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COMPUTED TOMOGRAPHIC EVALUATION OF PULMONARY TUBERCULOSIS & ITS SEQUELAE

Radio-diagnosis

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ABSTRACT

Background: Tuberculosis is one of the leading causes of mortality in a developing country like India among the infectious diseases. Early diagnosis of tuberculosis is by chest X-Ray, sputum examination, culture and nucleic acid amplification. Chest X-Ray findings are not very specific, sputum examination and culture take many days thus delaying the diagnosis. CT scan is very fast, non-invasive and accurate. It can diagnose the cause of unexplained cough, chest pain, fever and other chest symptoms. Because of accuracy, high speed and better resolution, CT scan is the modality of choice for early detection of pulmonary TB. The aim of the study is to evaluate the role of CT and HRCT in pulmonary TB.

Methods: It is a cross sectional study conducted at Department of Radio-diagnosis, Darbhanga Medical College and Hospital, Laheriasarai, Bihar from November 2010 to October 2011 in a series of cases. A detailed history was taken from all of them. Then they were subjected to thorough clinical examination and routine laboratory examination. The radiological features were tabulated and expressed as percentage.

Results: Ninety patients with pulmonary tuberculosis who presented to DMCH, Laheriasarai were included in the present study. There were 33 female and 57 male patients from age group ranging from below 10 years to 75 years, maximum cases were belonging to the age group 31-40 years. Fever and cough were the chief complaints seen in 63.33% and 56.66% cases respectively. Haemoptysis was the complain in 21 cases (23.33%). Breathlessness and Weight loss was the presenting complain in 6 cases (6.66%) each. Chest pain was the least common presenting feature accounting for only three cases (33.33%). Eighteen cases showed positive staining for acid fast bacilli in sputum. Mantoux test was done in 51 cases. 39 cases showed induration of 10-15 mm (positive) while 12 cases showed strongly positive reaction as evidenced by induration of more than 15 mm.

Conclusion: CT and HRCT can diagnose different stages of pulmonary TB and any associated diseases. It helps in taking treatment decisions and preventing disease spread which is an important health issue. For early detection of pulmonary TB, CT and HRCT is a must for diagnosis.

KEYWORDS

Tuberculosis (TB), Computed Tomography (CT), HRCT, Cough, Cavitating nodules, Lobular consolidation

INTRODUCTION

Tuberculosis is a specific granulomatous infectious disease cause by Mycobacterium tuberculosis. It primary affects lungs and causes pulmonary tuberculosis. Inspite of the discovery of tuberculous bacillus by Robert Koch more than a century ago and avialbility of antitubercular drugs, tuberculosis continues to be the major health problem all over the world and definitely India's biggest health problem. With the higher incidence of multidrug resistant tuberculosis in HIV-positive patients, tuberculosis is no longer a problem of third world only rather it has become a global problem.

Although standard radiograph is the first line of investigation for chest tuberculosis but it can miss subtle lesions and it may not provide complete information crucial in management. Particularly the activity of post primary disease cannot be accurately assessed by chest radiography.

The bacteriological analysis of sputum is although highly specific but not very much sensitive and dependent on the technique of sample collection and culture. Biopsy of lesion is invasive and that also requires some kinds of guidance.

Regarding MRI, parenchymal lung lesions are not well elucidated although mediastinal structures such as lymphadenopathy are better defined.

CT Scan particularly HRCT seems to be most useful imaging modality for tuberculous infection of lung and their sequelae.

CT displays overlapping structures in cross section format and so can detect small lesions and it also provides better contrast resolution. CT is capable of depicting the entire dynamic range of radio-densities like lung parenchyma, soft tissue, blood density, bone density and metallic densities in a single exposure.

In addition to increased sensitivity in detecting parenchymal lesions, pleural, pericardial disease and hilar/mediastinal lymphadenopathy can be well documented and characterized by CT.

Although no imaging modality can predict activity accurately, predictivity of activity is more in CT particularly HRCT, than any other imaging modality.

CT is much more sensitive in identifying complications of tuberculosis than any other imaging modality. Complications like bronchiectasis, intracavitary fungal ball, constrictive pericarditis, empyema necessitans and rib involvement can be well picked up.

CT can also help in selecting appropriate procedure and optimal site of biopsy in diagnostically problematic cases and mimicking lesions like bronchogenic carcinoma.

In a nutshell, CT scan with/without contrast and HRCT plays a pivotal role in diagnosis of pulmonary tuberculosis and their sequelae.

