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Utilizing high-resolution computed Tomography in individuals affected by ongoing Pulmonary Tuberculosis

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Even though active pulmonary tuberculosis can typically be diagnosed using chest radiographs, minor exudative tuberculosis may go unnoticed on these images. To investigate the efficacy of high-resolution computed tomography in assessing and monitoring the progression of pulmonary tuberculosis in affected patients. A descriptive study was conducted at radiology department, Shalimar Hospital Lahore's. All participants underwent low dose HRCT using a helical four-channel MDCT scanner (Siemen 64 slice). 70 patients were enrolled in this study with convenient sampling technique. Both male and female's patients with acid-fast bacilli positive and patients under anti tubercular therapy were included. Pregnant females and patients with known malignancy and compromised immune system were excluded. In this study, 70 patients visited Radiology department with pulmonary TB for HRCT. The number of males were 37 and female were 33. In terms of gender, there were subtle variations in the prevalence of radiological features, with consolidation at around 37.8% for males and 39.4% for females, while cavitation stood at 62.2% for males and 60.6% for females. Regarding age groups, older individuals consistently showed higher percentages of radiological features such as lymphadenopathy and pleural effusion compared to younger age categories. Symptoms like cough, fever, breathing difficulty, and bloating demonstrated varying associations with radiological manifestations. For instance, the presence of cough and fever seemed to correlate with higher rates of consolidation, cavitation, and lymphadenopathy. Breathing difficulty exhibited a strong association with increased prevalence of specific features, notably lymphadenopathy. Moreover, bloating among tuberculosis patients showcased a correlation with relatively higher percentages of lymphadenopathy compared to cases without bloating. In order to distinguish between active and dormant TB, HRCT is useful. When determining the extent of pulmonary TB, HRCT is superior to a normal chest radiograph. The occurrence of TB was higher in male than females. The most clinical finding is cough. In addition, most common HRCT finding is lymphadenopathy at age group of 21-40 years.

Keywords: HRCT, Pulmonary tuberculosis

INTRODUCTION

Chest radiography and regular CT are not as effective as high resolution computed tomography (HRCT) for examining the pulmonary parenchyma in tuberculosis. In this study, we investigate the impact of HRCT on the disease activity and consequences of pulmonary tuberculosis (PTB) for anti-tubercular medication. (ATT). (Jain, 2021)

In recent studies it has been shown that computed tomography is more sensitive than plain chest films at detecting lung parenchymal lesion and at determining whether or not pulmonary TB is active. Although some reports have highlighted the superiority of high-resolution

computed tomography (HRCT) in accessing the activity of pulmonary TB. There are no statistics available demonstrating HRCT's clinical value in assessing TB activity. (Majmudar, 2017)

The incidence of tuberculosis has increased dramatically throughout the world since 1985. In developing countries pulmonary tuberculosis is still a prevalent disease particularly among poor, elders and chronically ill. A prompt diagnosis and treatment of this disease are therefore essential. (Rahim, 2009)

Sputum smear for Acid Fast Bacillus (AFB) is 46-74% sensitive and sputum culture for AFB is 2-95% sensitive as a gold standard in the diagnosis of active tuberculosis.

In the national data adults with active pulmonary tuberculosis have smear positivity rate of 10-22%. (Naseem , 2008)

Every year, some 10 million individuals suffer from tuberculosis, which continues to be a serious health issue. In 2017, it was one of the top ten killers of people who tested negative for the HIV infection. According to the WHO, India is one of the nations with the largest burden of tuberculosis, with an estimated incidence of 204/100,000 and mortality of 31/100,000 people. Only 60% of these notified cases had bacteriology confirmation. (Kilaru, 2019)

By examining the existence and distribution of CT signals that might indicate parenchymal 7-9 fibrosis, high-resolution computed tomography (HRCT) was shown to be superior to traditional computed tomography images. Additionally, CT can help to identify between an active and a chronic infection. This study's goals included identifying the pattern of HRCT results in patients with active pulmonary tuberculosis and employing High-Resolution Computed Tomography (HRCT) to diagnose pulmonary TB.(Ahmad , 2020)

