Original Research Article

Evaluation of high resolution computed tomography (HRCT) in diagnosis of pulmonary tuberculosis and deciding activity of the disease

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Abstract

Background: HRCT is a useful adjunct to Chest radiography for diagnosing the tuberculosis and is more sensitive than conventional radiography in detection and characterization of parenchymal disease and lymphadenopathy in the mediastinum. The high sensitivity of HRCT provides an edge and may allow prompt diagnosis before the culture reports arrive. **Aim:** To evaluate the role of high resolution computed tomography in diagnosis of pulmonary tuberculosis and deciding activity of the disease. **Material and Methods:** A total of 200 patients suspected with pulmonary tuberculosis, smear negative with strong suspicion of tuberculosis, clinical suspicion of tuberculosis and not confirmed by other modality such as conventional radiography, smear positive patients during their follow up were studied. Two sputum samples were collected and sent for Z-N stain. After clinical workup, examining radiographs, patients were subjected to HRCT imaging. **Results:** The majority of patients were diagnosed as pulmonary tuberculosis (79%) and 42 (21%) patients were diagnosed as non-TB. The patients according to non-TB diagnosis were diagnosed as interstitial lung disease (76.17%) followed by malignancy (16.67%) and 3 (7.14%) patients were diagnosed as fungal disease.The common finding seen on HRCT were nodules both centrilobular (56%). Other important findings included lobular consolidation (53%) and cavities (45.5%). **Conclusion:** HRCT is a powerful and reliable investigation in the diagnosis of tuberculosis, when other means of diagnosis (e.g., culture, BAL) fail to settle the matter, is not available or is time consuming.

Key Words: High Resolution Computed Tomography, Pulmonary Tuberculosis, Non tuberculosis, Diagnosis.

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INTRODUCTION

Tuberculosis, which is an airborne infectious disease, is a major cause of morbidity and mortality especially in a country like ours that is developing and is caused by *Mycobacterium Tuberculosis*.[1-3] The definitive diagnosis of TB can only be made on culturing *M. Tuberculosis* organism taken from a specimen from the patient. As the organism is slow growing in laboratory it makes it difficult to diagnose through this method. The delay in diagnosis causes delay in isolation of the patient leads to further increase in chance of spread of infection and thereby increasing the severity of the disease. HRCT is a useful adjunct to Chest radiography for diagnosing the tuberculosis and is more sensitive than conventional radiography in detection and characterization of parenchymal disease and lymphadenopathy in the mediastinum.[4]The high sensitivity of HRCT provides an edge and may allow prompt diagnosis before the culture reports arrive.[5]

MATERIAL AND METHODS

This prospective study was carried out at Aacharya Vinoba Bhave Hospital, Jawaharlal Nehru Medical

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college, Wardha over aperiod of two years.All patients attending OPD and admitted in IPD with suspected pulmonary tuberculosis findingswere studied.

Ethical Consideration

The Ethical Committee of the Institute approved the study.

Inclusion Criteria

- All the patients suspected with pulmonary tuberculosis
- All smear negative with strong suspicion of tuberculosis
- All patients with clinical suspicion of tuberculosis and not confirmed by other modality such as conventional radiography
- All smear positive patients during their follow up if necessary.

Exclusion Criteria

- The patients of extrapulmonary tuberculosis
- The patients of HIV
- Pregnant patients

Sample size: A total sample size of 200 patients attending OPD in was included in the study calculated by using the :formula: $N=4PQ/L^2$(N= sample size; P= prevalence; Q=100-P; L=20% of P).In the study, planned to include 200 patients in the final diagnosis accordingly we included 220 patients referred from various departments of the institute which met the inclusion criteria in initial stage considering a drop out (subject or patient who got their MDCT but were not willing for pathological investigations) of 20 patients by the time of analysis. Thus, final analysis was carried out on 200 patients. Convenient sampling was used for the present study.

Methodology: After obtaining written informed consent from each patient, brief clinical history, physical examination findings and chest findings were recorded. Two successive samples of sputum for AFB were collected as per RNTCP Guidelines (Revised National Tuberculosis Control Program). If patient's sputum examination revealed AFB smear positivity, he/she was excluded from the study. All sputum samples were sent for direct smear examination using Zeihl-Neelsen stain. After clinical workup, examining radiographs, patients were subjected to MDCT imaging. The final report was made after examination by two radiologists, experienced in reporting HRCT thorax.