AIMS AND OBJECTIVES

- To describe the spectrum of radiological changes seen in the chest by computed tomography in patients with pulmonary tuberculosis.
- To analyze the sequelae of pulmonary tuberculosis.
- To describe the radiological manifestations seen in the chest by computed tomography in HIV positive patient having pulmonary tuberculosis.
- Review previous literature in the same field and comparing the results.

MATERIAL AND METHODS

90 cases of pulmonary tuberculosis presenting to Darbhanga Medical College and Hospital, Laheriasarai were included in the present study.

A detailed history was taken from all of them. Then they were subjected to thorough clinical examination and routine laboratory examination.

Confirmation Of Tuberculosis Was Done By -

1. Either bacteriological confirmation by acid fast bacilli in sputum or a significant skin reaction to purified protein derivative of tuberculo-protein (Mantoux-test) or both and/or radiographic evidence of current

disease. ELISA for tuberculous antigen was done in equivocal cases.

2. Clinical and radiological improvement after administration of antituberculous therapy.

3. Diagnosis of tuberculous effusion was done by biochemical and cytological evaluation of aspirated pleural effusion.

For the confirmation of HIV infection Western Blot test was done. Cases that could not be followed up or no definite diagnosis could be obtained were excluded.

RADIOGRAPHY :
All the cases had chest radiography postero-anterior view in erect position using 1000mA digital x-ray machine of Shimadzu.

COMPUTED TOMOGRAPHY :
In all cases CT examinations were performed using Siemens Somatom AR.SP – a third generation spiral Scanner with Somaris Software or Somatom sprit dual slice CT scan, within a week of starting antituberculous therapy. After topogram 10 mm contiguous slices were taken from apices to lung bases. Post contrast study with the same scanning parameters were performed after administration of iopamidol or iohexol 1-2mg/kg of body weight.

In regions of special interest HRCT was performed using 1 mm slice thickness and High Kernel B80 for high spatial resolution. All the sections were viewed in soft tissue (mediastinal window), lung window and in special circumstances bone window.

Statistical Analysis :
The radiological features were tabulated and expressed as percentage.

RESULTS
Ninety patients with pulmonary tuberculosis who presented to DMCH, Laheriasarai were included in the present study. There were 33 female and 57 male patients from age group ranging from below 10 years to 75 years, maximum cases were belonging to the age group 31-40 years. Fever and cough were the chief complaints seen in 63.33% and 56.66% cases respectively. Haemoptysis was the complain in 21 cases (23.33%). Breathlessness and Weight loss was the presenting complain in 6 cases (6.66%) each. Chest pain was the least common presenting feature accounting for only three cases (33.33%). Eighteen cases showed positive staining for acid fast bacilli in sputum. Mantoux test was done in 51 cases. 39 cases showed induration of 10-15 mm (positive) while 12 cases showed strongly positive reaction as evidenced by induration of more than 15 mm.

Table – 1 : Findings On Chest Radiographs (n=90)

Findings	Number of cases	Percentage (%)
Consolidation	36	40
Fibronodular changes	9	10
Fibrocavitary changes	21	23.33
Acinar nodules	21	23.33
Cavities	33	36.66
Lobar collapse	3	3.33
Miliary mottling	15	11.66
Pleural thickening	18	20.00
Pleural effusion	12	13.33
Mediastinal lymphadenopathy	18	20.00

The most common finding on chest was of consolidation that may be patchy or confluent or segmental, observed in 40% of cases.

Fibrocavitary changes and acinar nodules suggesting bronchogenic dissemination were seen in 23.33% of cases each. Cavities which also included fibrocavitary changes was observed in 36.66%. Fibronodular changes accounted for 10% of cases.

Lobar collapse was uncommon in this study accounted for only 3.33% of cases. Pleural thickening and mediastinal lymphadenopathy were seen in 20% of cases. Pleural effusion was seen in 13.33% of cases.

Computed Tomographic Findings :
The CT findings were grouped into four groups based on predominant pattern of involvement.

Table – 2 : Pulmonary Tuberculosis – Major Groups

Major Groups	Number of cases
Predominant Parenchymal excluding miliary	57
Predominant Miliary Parenchymal	15
Pleural effusion	9
Mediastinal lymphadenopathy	9

The predominant parenchymal lesions consisted of 3 major patterns. The 'nodular pattern' lesion were composed of multiple small nodules, usually of varying sizes ranging from <5mm to 5-10mm most often. The pattern of 'confluent consolidation' appeared as homogenos or nonhomogenous areas of consolidation while the pattern of 'consolidation with associated loss of volume' (CWALV) appeared as areas of consolidation with apparent focal loss of volume manifesting as bronchovascular distortion with or without associated fibrous bands in the adjacent parenchyma.