Miliary TB and bronchogenic PTB both have the condition known as acute respiratory distress syndrome (ARSD). PTB is a cause of acute respiratory failure that presents with short-lived symptoms similar to an acute febrile sickness or diffuse interstitial lung disease. This clinical condition occurs between 1.5 and 1.9% of the time, according to past investigations. According to reports, the fatality rate for patients who had the symptoms for more than two weeks was 75%.(Ors , 2007)

There is information about the relationship between the number of Acid-Fast Bacillus (AFB) on sputum smear in patients with pulmonary tuberculosis and the morphologic findings on high resolution computed tomography (HRCT) (PTB). It was also demonstrated that cavities and air space consolidation could influence PTB patients' smear positive.(Raghuvanshi , 2016)

Depending on the modality being utilized, chest imaging as a diagnostic tool for pediatric PTB faces particular difficulties, such as low inter-observer reliability, non-specific radiological indications, and a lack of defined scoring or categorization systems.(Nel , 2022)

Chest X-rays have been reported to be less sensitive than High Resolution Computed Tomography (HRCT) in detecting tiny exudative lesions, modest or occult parenchymal alignment, and accessing disease activity in pulmonary TB. Furthermore, it can take up to 6 to 8 weeks for sputum culture evaluations in sputum smear awful patients, creating a scientific quandary about whether or not to intervene. Nucleic acid implication approaches, such as the GeneXpert MTB/RIF (Mycobacterium tuberculosis/resistance to rifampicin) assay, are expensive and no longer widely available. In these instances, HRCT can help by providing a provisional diagnosis of tuberculosis so that empirical treatment can also be started, and on the other side, by selecting patients who

are unlikely to have the disease. (Shaarrawy, 2013)

Understanding the associations between symptoms and radiological findings assists in patient management. It allows clinicians to anticipate disease progression, plan appropriate interventions, and monitor treatment responses more effectively.

MATERIALS AND METHODS

A descriptive study was conducted at radiology department, Shalimar Hospital Lahore's. All participants underwent low dose HRCT using a helical four-channel MDCT scanner (Siemen 64 slice).70 patients were enrolled in this study with convenient sampling technique. Both male and female's patients with acid fast bacilli positive and patients under anti tubercular therapy were included. AFB positive (on sputum or end bronchial washings smear or culture were included. Patients suspected with pulmonary tuberculosis and newly diagnosed who were on treatment without positive chest radiograph findings with 2 sputum AFD examinations. Pregnant females and patients with known malignancy and compromised immune system were excluded. Data was collected according to the data collection sheet. SPSS software version 24 was used to analyses the data.

RESULTS

In this study, 70 patients visited radiology department for HRCT with active pulmonary tuberculosis. The number of males was 37 and female was 33.The occurrence of TB was higher in male than females.

Table 1: Symptoms in patients with active pulmonary tuberculosis

Symptoms	Frequency	Percentage	
Cough	Yes	67	95.7%
	No	3	4.3%
Fatigue	Yes	47	67.1%
	No	23	32.9%
Fever	Yes	60	85.7%
	No	10	14.3%
Nausea	Yes	27	38.6%
	No	43	61.4%
Congestion	Yes	64	91.4%
	No	6	8.6%
Breathing Difficulty	Yes	66	94.3%
	No	4	5.7%
Bloating	Yes	19	27.1%
	No	51	72.9%
Shortness of Breath	Yes	66	94.3%
	No	4	5.7%
Weight Loss	Yes	50	71.4%
	No	20	28.6%

Out of 70 patients, 95.7% patients had cough 4.3% don't have cough.67.1% patients had fatigue 32.9% don't have fatigue.85.7% patients had fever14.3% don't have fever.38.6% patients had nausea 61.4% don't have

nausea.91.4% patients had congestion 8.6, % don't have congestion.94.3% patients had breathing difficulty 5.7% don't have breathing difficulty.27.1% patients had bloating 72.9% don't have bloating.94.3% patients had shortness of breath 5.7% don't have shortness of breath.71.4% patients had weight loss 28.6% don't have weight loss.

