presentation and chest radiography abnormalities might arise in the older population. The greater morbidity and mortality found in older people is largely a result of the failure to notice these subtle changes in symptoms, leading to a delay in diagnosing the condition and initiating treatment at an early stage. [7].

II. MATERIALS AND METHODS

70 adult patients of newly diagnosed with sputum-positive pulmonary tuberculosis with Chest abnormalities in imaging and co-morbid conditions were documented. These individuals underwent evaluation according to the medical history and examination of the patient. The radiological findings were connected to the medical condition. The blood tests like Complete blood analysis, CRP, RBS, serum creatinine, HIV, LFT and ECG were done, and the therapy was commenced as per NTEP (National Tuberculosis Elimination Program) standards.

An observational study was made that is Analysis of Radiographic Patterns and Associated Co-Morbidities in Newly Diagnosed Sputum-Positive Pulmonary Tuberculosis in Adult Population Of Either Gender in a Tertiary Care centre Hapur Uttar Pradesh.

III. RESULTS

Table 1 Age Distribution

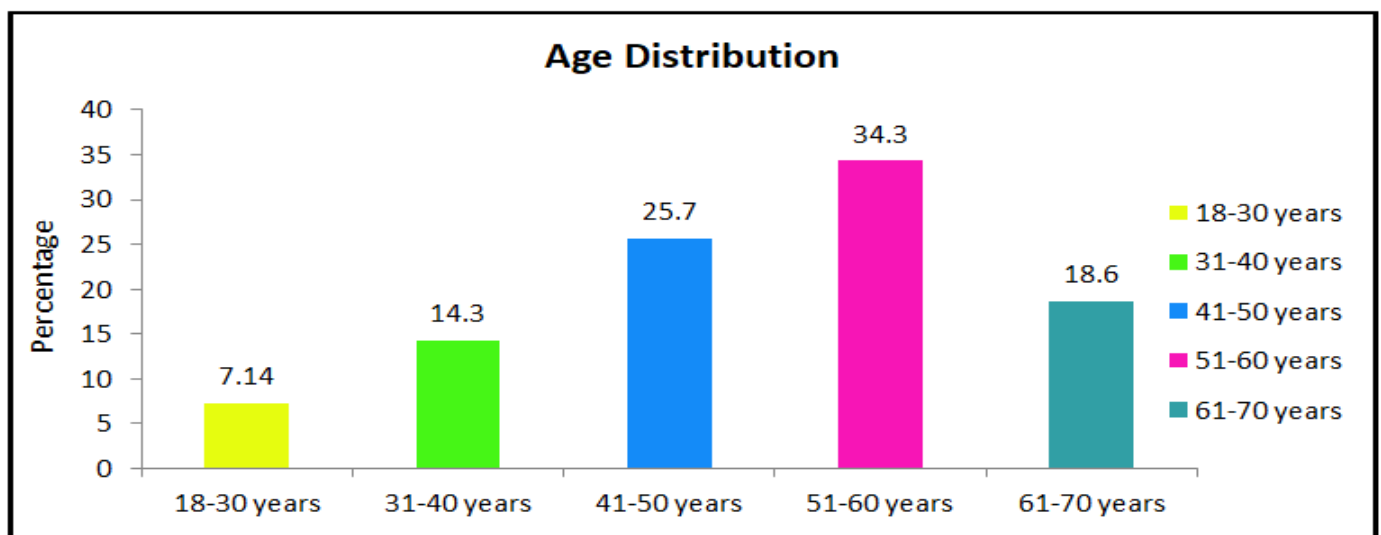| Age Group	Frequency	Percentage
18-30 years	5	7.14
31-40 years	10	14.3
41-50 years	18	25.7
51-60 years	24	34.3
61-70 years	13	18.6
Total	70	100.0
Mean Age	49.64 ±11.64	

Fig 1 Age Distribution

Table-1 shows an age range for the study individuals.

Majority of the patients in the present study were aged from 51-60 years (34.3%) followed by 41-50 years (25.7%), 61-70 years (18.6%), 31-40 years (14.3%) and 18-30 years (7.14%) with a mean age of 49.64 ±11.64 years.

Table 2 Gender Distribution

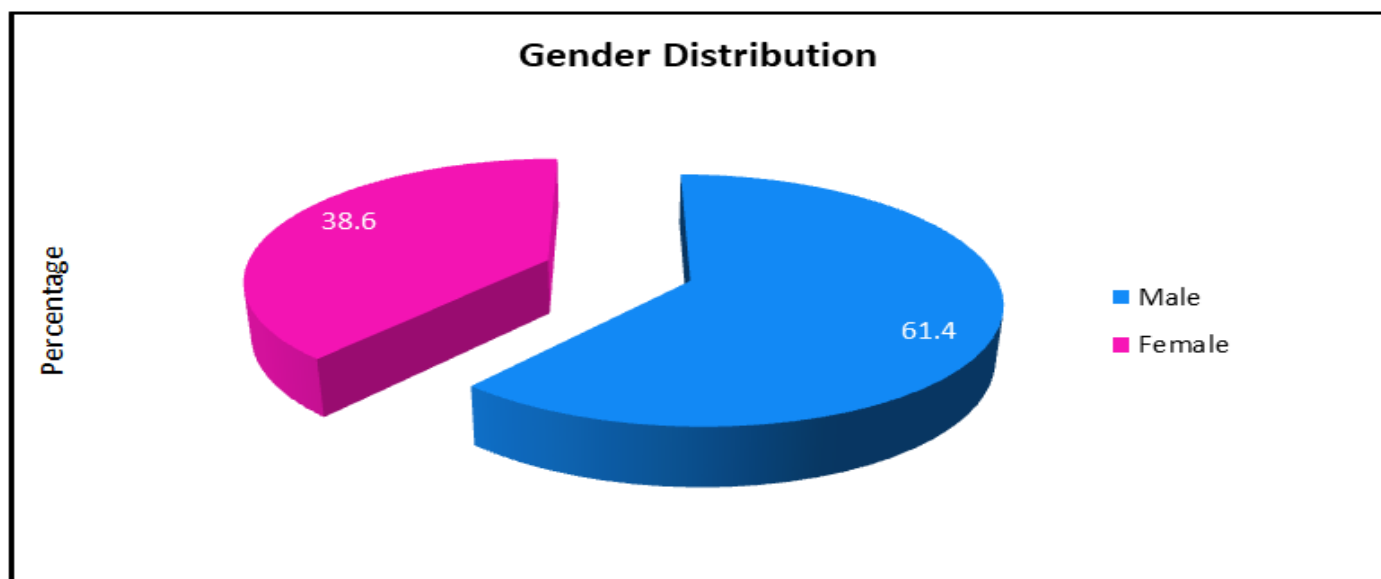| Gender	Frequency	Percentage
Male	43	61.4
Female	27	38.6
Total	70	100.0
Male: Female	1.59:1	

