HRCT Profile in Diagnosing Active Pulmonary Tuberculosis

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ABSTRACT

Background -The purpose of this study is to show the role of high-resolution CT scan (HRCT) in diagnosing active pulmonary tuberculosis. tree-in bud appearance in HRCT is more sensitive than chest X-ray in detection of early endobronchial spread, 97% of patients with active pulmonary TB had evidence of bronchogenic spread of the disease on HRCT.
Materials & Methods-One hundred clinically suspected of having active pulmonary TB with chest-X-ray appearances suggestive of the disease, underwent HRCT examination.
Results-HRCT results showed that 76 patients had active pulmonary TB and further clinical work-up indicated that the final diagnosis of the disease was confirmed in 52 patients. According to binomial test the combination of the two main HRCT appearances, the centrilobular nodule and "tree-in-bud" signs confirms TB diagnosis accurately. The sensitivity of HRCT in diagnosing active pulmonary TB in this study was 96% and the negative predictive value was calculated as 93%.
Conclusion-We conclude that HRCT is a powerful and reliable diagnostic tool in TB diagnosis, which means that it can be used even before mycobacteriologic results are available.
Keywords • HRCT • active pulmonary tuberculosis

INTRODUCTION

The frequency of tuberculosis has risen dramatically throughout the world since 1985. In developing countries, pulmonary tuberculosis is still a common disease particularly among the socioeconomically disadvantaged, elderly, chronically debilitated. Thus prompt diagnosis and treatment of this disease is crucial.

The chest radiograph has historically been a major tool in tuberculosis diagnosis, and it is used in concert with tuberculin skin test as a means of detecting the disease. Stability of the radiographic findings is a primary component in the assessment of disease activity. Accordingly, the chest radiograph has become increasingly important in disease detection, particularly in cases which patient reliability is not assured. In selected cases, high-resolution CT scan (HRCT) may identify indicators of active disease not seen on chest radiograph. In addition, CT is more sensitive in detection of subtle or occult parenchymal disease. Recent studies have suggested a possible role of CT in assessing disease activity. HRCT findings in active tuberculosis have been correlated with pathologic findings. 97% of patients of active tuberculosis had evidence of bronchogenic spread of disease on HRCT.

The characteristic HRCT appearance of active endobronchial disease includes poorly defined centrilobular nodules of 5-8mm in diameter, centrilobular branching structures, and the "tree-in bud" appearance. These lesions represent caseous material filling the bronchioles, alveolar ducts, and peribronchial alveoli as well as peribronchial granuloma. In the setting of acute infectious disease, they are characteristic of active tuberculosis .

The purpose of this study is to show the role of HRCT in diagnosing active pulmonary tuberculosis, when other means of diagnosing tuberculosis e.g. culture, BAL (Broncho Alveolar Lavage), or TBLB (Trans Bronchial Lung Biopsy) fail, are unavailable or are time consuming.

MATERIALS AND METHODS

One hundred clinically suspected of having active pulmonary tuberculosis and a chest radiograph with suggestive patterns of disease entered the study. These patients were sequentially enrolled during a cross-sectional study from February 2009 through October 2009 at the Ghulab Devi Hospital chest Hospital. After meeting the above-mentioned criteria, the patients were included in our survey.

Our method for gathering information was through a questionnaire, which was completed according to signs and symptoms, together with chest X-ray reports and laboratory results.

First a HRCT was performed, and some of the patients were then admitted into hospital for further work-up (sputum smear and culture, and if needed, BAL and TBLB). Our final diagnosis was based on either of the following criteria:

1. Positive smear and/or culture results for tuberculosis bacilli.
2. Positive smear and/or BAL culture results for tuberculosis bacilli.

3. Positive pathologic TBLB results.

If all above-mentioned results were negative but the patient showed dramatic response to anti tuberculosis drugs, he or she was categorized as "smear- negative" pulmonary tuberculosis cases.
Chest radiographs were viewed in order to find typical active lesions (e.g. apical opacities).

All patients underwent HRCT with Siemens Somatom Plus . Studies were performed with scans obtained at end-inspiratory lung volume. Intravenous contrast medium was not routinely utilized; instead, contrast media were selectively administered primarily to assess the mediastinum in patients with equivocal mediastinal pathology.

From the lung apices to the hemidiaphragms, 1.5-mm thick sections were obtained at 10mm intervals. All images were prospectively reconstructed using a high-resolution (bone) algorithm to evaluate the nature of the lung lesions.

At the end, the HRCT diagnosis was compared to that obtained from the clinical and paraclinical work-up of patient in order to evaluate the diagnostic yield of HRCT.

The analysis and comparison of rank values were performed through chi-square. P-values less than 0.05 were considered statistically significant. Sensitivity, specificity, positive and negative predictive value were also calculated.

RESULTS

One hundred and two patients (38 females and 62 males) aged 10 to 83 years, with an average age of 47.15 ± 22.6 entered the study.

