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Role of Radiography and High Resolution Computed Tomography In Multidrug Resistant Pulmonary Tuberculosis – A Descriptive Study.

KEYWORDS: MDR-TB, HRCT, thick walled cavities, fibrodestruction, early detection.

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ABSTRACT *Introduction: There is no significant difference in clinical features of MDR-TB and Drug sensitive TB patients. Hence determination of characteristic radiological findings in MDR-TB patients might be of help in early detection and appropriate management of this disease entity.*

Objectives:To study the pattern of Radiographic and HRCT findings in MDR-TB patients andto establish the role of HRCT in predicting the possibility of MDR-TB.

Materials and methods:34 culture positive MDR-TB patients underwent chest Radiograph and HRCT during January to June 2015. Detailed image analysis was done to describe parenchymal, pleural and mediastinal lesions.

Results: Most common HRCT findings in order of prevalence were fibrotic/parenchymal bands seen in 27 patients followed by bronchiectasis, parenchymal nodules, cavities, collapse, calcified lymph nodes, tree-in-bud appearance, pleural thickening and consolidation in 19, 19, 14, 9, 9, 8, 7& 5 patients respectively.

Conclusion: Multiple thick walled cavities distributed in upper lobes with simultaneous chronic changes like fibrodestruction, volume loss, calcified parenchymal granulomas and diffuse pleural thickening with calcifications strongly suggest MDR-T.B.

Introduction:
In developing countries, pulmonary tuberculosis is still a common disease particularly among the socioeconomically disadvantaged, elderly and chronically debilitated individuals. Tuberculosis is rated as second cause of death among infectious diseases following AIDS.As a consequence of increasing AIDS incidence, prevalence of MDR- TB is also increasing. On the other hand incomplete treatment of TB makes drug resistance more likely by spot mutation in mycobacterium genome. [1] According to the definition released by WHO, MDR-TB is referred to infections caused by mycobacterium resistant to isoniazid (INH) and Rifampicin(R).

Diagnosis of MDR-TB begins with isolating and culture of AFB from the sputum which often takes at least 2-3 weeks. Although chest radiographs usually provide adequate information for the diagnosis of pulmonary tuberculosis, early disease can be missed. High resolution computed tomography is found to be sensitive in detection of subtle or occult parenchymal disease and also to determine the extent of the disease. [2] However it is difficult to differentiate between the drug sensitive PTB from MDR-TB solely by radiological investigations.

The aim of our study is to provide more details of radiographic and high resolution computed tomography (HRCT) findings which help in predicting and to raise the possibility of MDR-TB before the laboratory reports are available. There are very few studies published in India on this subject.

AIMS AND OBJECTIVES:
1. To study the pattern of Radiographic and HRCT findings in MDR-TB patients.
2. To compare the findings with previous studies done in drug sensitive PTB patients
3. To determine the role of HRCT in predicting the pos-

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sibility of MDR-TB.

MATERIALS AND METHODS:

This is a cross-sectional study done in culture proved MDR-TB patients in Government General Hospital, Kurnool over a period of six months (January 2015-June 2015). Sputum culture &sensitivity was done in patients suspicious of MDR-TB (who were on treatment for PTB and failed to respond to the same, defaulters and patients with relapse). 34 patients who were on antiMDR-TB treatment for varying durations ranging from 2 days to 2 years got enrolled in our study. 5 patients were HIV positive. Patients in the age group of 6 years to 73 years were evaluated.

The patients were subjected to chest radiograph and HRCT on the same day. Radiographs were exposed on ALLENGERS 500 mA machine and read using AGFA CR system. HRCT was done on GE bright speed (16-Slice).

Inclusion criteria:

1. All patients of culture proved MDR-TB who attended the District Tuberculosis Control Programme clinic during January 2015 to June 2015.
2. Patients of any age and gender.
3. Patients positive or negative for HIV status.

