Comparison Between Low Dose Chest CT and Chest X-Ray in Smokers with Chronic Cough

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Abstract

Objective: this article was aimed to investigate the Comparison between Low-Dose Computed Tomography (LDCT) and Chest X-Ray (CXR) in Smokers with Chronic Cough.

Method: in this study all patients subjected who suffering from chronic cough to chest x-ray initially then underwent to low dose chest CT.

Results: The rate age of studies groups was (49.03 ± 16.12) years and the main age group was (31.1%) 60< years, male were more dominant than female (66.66% male) and (33.33% female).

This study shows that LDCT of chest is better than chest x-ray in detect the cause of chronic cough (0.005) (P value) and the result of the kappa test for enter observe accuracy between both tests was essential agreement (0.426).

Conclusion: The LDCT better than x-ray in detected of the cause's chronic cough and the findings of LDCT were more than chest x-ray, low dose CT is a good choice in detection of pulmonary lesions with using low exposure factors and hence low radiation dose.

Keywords

Low Dose CT • Chest X-Ray • Chronic Cough

Introduction

Cough, defense mechanism for clearing the а airways of secretions, exudate, or foreign bodies. mav become a troublesome symptom. Chronic cough, one of the most frequent symptoms requiring medical attention [1].Cough can be defined based on duration of symptoms: [1] acute, less than 3 weeks; (2) subacute, 3 to 8 weeks; and [3] chronic, longer than 8 weeks [2]

Uses special x-ray equipment to examine abnormalities found in other imaging tests and to help diagnose the cause of unexplained cough, shortness of breath, chest pain, fever and other chest symptoms. CT scanning is fast, painless, noninvasive and accurate. Because it is able to detect very small nodules in the lung, chest CT is especially effective for diagnosing lung cancer at its earliest, most curable stage [3] Because CT is a major source of radiation exposure, low-dose CT procedures are recommended unless it has an impact on management decisions. However, changing a standard chest CT routine procedure with a low-dose protocol is not an easy undertaking, owing concerns that picture quality degradation may to make recognition accurate of discoveries difficult, influencing Although the diagnostic result. multiple studies have examined the efficacy of low-dose СТ protocols for diverse reasons, there is no evidence that low-dose CT can be used to replace standard-dose CT protocols frequently [4]

Low dose CT screening is not without risk and although the associated radiation dose is about one-fourth that of Standard-Dose (SD) CT, on the basis of the linear non-threshold theory, the cancer risk from radiation exposure at LD CT cannot be ignored [5].Annual screening has been suggested to increase the risk for lung cancer , although the radiation-induced cancer risk from exposure to less than 100 mSv remains unclear [6].CT scanning of the chest is a technique for obtaining numerous cross-sectional images of the organs and tissues of the chest using specialized equipment. CT scans are significantly more detailed than traditional chest X-rays, and they're especially important since they can reveal multiple types of tissue at once, such as the lungs, heart, bones, soft tissues, muscle, and blood arteries [7].

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A chest X-ray is a diagnostic procedure that produces a picture of the heart, lungs, and bones. "Chest radiograph" is another term for a chest X-ray. Focused beams of radiation are utilized in X-rays[8]. The images of the inside of the body are created by these radiation beams. The negative images of black-and-white photographs resemble X-ray images. X-rays use a very small amount of radiation. The risks are minimal for adults. Lower radiation X-rays can be used in smaller children to minimize the risk in that population [9] Although the sensitivity and specificity of this X-ray technique are moderate, chest X-ray (plain film, projectional radiography) has been the established primary imaging modality for patients with acute chest pain, suspected pneumonia, and/or acute dyspnea in the diagnostic pathway of emergency departments for nearly a century [10].

acquisition and running costs The inexpensive of protectional radiography equipment, the short examination time, and the relatively low radiation dose all contribute to the widespread availability and use of chest X-ray [11]. In comparison to a chest X-ray, a CT scan provides a more detailed look. A chest X-ray, for example, may detect an anomaly, but a chest CT scan should be able to pinpoint the exact area and characterize the formation [12]. A chest X-ray gives a 2D image of organs, but a chest CT scan gives a 3D image. A CT scan may catch bones, soft tissues, and blood arteries all at once, whereas an X-ray is designed to analyze solid tissues [13], because a CT scanner must spin around the patient being examined, X-ray equipment is substantially smaller and less complex than a CT scan [13]. Chest X-ray is a good low-cost, first-look exam. In order to move forward with the diagnosis and treatment, the patient might have to do a chest CT scan to have a better picture [14]

Materials and Methods

In this study all patients subjected under wanted to chest x-ray initially then to low dose chest CT. After we had taken the chest x-ray of the patient in a standing position on the chest stand, the patient took a deep breath, the x-ray image appears, and then we had taken the patient's breath and photographed him with a CT, but with a low dose technique. Patient and image selection and analysis.