Table 2 Gender Distribution

There was a clear male preponderance among the study participants with 61.4% (43 out of 70) male patients. Data is shown in **Table 2**.

Table 3 Incidence of Co-Morbidities

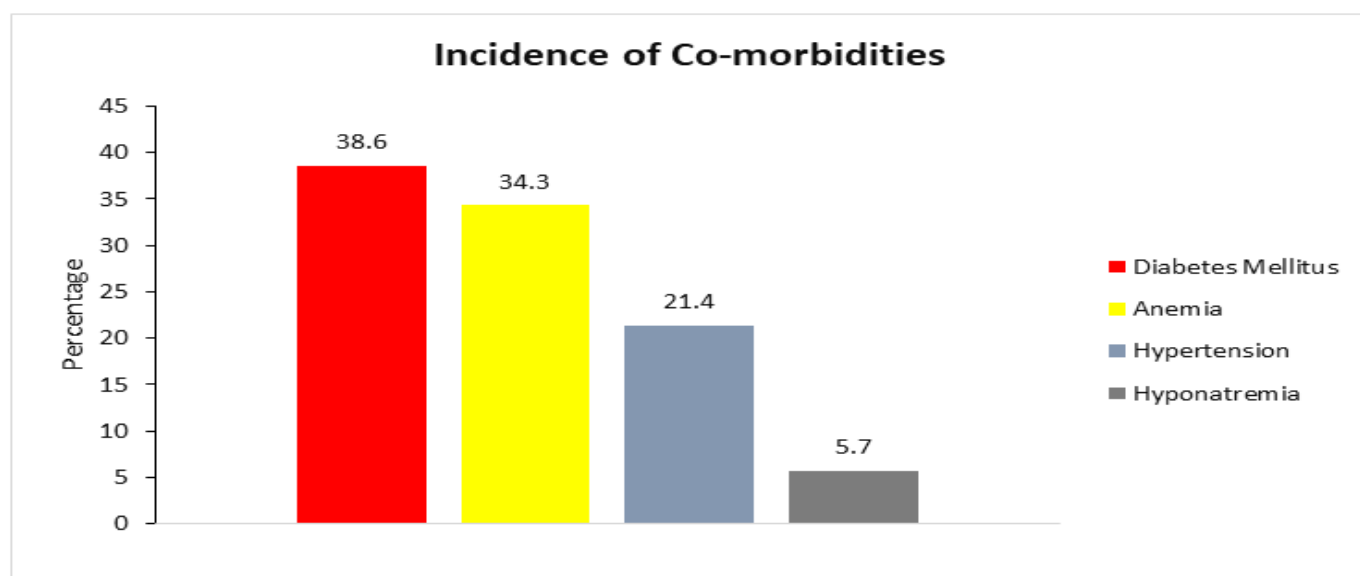| Co-morbidities	Frequency	Percentage
Diabetes Mellitus	27	38.6
Anaemia	24	34.3
Hypertension	15	21.4
Hyponatremia	4	5.7

Fig 3 Incidence of Co-Morbidities

Regarding the incidence of co-morbidities we found 27 (38.6%) had diabetes mellitus, 24 (34.3%) patients had anemia, 15 (21.4%) had hypertension, and 3 (4.3%) had hyponatremia. Data is shown in **Table 3**.

Table 4 Incidence of Patients According to the Ziehl Neelsen Stain

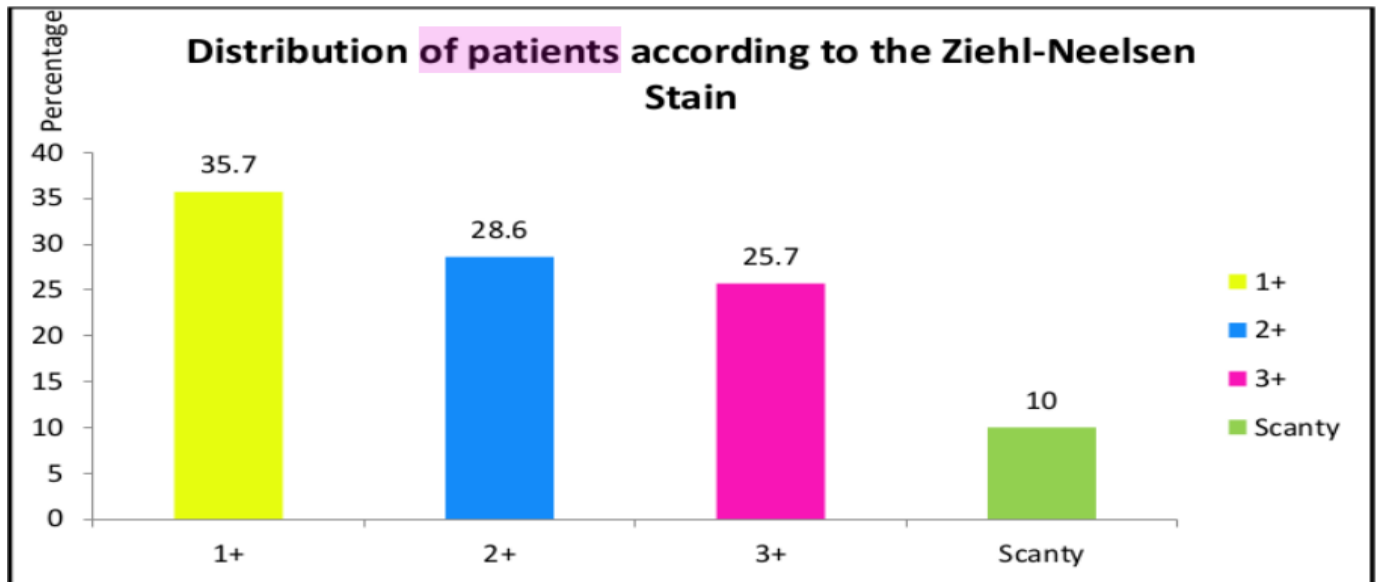| Ziehl-Neelsen Stain	Frequency	Percentage
1+	25	35.7
2+	20	28.6
3+	18	25.7
Scanty	7	10.0
T o t a l	7 0	1 0 0.0

