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DIAMETER, THICKNESS AND DISCORDANCE DEGREE OF SOLITARY PULMONARY CAVITARY LESION TO DIFFERENTIATE BENIGN FROM MALIGNANT LESIONS, A MUTLISLICE CT STUDY.

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Absctract

Cavities are frequent image findings in a variety of pulmonary diseases including both lung cancer and pulmonary tuberculosis, Computed Tomography (CT) is accepted as the modality of choice for detection of possible cavitating pulmonary nodules. The aim of this study is to assess the role of diameter, thickness and discordance degree of solitary pulmonary cavitary lesion to differentiate benign from malignant lesions in multislice CT.

This cross sectional study was done in the Computed Tomography Unit of Al-Imamain Al-Kadhimain Medical City, Baghdad, Iraq and Al-Sader Teaching Hospital, Basrah, Iraq between October 2016 and June 2017. All patients are with solitary pulmonary cavitary lesions detected by chest x-ray referred for different reasons. Exclusion criteria included: multiple cavitary lung lesions, patients with known lung carcinoma or pulmonary tuberculosis on treatment, and patients receiving chest radiotherapy for different reasons. CT examination of the chest was performed by multi-detector CT (Somatom definition edge, SIEMENS (256 slices)) with 2 sets of CT examination one before and another after giving IV nonionic iodinated contrast medium (Ultravist 370 mg /ml), 1.5 ml/kg Body weight. The final diagnosis was obtained depending on the sputum culture for AFB, bronchoscopy and biopsy, bronchoscopy and brush cytology and true cut biopsy.

Eighty percent of the patients were diagnosed as having benign lesions and 20% were diagnosed as having malignant lesions, the most frequent diagnosis was TB (60%), followed by squamous cell carcinoma (14%), lung abscess (10%), hydatid cyst (10%), adenocarcinoma (4%), and metastasis (2%). The discordance of CT scan (FDCW3) show highly significant association with malignant solitary cavitary lesions, while CT concordance (FCCW1 and FCCW2) were significantly associated with benign solitary cavitary lesions ($p<0.001$). A highly significant association was observed between increased mean thickness and increased mean diameter of lesion and malignant solitary cavitary lesion ($p<0.001$).

In conclusion, multi-slice computerized tomography is an appropriate diagnostic modality for differentiation between benign and malignant solitary pulmonary cavitary lesions. Increased diameter and thickness of pulmonary cavities and increased discordance degree are more likely to predict malignancy.

Introduction

A cavity is defined in the Fleischner glossary as "a gas-filled space, seen as a lucent or low attenuation area within pulmonary consolidation mass, or nodule[1]. Cavities are frequent image findings in a variety of pulmonary diseases. A cavity of lung cancer and pulmonary tuberculosis can be formed during their course[2]. The cavities formed during-these two particular diseases are difficult to distinguish[3], particularly in the case of peripheral lung cancer and single pulmonary tuberculous thick walled cavities. 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[4]. The noninvasive differentiation between benign and malignant cavitary pulmonary lesions is radiological evaluation[5]. The content of the cavities is of little help in differentiating benign and malignant lesions[6]. Computed Tomography (CT) is accepted as the state of the art modality for detection of possible cavitating pulmonary nodules[5]. Although numerous studies have been conducted in this area, there is still no pertinent literature on the differential diagnostic value of form concordance or discordance of cavitary internal and external walls-obtained from multi-slice spiral CT (MSCT)[7].

This study aimed to assess role of Diameter, thickness and discordance degree of solitary pulmonary cavitary lesion to differentiate benign from malignant lesion in multislice CT.

Patients and methods

This cross sectional study was carried out in the Computed Tomography Unit of Al-Imamain Al-Kadhimain Medical City in Baghdad, Iraq and Al-Sader Teaching Hospital, Basrah, Iraq in the period from 1st October 2016 to 30th June 2017. All patients presented to the Computed Tomography Unit with solitary pulmonary cavitary lesions detected by chest x-ray referred from clinicians for different reasons. Research approval was taken from Institutional Review Board, Al-Nahrain College of Medicine. Informed consent was taken from patients before enrolling in the study.