Statistical Analysis: Data was collected in predefined proforma, and entered in Microsoft excel, analysis was done in SPSS version 15. The categorical data was expressed as rates, ratios and proportions and comparison was done using Chi-Square test or Fisher's exact test. The continuous data was expressed as mean ± Standard Deviation (SD). A probability value ('p' value) of less than or equal to 0.05 at 95% confidence was considered statistically significant.

RESULTS

It was observed that majority of patients were in the age group 41-60 years (39.00%) followed by 21-40 years (29%). Majority of patients were in male 59% and females were 41%.Cough (81.5%) was the chief presenting complaint followed by dyspnea (71%), fever (56.5%) and weight loss (41.5%). Less common symptoms were night sweats (32.5%) and hemoptysis (21%).

Table 1: Clinical and Demographic characteristics of study population

Characteristics	No. of Patients	Percentage
Age group (years)		
0-20	13	7%
21-40	58	29%
41-60	77	39%
61-80	48	24%
>80	04	2%
Sex		
Male	118	59%
Female	82	41%
Symptoms		
Cough	163	81.5%
Hemoptysis	42	21%
Weight loss	83	41.5%
Fever	113	56.5%
Night sweats	65	32.5%
Dyspnea	142	71%

The majority of patients were sputum positive for tuberculosis (58.5%) and (41.5%) patients were sputum negative. The common finding seen on HRCT were nodules both centrilobular (56%). Other important findings included lobular consolidation (53%) and cavities (45.5%).

Table 2: Distribution of patients according to HRCT findings

Lesions on HRCT	No. of Patients (n=200)	Percentage
Centrilobular nodules (<8 mm)	112	56.00
Large nodules (8 mm to 30 mm)	73	36.50
Fine reticular pattern	13	6.50
Branching linear opacity	27	13.50
Tree-in-bud appearance	71	35.50
Lobular consolidation	106	53.00
Interlobular septal thickening	05	2.50
Consolidation	118	59.00
Ground glass appearance	89	44.50
Cavity	91	45.50
Bronchiectasis	31	15.50
Pleural effusion	12	6.00
Lymphadenopathy (LAP)	49	24.50

The majority of patients were diagnosed as pulmonary tuberculosis 158 (79%) and 42 (21%) patients were diagnosed as non-TB. The majority of patients were diagnosed as interstitial lung disease (76.17%) followed by malignancy (16.67%) and 3 (7.14%) patients were diagnosed as fungal disease.

Table 3: Comparison of HRCT findings among two groups

Lesions on HRCT	PTB (n=158)	Non-TB (n=42)	P value
Centrilobular nodules (<8 mm)	97(61.39%)	15(35.71%)	X^2=8.88;P=0.002 (Significant)
Large nodules (8 to 30 mm)	56(35.44%)	17(40.48%)	X^2=0.36;P=0.54 (Not Significant)
Fine reticular pattern	11(6.96%)	02(4.76%)	X^2=0.26;P=0.60 (Not Significant)
Branching linear opacity	09(5.70%)	18(42.86%)	X^2=39.24;P=<0.0001 (Significant)
Tree-in-bud appearance	71(44.94%)	00(0%)	X^2=27.33;P=<0.0001 (Significant)
Lobular consolidation	83(52.53%)	23(54.76%)	X^2=0.07;P=0.79 (Not Significant)
Interlobular septal thickening	05(3.16%)	00(0%)	X^2=0.37;P=0.54 (Not Significant)
Consolidation	88(55.70%)	30(71.43%)	X^2=3.39;P=0.06 (Not Significant)
Ground glass appearance	56(35.44%)	33(78.57%)	X^2=24.99;P=<0.0001 (Significant)
Cavity	82(51.90%)	09(21.43%)	X^2=12.42;P=0.0004 (Significant)
Bronchiectasis	18(11.39%)	13(30.95%)	X^2=9.69;P=0.001 (Significant)
Pleural effusion	05(3.16%)	07(16.67%)	X^2=10.43;P=0.001 (Significant)
Lymphadenopathy	21(13.29%)	28(66.67%)	X^2=51.10;P=<0.0001 (Significant)

There was significant difference in centrilobular nodules, tree-in-bud appearance, branching linear opacity, cavity, ground-glass opacity, bronchiectasis, pleural effusion and lymphadenopathy in two groups. ($p<0.05$) There was nodifference when two groups were compared statistically for large nodules, fine reticular pattern and consolidation. ($p>0.05$).