Fig 4 Division of Patients Based to the Ziehl-Neelsen Stain

The Ziehl-Neelsen stain pattern in participants, linking the strength of the positive with the bacterial burden was examined. A nearly similar number was seen in 1+ (35.7%), 2+ (28.6%) and 3+ (25.7%) grading, with 7 patients having sparse bacilli (10%). Data is shown in **Table 4.**

➤ *Radiological Features*
In this section we discussed about the radiological characteristics of the study subjects.

Table 5 Incidence of Bilateral Involvement

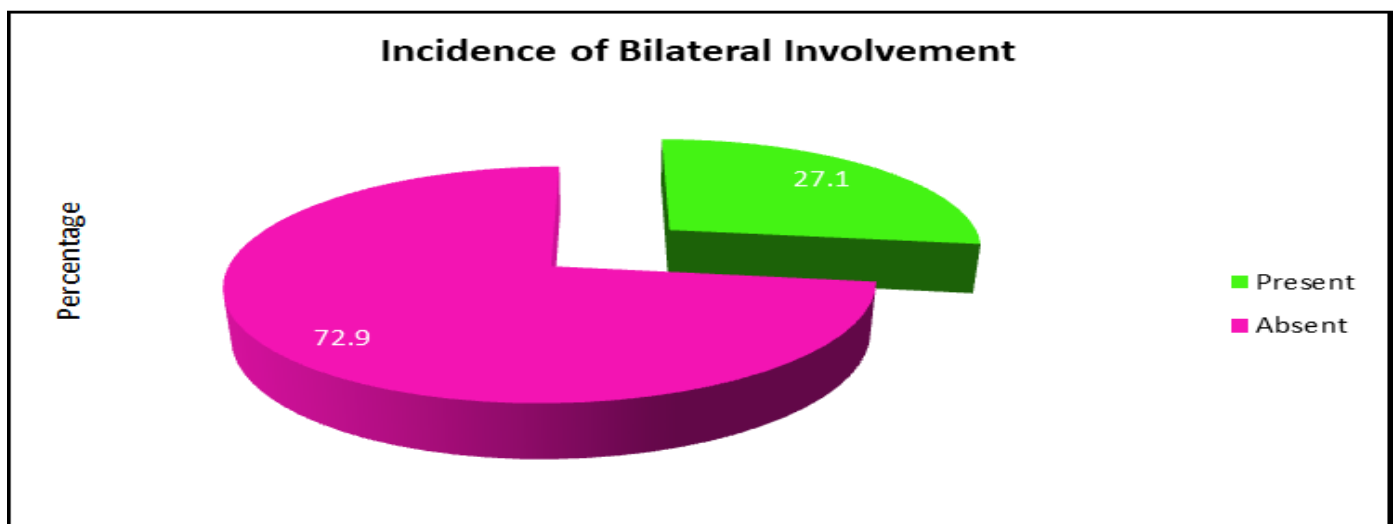| Bilateral Involvement	Frequency	Percentage
Present	19	27.1
Absent	51	72.9
Total	70	100.0

Fig 5 Incidence of Bilateral Involvement

Bilateral involvement of lungs was seen in 19 (27.1%) out of 70 patients in the present study. Data is illustrated in **Table 5**.