Table 2: HRCT findings in patients with active pulmonary tuberculosis

HRCT Findings		Frequency	Percentage
Cavitation	Yes	28	40.0%
	No	42	60.0%
Consolidation	Yes	27	38.6%
	No	43	61.4%
Lymphadenopathy	Yes	47	67.1%
	No	23	32.9%
Pleural Effusion	Yes	9	12.9%
	No	61	87.1%

Out of 70 patients, 28 (40.0%) patients had cavitation.27 (38.6%) patients had consolidation.47 (67.1%) patients had lymphadenopathy.9 (12.9%) patients had pleural effusion.

Among male patients, consolidation was observed in 14 cases, representing 37.8% of the cohort, whereas cavitation was more prevalent, accounting for 62.2% with 23 cases. Lymphadenopathy was evident in 15 cases (40.5%), while pleural effusion was detected in 25 cases, constituting a higher percentage at 67.6%. Conversely, in the female group, consolidation was slightly lower at 13 cases, making up 39.4% of the cases, while cavitation was present in 60.6% (20 cases). Lymphadenopathy was observed in 13 cases (39.4%), akin to the male group, and pleural effusion was found in 22 cases, accounting for 66.7% of the female cases.

In the younger age (8-20 years), there is a lower incidence of radiological features, with consolidation at 14.3%, cavitation at 28.6%, and no cases of pleural effusion noted. The 21-40 age group exhibits a moderate prevalence of these features, while the 41-60 and 61-80 age ranges indicate increased occurrences, particularly in lymphadenopathy and pleural effusion. Generally, older age groups tend to demonstrate higher rates of

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radiological manifestations associated with pulmonary tuberculosis compared to the younger age categories.

Among those reporting a cough, a considerable prevalence of radiological signs was observed. Specifically, consolidation was detected in 40.3% of cases (27 occurrences), cavitation in 41.8% (28 occurrences), lymphadenopathy in 68.7% (46 occurrences), and pleural effusion in 11.9% (8 occurrences). Conversely, in patients without a cough, the prevalence of radiological features was notably lower. For instance, consolidation was present in all cases (100%), cavitation in all cases (100%), lymphadenopathy in 33.3% (1 occurrence), and pleural effusion in 33.3% (1 occurrence). These findings underscore a strong association between the presence of cough and the higher prevalence of radiological manifestations associated with pulmonary tuberculosis.

Among patients with fever, a considerable prevalence of radiological features was evident. Specifically, consolidation was detected in 38.3% (23 cases), cavitation in 40.0% (24 cases), lymphadenopathy in 70.0% (42 cases), and pleural effusion in 13.3% (8 cases). Conversely, in patients without fever, the prevalence of these radiological features was marginally lower.

In patients experiencing breathing difficulty, a substantial prevalence of radiological features was observed. Specifically, consolidation was noted in 40.9% (27 cases), cavitation in 42.4% (28 cases), lymphadenopathy in 69.7% (46 cases), and pleural effusion in 12.1% (8 cases). Conversely, among patients without breathing difficulty, the prevalence of these radiological features was notably lower.

In patients reporting bloating, a notable prevalence of radiological features was observed. Specifically, consolidation was detected in 36.8% (7 cases), cavitation in 36.8% (7 cases), lymphadenopathy in 78.9% (15 cases), and pleural effusion in 5.3% (1 case). Conversely, among patients without bloating, the prevalence of these radiological features was somewhat lower. For instance, consolidation was present in 39.2% (20 cases), cavitation in 41.2% (21 cases), lymphadenopathy in 62.7% (32 cases), and pleural effusion in 15.7% (8 cases).

Table 3: Comparison of gender with Radiological Features in Pulmonary Tuberculosis

Gender		Consolidation		Cavitation		Lymphadenopathy		Pleural Effusion	
		Yes	No	Yes	No	Yes	No	Yes	No
Male	Frequency	14	23	15	22	25	12	5	32
	Percentage	37.8%	62.2%	40.5%	59.5%	67.6%	32.4%	13.5%	86.5%
Female	Frequency	13	20	13	20	22	11	4	29
	Percentage	39.4%	60.6%	39.4%	60.6%	66.7%	33.3%	12.1%	87.9%

Table 4: Radiological Features in Pulmonary Tuberculosis across Different Age Groups

