

An Evaluation of Chest Computed Tomographic Features in Multi - Drug Resistant Tuberculosis

P. P. Balamurugan¹, S. Kanaga Durga², D. Jayaraja³, S. Thaiyalnayaki⁴

¹Assistant Professor, Department of Radio – Diagnosis, Government Sivagangai Medical College and Hospital, Sivagangai.

²Assistant Professor, Department of Radio – Diagnosis, Government Ramanathapuram Medical College and Hospital, Ramanathapuram.

³Assistant Professor, Department of Radio – Diagnosis, Government Thanjavur Medical College and Hospital, Thanjavur.

⁴Assistant Professor, Department of Radio – Diagnosis, Government Coimbatore Medical College and Hospital, Coimbatore

Received: 13-12-2022 / Revised: 18-01-2023 / Accepted: 03-02-2023

Corresponding author: Dr P. P. Balamurugan

Conflict of interest: Nil

Abstract

Introduction: Diagnosis of drug sensitive Tuberculosis and Multi drug resistant tuberculosis (MDR – TB) starts with identifying acid fast bacilli (AFB) from sputum but to confirm the diagnosis sputum culture is mandatory which often takes at least two to three weeks. Similar failure to first line anti-TB treatment in MDR-TB and drug sensitive TB lead to misdiagnosis and deferred treatment with rise in pathogen spread. So we are in need an alternative way of early diagnosis and treatment.

Objectives: 1. To evaluate the chest tomographic features of multi-drug resistant tuberculosis (MDR-TB) patients 2. To detect the characteristic radiological features of MDR-TB, which would prove as findings to detect the doubt of MDR-TB in a patient with tuberculosis. So, they referred to gene expert for early detection and further management.

Materials and Methods: Total of 405 patient's underwent CT-chest during the study period and 100 cases proved MDR – TB in the study. Age, Gender, history of anti-tuberculosis drug taken and CT chest features were analyzing for the MDR – TB patients.

Results: Multiple thick-walled cavity and consolidation with cavitation were more commonly seen in MDR-TB patients. When these findings were present, they were extensive and involved all lobes. Pleural effusion, fibrosis, atelectasis, bronchiectasis and mediastinal lymphadenopathy is more commonly seen in multi drug resistant tuberculosis patients.

Conclusion: The feature of multiple thick-walled cavities, consolidation with cavitation with extensively noted in multiple lobes of bilateral lung fields should raise the doubt of multi-drug resistance Tuberculosis. These patients should be refers to gene-expert to confirm the diagnosis and further treatment / Management.

Keywords: Tuberculosis, Multi Drug Resistant, CT-chest, Cavities, Consolidation.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Tuberculosis is one of the most common cause of mortality among infectious disease [1]. In a global statistic done in 2009 about 1.7 million people died from tuberculosis (TB) and around 10 percent of them died due to multi drug-resistant-TB (MDR-TB) [2]. Mycobacterium tuberculosis is the main organism seen in more than 95% of this pulmonary TB infections [3]. Also rise in frequency of HIV (Human Immuno – deficiency Virus) co-infection there is an increase in the prevalence of MDR-TB.

Irregular treatment and poor follow up of TB made drug resistance more frequent among Tuberculosis, another cause is point mutation in mycobacterium genome. Cases who are immune Compromised due to organ transplantation or stem cells transplantation and patients with lymphomas or leukemias and steroid treatment are more susceptible to MDR-TB. WHO (World Health Organization) defines MDR-TB is defined as infection caused by mycobacterium resistant to isoniazid and rifampin.² Lungs are the most common site of involvement in MDR-TB [4]. Since pathologic findings of MDR-TB and drug sensitive TB like granulomatous inflammation and even cavity is very similar, it is hard to distinguish sensitive and resistant TB.