Table 6 Common Radiological Lesions

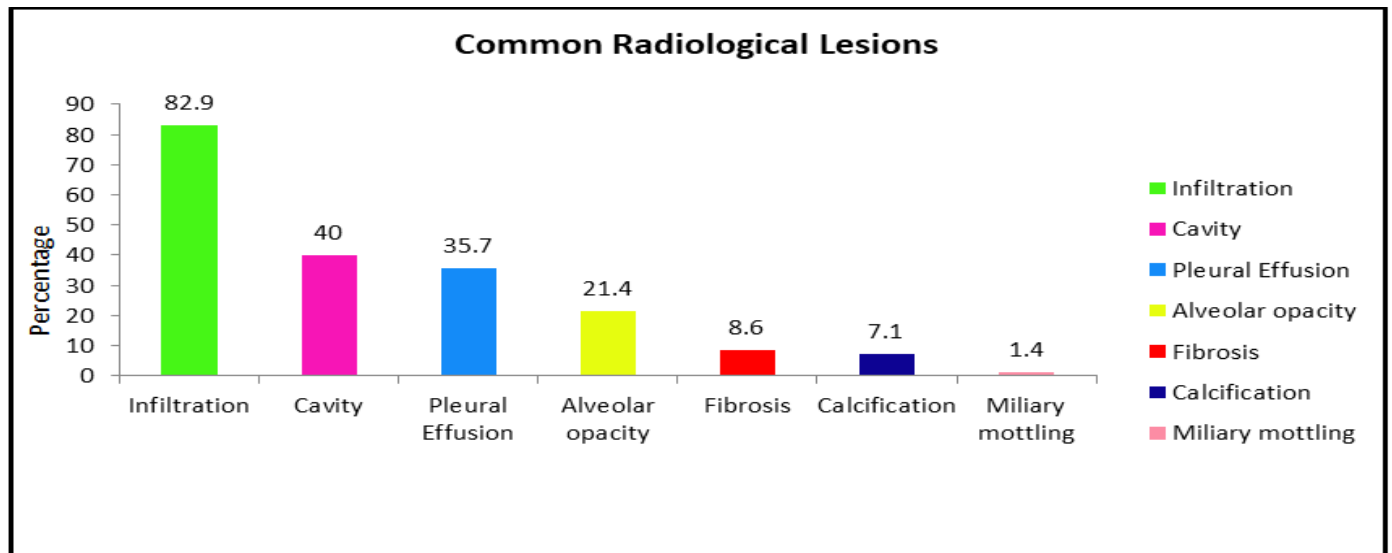| Radiological Lesions	Frequency	Percentage
Infiltration	58	82.9
Cavity	28	40.0
Pleural Effusion	25	35.7
Alveolar opacity	15	21.4
Fibrosis	6	8.6
Calcification	5	7.1
Miliary mottling	1	1.4

Fig 6 Common Radiological Lesions

Chest X ray were as follows. 58 (82.9%) had infiltration, 28 had cavity, 25 had pleural effusion, 15 had alveolar opacity, 6 had fibrosis, 5 had calcification and 1 had military mottling. Data is shown in **Table 6**.

Table 7 Involvement of Lung

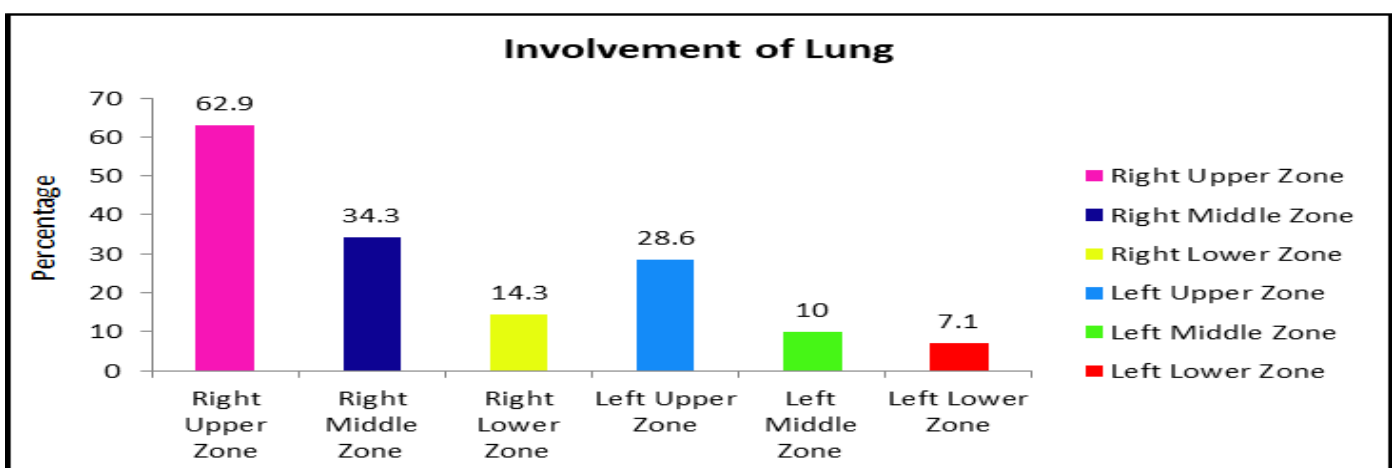| Involvement of Lung	Frequency	Percentage
Right Upper Zone	44	62.9
Right Middle Zone	24	34.3
Right Lower Zone	10	14.3
Left Upper Zone	20	28.6
Left Middle Zone	7	10.0
Left Lower Zone	5	7.1

Fig 7 Involvement of Lung

Right upper zone was the most common involvement found in 44 (62.9%) cases followed by right middle zone (34.3%), left upper zone (28.6%), right lower zone (14.3%), left middle zone (10.0%) and left lower zone (7.1%). Data is shown in **Table 7**.