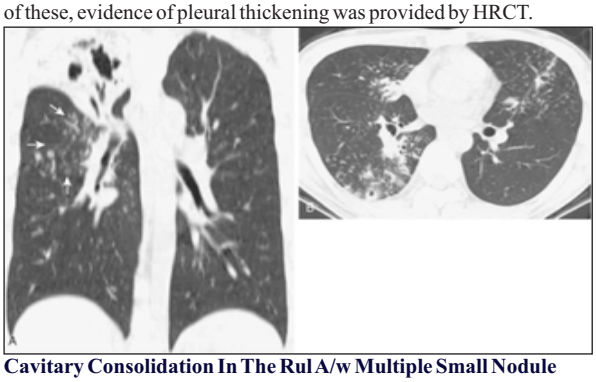
Of the three parenchymal patterns, nodular opacities were seen in all the 57 cases. The pattern of CWALV (Consolidation with associated loss of volume) was noted in 36 patients (63.16%). The 'confluent consolidation' was seen in 21 cases (36.84%). Six of these 21 patients also showed consolidation with associated loss of volume.

Findings On High Resolution CT :
Table – 3 : Findings On High Resolution CT (HRCT)

	Number of cases	Percentage(%)
Ground glass pattern	21	50
Bronchogenic spread	42	100
Centrilobular nodule or branching linear structures	36	85.71
Bronchial wall thickening with or without bronchiectasis	24	57.14
Tree in bud appearance	39	92.85
Poorly defined nodules (5-8 mm)	24	57.14
Hematogenous spread	Nil	
Additional areas of pleural thickening	15	35.71

Selective HRCT section (1.5 mm) were taken using high spatial Kernel B80 and sharp algorithm in 42 out of 57 cases. All the 42 cases showed evidence of bronchogenic spread (100%). The features suggestive of bronchogenic spread were – (a) centrilobular nodules/branching linear structures (36 cases; 85.71%). (b) Bronchial wall thickening with or without associated bronchiectasis (24 cases, 57.14%). (c) 'tree in bud appearance' (39 cases; 92.85%). (d) poorly defined nodules 5-8 mm in size (57.14%). None of the cases showed evidence of hematogenous spread. Although in three case diffuse nodular opacity simulated hematogenous spread but lack of subpleural nodules or inter-lobular septal thickening and the absence of nodularity or vessels and fissures suggested more of a bronchogenic spread rather than hematogenous spread.

Additional cases of pleural thickening were noted in 15 cases. In three of these, evidence of pleural thickening was provided by HRCT.



Cavitary Consolidation In The Rul A/w Multiple Small Nodule

DISCUSSION
Being treatable but serious healthcare problem and its magnitude of burden on healthcare services has leaded the undertaking of the present study.

90 cases of proven active tuberculosis have been included in the present study. All the patients were subjected to routine clinical,

laboratory and radiological examination. CT study of chest was performed within a week of starting the antituberculous chemotherapy, to avoid any influence of therapy on the CT appearance. Based on the predominant findings on CT these 90 patients were classified into four groups for the case of analysis. The groups were – (i) Predominant parenchymal – 57 cases, (ii) Predominant miliary parenchymal –15 cases, (iii) Pleural effusion – 9 cases, (iv) Mediastinal lymphadenopathy – 9 cases. In the group with predominant parenchymal disease 57 cases three major patterns were found (I) Nodular opacity pattern 100%, (II) Confluent consolidation 36.48% and (III) Consolidation with associated loss of volume 63.16%. Pattern I – the nodular opacities pattern – was the most common type, being seen in all the cases. These lesions were composed of multiple small nodule, usually of varying sizes (<5 mm with some of the nodules measuring 5-10 mm). These lesions were often multiple usually affecting more than one segment in both the lungs (27/57;47.36%). Although a slight preponderance was noted on the right side (126:102), no segment in either of the lung was spared. 57.8% of cases has associated CWALV lesions elsewhere while on 26.31% cases associated confluent consolidation pattern was noted. 73.68% of cases had an associated cavity elsewhere in the lung. Pattern II – Confluent consolidation was seen in 36.84% of cases. Lesion appeared as homogenous areas of consolidation. 42.86% of cases showed an air-bronchogram while cavity was seen in 71.43% of cases. Lesions were distributed equally on both sides but a preponderance of apico-posterior segment was noted. Satellite lesions suggestie of activity were noted in 100% of cases. Pattern III – consolidation with associated loss of volume (CWALV). Lesions appeared as consolidation with apparent focal loss of volume as suggested by bronchovascular distortion, and were seen in 91.66% of cases. Cavitations were noted in 91.66% of the cases while air bronchogram was present in 66.66% of cases. Lesion was seen more often or right side and most commonly in the apicoposterior segments. Satellite lesions in the form of small nodular lesions of slightly increased attenuation surrounding the main lesions were noted in all the lesions of confluent consolidation. 78.95% cases with nodular lesions and 91.66% with CWALV lesions. Cavitations was seen in 73.68% of cases. 78.57% cavities had lobular inner margin and air fluid within the cavity were distinctly unusual being present in only 7.14%.

