Original Research Paper

Radiology

IMAGING OF TUBERCULAR CAVITIES

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ABSTRACT **Objective:** To characterize the cavitatory lesions in pulmonary tuberculosis. **Methods:** This was a retrospective study conducted on Siemens Sensation 16 Slice CT Scan. Cavitatory lesions in diagnosed patients of pulmonary tuberculosis were characterized on the basis of wall thickness, pattern of distribution , number and size of lesions, morphology of cavity wall ,internal contents of cavitations, wall calcifications, associated abnormalities like consolidation, centrilobular nodules, pleural effusion and mediastinal lymphadenopathy. **Results:** In our study , 120 cases were studied. Maximum patients 65% were between 40-80 years of age, 46 patients were smokers (38.33%) .65% of total patients had wall thickness of less than 5mm ,28.88% had wall thickness of 5-7mm, 5% had wall thickness of 7-10 mm, 1.66% had wall thickness of 10-15 mm and none of the cavity measured more than 15mm. 63(52..5%) patients had single tubercular cavity, while 41(34.16%) had two cavities and 16(13.33%) had more than 2 cavities . Most common lobe involved was RUL 60% (predominantly posterior segment) . Most common associated finding with tubercular cavities were centrilobular nodules in 94 patients while consolidation was seen in 42 patients and lymphadenopathy in 36 patients, 22 patients had associated pleural effusion. **Conclusion:** Cavitatory lesions are common findings in pulmonary tuberculosis almost seen in 50% of patients , most common lobe involved is RUL followed by LUL, most of the cavities are thin walled less than 15mm , lesions are usually solitary but can be two are sometimes multiple.

KEYWORDS : Tuberculosis, HRCT, Cavities.

INTRODUCTION

Prevalence of tuberculosis is increasing after initial decreasing trends. The clinical manifestation may be subtle or completely absent. Symptoms include low-grade fever, malaise, loss of weight, and, when the lungs are affected, cough, with or without hemoptysis[1].Tuberculosis was divided on the basis of primary and secondary features which has been discredited[2]. Radiologically the pattern of involvement has been described in some studies with upper lobe cavitary disease commonly seen in immune competent adults, while lower lung zone disease, adenopathy, and pleural effusions more commonly found in immune compromised patients including children. The cavities in tuberculosis are present in 50 per cent of patients which usually involve upper zones of the lobes and are often surrounded by satellite nodules .

A cavity is defined in the Fleischner glossary as "a gas-filled space, seen as a lucency or low-attenuation area, within pulmonary consolidation, a mass, or a nodule". Cavity wall thickness and morphology may vary , with rim enhancement of these cavities on CT. With time cavitary diseases may progress into thin-walled cavities, or cysts. The involved lymph nodes may also show nodal rim enhancement around central necrosis with 25% of patients showing pleural effusion [3,4] .

Multiple diseases can present as cavitatory lung disease, however various HRCT finding can help us to narrow the differential diagnosis. The wall thickness of the cavitary lung lesions can be useful in differentiating between benign and malignant disorders, recent study found that a wall thickness of less than 7 mm was highly specific for benign disease, and a thickness of greater than 24 mm was highly specific for malignant disease[5]. Similarly presence of peri lesional centrilobular nodules and peri lesional consolidation was common around tubercular cavities[6].

MATERIALS AND METHODS

The study was conducted in Department of Radio diagnosis and Imaging of Chest Disease Hospital an Associated Hospital of Government Medical College Srinagar. The study was carried from January 2021 to January 2022 after approval from Institutional Ethical Committee.

Inclusion Criteria: All diagnosed pulmonary tuberculosis patients were included in the study after obtaining proper consent. A written and informed consent was taken from all patients.

Exclusion Criteria: Patients with contraindications to CT Scan (e.g pregnancy) and age <18 years were excluded.

Study design: The cases were reviewed on Siemens Sensation 16 Slice CT Scan. Patients were diagnosed by positive culture and staining of sputum for acid-fast bacilli in about 86 patients, 26 patients were diagnosed by PCR (Polymerase Chain Reaction).Three criteria were applied for diagnosing 16 patients, patients who meet two of the three criteria were taken as tuberculosis positive. Tuberculin skin test (Monteux test), ruling out other causes of disease and finding that subsequent clinical course of the disease was consistent with tuberculosis and discovery of at least one family member with contagious tuberculosis. Patients with active or suspected reactivation of tuberculosis on conventional chest radiographs or suspicious clinical findings under went examination with HRCT within seven days of diagnosis.

HRCT Protocol: HRCT scans were obtained with on Siemens Sensation 16 Slice CT scanner. Scanning was performed with 1-5 mm collimation, 120 kvP-170 mA, two second scan time, 512 x 512 matrix, and a bone algorithm at 10 mm intervals from the lung apices to the bases. Intravenous contrast medium was not administered. Images were obtained with a 35-40 cm field of view; some were targeted retrospectively with a 20 cm field of view.