Table 8 Extent of Involvement

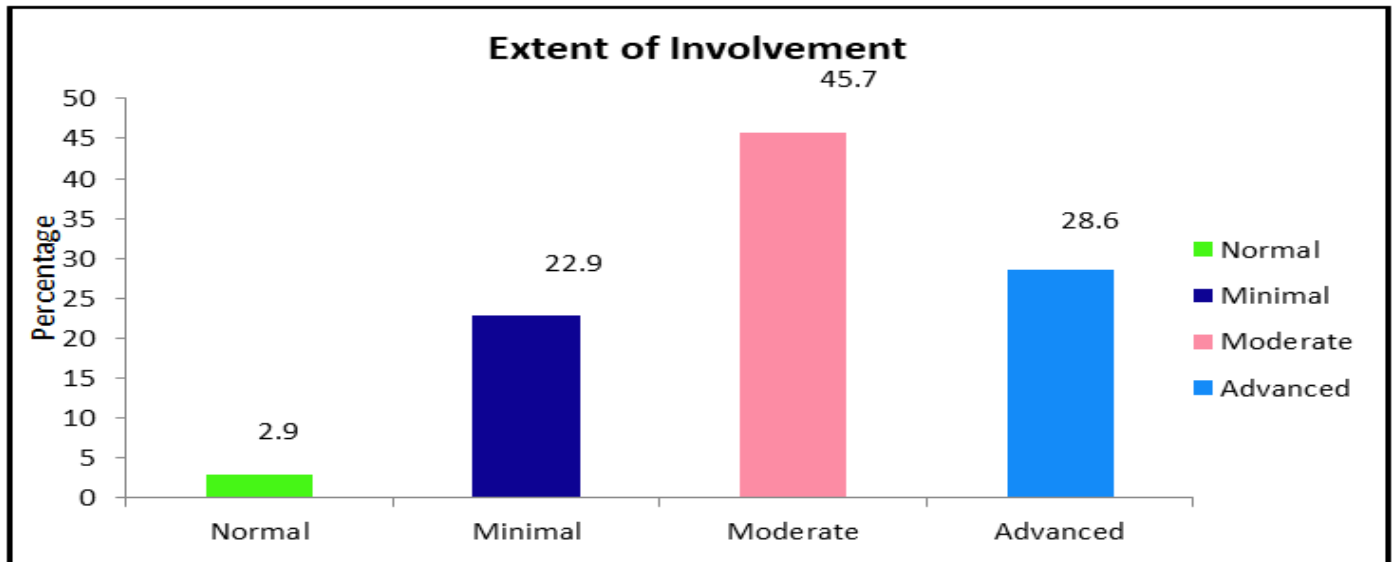| Involvement of Lung	Frequency	Percentage
Normal	2	2.9
Minimal	16	22.9
Moderate	32	45.7
Advanced	20	28.6
Total	70	100.0

Figure 8 Extent of Involvement

Out of total 70 cases of pulmonary tuberculosis 2 had normal radiological findings, 16 (22.9%) had minimal radiological involvement, 32 (45.7%) had moderate involvement and 20 (28.6%) had severe radiological involvement. Data is shown in **Table 8**.

Table 9 Association between Chest Xray Lesion and Comorbidities

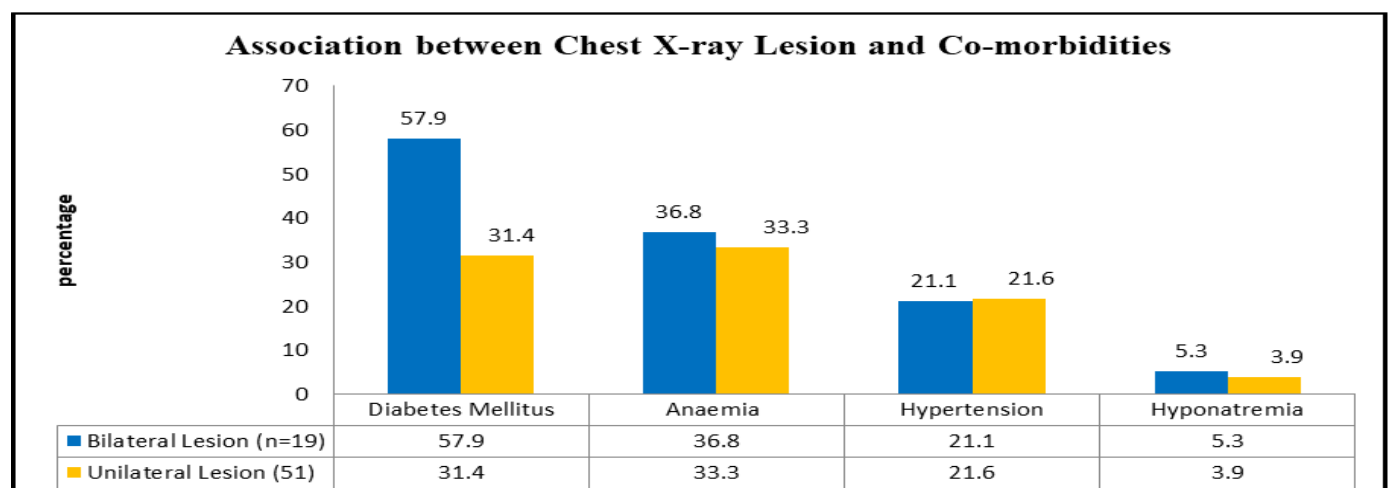| Co-morbidities	Bilateral Lesion (n=19)		Unilateral Lesion (51)		Statistical Inference
	Frequency	Percentage	Frequency	Percentage	
Diabetes Mellitus	11	57.9	16	31.4	0.04
Anemia	7	36.8	17	33.3	0.782
Hypertension	4	21.1	11	21.6	0.964
Hyponatremia	1	5.3	2	3.9	0.804

Fig 9 Association between Chest X-ray Lesion and Co-Morbidities

Table 9 presents the association between incidence of co-morbidities and chest X-ray lesions. Above analysis we found presence of diabetes mellitus was significantly associated with bilateral involvement (p value = 0.04). However the other co-morbid conditions did not show any significant association.

Table 10: Correlation between Incidence of Co-Morbidities & Intensity of Positive with the Load of Bacteria

