RESEARCH ARTICLE

CHARACTERISATION OF PULMONARY CAVITARY LESIONS BY MDCT

Mohammad Naseed, *Rajesh Sharma, Asif Muzaffer Reshi, Manjit Arora and Rashmi Sharma

Acharya Shri Chander College of Medical Sciences, Bye Pass Road, Sidhra, Jammu, Jammu and Kashmir 180017

ARTICLE INFO	ABSTRACT
	Objective: Detecting solitary or multiple pulmonary cavitary lesions on multi detector CT scan of the chest and assessing the role and value of multi detector CT in diagnosing the nature and causes of pulmonary cavitary lesions. **Materials and Methods:** The study was conducted on a 16 slice multi detector CT scanner (GE BRIGHT SPEED ELITE 16 SLICE). Characterizing number, location, size, shape , margin, nodularity, internal characteristics of nodule as calcification , wall thickness , wall contour, satellite nodule and feeding vessel with associated changes of lymphadenopathy, consolidation and pleural effusion were investigated. **Results**: Out of 30 pulmonary cavitary lesion cases 21 (70%) were non-malignant and 9 (30%) were malignant cavities. Thick wall (>15mm) was seen in 83% of malignant cases. Central location, nodularity, spiculation, and lymphadenopathy were seen in 44%, 55%, 33%, and 55% malignant cases respectively. Thin walled cavities (<7mm) was seen in 93% of benign cases and most of them were due to tuberculosis. **Conclusion**: Thick walled solitary cavities with nodularity, spiculation, irregular margins, central location and marked lymphadenopathy were more frequently in malignant cases whereas multiple thin , smooth walled cavities with centrilobular nodules, associated consolidative areas and peripheral and upper lobe location were seen in benign cases.

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INTRODUCTION

A cavity has been de ned in the literature as (pathologically) "a gas- lled space within a zone of pulmonary consolidation or within a mass or nodule, produced by the expulsion of a necrotic part of the lesion via the bronchial tree" and (radiographically) "a lucency within a zone of pulmonary consolidation, a mass, or a nodule; hence, a lucent area within the lung that may or may not contain a uid level and that is surrounded by a wall, usually of varied thickness" (Woodring *et al.,* 1986). A cavity is the result of any of a number of pathological processes including suppurative necrosis (e.g., pyogenic lung abscess), caseous necrosis (e.g, tuberculosis), ischemic necrosis (e.g., pulmonary infarction), cystic dilatation of lung structures (e.g., ball valve obstruction and Pneumocystis pneumonia), or displacement of lung tissue by cystic structures (e.g., Echinococcus). In addition, malignant processes may cavitate because of treatment-related necrosis, internal cyst formation, or internal desquamation of tumor cells with subsequent liquefaction (Miura *et al.,* 1998; Mortensen *et al.,* 2015). An abscess is an enclosed infection within a destroyed area of lung surrounded by a wall, which contains debris and pus. The abscess can be fluid filled or have air-fluid

levels, and may be differentiated from empyema by the presence of an irregular and relatively thicker wall that destroys rather than displaces the parenchyma, however, When clinical findings and conventional radiographic examinations are ambiguous, CT can accurately diagnose and influence the management of patients with suspected lung abscess (Tuddenham, 1984). Pulmonary cavitation causes significant morbidity and mortality. Early diagnosis of the presence and aetiology of a cavity is therefore crucial in order to avoid further demise in both the localized pulmonary and systemic disorders that may manifest with pulmonary cavity formation (Stark *et al.,* 1983).Thickness of cavity wall, shape , margins, location, number, nodularity, speculation, along with associated lymphadenopathy, pleural effusion and consolidation are extremely useful in diferentiating benign from malignant cavitary lesions (Franquet *et al.,* 2003; Gadkowski and Stout, 2008; Yang *et al.,* 2007).

MATERIALS AND METHODS

Aprospective cross sectional study of 30 patients with solitary or multiple pulmonary cavities detected on multi detector computed tomographywas conducted in the department of Radio-Diagnosis and Imaging in co-ordination with the department of Medicine at Acharya Shri Chander College of Medical Sciences and Hospital, Sidhra, Jammu.