Exclusion criteria:

1. Patients suspicious of MDR-TB awaiting culture report.

TABLE NO. 1 Patient Demographics:

Total no.of pts-34	Males -21	Females-13
Age group	5-50yrs (30)	51-75yrs(4)
HIV status	+ve(5)	-ve (29)
Duration of MDR-TB treatment	0-1yr(24)	1-2 yr(10)

Radiographic and HRCT images were interpreted by radiologists of 10 years' experience in X-ray and CT reporting. The lesions described on radiography are -Cavities, Consolidation, Fibrotic opacities, Bronchiectasis, Collapse, Nodules, Pleural thickening, Pleural effusion. Similarly the lesions described on HRCT are Consolidation, Fibrotic bands, Bronchiectasis, Parenchymal nodules, Collapse, Tree-in-bud appearance, Pleural thickening, Pleural effusion, Cavities, Lymph nodes. The above lesions are described and compared between Radiography and HRCT.

RESULTS:

* 13 females and 21 males aged 6 to 73 years were included in the study.
* According to culture report 32 patients were resistant to both INH and Rifampicin, 2 patients were resistant to only Rifampicin.
* Most common Radiographic findings were fibrotic opacities seen in 25 patients followed by collapse, nodules, cavities, bronchiectasis, pleural thickening and consolidation in 7, 5, 5, 5, 4 & 3 patients respectively.
* Most common HRCT findings in order of prevalence were fibrotic/parenchymal bands seen in 27 patients followed by bronchiectasis, parenchymal nodules, cavities, collapse, calcified lymph nodes, tree-in-bud appearance, pleural thickening and consolidation in 19, 19, 14, 9, 9, 8, 7 & 5 patients respectively.

Analysis of Radiographic and HRCT findings:

1. Cavities:

Cavities were seen in 14 patients, highest number 7, and lowest 1, with average number of cavities being 4. Highest number of cavities were observed in female patient aged 36 years, who was on treatment since 2 days. 4 patients who were on average duration of treatment for 6 months were seen to have a single cavity. Most of the cavities are thick walled and irregular with surrounding consolidation. Few cavities are thin walled.

TABLE NO. 2: Comparison of chest Radiograph and HRCT findings.

Lesions	Radiograph(n=34)	%	HRCT(n=34)	%
Parenchymal				
Consolidation	3	8.8	5	14.7
Fibrodestruction	25	73.5	27	79.4
Calcified granulomas	0	0	1	2.9
Bronchiectasis	5	14.7	19	55.8
Nodules	5	14.7	19	55.8
Collapse	7	20.5	9	26.4
Cavities	5	14.7	14	41.1
Tree-in-bud	0	0	8	23.5
Emphysema	0	0	6	17.6
Mosaic attenuation	0	0	9	26.4
Mediastinal				
Calcified lymph nodes	1	2.9	9	26.4
Non-calcified lymph nodes	0	0	0	0
Pleural				
Pleural thickening	4	11.7	7	20.5
Pleural effusion	1	2.9	1	2.9
Loculated pneumothorax	1	2.9	1	2.9

2. Collapse:

Collapse is most commonly seen in left lung of which segmental collapse is commonest. Lingular segmental collapse is seen in 4 patients, left upper lobe collapse in 1 patient, complete left lung collapse seen in 2 patients, right upper lobe collapse in 1 patient and right lower lobe posterior basal segment collapse in 1 patient.

3. Tree-in-bud:

Tree-in-bud appearance is seen in patients who were on treatment for less than 1 year duration. Out of these, 4 patients were on treatment since 2 days and remaining 4 patients were on average duration of 10 months treatment.

4. Lesions in HIV positive patients with MDR-TB:

No significant difference was noted in the lesions in 5 HIV positive patients compared to HIV negative patients.

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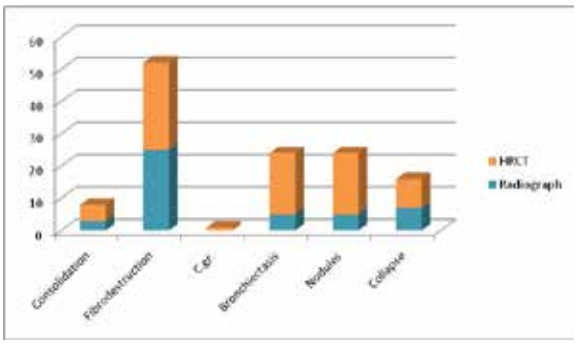
FIGURE 1- Radiography and HRCT comparison of parenchymal lesions: C.gr. - Calcified granuloma.



