



## Role of multi-slice CT in evaluation of cystic lung diseases

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**Abstract: Objective:** This study aims to evaluate role of MDCT in evaluation of cystic lung diseases. **Patients and Methods:** This Prospective study involved 20 patients which presented by different chest manifestations as cough, expectoration, chest pain and dyspnea with pulmonary cysts and some of patients were accidentally discovered pulmonary cysts. The patients were referred to MDCT in the radiology department in Al Zahra university hospital from the chest department and clinics. The study will be conducted for a period of one year from August 2018 to October 2019 after getting approval from the ethical committee of the institute. Informed consent from all patients was taken before inclusion in the study. **Results:** MDCT showed that 15 (75%) of cases have multiple cysts and 2 (10%) of cases have single cyst. 17 (85%) of cases showed with air containing cysts and 3 (15%) of cases showed air and fluid containing cysts. **Conclusion:** MDCT is currently the imaging modality of choice in diagnosis of different cystic lung lesions, being superior to chest radiography in demonstrating the presence and extent of lung abnormalities.

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**Keywords:** Multi detector Computed Tomography (MDCT), Lung Cyst.

### 1. Introduction:

The cyst is defined as any round circumscribed space that is surrounded by an epithelial or fibrous wall of variable a thickness. On computed tomography (CT) the lung cyst appears as a round parenchymal latency or low-attenuating area that has a well-defined interface with the normal lung. Cysts in the lung usually contain air, but occasionally contain fluid or solid material. They can have a variable wall thickness, but are usually thin walled (<2 mm), (Francisco et al., 2015).

Lung cysts are known to occur with increasing frequency with advancing age, and are not normally expected in healthy individuals aged <50 years. The peak incidence varies among the diseases, but typically falls in the third or fourth decade of life. Sex-based predilection varies among cystic diseases, (sheard et al., 2018).

Patients with different types of cystic lung disease often have similar nonspecific symptoms, such as chronic cough and shortness of breath. Pneumothorax is the most common acute presentation of cystic lung disease. Spontaneous pneumothorax can be a sentinel event leading to the diagnosis of diffuse cystic lung disease, (Trotman-Dickenson, 2014).

Lung cysts can originate from various mechanisms, such as airway obstruction with distal airspace dilatation, necrosis of the airway walls, and lung parenchymal destruction, (Ha, D et al., 2015).

Multi detector CT (MDCT) is the main diagnostic imaging for pulmonary cystic lesions that provide good spatial resolution. It enables imaging of a large tissue volume in a short acquisition time, reducing the effect of respiratory motion in the thorax, and it helps to define the morphological aspects and distribution of lung cysts, as well as associated findings, (Ley-Zaporozhan and van Beek, 2017).

Air-filled lucencies within the lung parenchyma are frequently detected on routine chest CT. These lucent areas may represent pulmonary cysts, but other causes include cavities and honeycombing. These entities can mimic a lung cyst on both chest radiograph and chest CT (Table.1). Additional imaging findings, clinical data, and laboratory data help narrow the differential diagnosis (Oliva et al., 2012).

Focal disease is defined as more than one cyst in one lobe of the lung, while multifocal disease involves more than one lobe but does not involve all the lobes. Diffuse is defined as involving all five lobes of the lung, (Raoof et al., 2016). (Table 2)

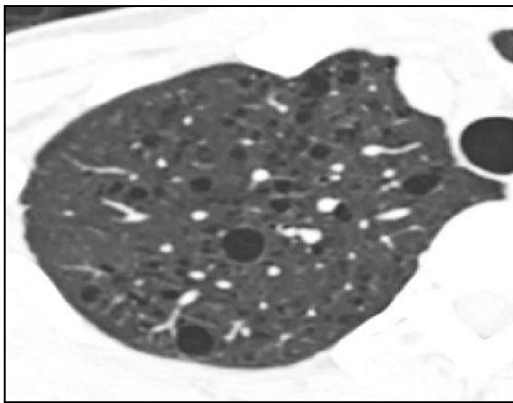
Diffuse cystic lung disease (DCLD) is classically associated with 2 uncommon lung diseases, lymphangioleiomyomatosis (LAM) and Pulmonary Langerhans cell histiocytosis (PLCH) (*Webb et al., 2014*). (Table 3)

**2. Patients and Methods**

This prospective study involved 20 patients 13males (65.0%) and 7 females (35.0%). The patients were referred to the Radiology Department in Al Zahraa University hospital from the chest department and clinics. The study will be conducted for a period of one year from August 2018 to October 2019 after getting approval from the ethical committee of the institute.