*Corresponding author: Rajesh Sharma
Acharya Shri Chander College of Medical Sciences, Bye Pass Road, Sidhra, Jammu, Jammu and Kashmir 180017

All patients had undergone computed tomography scan of the chest on a 16 slice multi detector CT scanner (GE BRIGHT SPEED ELITE 16 SLICE). With the patient in supine position scans were obtained cranio-caudally at full inspiration and three sets of CT images were obtained (lung, mediastinum and bone windows). Sagittal and coronal reformatted images were obtained from initial axial CT data images. Final diagnosis were obtained by CT guided biopsy, sputum microscopy and clinical and radiological follow up.

Statistical methods: Data wasanalysed using appropriate statistical method.

RESULTS

In our series , 30 cases were included. There were 17 (56.66 %) males and 13 (43.33 %) females, range in age from 19 – 74 years with mean age (54.66 % years). Maximum patients 16/30 (53.33%) were between 51-70 years of age (Table 1).Out of 30 cases 9 were malignant and 21 were benign (Table 2). The commonest clinical presentation was cough 12/30 (40.0%), followed by dyspnea 9/30(30%), fever 5/30(16.66%), haemoptysis 3/30(10%), generalized malaise 1/30(3.33%). (Table 3). 16/30 (53.3 %) were thin walled cavities (maximum wall thickness <7 mm), out of which 15/16 (93.7%) were benign and 1/16 (6.3%) was malignant on final diagnosis. Out of 8/30 (26.6 %) cavities with intermediate wall thickness (7-15 mm), 5/8 (62.5%) were benign and 3/8 (37.5%) were malignant. Most of the thick walled (maximum wall thickness >15mm) cavitary lesions, 6/30 (20%),were malignant,5/6 (83.3%). However 1/6 (16.6%) of thick walled cavity was benign on final diagnosis (Table 4).

Seventeen (56.66 %) patients with cavitary lung lesions proved to be tubercular, 8(26.66 %), Bronchogenic carcinoma, 3(10 %), pyogenic abscess, 1(3.3 %), metastases and 1(3.3 %), aspergilloma. (Table 5). There were 13 patients of cavitary tuberculosis with Thin wall(<7 mm) cavities, 3 patients had intermediate wall thickness(7-15 mm) and 1 patient had thick walled(>15 mm) cavities. (Table 6). Eleven patients had single tubercular cavities, while six had multiple cavities (Table 7). Centrilobular nodules were associated with tubercular cavities in 15 patients while consolidation was seen in 8 patients and lymphadenopathy in 4, three patients had associated pleural effusion. (Table 8). Nine patients had cavitary neoplasm, 8 were bronchogenic carcinoma, squamous cell carcinoma (n=7), adenocarcinoma (n=1). The remaining cavity were due to metastases to lung from Carcinoma colon. 4 out of 9 (44.4%) neoplastic cavities were present at central location, 3(33.3%) at intermediate location and 2(22.2%) were present at peripheral location. (Table 9). 5 out of 9(55.5%) cavitary neoplasms were thick walled with maximum wall thickness measuring >15mm, followed by intermediate wall thickness in 33.3%(3) patients and only 1(11.1%) patient with neoplastic cavity had thin walled cavity (<7mm) (Table 10). Spiculations were seen in 3/9(33.3%) cavitary neoplasms, while nodularity was seen in 5/9(55.5%) patients, one case of cavitary neoplasm had smooth margins. (Table 11). Lymphadenopathy was present in 5/9(55.5%) patients of cavitary neoplasms. Pleural effusion was seen in 3/9(33.3%) patients of cavitary neoplasms. (Table 12). All lung abscess cavities had wall thickness of 7-15 mm 3/3(100%). (Table 13). Two patients with lung abscesses had solitary cavities while one patient had multiple cavities. (Table 14).