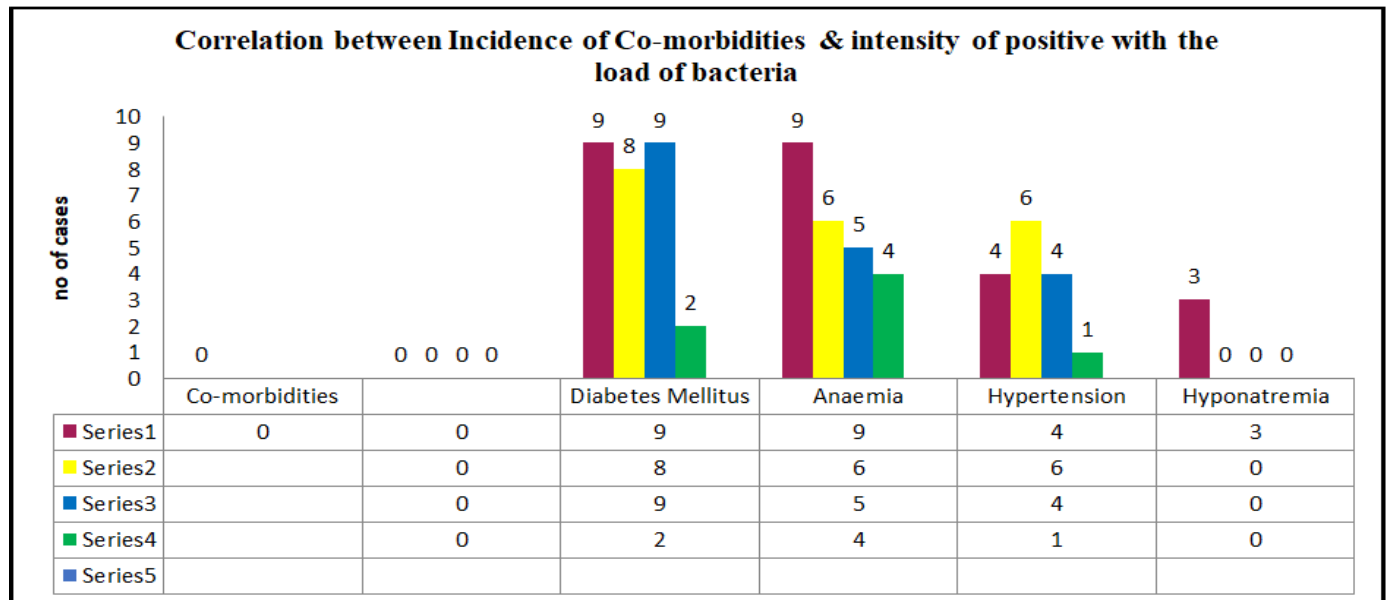| Co-morbidities	Positivity with the bacterial load				
	1+ (n=25)	2+ (n=20)	3+ (n=18)	Scanty (n=7)	Frequency
Diabetes Mellitus	9	8	9	2	28
Anemia	9	6	5	4	24
Hypertension	4	6	4	1	15
Hyponatremia	3	0	0	0	3

Fig 10 Correlation between Incidence of Co-Morbidities & Intensity of Positive with the Load of Bacteria

Table 10 presents the correlation between the incidence of various co-morbidities and t The intensity of positive with the load of bacteria. Diabetes Mellitus was observed in 28 cases, distributed as 9 with 1+, 8 with 2+, 9 with 3+, and 2 with scanty bacterial load. Anemia was noted in 24 cases, with 9 showing 1+, 6 with 2+, 5 with 3+, and 4 with scanty bacterial load. Hypertension appeared in 15 cases, with 4 showing 1+, 6 with 2+, 4 with 3+, and 1 with scanty bacterial load. Hyponatremia was the least common, observed in only 3 cases, all of which had a 1+ bacterial load.

Table 11 Correlation between Bilateral Involvement and strength of positivity with the bacterial load

Bilateral Involvement	Positivity with the bacterial load				
	1+ (n=25)	2+ (n=20)	3+ (n=18)	Scanty (n=7)	Frequency
Present	5	4	6	4	19

Table 11 shows the correlation between bilateral involvement and The intensity of positive with the load of bacteriaBilateral involvement was present in 19 cases, with the distribution as follows: 5 cases with a 1+ bacterial load, 4 cases with a 2+ bacterial load, 6 cases with a 3+ bacterial load, and 4 cases with a scanty bacterial load.

Table 12 Correlation between Common Radiological Lesions & intensity of positive with the load of bacteria

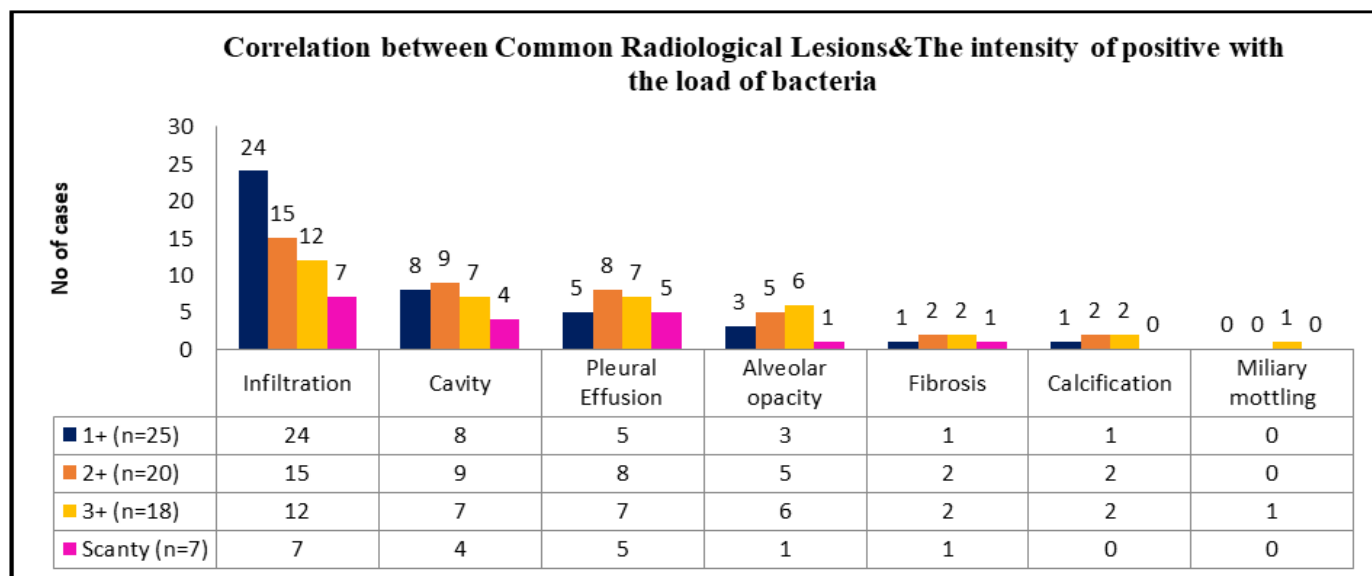| Common Radiological Lesions	Positivity with the bacterial load				
	1+ (n=25)	2+ (n=20)	3+ (n=18)	Scanty (n=7)	Frequency
Infiltration	24	15	12	7	58
Cavity	8	9	7	4	28
Pleural Effusion	5	8	7	5	25
Alveolar opacity	3	5	6	1	15
Fibrosis	1	2	2	1	6
Calcification	1	2	2	0	5
Miliary mottling	0	0	1	0	1