Statistical Analysis: The recorded clinical, laboratory and

Radiological data was entered and tabulated in MS Excel software. All the stored data was then mopped up to find the spectrum of HRCT findings of these patients. Continuous variables were presented as mean and standard deviation. Categorical variables were presented as frequency and percentage.

RESULTS AND OBSERVATIONS

Table 1: Age distribution of study patients

Age	Number
< 20 years	6
20-40 years	30
40-60 years	42
60-80 Years	36
>80years	6

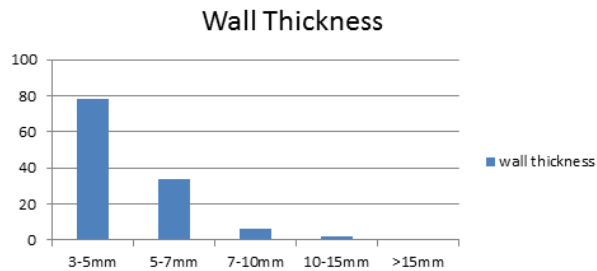Maximum patients 78/120(65%) were between 40-80 years of age.

Table 2: Gender distribution of study patients

Males	Females
74 (61.66%)	46 (38.33%)

74(61.66 %) of our study patients were males and 46 (38.33 %) female.

Table 3: Thickness of cavity wall.

Maximum wall thickness in mm	Number of patients
3-5	78 (65%)
5-7	34 (28.33%)
7-10	6 (5%)
10-15	2 (1.66%)
>15	0 (0%)

Wall Thickness

65% had wall thickness of less than 5mm , 28.88% had wall thickness of 5-7mm, 5% had wall thickness of 7-10mm and 1.66% had wall thickness of 10-15%. None of the cavity measured more than 15mm.

Table 4: Size of the cavity.

Size of cavity in cm	Number of patients
< 2	25 (20.88 %)
2 to 4	65 (54.16%)
4 to 6	23 (19.16%)
>6	7 (5.83%)

25 patients had cavity size of less than 2cm ,65 had size between 2 to 4 cm , 23 patients had size between 4 to 6 cm and 7 patients had size of more than 6cm.

Table 5: CT findings of study patients

One	Two	More than two
63(52.5)	41 (34.16%)	16 (13.33%)

63(52.5%) patients had single tubercular cavity, while 41(34.16%) had two cavities and 16(13.33%) had more than 2 cavities.

Table 6: Morphology of cavities

Morphology	Number of patients
Smooth Wall	(88 %)
Irregular Wall	(12%)
Air Fluid Level	(11%)

Table 7: Segmental Distribution of Cavities

LOBE OF LUNG	NO. OF PATIENTS (%)
RUL Anterior segment(11) Posterior segment(35) Apical segment (26)	72 (60%)
LUL Anterior segment (12) Apico posterior segment (46)	58 (48.33%)
RML Medial (8) Lateral (6)	14 (11.66%)
RLL Superior segment (7) Rest of segments (3)	10 (8%)
LLL Superior segment (4) Rest of segments (2)	6 (5%)

The most common lobe involved was RUL in 60% predominantly posterior segment , followed by LUL in 48.33% , then RML in 7% , RLL in 5% and LLL in 3%.

Table 8: Associated findings with Cavities

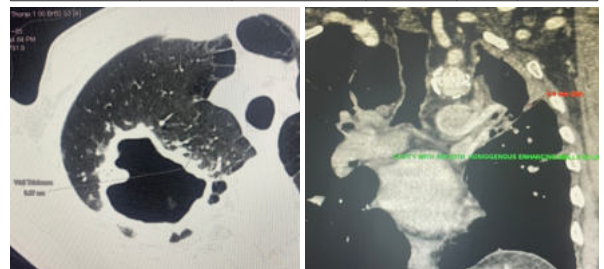| Centrilob-ular nodules	Consoli-dation	Parenchymal Calcification	Effusion	LAP	Mycetoma
82 (68.33)%	42 (35%)	18 (15%)	22 (18.33%)	36 (30%)	4 (3.33%)

Fig. 1. a) Axial CT cuts of right upper lobe showing tubercular cavity with wall thickness of <7mm. b) Coronal CT section of chest revealing cavity in left upper lobe with smooth enhancing walls.
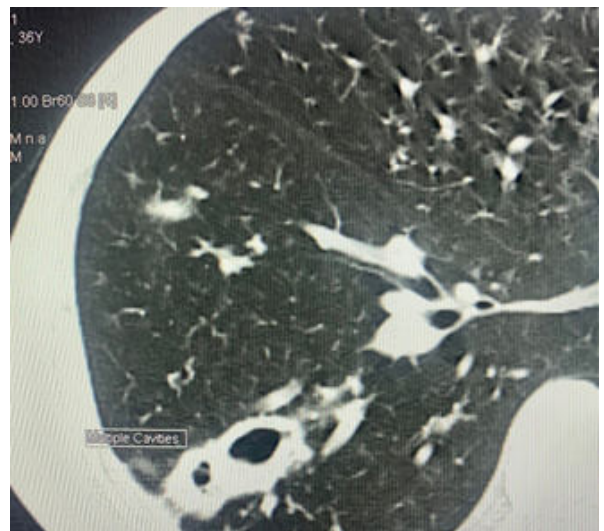

Fig. 2. Axial CT cuts showing two tubercular cavities in right middle lobe.