Table 1: Sex and age distribution of patients

Total number of cases	30
Males	17
Females	13
AGE(IN YEARS)	**NO. OF PATIENTS**
11-20	1
21-30	2
31-40	2
41-50	5
51-60	8
61-70	8
71-80	4

Table 2. Nature of pulmonary cavities

Benign	Malignant
21	9

Table 3: Clinical presentation of patients

CLINICAL PRESENTATION	NO. OF PATIENTS
COUGH	12
DYSPNEA	9
FEVER	5
HAEMOPTYSIS	3
GENERALISED MALAISE	1

Table 4: Maximum wall thickness of pulmonary cavities

	BENIGN	MALIGNANT	TOTAL
THIN (< 7 MM)	15	1	16
INTERMEDIATE (7-15 MM)	5	3	8
THICK (>15 MM)	1	5	6

Table 5: Causes of pulmonary cavitations

DISEASE	NO. OF CASES	%
TUBERCULOSIS	17	56.66
BRONCHOGENIC CARCINOMA	8	26.66
METASTASIS	1	3.3
LUNG ABSCESS	3	10
ASPERGILLOSIS	1	3.33
TOTAL	30	100

Table 6: Wall thickness of tuberculous cavities

THIN < 7mm	INTERMEDIATE 7-15 mm	THICK >15 mm
13	3	1

Table 7: Multiplicity of tuberculous cavities

SINGLE	MULTIPLE
11	6

Table 8: Associated findings of tubercular cavities

CENTRILOBULARNODULES	CONSOLIDATION	LAP(>10 mm)	PLEURAL EFFUSION
15	8	4	3

Table 9: Location of cavitary neoplasms based on centrality

CENTRAL	INTERMEDIATE	PERIPHERAL
4	3	2

Table 10 : Wall thickness of cavitary neoplasms

THIN < 7mm	INTERMEDIATE 7-15 mm	THICK >15 mm
1	3	5

Table 11: Other findings of cavitary neoplasms

NODULARITY	SPICULATION
5	3

Table 12: Associated findings of cavitary neoplasms

LAP (>10 mm)	PLEURAL EFFUSION
5	3

Table 13: Wall thickness of lung abscess

THIN < 7mm	INTERMEDIATE 7-15 mm	THICK > 15 mm
0	3	0

Table 14: Multiplicity of lung abscess

NO. OF CAVITIES	NO. OF PATIENTTS
SOLITARY	2
MULTIPLE	1

Table 15: Contour of lung abscess

CONTOUR	NO. OF PATIENTS
REGULAR	0
IRREGULAR	3

Table 16: Associated findings of lung abscess

ASSOCIATED FINDING	NO. OF PATIENTS
FLUID LEVEL	3
CONSOLIDATION	2
PLEURAL EFFUSION	1

Table 17: CT findings of other pulmonary cavities

DISEASE	LOCATION		WALL CONTOUR		WALL THICKNESS			MURAL NODULE	AIR CRESCENT SIGN
	RIGHT LUNG	LEFT LUNG	REGULAR	IRREGULAR	THIN	INTERMEDIATE	THICK		
	RUL RML RLL	LUL LLL							
METASTASIS	RLL			1		1			
ASPERGILLOMA	1		1		1			1	1

Thin walled cavitary lesion in apico posterior segment of left upper lobeCT scan showing cavitary lesion in apical. Tuberclosis segment of right upper lobe with surroundingcentri lobular nodules… Tuberculosis…

