Role of HRCT in Diagnosing Disease Activity in Pulmonary Tuberculosis

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ABSTRACT

Introduction: Introduction of HRCT in radiology field has improved the diagnosis of many respiratory diseases, since pulmonary TB is major concern for India, role of HRCT in diagnosis for disease activity is very pivotal. Study aimed to determine the pattern of HRCT findings in active and inactive Pulmonary Tuberculosis and the value of HRCT in predicting disease activity in pulmonary tuberculosis.

Material and methods: A retrospective correlational study was conducted over a period of six months on 50 patients from September 2016 till April 2017, referred to our department of Radiology at AMC MET Medical College in Maninagar, Ahmedabad with suspected pulmonary tuberculosis. The patients were subjected to HRCT on Phillips MX 16 and the patterns of disease activity and inactivity were analysed. These features were then correlated with Sputum AFB examinations.

Results: In our study, 27 patients were males and 23 were females. Average age at presentation was found to be about 44 years. Tree-in-bud appearance, Ill-defined nodules, Consolidation were found to have a high predictive value in diagnosing disease activity. Mediastinal adenopathy, pleural effusion and Ground Glass Opacity were statistically insignificant.

Conclusion: Although chest radiography is the foremost imaging technique in the evaluation of pulmonary tuberculosis. HRCT can be important in the diagnosis and management as it can differentiate active from inactive disease with greater sensitivity. Ill-defined nodules, consolidation and tree-in-bud were best indicators of active disease. Combination of indicators was found to improve the predictive value.

Keywords: HRCT, Diagnosing Disease Activity, Pulmonary Tuberculosis

INTRODUCTION

Pulmonary TB is a major concern for the whole society and has appeared again in west since the pandemic of AIDS. In a country like ours, pulmonary tuberculosis is widespread amongst the old people and poor socioeconomic class. TB can present clinically and radiologically like many other diseases as pneumonia, malignancy and interstitial lung diseases, the yield of sputum smear is still low and needs few days to get the results.[1] HRCT is more sensitive than chest x-ray[2] in the detection of minimal exudative lesions, subtle or occult parenchymal disease and in assessing disease activity in pulmonary TB.[3] In post-primary pulmonary TB, CXR frequently shows upper lung field infiltration with or without cavitation,[4-6] and it is difficult to accurately assess disease activity. Even in patients with unchanging serial radiographic tuberculous scars, active pulmonary TB may only be disclosed by positive sputum cultures for *Mycobacterium tuberculosis*. Recent studies indicate that computed tomography is more sensitive than plain chest film in the detection of lung parenchymal lesions and that it plays an important role in evaluating the activity of pulmonary TB. While some reports stressed the superiority of high resolution computed tomography (HRCT) in assessing the activity of pulmonary TB,[7] the clinical value of HRCT in assessing the activity of pulmonary TB has not been statistically reported. Important CT findings of active pulmonary tuberculosis are centrilobular nodules and branching linear structures (tree- in-bud appearance), lobular consolidation, cavitation, and bronchial wall thickening. The CT findings of inactive pulmonary tuberculosis include calcified nodules or consolidation, irregular linear opacity, parenchymal bands, and pericicatricial emphysema.[8] Because of limitations in the yield of chest X-ray in diagnosis of pulmonary TB (PTB) computed tomography (CT) scans provide more accurate information about the extent and distribution of PTB with cavities and satellite lesions that are not seen on chest x ray.[9] Moreover, CT can contribute to distinguish active from old infection.[10,11] The aim of this study was To determine the pattern of HRCT findings in active and inactive Pulmonary Tuberculosis and to determine the value of HRCT in predicting disease activity in Pulmonary Tuberculosis.

MATERIAL AND METHOD

A retrospective co-relational study was conducted over a period of six months on 50 patients from September 2016-April 2017, referred to our department from the medicine and TB and Chest departments, with suspected pulmonary tuberculosis. Study was done after ethical clearance and informed consent.

The patients were subjected to HRCT on Phillips MX 16 CT scan machine. The patterns of the disease activity and inactivity were analysed. These features were then correlated with Sputum AFB examinations.

Inclusion Criteria:

Patients suspected with pulmonary tuberculosis and the newly diagnosed cases who were on treatment, with or

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without positive chest radiograph findings and 2 sputum AFB examinations were included for this study.