**Table (1): Imaging Clues to Help Differentiate Pulmonary Cysts and Their Mimics, (*Oliva et al., 2012*).**

Entity	Imaging Characteristics
<b>True pulmonary cyst:</b>	Well-circumscribed, rounded, thin-walled ( $\leq 3\text{mm}$ ) air-filled structure within the lung parenchyma.
<b>Bullae:</b>	Are larger than 1 cm in diameter, sharply demarcated by a thin wall, and usually accompanied by emphysematous changes in the adjacent lung.
<b>Blebs:</b>	$\leq 1$ cm in diameter, located within the visceral pleura or the sub pleural space, and appears as thin-walled air spaces that contiguous with the pleura.
<b>Cavity</b>	Air-filled space with thick wall ( $>4$ mm) which develop in an area of consolidation, mass or nodule as a result of internal necrosis.
<b>Honeycombing</b>	Clustered sub pleural airspaces with variable size and wall thickness. Other signs of pulmonary fibrosis: architectural distortion, traction bronchiectasis, and reticular opacities.



**Figure (1):** true pulmonary cyst. CT shows multiple air filled well-circumscribed lesions with thin walls, (*Quoted from Sato et al., 2015*).



**Figure (3):** Honeycombing: A cluster or row of closely approximated cysts in the subpleural distribution of the lower lobes. The finding is consistent with end-stage lung disease, (*Quoted from Sato et al., 2015*).



**Figure (2):** Cavity. High-resolution CT shows a thick-walled cavity with air-fluid level in the right lower lobe, confirmed on culture to be coccidioidomycosis, (*Quoted from Sato et al., 2015*).

**(Table 2): Causes of focal or multifocal cystic lung disease, Quoted from (*Webb et al., 2014*).**

<b>Cystic (wall thickness <math>\leq 4</math> mm)</b>	
1.	<b>Traumatic cysts</b>
2.	<b>Incidental Cysts</b>
3.	<b>Pneumatoceles</b>
4.	<b>Congenital cystic lesions:</b>
-	Bronchogenic cyst
-	Pulmonary sequestration
-	Congenital adenomatoid malformation
5.	<b>Infections:</b>
-	Hydatid cyst
6.	<b>Bronchiectasis, localized</b>

**(Table 3): Causes of DCLD, Quoted from (Webb et al., 2014).**

•	<b>Neoplastic as:</b>
-	LAM / tuberous sclerosis (TS).
-	PLCH.
•	<b>Pulmonaryemphysema</b>
•	<b>Cystic Bronchiectasis, diffuse.</b>
•	<b>genetic, developmental, or congenital, such as:</b>
-	Birt-Hogg-Dubé syndrome (BHD).
•	<b>associated with lymphoproliferative disorders as:</b>
-	Lymphocytic interstitial pneumonia (LIP).
-	Follicular bronchiolitis.
-	Amyloidosis and light-chain deposition disease (LCDD).
•	<b>inflammatory as:</b>
-	Desquamative interstitial pneumonia (DIP).
•	<b>Infections</b>
-	Pneumocystis jirovecii pneumonia [PJP]
•	<b>Cystic pulmonary metastatic disease.</b>

**\*CT of chest:**

All patients underwent thin-section CT with (Toshiba aquillion 164 slice, Tokyo, Japan).

**1-Scannogram:** Covering the area from lower neck to upper abdomen.

**2-Pre contrast scan** of the chest in craniocaudal direction during breath hold to screen for lung cysts.

**3-Reconstructed interval:** 0.5 mm Slice thickness: 5mm with, K V: 140, m As: 200, Pitch: 1.5, and Scan time: 10-20 second.

**4-IV contrast material injection** is nonionic iodinated contrast media in a dose 1-2 ml /Kg BW. The contrast media is was injected at a flow rate of 4ml/sec in a total volume of 80-120 ml with automatic injector.