Features in chest radiograph and Computed tomography scans are similar [5]. Diagnosis of drug sensitive TB and MDR-TB starts with identifying acid fast bacilli (AFB) from sputum but to confirm the finding sputum culture is mandatory which often takes atleast two to three weeks [6,7]. Similar failure to first line anti-TB treatment in MDR-TB and drug sensitive TB lead to misdiagnosis and deferred treatment with rise in pathogen spread [5-8]. So, we are in need an alternative way of early diagnosis and treatment. This study aims to evaluate the chest tomographic features of multi-drug resistant tuberculosis (MDR-TB) patients and to detect the typical

radiological features of MDR-TB, which would prove as findings to detect MDR-TB in a patient with tuberculosis and its help as a worthy tool in early diagnosis of MDR-TB.

Materials and Methods

Present study was single-center, Retrospective observational study, conducted in department of radiology in association with department of medicine and Thoracic medicine, at Government sivagangai medical college and hospital, Sivagangai, Tamilnadu, India. The patients referred for CT - Chest to department of radio diagnosis. The study conducted for a period of two years from June 2020 to June 2022. Patients who were referred for CT chest by the clinician, medicine department and thoracic medicine department when clinically indicated.

Patients with history of cough with expectoration, Sputum is positive for mycobacterium tuberculosis, Primary Multi-drug resistant TB patients, Acquired MDR-TB, who had received Anti-tuberculosis drugs for one month or more in the past were included in the study whereas Sputum negative cases, Old TB cases and inactive cases of tuberculosis, HIV positive cases, Pregnant and lactating patients and any contraindication to CT were excluded from the study.

A total of 405 patients who fulfilled the inclusion criteria were enrolled in the study. Multi-detector computed tomography was performed using 16 slices MDCT scanner (TOSHIBA Aquilion). Patients were analyzed in terms of age, sex, anti-tuberculous treatment and CT chest radiological features. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics.

Results

After performing culture for 405 patients suspected of MDR-TB, 100 cases proved to

be MDR-TB. MDR – TB more commonly seen in 30 to 40 years of age. Male to female ratio of 2.8:1. Past history of anti-tuberculous treatment common in MDR – TB.

Most common CT- scan features in MDR – TB patients: Multiple cavities particularly thick walled, cavity with consolidation, bronchiectasis, nodular opacities, fibrotic strands, pleural effusion and mediastinal lymphadenopathy.

Multiple thick Cavities were significantly

more commonly seen in MDR-TB patients. Its seen in variable thickness like Thick walled, thin walled and intermediate wall thickness.

Multiple cavities in the MDR patients not only seen in upper lobes and it seen all lobes. Bronchiectasis more commonly seen in middle and lower lobe on right side. Fibrotic strands, pleural effusion and mediastinal lymphnode involvement commonly seen in MDR TB cases.

Table 1: Distribution of all CT findings in MDR – TB patients

Ct findings	Mdr-tb(n=100)	Percentage
Single Cavity	23	23%
Multiple Cavities	76	76%
Cavity With Nodularity	68	68%
Thick Walled Cavity	71	71%
Cavitary Consolidation	60	60%
Consolidation	55	55%
Fibrosis	34	34%
Atelectasis	21	21%
Bronchiectasis	35	35%
Nodular Infiltration	87	87%
Lymphadenopathy	29	29%
Pleural Effusion	30	30%
Pleural Thickening	8	8%