Inclusion criteria: adult patients with single cavitary lung lesion detected by chest x-ray regardless of symptoms.

Exclusion criteria: multiple cavitary lung lesions, patients with known lung carcinoma on treatment, patients with known pulmonary tuberculosis on treatment and patients receiving chest radiotherapy.

The CT examination of the chest was performed by multi-detector CT (Somatom definition edge, SIEMENS medical system, Germany (256 slices)). All patients were examined in supine position in caudo-cranial direction during breath holding period of 5-10 sec. with slice thickness 5mm, KVp 100-120, mA 200-300. All patients had 2 sets of CT examination one before and another after giving IV nonionic iodinated contrast medium (Ultravist 370 mg/ml), the dose of contrast medium in an adult patient is given as 1.5 ml/kg body weight and the magnitude of enhancement was assessed by measuring CT number pre- and post-contrast administration and was considered significant if the increase in CT number more than 15 HU. Images were viewed in 2 window settings: lung window (WL=-600, WW=-1600), and mediastinum window (WL=40, WW=350). Sagittal and coronal reformatted images were obtained from initial axial CT data images.

The detected cavities by CT scan were categorized depending on their internal and external wall characteristics. The cavities were categorized into discordance of cavity wall (FDCW) and from concordance of cavity wall (FCCW). The FDCW was subdivided into 3 subtypes: FDCW-I; cavities with smooth inner walls and uneven outer walls, FDCW-II; cavities with smooth outer walls and uneven inner walls and FDCW-III; cavities with uneven outer and inner walls and discordant uneven sectors. The FCCW was subdivided into 2 subtypes: FCCW-I; cavities with smooth inner and outer walls, whereas FCCW-II; cavities with uneven outer and inner walls and concordant uneven sectors (figure 1). When a cavity showed different layers, the classification was based on the form of the central layer.

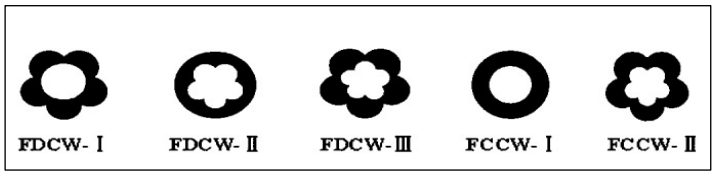

Figure 1: Various types of cavities depending on internal and external wall characteristics

Final diagnosis was obtained by sputum culture for AFB, bronchoscopy and biopsy, bronchoscopy and brush cytology and true cut biopsy. All CT image findings were interpreted by 2 independent radiologists to decrease inter-observer errors.

Statistical analysis of data was done using Statistical Package for Social Sciences (SPSS) version 22. Descriptive statistics was presented as (mean±standard deviation) and frequencies as percentages. Chi-square test was used for comparison between categorical data (Fishers exact test was used when expected variables were less than 20% of total). Independent sample t-test was used to compare between two means. In all statistical analysis, level of significance (p-value) set at ≤ 0.05.

Results

The final diagnosis of the 50 patients with solitary pulmonary cavitary lesions was as follows: 80% of the patients have benign lesions and 20% of them have malignant lesions. Regarding specific diagnosis: the most frequent diagnosis was TB (60%), followed by squamous cell carcinoma (14%), lung abscess (10%), hydatid cyst (10%), adenocarcinoma (4%), and metastasis (2%).

Table I: Final and specific diagnosis of 50 patients with solitary pulmonary cavitary lesions.