5-All patients were subjected to Clinical, history taking, laboratory data and pulmonary function test if needed, together with MDCT evaluation, regarding cysts as: Site, Size, Shape, Number, Content, Wall appearance, Extent, Parenchyma around cyst, The CT appearance of the cyst was considered and evaluated considering available clinical data and previous investigation.

**3. Results**

This prospective study included 20 patients with pulmonary cysts. Cystic lesions were incidentally discovered in one patient. The rest of the patients were recommended for CT evaluation after being examined by a chest X-ray to assess a cystic lesion. They were

13males (65.0%) and 7 females (35.0%). their age ranged between 22 and 85 years (average of 45±16years). (Tables 4, 5)

**Table (4): Distribution of patients according to sex**

Sex	Number of patients	%
Female	7	35.0
Male	13	65.0
<b>Total</b>	<b>20</b>	<b>100.0</b>

**Table (5): Distribution of patients according to age**

Age in years	Number of patients	%
≥50 years old	9	45
<50 years old	11	55
<b>Mean ± SD</b>	<b>45±16</b>	
<b>minimum-maximum</b>	<b>22-85</b>	

\*In this study there were 10 patients with Idiopathic lesions (50%) which is the commonest followed by 6 patients with infective lesions (30%) and 2 patients with traumatic lesions (10%). (Table 6)

**Table. 6): Distribution of patients according to final diagnosis**

Final diagnosis	Number of patients	%
<b>Idiopathic</b>	<b>10</b>	<b>50</b>
<b>Infective</b>	<b>6</b>	<b>30</b>
<b>Traumatic</b>	<b>2</b>	<b>10</b>
<b>Autoimmune</b>	<b>1</b>	<b>5</b>
<b>Aging change</b>	<b>1</b>	<b>5</b>
<b>Total</b>	<b>20</b>	<b>100</b>

Classification of patients into separate categories according to the multiplicity of the lesions. Diffuse lung lesion affection was seen in 14 patients (70.0%) while Focal lung lesions were found in 2 patients (10.0%), 2 patients showed multifocal lesions (10.0%) and 2 patients showed segmental affection (10.0%). (Table 7).

**Table (7): Distribution of patients according to distribution of the lesions**

Multiplicity of affection	Number of patient	%
<b>Diffuse</b>	<b>14</b>	<b>70.0</b>
<b>Focal</b>	<b>2</b>	<b>10.0</b>
<b>Multifocal</b>	<b>2</b>	<b>10.0</b>
<b>Segmental</b>	<b>2</b>	<b>10.0</b>

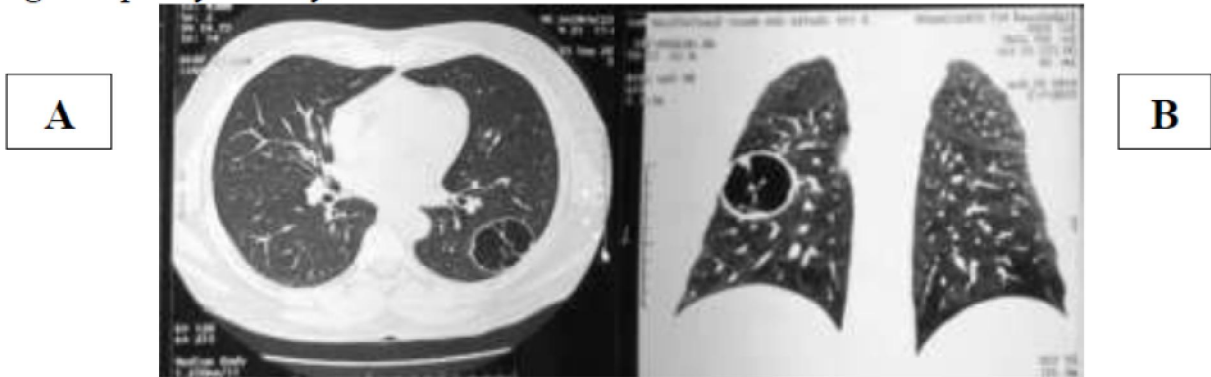
The most frequently encountered were diffuse cystic lesions - LAM in particular after which Cystic bronchiectasis and PLCH were the second commonest to be encountered (Table 8).