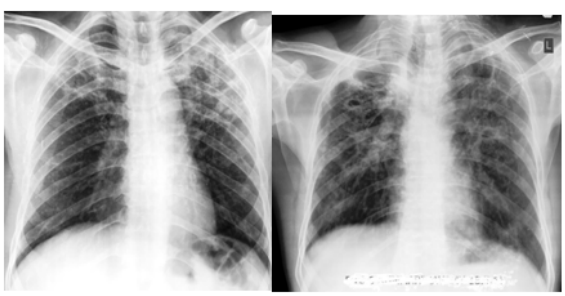


Image 1: Chest Radiograph of (a) 35 yr old male patient on treatment since 2days showing fibrocavitory lesions in bilateral upper zones and (b) 45 yr old male patient on treatment since 5 days showing extensive fibrocavitory lesions in bilateral upper and mid zones.

5. Incidental findings on HRCT:

While reviewing the HRCT images, we have found some incidental findings. Of these, some are related to tuberculosis. These are enlarged thymus in 6 years male and 18 years female patient. 1 patient found to have Pott's spine at D11-12. Focal liver lesions seen in 2 patients. Other lesions seen in different patients are left chronic hydronephrosis, left renal cortical simple cysts, D12 wedge compression fracture, focal left breast lesion and renal calculus.

TABLE NO. 4: Incidental findings detected on HRCT.

INCIDENTAL LESION ON HRCT	NO. OF PATIENTS
Thymus	2
Pott's spine	1
Focal hypodense liver lesions	2
Left chronic hydronephrosis	1
Left renal cortical simple cysts	1
D12 wedge compression fracture	1
Focal left breast lesion	1
Renal calculus	1

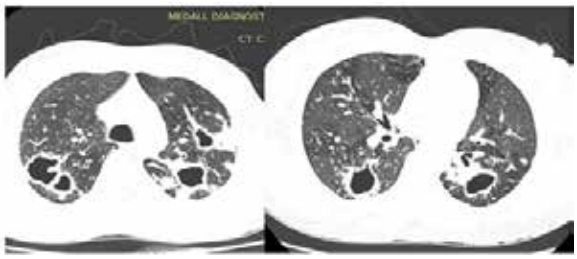
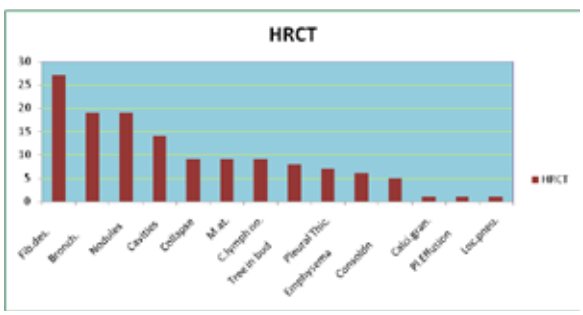


Image 2(a) and (b) Axial HRCT images in different patients aged 36yrs and 35yrs on MDR-TB treatment started 2days back showing thick walled cavities in bilateral upper lobes. Some areas of mosaic attenuation also noted in the image on the right.

FIGURE 2- Parenchymal and pleural lesions detected on HRCT in decreasing prevalence:



Fib.des. - Fibrotic destruction; Bronch. - Bronchiectasis; M.at. - Mosaic attenuation;

C.lymph no. - Calcified lymph nodes; Pleural Thic. - Pleural thickening; Consoldn- Consolidation; Calci.gran. - Calcified granulomas; Pl.Effusion-Pleural Effusion; Loc.pneu.-Loculated pneumothorax.