We start with the x-rays and compare them with the low dose scans first in terms of normal and abnormal and compare if the patient's X-ray contains any lesions and in return, we compare it with the low dose scans and through this comparison we were able to find the results according to the findings in the Xrays and scans of the same patient.

Chest X-Ray (CXR)

chest X-ray technique uses small mount dose of ionizing radiation to made an image from inner part of thoracic cave and it is estimating lungs, heart and chest wall and sometimes detect pulmonary and extrapulmonary diseases. Exam of Chest not required to special preparing. The technologist asked the female patients if she is pregnant and takeoff jewelry and wear comfortable clothing or wear the hospital gown. The standard position of chest is (PA) Postero Anterior erect position, nearly all of chest X-ray exams are doing in PA position unless the patient can't stand in this case there are suitable positions. PA position is doing with patient stand and with full inspiration, theanterior part of chest front of X-ray film and the tube the patient about 6 feet, the superior part of the cassette is 5 cm above the joint of shoulder. The Chin is high as to be far of the picture field, shoulders must rotate to anterior to permit the scapula to runaway lateral from the lungs and this can be happened by two ways:

- Put the hands on the posterior part of patient's hips where both elbows will be flexed rolled anteriorly.
- Put the hands around the picture's receptor like hugging the receptor and scapula in lateral movement.

And shoulders will be depressed to clavicles bone bellow the epic of both lungs.

Low dose chest CT

Computed tomography scan is one of type of imaging exams. CT scan uses computer technology and x-ray to make and collected the details of images. In CT scan beam of X-ray is rotated around the patient's body in circle movement and take many pictures its name is slices, then computer take these images and process it to display on monitor.

All CT examinations were proceeded use as 64 detectors-row CT scanner (Siemens SOMATON Definition As 64 slices: Germany). All patients are sharing in this study submitted one scan, and asked the female patients if she is pregnant and tell them wear a gown and remove all piercings and jewelry. This scan performed patients are lying in supine position from lower neck down to adrenal level and arm must be over the head and take single breath and hold it. That was happened in the same CT scan parameter except for mAs used 50 mAs for low dose chest CT.

The other parameters scan was still the same for both scans (peak tube voltage 120KV, speed of gantry 0.5s per rotation. slice collimation 0.5mm x 64, table feed 53mm/s. pitch 0.828. computed factor tomography index weighted (CTDIw) for axial scanning was dose measured (64 x 0.5mm) detector arrangement, using 32cm acrylic dosimetry phantom and 100mm chamber ionization.

Results

Across sectional study that is happened at the oncology teaching hospital in medical city in Baghdad from 1st of October 2020 to the end of June 2021.Forty-five 45 patients have chronic cough they enrolled in this study, the case sheet was including this data (name, gander, age, history of smoking, past medical history, referral, finding of chest X-ray, finding of low dose chest CT, duration of cough and cause of cough).

This study was enrolled on 45 patients and the mean of age is (49.03 \pm 16.12)years , main age group was 60< in 14 patients (31.1%), smoking males were higher than females in current study 30 (66.66%) for males while females were 15 (33.33%), the patients that they have past medical history were 29 (64.44%) and patients they didn't take ACEi (angiotensin converting enzyme inhibitor medication) were 32 (71.11%) while they who take ACEi were 16 (35.55%) and the patients were referred from other hospital or health care centers (secondary and primary) were 32(71.11%) and all this demographic data were showed in the Table 1 and Figure 1.

Variables		No 45	%
Age	20-29	5	11.2
	30-39	7	15.55
	40-49	8	17.77
	50-59	11	24.44
	60<	14	31.1
Mean±SD	49.03±16.12		
Gander	Female	15	33.33
	Male	30	66.66
Post medical history	Yes	16	35.55
	No	29	64.44
ACEi	Yes	13	28.88
	No	32	71.11
Referral	Yes	32	71.11
	No	13	28.88

 Table 1. Demographic criteria of the patients N=45.



 Figure 1. The rates of smokers according to gender.

 Duration of symptoms
 No.
 %

 > 3 months
 27
 60

 4-6 months
 13
 28.88

 < 6 months</td>
 5
 11.11

45

 Table 2. Duration of symptoms in study group.

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Total

According to the results of current study in Table 2 the highest duration of symptoms was (<3 months) 27 patients with (60%), Figure 2.