**Table (8): Distribution of cystic lesions according to distribution of lesions**

Multiplicity of affection	Final diagnosis		Frequency	%	
		N			%
Diffuse	LAM	5	100	14	70%
	Cystic bronchiectasis	2	50.0		
	PLCH	2	100		
	LIP	1	100		
	UIP	1	100		
	PJP	1	100		
	Emphysematous bullae	2	100		
Focal	Pneumatocele	1	33.3	2	10%
	hydatid cyst	1	100		
Multifocal	Pneumatocele	2	66.7	2	10%
Segmental	Cystic bronchiectasis	2	2	2	10%

**Case (1):** A 45 years old male, former smoker, complain of cough, left side chest pain, sputum, fever and progressive dyspnea with past history exposure to sheep and dogs.

**Imaging finding:** Simple hydatid cyst



u-ructed images (pulmonary window) of (CECT): (A, B): there are solitary air fluid level cysts with septation inside seen in left lower lung lobe and presence of mildly thickened wall with contrast enhancement (ring enhancement sign).

**Case (2):** A 31 years old male, no smoking, complain of chest pain, dyspnea, cough since 2days with history of chest trauma few weeks before by motor cycle.

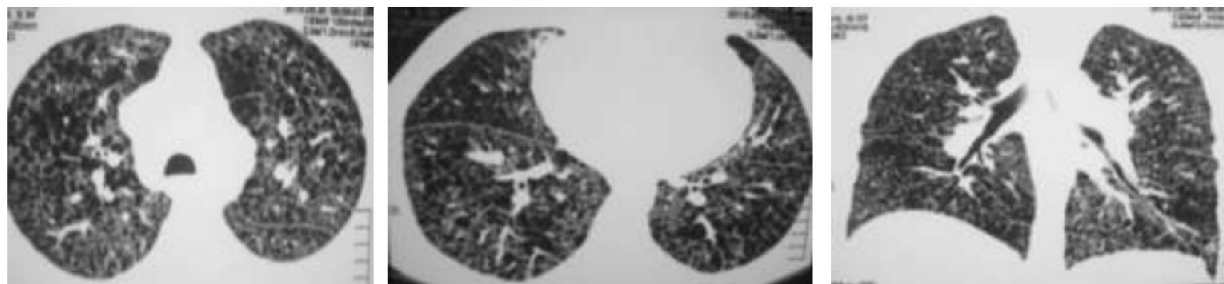
**Imaging finding:** pneumatocele.



Chest CT scan, axial cut (pulmonary window) of (NCECT): there are bilateral pneumatoceles and associated ground glass opacities.

**Case (3):** A 40 years old female, no smoking, complain of dyspnea on exertion and dry cough.

**Imaging finding:** lymphangioleiomyomatosis.



A

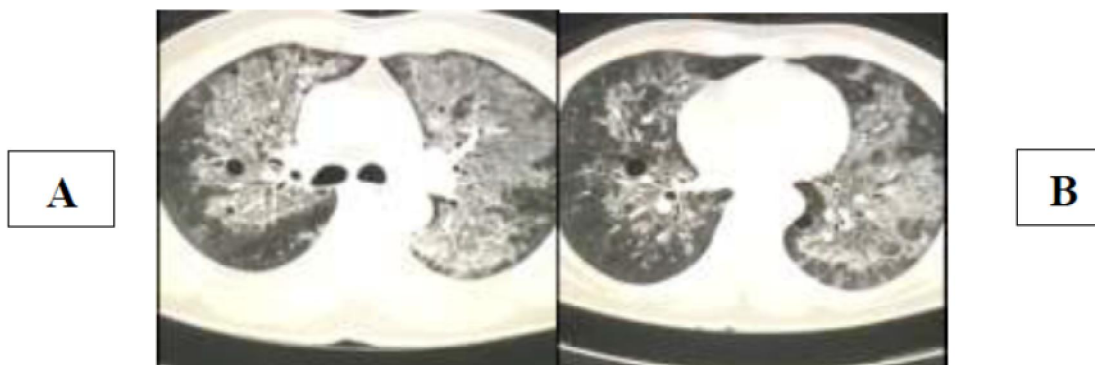
B

C

Chest CT scan, axial and coronal reconstructed images (pulmonary window) of (NCECT): (A, B, c): there are showing numerous bilateral air-filled cysts evenly distributed in lung lobes together with thickened fissures. All cysts are less than 1.5 cm in diameter.