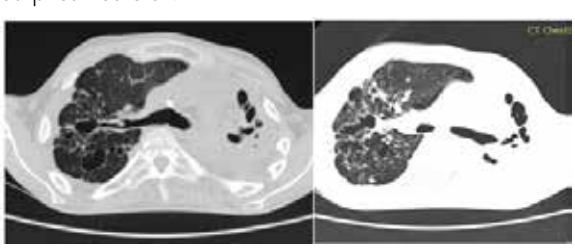


Image 3 (a) Thin section Axial CT and (b) HRCT image of a single patient aged 29yrs on MDR-TB treatment since 10 months showing complete collapse of left lung with massive pleural thickening and cystic bronchiectasis. Thin walled cavities also noted communicating the right upper lobe bronchus in image (a).

DISCUSSION:

Drug-resistant TB represents a threat to TB control programmers. Inappropriate use of currently available medications, HIV-TB co-infection, and concerns about transmission of drug-resistant strains in the general population, all contribute to a worrying picture. Unfortunately, the practitioner's error and poor patient adherence to the treatment may result in resistance and hence, treatment failure. [3]

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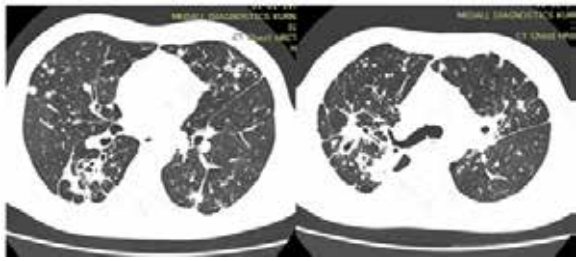

Image 4: (a) and (b) Axial HRCT images of a single patient aged 45yrs on treatment since 5days showing multiple parenchymal nodules of 5-10mm in right middle lobe and left lingular segments. Bilateral perihilar extensive fibrosis with traction bronchiectasis also noted.

In this cross-sectional study of 34 MDR-TB patients conducted in Government General Hospital, Kurnool, we found the number of parenchymal, pleural and mediastinal lesions were significantly more on HRCT compared to chest radiograph. Most common radiographic findings in our study are fibrotic opacities followed by collapse, nodules, cavities, bronchiectasis, pleural thickening and consolidation. According to a study conducted by Fishman JE et al in 1998, [4] those patients who acquired MDR- TB due to low adherence to treatment protocol, have shown radiographic findings consistent with that of secondary TB. In this group, they found cavitatory lesions in 50% of patients.

Most common HRCT findings in order of prevalence were fibrotic/parenchymal bands, followed by bronchiectasis, parenchymal nodules, cavities, collapse, calcified lymph nodes, tree-in-bud appearance, pleural thickening and consolidation.

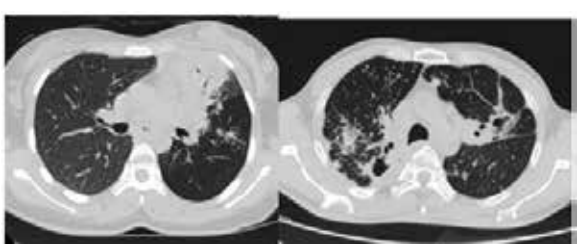

Image 5: (a) Axial thin slice CT image in 18 yr old female patient on MDR-TB treatment since 2 days showing consolidation of the left lingular segment and tree-in-bud appearance. (b) Axial thin slice CT in 45yr old male patient on MDR-TB treatment since 5days showing multiple alveolar nodules with tree-in-bud appearance and a thin walled cavity communicating with the upper lobe bronchus with surrounding consolidation.

Our results are similar to a study conducted by Shahram Kahkouee et al in 43 MDR-TB patients in 2012. [1]No significant difference was found between chest radiograph and HRCT to identify fibrodestruction and volume loss in MDR-TB patients. HRCT demonstrated more number of cavities, nodules, bronchiectasis, emphysema, pleural thickening and calcified mediastinal lymph nodes compared to chest radiograph. The number and size of the cavities decreased with the duration of antiMDR-TB treatment. The cavities are most commonly seen in the upper lobe of right lung followed by lingular and apical segments of left upper lobe.