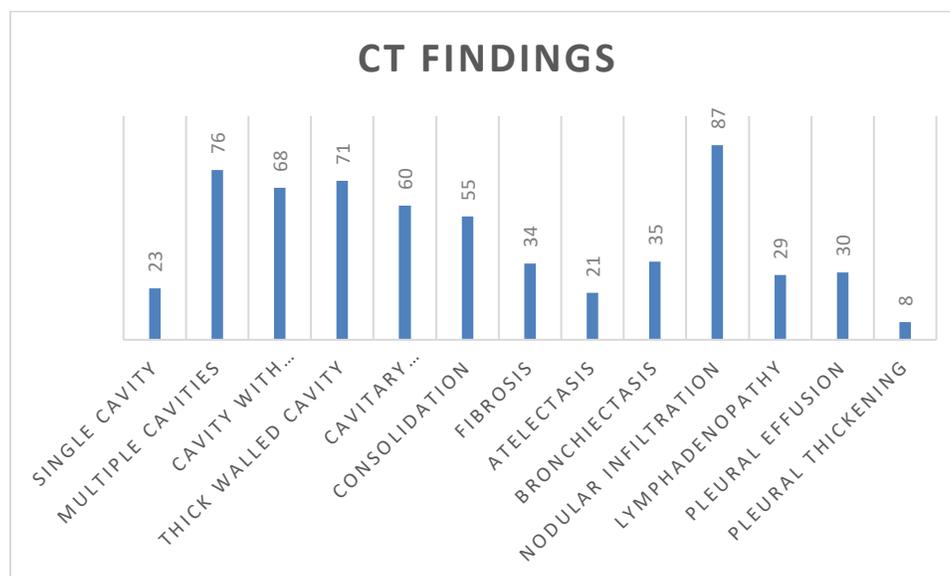


Chart 1: Distribution of all CT findings

Table 2: Lobe wise distribution of CT findings in MDR – TB patients

	RUL	RML	RLL	LUL	LINGULA	LLL
Single Cavity	4	2	2	18	2	3
Multiple cavities	55	16	9	40	12	17
Thick-Walled cavity	40	10	3	30	14	12
Cavitary consolidation	32	15	3	31	11	10
Consolidation	14	8	9	10	12	22
Fibrosis	18	3	5	8	5	3
Atelectasis	9	8	6	3	3	3
Bronchiectasis	9	10	11	2	3	3
Nodular infiltration	58	47	45	49	47	40

Discussion

The main aim of this study is to evaluate the chest tomographic features of multi-drug resistant tuberculosis (MDR-TB) patients and to detect the characteristic radiological features of MDR-TB. The mean age of patients with MDR-TB in our study was 47 years of age. Patients commonly were from third and fourth decade which is similar to previous study done by Kanaga durga *et al* [9]. Male patients were common in our study with a ratio of 2.8:1. This was analogous to that of previous study done by Kanaga Durga *et al* [9]. Next, we assessed the history of anti-tuberculous drug intake, this history of previous Anti tuberculous drug intake more common in the MDR-TB cases. So previous history of ATT intake commonly seen in MDR – TB Patients, which is similar to the previous studies done by Kanaga durge *et al* [9].

The commonly detected CT features in MDR – TB patients were multiple thick-walled cavities, and its more than six, cavity with consolidation, volume loss, pleural effusion and mediastinal lymphadenopathy. Its commonly noted in upper lobes, Right side lung more than left side lung. Multiple Thick-walled cavities were more common in MDR-TB, In our study 76 percentage of patients had multiple thick walled cavities.

Multiple Thick-walled cavities is one of the

most common CT features in MDR-TB patients. In MDR-TB cases with past history of drug intake, multiple and thick-walled cavities were commonly seen, Multiple thick-walled cavities more common in upper lobes, right more than left.

A single Cavity which was commonly noted in Drug sensitive tuberculous cases was commonly seen in the right upper lobe. But in MDR – TB cases, single cavity was commonly seen in left upper lobe.

In pulmonary tuberculosis cavity is the main reason to spread the disease. The cavity wall reduces the action of drugs / tablets and increase the growth of the bacilli. So, more bacilli seen in the cavities and its increase the bacilli load and reduce the drug action. It's also increased the mutations and promotes drug resistance. This, theory tell us the more incidence of multiple and thick-walled cavities seen in MDR – TB patients. So, the cavities render patients more infectious and also increase the spread of the disease. So early diagnosis and early treatment to reduce the infectivity and spread of the disease. These observations in our study correlated well with the study conducted by Cha JH *et al* [10]. in which they had proved that multiple and thick-walled cavities were significantly

more commonly seen in MDR-TB.