All had the clinical signs and symptoms of active pulmonary tuberculosis; comprising, 82.3% cough, 50% fever, 38.2% hemoptysis, 64% sputum, 31% night sweats, and 50% weight loss.

Sixty patients were sputum smear and culture negative, 9 were positive for both sputum smear and culture, 5 were sputum smear negative and culture positive, and 26 were diagnosed according to BAL and TBLB results.

All cases had chest radiographs with suggestive pattern of active pulmonary tuberculosis, namely infiltration or cavitation in the upper lobes.

According to HRCT results, 76 patients (74.5%) had active pulmonary tuberculosis, while further clinical work-up confirmed the final diagnosis of active pulmonary tuberculosis in only 52 patients . The final diagnosis and HRCT diagnosis showed a strong positive correlation . The sensitivity of HRCT in diagnosing active pulmonary tuberculosis was 96%, the specificity was 50%, the positive predictive value was 67%, and the negative predictive value, 93%.

Because of low number of TBLB and BAL performed, no correlation was found between these and HRCT results. In order to find the diagnostic yield of each of the characteristic radiologic manifestations of tuberculosis found on CT scan , we performed binomial tests between the final diagnosis and each of the characteristic "tree-in-bud" and "centrilobular nodule" appearances.
Analysis of data showed that although none of these two parameters can individually be diagnostic (P=0.80), their combination, however, accurately confirms the diagnosis of tuberculosis (P=0.082).

DISCUSSION

Post-primary tuberculosis is usually a disease of adolescence and adulthood. The earliest finding of post-primary tuberculosis is a heterogeneous, poorly marginated opacity (exudative lesion), usually in the apical or posterior segment of the upper lobes. Cavitation is seen by chest radiography in 40% to 87% (mean 50%) of patients sometimes during the course of the disease. Chest CT has proved to be more accurate in detection of cavitation, particularly in cases complicated by extensive fibrosis and architectural distortion.

The most common complication of tuberculous cavitation is endobronchial spread which is detected radiographically in 19% to 58% and by HRCT in up to 98% of cases.

Thus, finding centrilobular nodules and a tree-in-bud appearance in HRCT is more sensitive than the chest radiograph in detection of early endobronchial disease[8].

In selected cases, HRCT may identify indicators of active disease not seen on chest radiographs.
The increased sensitivity of CT scan may also prompt diagnosis, even at a time when microbiology results are pending.

Fig. Consolidation with cavity formation seen on HRCT.

What we found in our study was that in 76 cases (74.5%), HRCT suggested the diagnosis of active pulmonary tuberculosis, before bacteriologic results were available. Further studies showed that 52 of these cases (51%) were in fact infected with *Mycobacterium tuberculosis* and thus underwent anti-tuberculosis therapy with promising results.
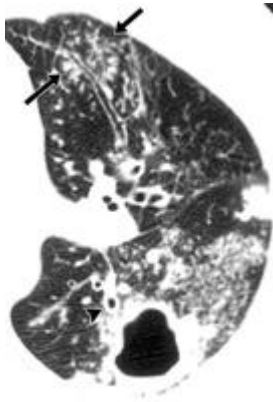

Fig. Consolidation with bud tree appearance

Chi-square analysis showed a strong positive correlation between the final diagnosis and HRCT diagnosis with a sensitivity of 96% and a specificity of 50%, which strongly confirms our hypothesis on the role of HRCT in diagnosing active pulmonary tuberculosis.

Although chest radiographs usually provide adequate information for the diagnosis of active pulmonary tuberculosis, minimal exudative tuberculosis can be overlooked on standard chest radiographs. The aim of the present study was to assess the findings of active pulmonary tuberculosis on high resolution computed tomographic (HRCT) scans, and to evaluate their possible use in determining disease activity. The diagnosis of active pulmonary tuberculosis was based on positive acid fast bacilli in sputum and bronchial washing smears or cultures and/or changes on serial radiographs obtained during treatment. With HRCT scanning centrilobular lesions (n=29), "tree-in-bud" appearance

(n = 23), and macronodules 5-8 mm in diameter (n = 22) were most commonly seen in cases of active pulmonary tuberculosis. HRCT scans showed fibrotic lesions (n = 34), distortion of bronchovascular structures (n = 32), emphysema (n = 28), and bronchiectasis (n = 24) in patients with inactive tuberculosis. Centrilobular densities in and around the small airways and "tree-in-bud" appearances were the most characteristic CT features of disease activity. HRCT scanning clearly differentiated old fibrotic lesions from new active lesions and demonstrated early bronchogenic spread.

Also, our results showed that although infiltration was the dominant HRCT manifestation, "centrilobular nodule" and "tree- in-bud" appearances were the main findings in the majority of active pulmonary tuberculosis cases.

In this study, we reached the conclusion that HRCT is a powerful and reliable tool in tuberculosis diagnosis, when other means of diagnosing tuberculosis (e.g., culture, BAL or TBLB) fail to settle the matter, are not available or time consuming.

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