Fig 11 Correlation between Common Radiological Lesions & Intensity of Positive with the Load of Bacteria

Table 11 outlines the correlation between common radiological lesions and the strength of positivity with the bacterial load. Infiltration was the most frequent lesion, appearing in 58 cases, with a distribution of 24 with 1+, 15 with 2+, 12 with 3+, and 7 with scanty bacterial load. Cavity formation was noted in 28 cases, with 8 having 1+, 9 with 2+, 7 with 3+, and 4 with scanty bacterial load. Pleural effusion was present in 25 cases, distributed as 5 with 1+, 8 with 2+, 7 with 3+, and 5 with scanty bacterial load. Alveolar opacity was observed in 15 cases, with 3 showing 1+, 5 with 2+, 6 with 3+, and 1 with scanty bacterial load. Fibrosis was found in 6 cases, with 1 each in 1+ and scanty, and 2 each in 2+ and 3+. Calcification appeared in 5 cases, with 1 in 1+, 2 in 2+, and 2 in 3+. Miliary mottling was the least common, observed in only 1 case with a 3+ bacterial load.

Table 13 Correlation between Extent of Involvement & Intensity of Positive with the Load of Bacteria

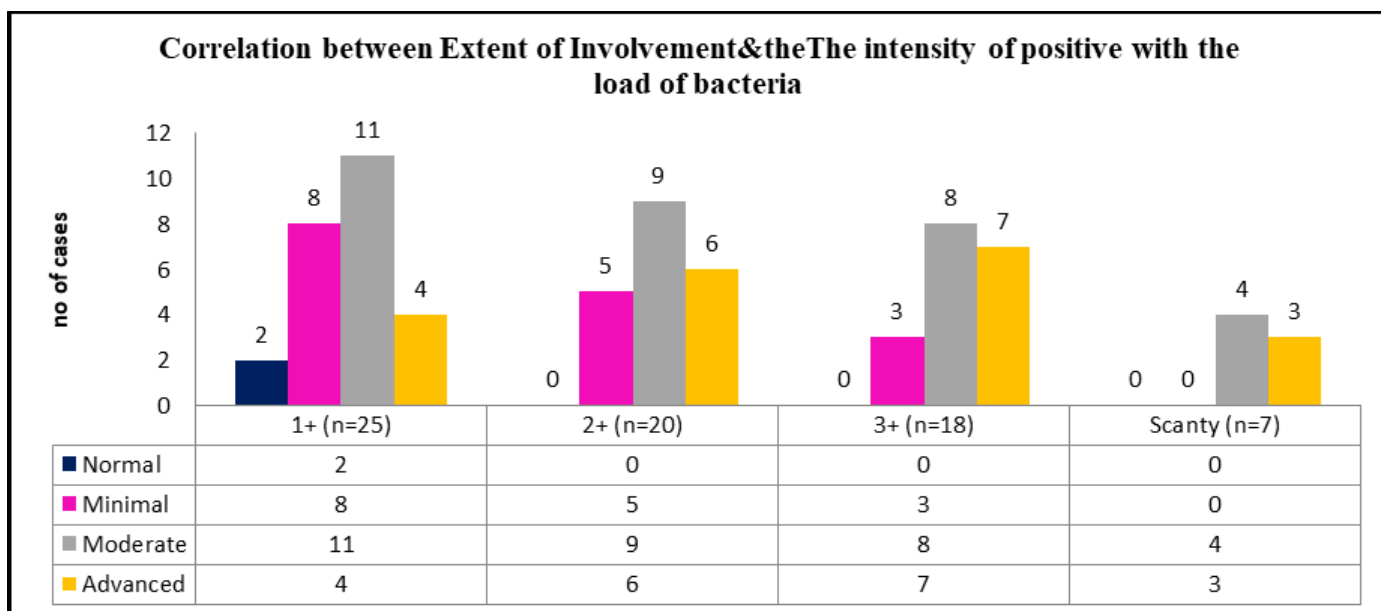| Extent of Involvement	positivity with the bacterial load				
	1+ (n=25)	2+ (n=20)	3+ (n=18)	Scanty (n=7)	Frequency
Normal	2	0	0	0	2
Minimal	8	5	3	0	16
Moderate	11	9	8	4	32
Advanced	4	6	7	3	20

Fig 12 Correlation between Extent of Involvement & Intensity of Positive with the Load of Bacteria

Table 13 highlights the correlation between the extent of lung involvement and intensity of positive with the load of bacteria. Normal lung involvement was observed in 2 cases, both with a 1+ bacterial load. Minimal involvement was noted in 16 cases, distributed as 8 with 1+, 5 with 2+,

and 3 with 3+. Moderate involvement appeared in 32 cases, with 11 showing 1+, 9 with 2+, 8 with 3+, and 4 with scanty bacterial load. Advanced involvement was found in 20 cases, with 4 having 1+, 6 with 2+, 7 with 3+, and 3 with scanty bacterial load.