Cavity with Consolidation is another feature commonly seen in MDR TB. Cavity with consolidation is a common feature in both upper lobes, Right > Left. MDR - TB cavities are mostly seen surrounded by areas of consolidation with thick walls. This feature seen in the study by Scott Metalis also seen in our study with the predominance of thick wall cavities with surrounding consolidation in drug- resistant cases [11].

Consolidation was seen in 55 % of MDR – TB patients. It's commonly seen in left lower lobe in our study. Nodular infiltration is a frequent CT feature in MDR – TB patients, in our study, 87 % of MDR – TB patients had Findings of nodular infiltration in Chest CT and its seen in Multiple lobes on both sides. Pleural effusion is a common feature in MDR-TB patients.

Mediastinal lymph node enlargement was commonly seen in MDR-TB patients. Lymph node enlargement due to tuberculous infection may be with

calcification and without calcification. In MDR – TB patients Calcified and Non-calcified lymph nodes were a frequent feature. Our study correlated well with the finding of Kanga durga *et al* [9]. In that study the incidence of lymphadenopathy was commonly seen MDR-TB patients.

Atelectasis or volume loss is another feature, it's a chronic finding seen in MDR TB. In MDR-TB atelectasis was commonly seen in right upper lobe

Chronic features like fibrosis and bronchiectasis also analyzed. Fibrotic strands were seen in 34 % of MDR – TB patients. Fibrosis strands are commonly seen in right upper lobe followed by left upper lobe.

There were 35 % of MDR-TB patients had bronchiectasis changes in our study. Its commonly seen in right lower lobe, middle lobe followed by right upper lobe. Pleural thickening and calcification also noted in some cases. In our study miliary pattern of tuberculosis is not seen in any MDR TB patients