Variable	No.	%
Final diagnosis		
Benign	40	80.0
Malignant	10	20.0
Total	50	100.0
Specific Diagnosis		
TB	30	60.0
Squamous cell carcinoma	7	14.0
Lung abscess	5	10.0
Hydatid cyst	5	10.0
Adenocarcinoma	2	4.0
Metastasis (adenocarcinoma)	1	2.0
Total	50	100.0

The CT wall criteria: mean diameter of solitary cavitary lesions was 35.03±10.12 mm in benign lesions and 52.4±5.5 mm in malignant lesions. Mean thickness of solitary cavitary lesions was 5.3±4.9 mm in benign lesions and 21.5±4.4 mm in malignant lesions. The CT scan concordance findings were distributed as follows; FCCW1 (42%), FCCW2 (32%), FDCW1 (4%), FDCW2 (6%), and FDCW3 (14%) (Table II).

Relationship between CT wall criteria and final diagnosis: The discordance of CT scan (FDCW3) show highly significant

association with malignant solitary cavitary lesions, while CT concordance (FCCW1 and FCCW2) were significantly associated with benign solitary cavitary lesions (p<0.001). The mean diameter of malignant cavitary lesions was higher than mean diameter of benign cavitary lesions with statistical significant difference (p<0.001). A highly significant association was observed between increased mean thickness of lesion and malignant solitary cavitary lesion (p<0.001). These findings were shown in Table II.

Table II: The CT scan characteristics distribution according to CT scan findings.

Variable Concordance	Benign		Malignant		Total		P value
	No.	%	No.	%	No.	%	
FCCW1	19	47.5	2	20.0	21	42.0	<0.001*
FCCW2	17	42.5	0	-	17	32.0	<0.001*
FDCW1	0	-	2	20.0	2	4.0	Not significant
FDCW2	3	7.5	0	-	3	6.0	Not significant
FDCW3	1	2.5	6	60.0	7	14.0	<0.001*
Diameter (mm) Mean±SD	35.03±10.12		52.4±5.5				<0.001*
Thickness (mm) Mean±SD	5.3±4.9		21.5±4.4				<0.001*

Figures 2 & 3 shows the CT images of some patients included in the study.

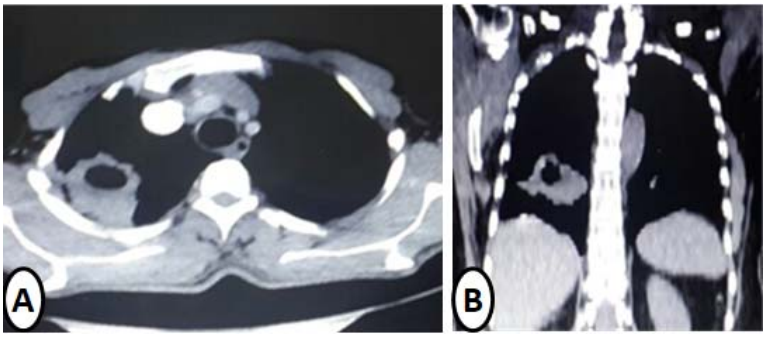

Figure 2: A: CT scan of a 50 year old male presented with hemoptysis, CT scan show cavitary lesion in the posterior part of the Rt. upper lobe with FDCW-1 pattern, final diagnosis was adenocarcinoma). B: another 52 year old male with Rt. Lower lobe cavitary lesion with FDCW-3 pattern, final diagnosis was squamous cell carcinoma.

Figure 3: CT of 3 different patients with pulmonary TB have solitary pulmonary cavitary lesion, A: show FCCW-2 pattern, B: show FCCW-1 pattern and C: show FDCW-2 pattern.

Discussion

It is important in clinical and radiological fields to distinguish a cavitary malignant lesion from a benign lesions. In some occasions, CT scan findings revealed some signs for the underlying causes, particularly in differentiation between benign and malignant causes[7]. The CT results of some rare lung tumors and lesions are frequently non-specific. Furthermore, there are some uncommon lung tumors with imaging characteristics interfere with other different conditions, subsequently making radiologic determination challenging[8].