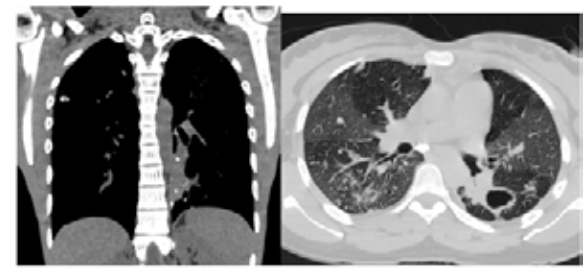

Image 6: (a) Coronal reformatted image in a 20 yr old male patient on MDR-TB treatment since 8 months showing calcified granuloma in the right upper lobe and left lower lobe. (b) Axial HRCT image in a 36 yr old female on treatment since 2 days showing extensive mosaic attenuation in both lungs, thick walled cavity in the left lung and a calcified sub-carinal lymph node.

It is told that multiple cavities are more common in MDR-TB than drug sensitive TB(40% and 11%) according to a study conducted by Scott M. et al.[5,7] Both cystic and traction bronchiectasis are seen with equal frequency in our study group. Bronchiectasis is most commonly seen in left lung upper lobe followed by right lung upper lobe and no difference was found with the duration of treatment.

Tree-in-bud appearance which is an indicator of extensive bronchogenic spread [6] on HRCT is seen in 8 patients. It is found in patients who were on treatment for less than 1 year duration. Mosaic attenuation, emphysema are observed in 9 and 6 patients respectively on HRCT. Calcified mediastinal lymph nodes and pleural thickening are best demonstrated on HRCT. Associated incidental findings while reviewing HRCT may help in detecting the complications of tuberculosis like Pott's spine in our study.

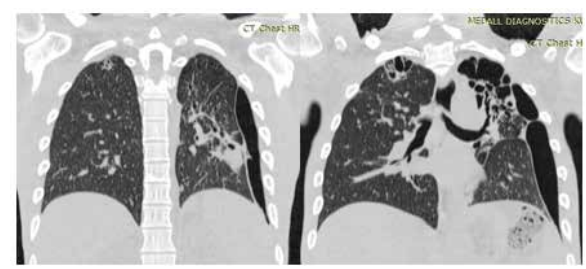

Image 7: (a) and (b) Coronal reformatted images in a 32 year old male patient on treatment since 3 months showing loculated pneumothorax on left side and cystic bronchiectasis in the left upper lobe.

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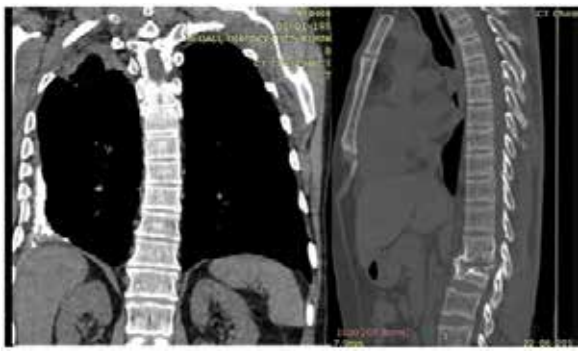

Image 8: (a) Coronal reformatted image (mediastinal window) in a 58 yr old male patient on treatment since 1yr 6 months showing diffuse pleural thickening and calcification with volume loss on right side. (b) Sagittal reformatted image (bone window) in a 46 year old male patient on treatment since 1 yr 6 months showing reduced disc height with end plate destruction and sclerosis causing focal gibbus at D11-12 suggestive of Pott's spine.

CONCLUSION:

In spite of lots of imaging similarity between MDR-TB and drug sensitive TB, some HRCT findings can help in earlier differentiation between these two groups. We conclude that radiological features with certain pattern could raise suspicion of MDR-TB. Our study revealed some radiological findings that could be used as markers of MDR-TB. Multiple thick walled cavities distributed in upper lobes with simultaneous chronic changes like fibrodestruction, volume loss, calcified parenchymal granulomas and diffuse pleural thickening with calcifications strongly suggest MDR-T.B.

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