CT scan shows multiple variable sized nodulesMultiple intermediately thick walled witharea of consolidation….tuberculosis.cavities… multiple lung abscess
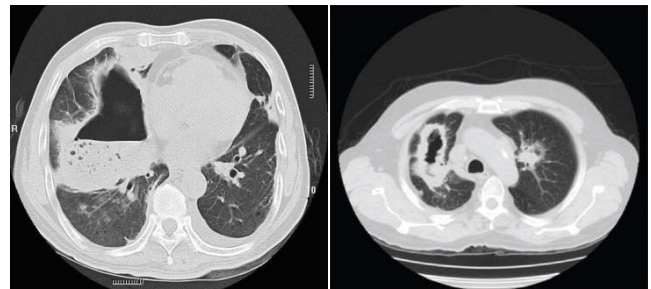
Lung abscess with airfluid level.Thick walled cavity with irregular margins in right upper lobe .histological analysis. confirmed …squamous cell carcinoma
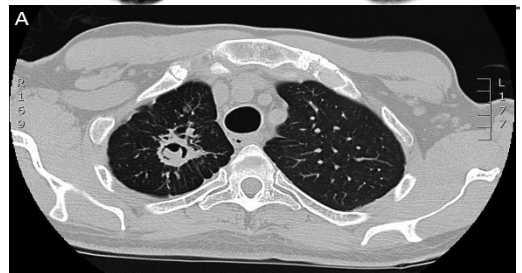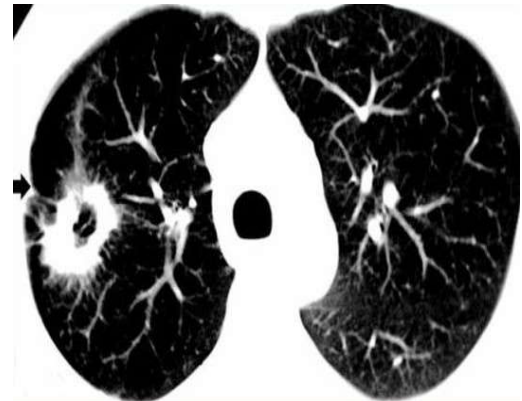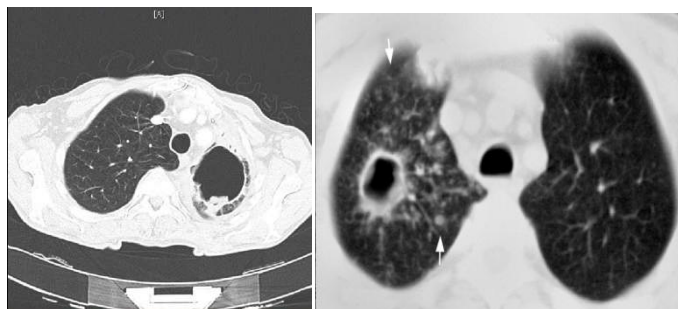

Thick walled cavity with irregular margins. Cavitary lung lesion filled with mass with Histological analysis following lung biopsy air crescent sign and showing mobilityconfirmed … squamous cell carcinomawith prone imaging. Aspergilloma
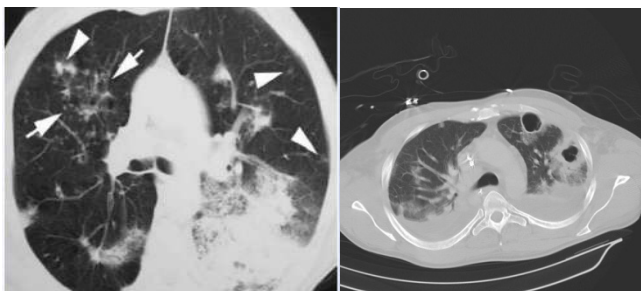
All lung abscess cavities were irregular in contour 3/3(100%). (Table 15). Lung abscesses were associated with the fluid levels 3/3(100%), consolidation in 2/3(66.6%) and pleural effusion in 1/3 (33.3%). (Table 16). Cavitation due to other lesions were metastasis from carcinoma colon (n=1) and aspergilloma (n=1). Metastatic cavity was present was present in right lower lobe and had intermediate and irregular wall. Aspergilloma was present in right upper cavity and had thin and regular wall, with presence of a mural nodule. Air crescent sign was also present. (Table 17).