The current study included 50 patients with solitary pulmonary cavitary lesions diagnosed by x-ray. About 80% of patients with solitary cavitary lesions were diagnosed as benign lesions and 20% of them were malignant lesions. High proportion of malignant cavitary lung lesions diagnosed by CT scan in current study were histologically squamous cell carcinoma while the benign cavitary lung lesions detected were mainly infections (TB and hydatid cyst). These findings are consistent with results of Abdulazeez[9] study in Iraq which characterized the cavitary lung lesions of suspected patients by CT scan and stated that malignant lesion was represented by squamous cell carcinoma while benign lesion were mainly infections (hydatid cyst and TB). Our findings were also similar to the results of Onn et al[10] study in USA which showed that main histological malignant lesions of lung cavitations were squamous cell carcinomas. Our study revealed that 80% of solitary pulmonary cavitary patients were with benign cavities and 20% of patients were with malignant cavities. This finding is close to malignant proportion of 19.4% reported by Abdulazeez[9] study in Iraq. However, our finding is lower than the results of Hu et al[11] study in China which examined 112 ground glass solitary pulmonary nodules with Multi-Slice CT scan and found that 73% of these nodules were malignant.

In this study the common significant CT characteristics of malignant solitary pulmonary cavities was discordance on CT scan (FDCW3) ($p<0.001$). This finding was consistent with the results of many previously reported studies like Sim et al[12] study in UK, Li et al[7] study in China and Ödev et al[13] study in Turkey. It was found that tumor outer margin represented also the side wall of malignant pulmonary cavitary lesion. The shape of pulmonary cavity is related to velocity of growth of cancer which affected by the larger pulmonary vessels and bronchi[14]. The inner wall of pulmonary cavity is categorized according to presence of wall nodule. The malignant solitary cavitary lesion is commonly appears as FDCW-III, and in less extent as FDCW-II or FDCW-I. The explanation of this finding is due to fact that growth velocity is discordant and blocked by the larger pulmonary vessels and bronchi, the necrosis is also uneven and a wall nodule is present at the same time[6].

The present study showed that the means diameter and thickness of malignant cavitary lesion were significantly higher than benign cavitary lesions ($p<0.001$). This finding coincides with the results of Figueroa et al[15] study in USA and Nin et al[16] study in UK which reported that increase of diameter and thickness of solitary pulmonary cavities is significantly related to malignancy. Another study conducted in South Korea Park et al[6] revealed that wall thickness is significantly differentiating between malignant and benign cavitary lung lesions. Inconsistently, previous Chinese study done by Tripathi et al[17] documented that cavitary wall thickness is unreliable for differentiating between malignant and benign lesions. Cavitary nodules were more commonly reported as malignant in many literatures[18]. Malignant pulmonary cavitation characterized by irregular or round appearance with discrepancy in wall thickness. The thickness above 24

mm with the presence of consolidation is predictive of malignancy[19]. The use of cavity wall thickness to discriminate among infectious etiologies of pulmonary cavities is even more problematic. While some infections, such as pneumocystis pneumonia, coccidioidomycosis, and echinococcus, have been classically associated with thin walled cavities, the absence of comparative studies with systematic and objective measurements of cavity wall thickness among infectious etiologies severely limits the use of cavity wall thickness as a diagnostic tool in discriminating among infectious causes of cavities[20].

This study had many clinical advantages regarding describing the role of CT scan in solitary pulmonary cavitary lesion and the detection of important role of discordance on CT scan, diameter and thickness of pulmonary cavities in facilitating the diagnosis of malignancy in earlier time which help in earlier management and saving lives. The main limitations of present study were loss temporal relationship as this study is cross sectional study, single center study and variability in interpretation of CT scan finding between radiologists.

Conclusion

The multi-slice computerized tomography is an appropriate diagnostic module for differentiating between benign and malignant solitary pulmonary cavitary lesions, increased diameter and thickness of pulmonary cavities and increased discordance degree are more likely to predict malignancy.

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