Exclusion Criteria

Patients with known malignancy and the patients who were immuno compromised were excluded from the study.

STATISTICAL ANALYSIS

Microsoft office 2007 was used for analysis of the data. Descriptive statistics were used for the analysis.

RESULTS

In our study, 27 patients were males and 23 were females. Average age at presentation was found to be about 44 yrs. As shown in table-1, Tree-in-bud appearance (77%), Ill-defined nodules (72%) and consolidation (68%) were found to have a high predictive value in diagnosing disease activity. Cavity (40.9%),Traction bronchiectasis (18.1%), atelectasis(9%) and Ground Glass Opacity (18.1%)were associated findings. As shown in table-1 Traction bronchiectasis (64%), Scar formation, atelectasis (50%), peribronchial thickening and calcified granulomas (21.4%) were the findings suggesting inactive disease.

Figure-1 shows multiple linear branching opacity with surrounding nodular infiltrations, suggestive of a tree-in-bud appearance. Tree-in-bud appearance signifies endobronchial spread, an active form of the disease.

Figure-2 shows illdefined nodules one of the common findings in HRCT .

DISCUSSION

Tuberculosis is a disease with caseating granulomas. TB infection has been considered in two stages: primary infection and reactivation or post primary disease. It has tendency to involve the upper lobes without lymphadenopathy, and also cavitation. Main findings on imaging are consolidation, opacities or both (100%), mostly in the apical and posterior segments of the upper lobes (91%), cavitation (40% to 87%), ill-defined nodules (19% to 58%), fibrosis (29%) and pleural effusion (18%).[12] The CT and HRCT findings seen in post-primary TB are different. Findings include (1) consolidation; (2) cavitation; (3) centrilobular nodules and branching linear opacities "tree-in-bud appearance".[13] All these features in combination are useful in diagnosis of TB. HRCT findings in patients with post TB are deranged bronchovascular structures, bronchiectasis, emphysema, and fibrotic bands suggestive of past infection.[13]

Determination of diagnosis and activity in patients with pulmonary tuberculosis usually depends on the detection of acid-fast bacilli in sputum smear or culture.[14] Value of sputum culture in diagnosis is same or even better than the HRCT. HRCT provides trust to treating doctors and radiologists in differentiating the other diseases that produce similar appearances without using invasive methods .In view of delay in reports of sputum culture HRCT has vital role in primary diagnosis of tuberculosis and empirical therapy can be started.[15]

Activity of post-primary disease cannot be properly assessed by chest radiography. A normal chest radiograph has a high negative predictive value for the presence of active TB. HRCT is helpful in detecting indicators of active disease not seen on chest x ray.[13,16]

X-ray chest signs of active TB are apical patchy consolidation, generally apical and in the the superior segments of the lower lobes, cavitation, miliary pattern , pleural effusion, empyema and hilar / mediastinal lymph nodes.[13] HRCT findings in active disease are patchy consolidation on one side or both sides, thick or thin wall cavity, airspace nodules, centrilobular branching structures and tree-in-bud appearance, miliary pattern, pleural effusion , empyema and bronchopleural fistula, and lymph nodes present in hilar / mediastinal region.[13,14] Lesions in and around the small airways are the most peculiar CT feature of early active tuberculosis and criterion for disease activity.[14] Cavitation is the hallmark of post-primary Tuberculosis.[17] Cavities were seen in 9 out of 22 disease positive (40.9%) and 4 out of 28(14%) disease negative patients. Importantly CT will show the presence of cavitation in a patient with suspected tuberculosis. HRCT is better than chest radiograph to show the presence of small cavities in the apices, lung bases, and paramediastinal and retrocardiac areas.[13] On HRCT, cavitation can be thick or thin

HRCT Findings	Disease positive	Disease negative
Ill-defined nodules	16/22(72%)	2/28(7.1%)
Consolidation	15/22(68%)	3/28(10.7%)
Tree-in-bud	17/22(77%)	2/28(7%)
Cavity	9/22 (40.9%)	4/28(14%)
Ground glass opacity	4/22(18.1%)	2/28(7%)
Traction bronchiectasis	4/22(18.1%)	18/28(64%)
Atelectasis	2/22(9%)	14/28(50%)
Calcified granuloma	0/22(0%)	6/28(21.4%)