100



As regarded to the site that found in abnormal findings by low dose chest CT, we can see in the Table 3 and Figure 3. The most site of lesion was in right upper lobe 11 (24.44%), Left lower Lobe 10 (22.22%), Left Upper Lobe and RUL+RML 4 patients of each one (8.88%) while Right Middle Lobe 3 (6.66%).

Low dose		
Site of lesion	No.	%
Normal	8	17.77
Right Upper Lobe	11	24.44
Right lower Lobe	5	11.12
Left Upper Lobe	4	8.88
Right Middle Lobe	3	6.66
Left lower Lobe	10	22.22
RUL+RML	4	8.88
Total	45	100

Table 3. Low dose chest CT results according to site of lesion.



As showed in Table 4 and Figure 4, site of abnormal findings of chest X-ray, the most site common of lesions was in the right upper lobe 10 (22.22%), Right Middle Lobe 6 (13.33%), Left lower Lobe 4 (8.88%), Right lower Lobe 3 (6.66%) and Left Upper Lobe 2 (4.44%).

Figure 3. Low dose chest CT results according to site of lesion.

Chest X-ray		
Site of lesion	No.	%
Normal	20	44.66
Right Upper Lobe	10	22.22
Right lower Lobe	3	6.66
Left Upper Lobe	2	4.44
Right Middle Lobe	6	13.33
Left lower Lobe	4	8.88
RUL+RML	-	
Total	45	100

Table 4. Site of lesions that found in chest x-ray abnormal.



The abnormal most common finding in low dose chest CT (LDCT) was fibrosis and Opacities with the same number and rate 12 (26.66%), Calcified 8 (17.77%), Cystic 3 (6.66%) and Air-fluid level 2 (4.44%). As shown in T able 5 and Figure 5.

Figure 4. Site of lesions that found in chest x-ray abnormal.

Low dose finding		No.	%
Normal finding		8	17.77
Abnormal finding	Cystic	3	6.66
N = 37	Opacities	12	26.66
	Fibrosis	12	26.66
	Air-fluid level	2	4.44
	Calcified	8	17.77
Total		45	100

Table 5. Low dose chest CT (LDCT abnormal finding).



In Table 6 and Figure 6 it shows the finding of abnormal chest x-ray. The most common was opacities 12 (26.66%), fibrosis and cystic got the same result which was 6 (13.33%) then air-fluid level 1 (2.22%).

Figure 5. Low dose chest CT (LDCT abnormal finding).

Chest-X-ray finding		No.	%
Normal finding		20	44.44
Abnormal finding	Cystic	6	13.33
N = 25	Opacities	12	26.66
	Fibrosis	6	13.33
	Air-fluid level	1	2.22
Total		45	100

Table 6. Finding of abnormal chest x-ray.



Table 7 shows that chest x-ray detected normal 20 (44.44%) patients while 25 (55.55%) patients' abnormal findings, from the other side there are 8 (17.77%) patients normal in low dose chest CT exam and 37 (82.22%) patients' abnormal findings with significant association (P=0.005).

Figure 6. Finding of abnormal chest x-ray.

	x-ray		LDCT	P value	
	NO.	%	NO.	%	
Normal finding	20	44.44	8	17.77	0.005*
Abnormal finding	25	55.55	37	82.22	-
Total	45	100	45	100	

Table 7. Association between x-ray and low dose chest CT concerning to findings in the sample collection.

The main cause of chronic cough in this study was (GERD) Gastro Esophageal Reflex (17/45) 37.77% then the upper air way infection

and lower respiratory tract infection with the same result which was (9/45) 20%, then COPD (7/45) 15.55%, then ICC (3/45) 6.66% and this detail shows in Table 8 and Figure 8.

Cause of cough	No.	%
lower respiratory tract infection	9	20
upper air way infection	9	20
ICC	3	6.66
COPD	7	15.55
GERD	17	37.77



Table 8. Causes of chronic cough in sample patients.

The sensitivity of the low dose chest CT of abnormality compares with chest x-ray (67.6%) as the low dose chest was diagnosis (25/45) abnormal findings that chest x-ray, while the specificity of low dose chest CT regarding to chest X-ray is (50%), positive predictive value is (50%) and negative predictive value is (45.94%) and the accuracy of low dose chest CT to chest x-ray to detect chronic cough is (73.96%). The value of kappa test for inner observer reliability between both test is substantial agreement (0.426), Table 9 shows these details.



	LDCT		
Validity test	Abnormal (+ve)	Normal	Total
		(- ve)	
	No (%)	No (%)	

X-ray	abnormal	25	0	25
	normal	12	8	20
	total	37	8	45
Sensitivity		67.6		
Specificity		50		
+ ve predictive value		50		
+ve predictive value		45.94		
ACCURCY		73.96		
Kappa test value for interobserver reliability		0.426		
Agreement between both tests		agreement		

Table 9. Validity test and Kappa test.