DISCUSSION

Characterization of cavitary lesions by MDCT of lung can narrow the list of differential diagnosis. CT of the chest is valuable procedure in characterizing cavitary diseases. Morphology, location, distribution and associated radiological

finding provide important clues to the nature of the underlining diseases. Thus this present study was done to characterize the pulmonary cavitary lesions by multidetector computed tomography and the observations are discussed under the headings of age, sex, clinical presentation , location , nature of cavitary lesions, maximum wall thickness and causes of cavitary lesions along with MDCT features of tuberculosis, neoplasms, lung abscess, metastasis and aspergillosis. In our study we had patients of age ranging from 19 years to 74 years, with the mean age of 54.6 years. Maximum patients, 16/30 (53.31%) were between 51-70 years of age.

We found that the mean age of patients having malignant cavities was 60.6 years and having non-malignant cavities was 52 years with slightly higher incidence in males 56.6% than in females 43.3%. Out of 30 patients, 12(40%) patients presented with cough, being the most common presenting feature, followed by dyspnea in 9(30%) patients, fever in 5(16%) and hemoptysis in 3(10%) patients. One patient did not had any significant symptom except generalized malaise, however his X-ray chest showed a cavitary lesion in right apex so was evaluated with MDCT. Out of 30 cavitary lesions 21 (70%) were non-malignant and 9 (30%) were malignant cavities. 16/30 (53.3 %) cavities with maximum wall thickness measuring <7 mm i.e, thin walled cavities out of which 15 (93.7%) were benign and 1 (6.3%) was malignant on final diagnosis. Out of 8/30 (26.6 %) cavities with intermediate wall thickness, measuring 7-15 mm, 5 (62.5%) were benign and 3 (37.5%) were malignant. Most of the thick walled cavitary lesions having maximum wall thickness >15mm were malignant and was present in 5 (83.3%) out of total 6/30 (20%) lesions. However 1/6 (16.6%) of thick walled cavity was benign on final diagnosis.

The most common cause of cavitary lung lesions was tuberculosis, 17/30 (56.6%), followed by bronchogenic carcinoma, 8/30 (26.6 %), lung abscess, 3/30 (10%). There were also single case of pulmonary cavitary metastasis, 1/30 (3.3 %), with primary being the colonic adenocarcinoma, and a single case of aspergilloma, 1/30 (3.3%). We also found that most 4/9 (44.4%) neoplastic cavities were present at central location, 3(33.3%) at intermediate location and 2(22.2%) were present at peripheral location. Most of the cavitary neoplasms, 55.5%(5/9) were thick walled with maximum wall thickness measuring >15mm, followed by intermediate wall thickness in 33.3%(3) patients and only 1(11.1%) patient with neoplastic cavity had thin walled cavity (<7mm).

Spiculations were seen in 3/9(33.3%) cavitary neoplasms. Nodularity was seen in 5/9(55.5%) patients. There was one case of cavitary neoplasm with smooth margins. 3 patients with pulmonary cavities were finally diagnosed as lung abscess. Two patients had solitary lung abscess while one patient had multiple lung abscess cavities. The lung abscesses were located in right lung in 2/3(66.6%) and in left lung in 1/3(33.3%). All the lung abscess cavities were intermediatewalled (7-15 mm) 3/3(100%) and had irregular contour 3/3(100%).

Lung abscesses were associated with the fluid levels 3/3(100%), consolidation in 2/3(66.6%) and pleural effusion in 1/3 (33.3%). One patient of cavitary metastasis with primary being colonic adenocarcinoma. The location was right lower lobe. The cavity presented with intermediate wall thickness and had irregular contour. No associated findings were seen. One patient had metastatic cavitation from carcinoma colon (n=1), metastatic cavity was present in right lower lobe and had intermediate thickness and irregular wall. A single case of aspergilloma. Location of the cavity was right upper lobe. the cavity contour was regular with thin walls. There was presence of mural nodule. Air crescent sign was also present.

Conclusion

MDCT can detect and characterize the cavitary lesions of lung in a non invasive way which is useful in treatment plan. Thick walled solitary cavities with nodularity, spiculation, irregular margins, central location and marked lymphadenopathy were more frequently in malignant cases whereas multiple thin, smooth walled cavities, with centrilobular nodules, associated consolidative areasand peripheral and upper lobe location were seen in benign cases.

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