Age Group		Consolidation		Cavitation		Lymphadenopathy		Pleural Effusion	
		Yes	No	Yes	No	Yes	No	Yes	No
8-20	Frequency	1	6	2	5	4	3	0	7
	Percentage	14.3%	85.7%	28.6%	71.4%	57.1%	42.9%	0.0%	100.0%
21-40	Frequency	6	11	6	11	12	5	2	15
	Percentage	35.3%	64.7%	35.3%	64.7%	70.6%	29.4%	11.8%	88.2%
41-60	Frequency	8	11	8	11	12	7	2	17
	Percentage	42.1%	57.9%	42.1%	57.9%	63.2%	36.8%	10.5%	89.5%
61-80	Frequency	12	15	12	15	19	8	5	22
	Percentage	44.4%	55.6%	44.4%	55.6%	70.4%	29.6%	18.5%	81.5%

Table 5: Presence or absence of cough among individuals diagnosed with pulmonary tuberculosis

Cough		Consolidation		Cavitation		Lymphadenopathy		Pleural Effusion	
		Yes	No	Yes	No	Yes	No	Yes	No
Yes	Frequency	27	40	28	39	46	21	8	59
	Percentage	40.3%	59.7%	41.8%	58.2%	68.7%	31.3%	11.9%	88.1%
No	Frequency	0	3	0	3	1	2	1	2
	Percentage	0.0%	100.0%	0.0%	100.0%	33.3%	66.7%	33.3%	66.7%

Table 6: Presence or absence of fever among individuals diagnosed with pulmonary tuberculosis

Fever		Consolidation		Cavitation		Lymphadenopathy		Pleural Effusion	
		Yes	No	Yes	No	Yes	No	Yes	No
Yes	Frequency	23	37	24	36	42	18	8	52
	Percentage	38.3%	61.7%	40.0%	60.0%	70.0%	30.0%	13.3%	86.7%
No	Frequency	4	6	4	6	5	5	1	9
	Percentage	40.0%	60.0%	40.0%	60.0%	50.0%	50.0%	10.0%	90.0%

Table 7: Presence or absence of breathing difficulties among individuals diagnosed with pulmonary tuberculosis

Breathing difficulty		Consolidation		Cavitation		Lymphadenopathy		Pleural Effusion	
		Yes	No	Yes	No	Yes	No	Yes	No
Yes	Frequency	27	39	28	38	46	20	8	58
	Percentage	40.9%	59.1%	42.4%	57.6%	69.7%	30.3%	12.1%	87.9%
No	Frequency	0	4	0	4	1	3	1	3
	Percentage	0.0%	100.0%	0.0%	100.0%	25.0%	75.0%	25.0%	75.0%

Table 8: Presence or absence of bloating among individuals diagnosed with pulmonary tuberculosis

Bloating		Consolidation		Cavitation		Lymphadenopathy		Pleural Effusion	
		Yes	No	Yes	No	Yes	No	Yes	No
Yes	Frequency	7	12	7	12	15	4	1	18
	Percentage	36.8%	63.2%	36.8%	63.2%	78.9%	21.1%	5.3%	94.7%
No	Frequency	20	31	21	30	32	19	8	43
	Percentage	39.2%	60.8%	41.2%	58.8%	62.7%	37.3%	15.7%	84.3%

DISCUSSION

In current study, the findings of radiological features concerning specific symptoms and demographic factors among individuals diagnosed with pulmonary tuberculosis

offer valuable insights into the potential associations between clinical presentations and disease manifestations. The notable trend of higher rates of certain radiological features, such as lymphadenopathy and

pleural effusion, among older age groups aligns with the general understanding of tuberculosis as a disease that may present differently in various age brackets. These findings highlight the importance of age stratification in assessing disease severity and guiding clinical management.

In a study in August 2017, there were 23 female patients and 27 male patients. An average age of 44 years was determined to be the age at presentation. It was discovered that consolidation (68%) has a strong predictive value for identifying disease activity. (Majmudar, 2017). Out of 70 patients in our study, 37 were men and 33 were women. Lymphadenopathy in the age range of 21 to 40, a strong predictive value of 67.1% was discovered for disease activity diagnosis.

In a research, high-resolution computed tomography revealed pulmonary TB in 80 (80%) of the 100 participants (HRCT). Tree-in-bud appearance (77%), fibrotic changes (72%), consolidation (68%), cavitation (40%), bronchiectasis alterations (18%), ground-glass haze (18%), and calcified granulomas (10%) were the most frequent observations on HRCT. (Kilaru, 2019). In our study, cavitation (40%), consolidation (38.6%), lymphadenopathy (67.1%), and pleural effusion (12.9%) were the most frequent HRCT results.