DISCUSSION

HRCT can be useful for the evaluation of pulmonary tuberculosis and can provide elaborative information to make a proper diagnosis and management of disease. High resolution CT is recommended when the radiographic findings are normal or are non-conclusive and yet tuberculosis is suspected clinically and for the confirmation of the diagnosis and determining the disease activity. The majority of patients were sputum positive for tuberculosis (58.5%) and (41.5%) patients were sputum negative. The majority of patients were diagnosed as pulmonary tuberculosis (79%) and (21%) patients were diagnosed as non-TB. The patients according to non-TB diagnosis were diagnosed as interstitial lung disease (76.17%) followed by malignancy (16.67%) and (7.14%) patients were diagnosed as fungal disease. While the clinical findings between the PTB and other pulmonary diseases rarely differ significantly, HRCT can help differentiate between them significantly. The common finding seen on HRCT were nodules both centrilobular (56%). Other important findings included lobular consolidation (53%) and cavities (45.5%). There was significant difference in branching linear opacities, centrilobular nodules, ground glass appearance, tree-in-bud appearance, cavity, bronchiectasis, pleural effusion and lymphadenopathy in two groups ($p<0.05$). There was no significant difference when the two groups were compared statistically when two groups for large nodules, fine reticular pattern and consolidation ($p>0.05$). The association of centrilobular nodules with tuberculosis has also been demonstrated in previous studies. Nakanishi *et al*,[6] Lee *et al*[7] and Tozkoparan *et al*[8] found centrilobular nodules to be significantly associated with tuberculosis. These nodules were mostly distributed in the upper lobes and apical segment of lower lobe. Centrilobular nodules are well-defined lesions in the center of the secondary pulmonary lobules that measures 2-4 mm in size and are separated from the pleural surface or the interlobular septa by more than 2 mm. there was an established significance in the centrilobular nodules with the risk of TB. A branching linear structure with more than one contiguous branching side was the most specific finding seen in the patients oftuberculosis in our study. In a similar study by Nakanishi *et al*[6] the significant findings found to be associated with tuberculosis were the occurrence of large nodules, with lobular consolidation, and tree-in-bud appearance. Tozkoparan *et al*[8] found out centrilobular nodules, other small nodules, lobular consolidation and cavitatory lesions to be associated with tuberculosis. Lee *et al*[7] also found centrilobular nodules, tree-in-bud and cavity to be the most important findings as in our study. In the study by Yeh *et al*[9] cavity and tree-in-bud pattern were found to be deterministic in making a diagnosis of TB. The high specificity demonstrated in our study can be because of high prevalence of TB in our country and a low sensitivity and specificity of smear examination, which may produce false negative results. Few of the cases also demonstrated miliary nodules distributed randomly miliary nodules being caused by haematogenous dissemination are smaller in size than centrilobular nodules caused by endobronchial spread. It is of paramount importance to make a diagnosis of active TB by finding the endobronchial spread of infection. On HRCT, this may be detected by the presence of poorly defined centrilobular nodules or rosettes of nodules 2-10

mm in diameter branching and centrilobular opacities. Pathologically these centrilobular nodules represent the presence of intra-bronchiolar and peri-bronchiolar inflammatory exudates, although the branching tree-in-bud pattern correlates with the presence of solid caseous material that is filling or surrounding terminal or respiratory bronchioles or alveolar ducts. However, with a more extensive form of disease coalescence of the centrilobular opacities and tree-in-bud appearance is evident in our case as well as other similar studies. The study concludes that HRCT is a powerful and reliableinvestigation in the diagnosis of tuberculosis, when othermeans of diagnosis (e.g., culture, BAL) fail to settle the matter, is not available or is time consuming.

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