DISCUSSION

Cavitatory lesions are common in pulmonary tuberculosis especially in reactivation tuberculosis and to diagnose them possess a serious challenge to radiologist as differential diagnosis of cavitatory lesions is wide and includes both

malignant and non-malignant diseases[7] .Various pathogenic mechanisms underlie the formation of cavitary lesions: inadequate local blood supply creating central necrosis, infarction from occlusion of regional nutritional vessels, and blockage of a bronchus resulting in necrosis distal to the obstruction[8,9]. Many reports have suggested that primary lung abscess, bronchogenic carcinoma, and post-primary tuberculosis are the most common causes of lung cavitation, followed by metastatic tumours, fungal disease, lymphoma, rheumatoid nodules, and granulomatous vasculitides[10]. In adults, the two main causes of cavitation are pulmonary tuberculosis and carcinoma.

In our study patients 74(61.66 %) were males and 46 (38.33 %) females. The incidence of cavitatory tuberculosis was found more in male gender as compared to female gender. Similar results were observed by R.marcao et al [11] were 65.5% of the study patients were males and 35.5% females. Mean age of patients was between 40-80 years. Out of 120 cases 46 were smokers (38.33%). R. A.Naini et al[12] in his study observed cigarette smokers were 3.1 (95% CI: 1.4-10.3) times more frequent in TB patients compared with controls. In our study patients of cavitary pulmonary tuberculosis , 65% had wall thickness of less than 5mm ,28.88% had wall thickness of 5-7mm, 5% had wall thickness of 7-10mm, 1.66% had wall thickness of 10-15% and none of the cavity measured more than 15mm. Which is in concordance with Guo, J, Liang et al.[13] whome study observed that a wall thickness of less than 7 mm was highly specific for benign disease, and a thickness of greater than 24 mm was highly specific for malignant disease. Multiple other studies have documented that combination of solitary cavities with thicker walls and irregular inner contours favoured the diagnosis of mitotic etiology. Woodringet al[14] reported that most cavities with a maximum wall thickness >15 mm on CXRs are likely to be malignant in nature, whereas most of those with a maximum wall thickness of 4 mm indicate a benign condition. Similarly, other authors had suggested the cut-off points of 15 and 3 mm, respectively[3].

In our study patients, 20.88% patients had cavity size of less than 2cm ,54.6 %had size between 2 to 4 cm , 19.6% patients had size between 4 to 6 cm and 5.83% patients had size of more than 6cm. Similar observations were made by Woodringet al[14] in his study , he studied the tubercular cavities and observed cavity size of less than 2cm in 20.88% ,54.16%had size between 2 to 4 cm , 19.16% patients had size between 4 to 6 cm and 5.83% patients had size of more than 6cm.

Tubercular cavities can be solitary or multiple. Solitary cavity was found in 52.5% , two cavities in 34.16% and multiple in 13.33% in our study patients, thus the most common being single cavity. Multiplicity usually favours tuberculosis than primary lung malignancy. Perilesional centrilobular nodules around a cavity are common around tubercular cavities (68.33% in our study) than in malignant cavities. This is because of the rapid endobronchial spread of mycobacterium.

In our study the most commonly involved parts of the lungs in post primary disease are the apical and posterior segments of an upper lobes ,60% of patients had cavity in RUL, 48.33% in LUL, RML 11.66%, RLL 8% and LLL 5%. Factor been postulated to explain this common location of post primary tuberculosis is higher regional oxygen tensions of the apical and sub apical parts of the upright lung and poor lymphatic drainage from lung apices. Our results were in concordance with study done by Woodringet al [14] and R. A. Goodwin et al [15].

Various clinical and radiological presentations as discussed above may be helpful to radiologist in assessing pulmonary cavities. Various imagining features like lesion's diameter , thickness, number, location, inner aspect (smooth or irregular), and other associated features play a very

important part in differentiating various etiologies. When addressed individually, a considerable overlap between malignant and non malignant etiologies tends to occur.

CONCLUSION
Cavitatory lesions are common findings in pulmonary tuberculosis almost seen in 50% of patients , most common lobe involved is RUL followed by LUL, most of the cavities are thin walled less than 15mm , lesions are usually solitary but can be two are sometimes multiple .Nodal enlargement is common usually necrotic or calcified , most common associated finding associated is centrilobular nodules with tree in bud appearance and consolidation

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