**Case (4):** A55 years old male, former smoker, complain of chest pain, fever, weight loss with past history of AIDS who have CD4 counts<200 cells mm.

**Imaging finding:** Pneumocystis carinii Pneumonia (PCP)



A

B

Chest CT scan, axial images (pulmonary window) of (NCECT): (A, B): there are diffuse multiple small thin walled air containing cysts are seen Predominant affection of upper and middle lobes Subpleural sparing. Presence of bilateral perihilar ground glass opacities with Inter intra lobular smooth thickening.

#### 4. Discussion

The aim of this study is to evaluate the role of MSCT examination in evaluation of cystic lung diseases.

**In our study**, patients ranged from 22 to 85 years, the age group of less than 50 years old was the most common age group (55% of cases) and this observation doesn't match with (Araki et al., 2015). In regard to difference between males and females, included 13males (65.0%) and 7 females (35.0%) with cysts detected in their MSCT, agree with (Francisco et al., 2015).

**In our study**, Overall 2 (10%) of patients had single cyst and 3 (15%) of patient had sporadic cyst while the remaining 15 (75%) of them had multiple cysts. Air filled cyst were found in 17 cases (85%) and

air-fluid filled cysts were encountered in 3 (15%) of 20 patients.

Concerning focal, multifocal lesion pneumatoceles were seen in 2 patients in this study and they were less than 50 years (10% of the sporadic lung cysts), and one was an old female > 50 years (5% of the sporadic lung cysts). Previous chest trauma was confirmed from the clinical histories of the 2 patients who were less than 50 years. The lesions were small sized with thin walls present in upper lung zone, and minimal parenchymal reaction was noted adjacent to the cystic lesions. In the older female patient who runs on a long-term treatment of immune-suppressing medication, pneumatocele was incidentally discovered on performing a routine CT scan of the chest. Pneumonic patches of ground glass opacity were seen on CT with small thin walled pneumatoceles.

<b>(Table. 9): Types of cases with single lung cyst prevalence and approach used to reach diagnosis.</b>									
		No. cases	% Case	Clinical features	CT technique	Cyst distribution	Cyst characteristic	Other CT findings	for other investigation
<b>(Table. 9): Types of cases with single lung cyst prevalence and approach used to reach diagnosis.</b>	Aging change	1	5%	Long treatment with immune-suppressing medication	(NECT)	multifocal	Well defined, homogenous, Air filled cyst	Ground glass opacity	Comparison with previous chest studies
	Traumatic lung cyst	2	10%	Incidental chest trauma	(NECT)	Focal single or multiple	Air o filled cyst, without air-fluid levels	Associated surrounding pulmonary contusion	Comparison with previous chest studies
	Hydatid lung cyst	1	5%	Cough, incidental, travel history	(CECT)	Focal, Lower lobe Predominance	medium (>10mm)regular shapes; can be multiloculated; fluid hypodense contents	Complicated cyst show air-fluid levels	Hydatid serological tests
	<b>Focal cystic lung Disease</b>	<b>No. cases</b>	<b>% Case</b>	<b>Clinical features</b>	<b>CT technique</b>	<b>Cyst distribution</b>	<b>Cyst characteristic</b>	<b>Other CT findings</b>	<b>for other investigation</b>
<b>(Table. 10): Types of cases with multiple lung cysts prevalence and approach used to reach diagnosis.</b>	Emphysematous bullae	2	10%	progresive exertional dysnea chronic cough, current smoker	(NECT)	multifocal	variable sized thin walled. The cysts were distributed in a panacinar, paraseptal and centrilobular pattern.	Apperant normal	Comparison with previous chest studies
	Cystic Bronchiectasis	4	20%	Productive cough, recurrent infection	(NECT)	Single lobe or multilobar, multiple	Bronchial dilatations; thick wall cyst Air filled mucus plugging, air-fluid levels. Differentiated from cysts by continuity with airways	Pulmonary oligoemia with mediastinal shift	Comparison with previous chest studies
	Diffuse infiltrative lung disease (ILD)including: UIP, LAM, PLCH, DIP, LIP	9	45%	Long history of dry cough, dyspnea, chest pain. History of Smoking with PLCH & DIP. Female in LAM. autoimme disease in LIP	(NECT) HRCT except (CECT) For PLCH, LIP	Bilateral near symmetrical, UIP: lower lobes PLCH: upper lobes. LAM diffuse. perivascular	UIP: honeycombing; cluster Of subpleuralcysts. LAM: mainly rounded cysts PLCH: bizarrt DIP: small, few & peripheral cysts	UIP: fibrosis with reticulations LAM: normal intervening lung, May pneumothorax. PLCH: bizarre shape cysts and nodules LIP: may ground glass, interlobar septal thickening & centrilobular nodules DIP: diffuse ground glass opacities	PFT, pathological evaluation in equivocal cases
	<b>Multiple cystic lung</b>	<b>No. cases</b>	<b>% Cases</b>	<b>Clinical features</b>	<b>CT technique</b>	<b>Cyst distribution</b>	<b>Cyst characteristic</b>	<b>Other CT findings</b>	<b>for other investigation</b>