A study by Radiology Department of District Hospital Gujranwala, Overall, 80 (80%) out of 100 High-Resolution Computed Tomography revealed that the participants had pulmonary TB (HRCT). Tree-in-bud appearance (77%), fibrotic changes (72%), consolidation (68%), cavitation (40%), bronchiectasis alterations (18%), ground-glass haze (18%), and calcified granulomas (10%) were the most frequent observations on HRCT. In our study, most common HRCT findings were consolidation (38.6%), cavitation (40%), lymphadenopathy (67.1%) and pleural effusion (12.9%). (Ahmad, 2020)

Patients above the age of 65 are at a higher risk of contracting tuberculosis, according to a prior cross-sectional study published in 2020 by Rasheed ET al. (Tasawar, 2022). In our study, age is distributed into four groups. In 8-20 age group 14.3% had consolidation, 28.6% had cavitation, 57.1% had lymphadenopathy, and 0.0% had pleural effusion. In 21-40 age group 35.3% had consolidation, 35.3% had cavitation, 70.6% had lymphadenopathy, and 11.8% had pleural effusion. In 41-60 age group 42.1% had consolidation 42.1% had cavitation, 63.2% had lymphadenopathy, and 10.5% had pleural effusion. In 61-80 age group 44.4% had consolidation, 44.4% had cavitation 70.4% had lymphadenopathy, 18.5% had pleural effusion.

During a study on June 30, 2021 50 participants were enrolled in this prospective observational study based on the inclusion and exclusion criteria. The majority of patients in the study population (22%), who had a mean age of 43.06 17.17 years, were between the ages of 51 and 60. There were 50 patients, with an M: F ratio of 9:1. Of those, 45 patients were men. The most prevalent

clinical symptoms were a cough (88%), sputum production (68%), fever (60%), weight loss (52%), and night sweats (24%). (Sharma, 2021). In our study 37 were male and 33 were female. Cough (95.7%), fever (85.7%), nausea (38.6%), weight loss (71.4%).

During a study in Oct-Dec 2009 by Department of Radiology, Gulab Devi Hospital, Lahore, A total of 102 patients were enrolled in the trial, ranging in age from 10 to 83, with a mean age of 47.1522.6 (38 females and 62 males). All of them displayed the clinical features of active pulmonary tuberculosis, including 82.3% coughing, 50% fever, 64% sputum production, 31% night sweats, and 50% weight loss. (Rahim, 2009). While in our study 70 patients visited radiology department at Shalimar hospital Lahore with age group 8-20 entered the study. Out of 70 patients 95.7% had cough, 85.7% had fever and 71.4% had weight loss.

These findings align with earlier research, showcasing similar symptom prevalence and radiological patterns. Our study corroborates the diagnostic relevance of radiological features such as consolidation, cavitation, lymphadenopathy, and pleural effusion, echoing previous studies' observations of these features' diagnostic value in pulmonary tuberculosis.

The consistency in HRCT findings between our study and prior research, particularly regarding consolidation, cavitation, lymphadenopathy, and pleural effusion, underlines the robustness of these manifestations as diagnostic markers. These observations parallel established HRCT patterns associated with pulmonary tuberculosis, reinforcing their significance in disease diagnosis and assessment. Our study is aligned with prior research regarding symptom prevalence, radiological patterns, and HRCT findings substantiates the reliability of these associations. These consistent observations highlight the diagnostic value of specific symptoms and radiological features, supporting their crucial role in pulmonary tuberculosis assessment and guiding clinical decision-making.

CONCLUSION

In order to distinguish between active and dormant TB, HRCT is useful. When determining the extent of pulmonary TB, HRCT is superior to a normal chest radiograph. The occurrence of TB was higher in male than females. The most clinical finding is cough. Moreover, most common HRCT finding is lymphadenopathy at age group of 21-40 years.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

AK, MIK, SA, IB, FS and AH was involved in data collection and writing the manuscript. MZK and SA designed and supervised the project. SMYF reviewed the manuscript. All authors read and approved the final version.

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