Discussion

Cough is considered one of the most and common symptoms for patients they request medical notice with different causes [15]. There are a big different of chronic cough resonance that including variety pulmonary and extra pulmonary disorders. ACEi (Angiotensin Converting Enzyme Inhibitor Medication) smoking, asthma, and upper airway diseases (post nasal drip and chronic rhino sinusitis) GERD (Gastro-Esophageal Reflex Diseases) all these considered common contributing resonance but the relative frequency of these causes connected frequency of each possibly be based on the clinical setting. While there are many doctors still not transmission the patients' smokers or past smokers to measure lung functions to decide if they have Chronic Obstructive Pulmonary Disease (COPD) or for Low Dose Chest CT scan (LDCT) that will help to detect lung cancer in early stage better than X-ray, subsequently early diagnosis will be helpful to people with (COPD) and patients with lung cancer to live better and long live [16]

In this study shows that male was more dominant than female (66.66% male) and (33.33% female) with total mean age (49.03 ± 16.12) years, that is agree with what found by [19]. Who said smoking activates men's reward pathways more than women? This finding is consistent with the idea that men smoke for the reinforcing effects of nicotine, whereas women smoke to regulate mood or in response to cigarette-related cues and agreed with. While disagreed with Song et al, that is complemented epidemiologic data show that the patients who visiting clinics of cough around world they were mainly females [19], moreover beside it is agree with Harding et al that found in this study and complemented females were more distinguished than males. [16] The mean of age of the subjected population were 20 years and more, and that agree with European community respiratory health survey that was limited to young adult aged between (20-44) years but in current study we enrolled older age so that we not miss large number of old populations [17]. Concerning of ACEi-connected with cough patients they didn't take ACEi (Angiotensin Converting Enzyme Inhibitor Medication) were 32 (71.11%) while they who take (ACEi) were 16 (35.55%), this medication (ACEi) can be led to chronic cough even years or monthsspecificity value is (50%) with the accuracy of th xray in therapy [18] may be by rising sensitivity of cough reflexe

to cause fanaticism of otherwise in harmful stimuli [19]It is recommending every one presenting with chronic cough should not keep on with ACEi treatment [20] induced cough is straight forward to achieve and symptoms can take more than 3 months to resolve [18]. Concerning to referral this study shows that 32(71.11%) were referral to secondary center, and that was agree with what found by Turner R et al, the majority (80 %) of subjects were referral from another hospitals and centers care[16]. Current study was better than study that do by Mackely R et al in England regarding the referral of patients that was the doctors referred only 31% of patients [21]

Regarding to cause of cough, our study shows more than half of the patients have GERD as the main cause of cough whereas found in 17/45, it is same that found in study by expert [22] while he main reason of chronic cough in his study was about 40% from patients for GERD cause. In addition, it is agreeing with what expert found in his study [23] however expert found in his study that more when he found 30% of patients with GERD. [24] while study by expert found that GERD is the most cause of chronic cough with 60% of the patients and this may due to variation in collection of sample size [25]. Our study discovered that the upper airway cause of chronic cough was found in 20%of patients, that is less than of what expert found, his study found 46% of cases presenting with upper air way infection, that is may be because of variation of sample size in the last study was bigger than of our study in the sample collection and number of patients [22]. In the current study normal finding in chest x-ray was higher than normal finding of low dose chest CT was found 20 (44.44%) of cases which more than found by expert [26] that he based in his study on the diagnosis, moat of the cases was normal findings on plain image of chest x-ray and prevalence 38% and this disagreement with the past Iraqi study of expert states that he found the X-ray was detected most of the abnormal findings of cases [27]. This study shows that shows that the low dose chest CT (LDCT) was significantly better than Chest radiography (chest Xray) in diagnosis of chronic cough (0.005) and the result of Kappa test inner observer accuracy between both tests were fundamental agreement (0.426) with sensitivity (67.6 %) as the xray was diagnosis 20 normal and 25 abnormal findings while low dose chest CT 8 normal and 37 abnormal findings. The specificity of chest x-ray regarding to low dose chest CT is (50%) and positive specificity value is (50%) while the negative

regarding to low dose chest CT is (73.96%) to diagnosis the chronic cough.

This is referring that is low dose chest CT (LDCT) was better to diagnose the chronic cough in the patients.

Conclusion

The exam of low dose chest CT (LDCT) is better than exam of chest X-ray in diagnosis of chronic cough. The low dose chest Ct is a good choice in detection of lungs lesions and pulmonary diseases and using low dose (low exposure factors) and there for low radiation dose.

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