In a study by (Marchiori et al., 2015) stated that Pneumatoceles manifest on CT as scattered, thin-walled, gas-filled cysts interspersed with normal lung in areas previously affected by pneumonia, especially that caused by *Staphylococcus aureus* or trauma.

In our study, hydatid cyst was diagnosed in one febrile patient with marked eosinophilia. Hydatid lung cysts account for 5% of single lung cysts and one

patient presented by cough. CT findings of a non-calcified cystic single parenchymal air-fluid at left lower basal lung lobes. Diagnosis is made based on the characteristic radiologic findings supported by serological test for hydatid and confirmed by operative findings; agree with (El Khattabi et al., 2012).

In our study, concerning segmental lesion cystic bronchiectasis was seen in 4 patients. Cystic

bronchiectasis showed air filled cystic dilatation of the bronchioles associated with bronchial wall thickening. Superadded infection was also a feature confirmed by partial replacement of the air with fluid with characteristic air–fluid leveling. Ground glass opacity of the surrounding lung parenchyma was noted together with fine reticular bands stretching the proximally dilated bronchi. Many authors have researched cystic bronchiectasis and agreed with the findings of the present study. (Irwin and Cook, 2016), agreed that bronchiectasis can be focal, multifocal, unilateral, bilaterally asymmetrical, or bilaterally symmetrical. Bronchiectasis is central (affecting the lobar and proximal central bronchi in the inner two-thirds of the chest) or peripheral (affecting distal airways).

**In our study**, diffuse cystic lung disease encountered in this study was seen in 2 patients. Emphysematous bullae showed features of variable sized thin walled air filled cystic spaces that shared their walls. Variability in size and innumerable lesions were common. The cysts were distributed in a panacinar, paraseptal and centrilobular pattern and this agree with, (Lynch et al., 2015).

**Diffuse infiltrative lung diseases in the current study** represent 70% of multiple lung cysts. Diffuse LAM was the prevailing diffuse cystic lung disease. All the patients of current study were females as the disease occurs almost exclusively in females, affecting almost exclusively young women in their reproductive age however some researchers reported LAM in men, (Henske et al., 2012).

**In consistent with our study**, (Francisco, et al., 2015) and (Seaman, et al., 2011), stated that the predominant HRCT findings in patients with LAM were multiple variable sizes thin-walled round cysts distributed diffusely throughout the lungs with thickened fissures and interlobular septal thickening among the cysts.

**In our study**, PLCH was seen in two patients with irregular (bizarre) cysts predominantly upper lobar small sized cystic lesions which were well defined and did not exceed 10mm diameter. The cysts had variable shapes with thin walls. Nodules were also noted in the two patients. The cysts although diffusely dispersed; spared the costophrenic angles. The striking association of LCH with a neoplastic mass lesion with speculated margins and cavitating core was seen in the two heavy smoking patients; agree with (Sabri et al., 2016).

**In our study**, The HRCT findings in one patient with LIP were ground glass attenuation and poorly defined centrilobular nodules, and cystic changes were noted. Cysts were bilateral, and had a random distribution involving less than 10% of the lung parenchyma and this agree with, (Chung et al., 2015).

**In our study**, Ground glass attenuation was the most common radiographic abnormality in DIP and cystic changes have been reported. The cysts in DIP were typically lower lung zone predominant, involve less than 10% of the parenchyma and often appeared within areas of ground glass attenuation in smoker patients and this agree with, (Gupta et al., 2015).

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