Sequelae of Tuberculosis were seen in majority of cases :
a. Brochiectasis – it was seen in 42 of the 57 cases often bilaterally. Isolated right lung involvement was seen in 35.75% of cases. A predominance of upper lobe lesions, especially of apicoposterior segment was noted (38.46%).
b. Isolated fibrotic strands seen in 6 cases (apico posterior segment was involved).
c. Emphysematous bullae/cysts – 9 out of 57 cases showed multiple small cystic areas subpleurally in the periphery of the CWALV lesion in apicoposterior segment.

Associated pleural thickening was noted in 56.25% while mediastinal lymphadenopathy was seen in 21.05% of cases. The right paratracheal group was commonest to be involved.

HRCT showed evidence of bronchogenic spread in the form of (i) centrilobular/branching linear opacities (85.71%), (ii) bronchial wall thickening (57.14% of cases), (iii) 'tree in bud appearance' (92.85%), (iv) poorly defined nodules 5-8 mm in size (57.14%) and (v) ground glass appearance in 50% of cases.

The 15 cases of miliary tuberculosis showed multiple 1-3 mm nodules. These nodules were distributed uniformly in both lung fields in nine cases while they were predominantly right sided and peripheral in three cases each. The most common finding was that of subpleural nodularity seen in all the fifteen cases (100%). Perivascular nodularity was seen in 60% of cases, nodular septae and studded fissures were seen in 40% of cases. Diffuse intra and interlobular thickening was seen in 40% and 60% cases repectively. While enlarged lymphnode was seen in three, none of the cases showed any parenchymal focus.

In the nine cases of pleural effusion, three case showed associated smooth pleural thickening while underlying parenchymal nodular opacities were noted in other three cases.

Of the nine cases with a predominant picture of mediastinal lymphnode enlargement, low density centres were noted in 6 cases (66.7%). The right paratracheal, right tracheobroncheal and subcarinal nodes were the most common groups to be involved (100%).

In the nine HIV positive cases , three cases showed confluent consolidation. Miliary tuberculosis, medistinal lymphadenopathy, and pleural effusion was present in two cases each.

CONCLUSION

CT showed three major patterns of parenchymal lesions – the nodular opacities, confluent consolidation and consolidation with associated loss of volume (CWALV). The nodular opacities pattern suggesting bronchogenic spread and initial stage of the pathological process were seen in all the cases with predominant parenchymal involvement and both lungs were equally involved. The HRCT finding of bronchogenic spread was evidenced by centrilobular/branching linear structures, bronchial wall thickening, tree in bud appearance and poorly marginated 5-8 mm nodules. The patterns of confluent consolidation and consolidation with associated loss of volume (CWALV) lesions were seen more commonly in the apicoposterior segment and denote advanced stages of nodular opacity. Most of the patterns showed satellite lesions in the form of small nodules or peripheral areas of increased attenuation. Cavitations were most common with CWALV lesions suggesting liquifarctive necrosis of caseous focus and its removal at more advanced stages of pathological process. Cavities usually had a lobulated inner wall and air-fluid levels were distinctly uncommon. Bronchiectasis was a common accompaniment and their occurance paralleled the distribution of parenchymal lesions and suggests the ongoing fibrotic process. Associated pleural thickening was noted in 1/3rd of the cases. Few cases also showed other sequelae of tuberculosis like emphysematous bullae, fibrotic bands etc. HRCT of milliary tuberculosis like emphysematous bullae, fibrotic bands etc. HRCT of miliary tuberculosis showed subpleural, perivascular, septal and fissural nodularity. Diffuse intra and inter lobular thickening was also seen. Lymph node enlargement was more common on the right side and majority showed low density centres suggesting necrosis.

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