Table 14 Correlation between Co-Morbidities and Involvement of Zone

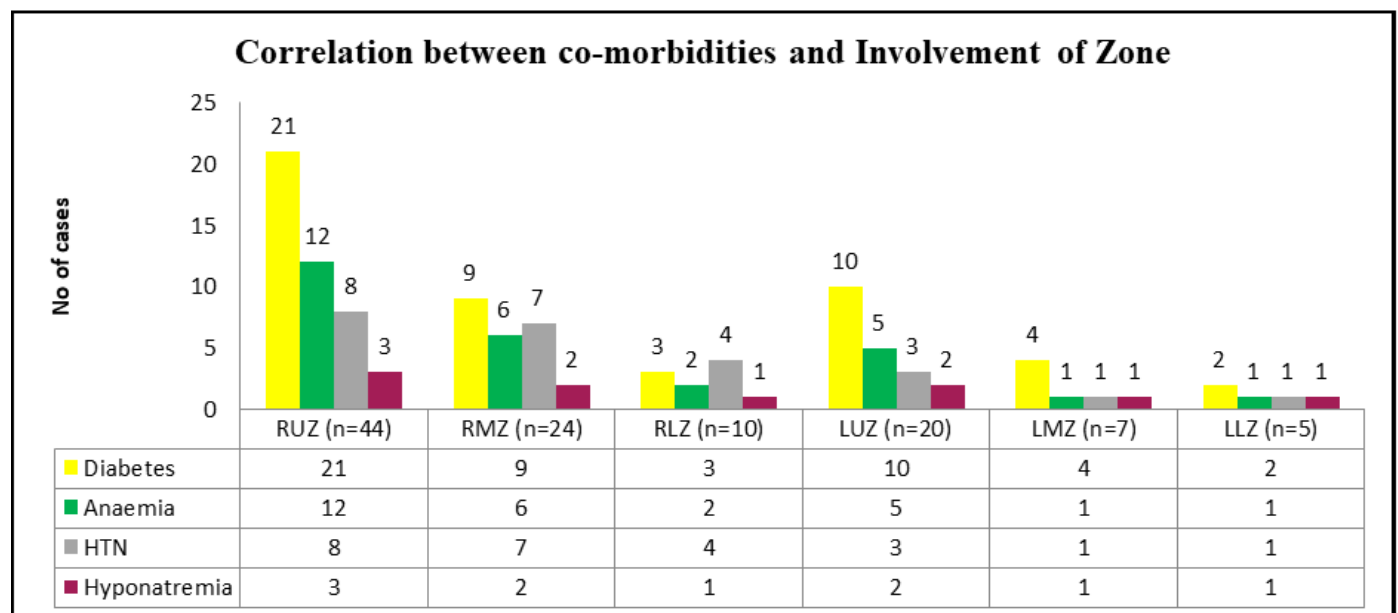| Co-morbidities	RUZ (n=44)	RMZ (n=24)	RLZ (n=10)	LUZ (n=20)	LMZ (n=7)	LLZ (n=5)
Diabetes	21	9	3	10	4	2
Anemia	12	6	2	5	1	1
HTN	8	7	4	3	1	1
Hyponatremia	3	2	1	2	1	1

Fig 13 Correlation between Co-Morbidities and Involvement of Zone

Table 14 presents the correlation between co-morbidities and zonal involvement. It was observed that atypical lesions were more common in diabetes mellitus.

IV. DISCUSSION

Pulmonary tuberculosis (sputum positive newly diagnosed) with many comorbidities and their correlation was actively tested for in this study in a tertiary care hospital.

According to the results, the largest age group consisted of patients between 51 and 60 years old (34.3%), followed by those between 41 and 50 years old (25.7%), those between 61 and 70 years old (18.6%), those between 31 and 40 years old (14.3%), and finally, the youngest age group, those between 18 and 30 years old (7.14%), with a mean age of 49.64+ 11.64 years.

Men and women were equally considered for inclusion in this study's patient pool. The gender breakdown of the patients was as follows: 61.4% male and 38.6% female.

The major co-morbidities identified in this study, 38.6% were Diabetes mellitus, 34.3% were Anemia, 21.4% were Hypertension, and 4.3% were Hyponatremia.

A higher risk of pulmonary TB is thus associated with diabetes. When diabetes mellitus was present alongside tuberculosis, research revealed that treatment response was poor. An earlier recovery from pulmonary tuberculosis treated with anti-tubercular medicines may be possible if diabetes is better managed. Of the 70 participants in this study, 19 (or 27.1%) had bilateral involvement.

Of the radiological lesions seen on chest x-rays, the most prevalent ones were patchy infiltrates (82.9%), cavities (40%), pleural effusion (35.7%), alveolar opacities (21.5%), fibrosis (8.6%), calcification (7.1%), and miliary mottling (1.4%), according to this study.

In recently diagnose PTB , the involvement of the lung zones was compared in both lungs. The right upper zone was found to be the commonly, 63% of cases. The right middle zone was second most common at 34.3%, followed by the left upper zone at 28.6%, and the left lower zone at the lowest.

This study indicated that a higher prevalence of atypical lesions was associated with diabetes mellitus. The impact of glucose levels on radiological presentation in pulmonary tuberculosis was investigated. Patients with diabetes mellitus were more likely to have unusual radiological manifestations of pulmonary tuberculosis. Gazi et al. also showed that people with diabetes often have an unusual pattern of chest radiographs when they have pulmonary tuberculosis.

Patients with diabetes mellitus should be carefully evaluated when interpreting chest radiographs due to the increased likelihood of an abnormal pattern and the presence of severe lesions.

V. CONCLUSION

We found our investigation revealed that newly diagnosed sputum positive PTB patients often exhibited chest X-ray abnormalities such as infiltration, cavitary lesions, and comorbidities such diabetes and anemia.

Only 27% of the patients have bilateral lung involvement. Most common feature on chest x ray is infiltration followed by cavitation. Right upper zone is the most commonly involved zone. Majority of the patients found to have moderate involvement. Bilateral involvement is maximally seen with diabetes mellitus.

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