Representative images

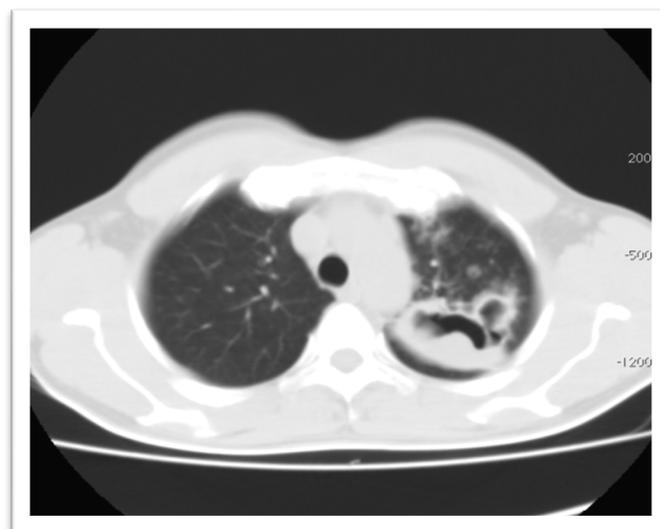


Figure 1: Cavity with consolidation

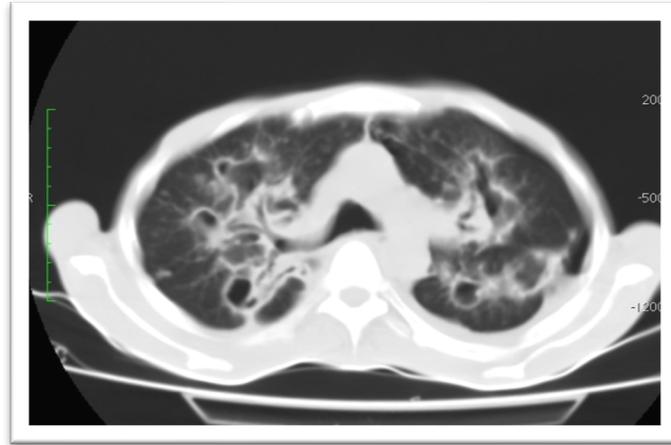


Figure 2: Multiple cavities



Figure 3: Cavity with nodules



Figure 4: Bronchiectasis

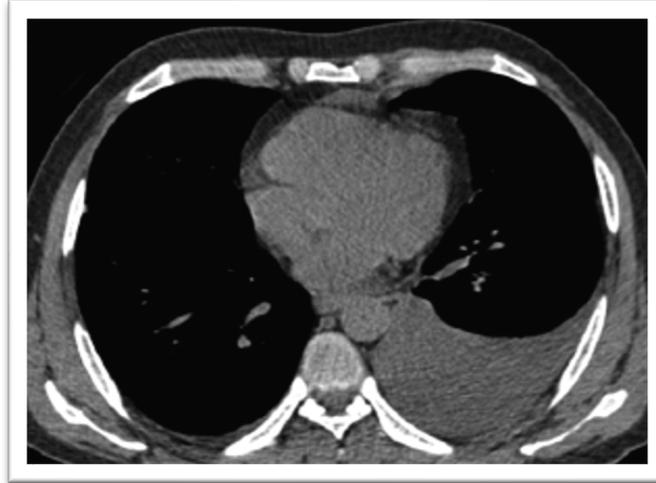


Figure 5: Pleural effusion

Conclusion

There are some characteristic thoracic computed tomographic features more commonly observed in cases with MDR-TB. Multiple thick-walled cavities, Cavity with consolidation, atelectasis / Volume loss, bronchiectasis, pleural effusion and mediastinal lymphadenopathy are the predominant features of MDR TB in our study and its suggest characteristic features of MDR TB.

Knowledge of the typical CT findings of MDR-TB used to earlier detection of disease, earlier evaluation of drug sensitivity and start of proper anti-tuberculous drug treatment in infected patients. So early diagnosis and early starting of the treatment reduces the infectivity and spread of the disease and reduce the common public health problem of tuberculosis

References

1. Cegielski JP, Chin DP, Espinal MA, et al. The global tuberculosis situation: progress and problems in the 20th century, prospects for the 21st century. *Infect Dis Clin North Am.* 2002; 16:1–58
2. Corbett EL, Watt CJ, Walker N, et al. The growing burden of tuberculosis: global trends and interactions with the HIV epidemic. *Arch Intern Med* 2003; 163:1009–1021
3. Tufariello JM, Chan J, Flynn JL. Latent tuberculosis: mechanisms of host and bacillus that contribute to persistent infection.
4. Lee KS, Im JG. CT in adults with tuberculosis of the chest: characteristic findings and role in management. *AJR*1995; 164:1361–1367
5. American Thoracic Society. Diagnostic standards and classification of tuberculosis. *Am Rev Respir Dis* 1990; 142:725–735
6. Mac Gregor RR. tuberculosis: from history to current management. *Semin Roentgenol* 1993; 28:101–108
7. Chakraborty, Mycobacterium tuberculosis. In *A text book of Microbiology*, 1sted. (Reprint), New central Book Agency, Calcutta,700009, INDIA. 1999; 351-371.
8. Chesnutt, M. S., Prendergast T. J. Lung, Pulmonary Tuberculosis., in Tierney, L.M., McPhee, S. J., Papadakis, M. A. *Current Medical Diagnosis and treatment*, 46thedition, McGraw Hill Medical. 2007; 222-315.

9. Kanaga Durga, et. al. A Comparison of Chest Computed Tomographic Findings in Multi-Drug Resistant Tuberculosis and Drug Sensitive Tuberculosis. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), 2020; 19(8): 01-08
10. Cha J, Lee HY, Lee KS, et al. Radiological findings of extensively drug-resistant pulmonary tuberculosis in non-AIDS adults: comparisons with findings of multidrug-resistant and drug-sensitive tuberculosis. Korean J Radiol. 2009; 10:207–16.
11. Scott M. Radiographic patterns in multidrug-resistant and extensively drug resistant tuberculosis in HIV-positive patients in South Africa. Available from: <http://www.biomath.info/Protocols/Duke/docs/ScottMichelle.pdf>.