Table-1: HRCT findings in disease positive and negative patients

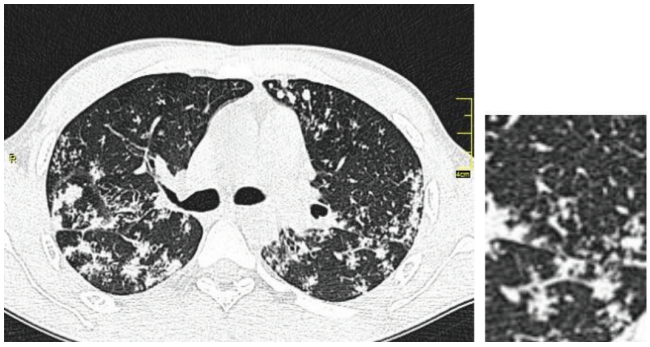

Figure-1: Tree-in-bud appearance

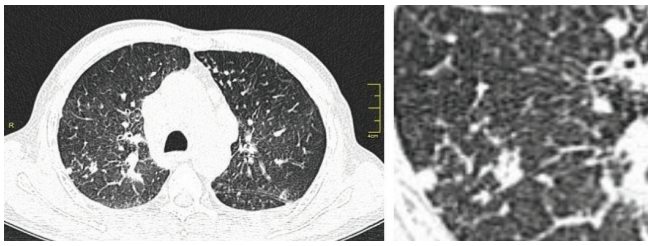

Figure-2: ILL defined nodules

HRCT findings	Steven et al (N=45)	Lee et al[8] (N=41)	Raniga et al[24] (N=25)	Present study (N=22)
Ill-defined nodules	5(11%)	25(61%)	10(40%)	16(72%)
Consolidation	23(51%)	17(41%)	13(52%)	15(68%)
Tree in bud	32(71%)	39(95%)	20(80%)	17(77%)
Cavity	16(36%)	24(58%)	16(64%)	9(40.9%)

Table-2: Comparison of HRCT findings of active Tuberculosis with previous studies HRCT FINDINGS

walled and smooth or irregular. Sputum culture along with CT Scan findings of cavities will help in predicting disease activity. Air-fluid levels in tubercular cavities are suggestive of superimposed bacterial or fungal infection.

Consolidation will be seen as areas of increase attenuation with loss of underlying bronchovascular markings on HRCT scans, mostly in the apical and posterior segments of upper lobes and superior segments of lower lobes.[18]

Presence of "tree-in-bud" sign has high sensitivity but low specificity for the diagnosis of active Tuberculosis.[19,20] Initially it was a sign of endobronchial spread of Mycobacterium tuberculosis, but now it is there in ct findings of other diseases also[21] like peripheral airway diseases such as infection , congenital diseases, idiopathic diseases (obliterative bronchiolitis, panbronchiolitis), aspiration or inhalation of foreign bodies, immunologic diseases , and connective tissue diseases and pulmonary vascular diseases such as pulmonary emboli due to pulmonary malignancy.[21]

The HRCT signs of active Tuberculosis are presence of airspace consolidation in one side or both sides, cavities, diffuse nodules, tree-in-bud appearance, miliary pattern, pleural effusion, empyema and bronchopleural fistula, lymphadenopathy in hilar/mediastinal areas.[13,14] Peculiar picture of CT in early active tuberculosis is small airways lesions and also predict disease activity. The most accurate HRCT features of active Tuberculosis are combination of centrilobular nodules and tree in bud appearance.[22,23]

As shown in table-2, our findings were consistent with other studies. In studies done by Steven et al, Lee et al and Raniga et al, Tree-in-bud appearance was the most common finding (71%), (95%) and (80%) respectively which was consistent with our finding of (77%), Ill-defined nodules and consolidation were other common findings in these studies.[8,24]

CONCLUSION

Although chest radiography is the foremost imaging technique in the evaluation of pulmonary tuberculosis, HRCT can be important in the diagnosis and management as it can differentiate active from inactive disease with greater sensitivity. Ill-defined nodules, consolidation and tree-in-bud appearance were the best indicators of active disease. Combination of indicators was found to improve the predictive value.

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