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Low dose CT scan of chest in screening for lung cancer in Iraq

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Abstract
Background: The most common cancer worldwide is bronchiogenic carcinoma, with a 5-year survival rate of <15%. Low-Dose Computed Tomography (LDCT) is a promising tool for early detection of lung cancer in asymptomatic smokers and former smokers. Aim of this study: to assess the detective value of low dose CT scan.
Methods: an analytic retrospective cross-sectional study of low-dose CT scan screening of asymptomatic people (ages 50-74) who are smokers with at least 15 pack years or who quit smoking within 10 years in medical city - oncology teaching hospital from July 31, 2018 to June 17, 2019, totalling 197 people.
Results: This opportunistic lung cancer (CA) screening program included 197 participants (174 from the ministry of oil and 23 from the ministry of transport) who underwent LDCT scans. Results were categorised by lung Reporting and Data System (RADS) and lung RADS 1 had the highest rate (87.7%). 8 of them had lung disease rather than CA and were referred to a pulmonologist, 14 had lung RADS II (7.1%), 7 had lung RADS III (3.6%), and 3 had lung RADS IV (1.5%), one with lung IVa and two with lung IVb (1%) were sent to a cardiothoracic surgeon and biopsied and diagnosed with lung CA.
Conclusion: There is a detective value of low dose CT scan for detection of lung cancer in early stage to be treated as curative intent.

Keywords: Lung CA, LDCT scan, screening, lung RADs

Introduction
Lung cancer remains the leading cause of cancer death globally, with 1.8 million new cases reported in 2012 by the WHO's International Agency for Research on Cancer (IARC) [1]. The five-year survival rate in the United States is a mere 18% [2]. Lung cancer's mortality burden is significant, causing approximately 1.59 million deaths annually worldwide. In the U.S., lung cancer is responsible for nearly one-third of all cancer deaths, surpassing the combined deaths from breast, colon, prostate, and pancreas cancers [2]. While smoking is a well-known risk factor, lung cancer also occurs in never-smokers, accounting for around 20,000 deaths annually in the U.S., highlighting its complex etiology [2]. Lung cancer incidence and mortality are highest in men from Central and Eastern Europe, Southern Europe, Eastern Asia, Micronesia, and North America, and in women from North America, Northern Europe, Australia/New Zealand, and Micronesia [1]. Developed regions with higher smoking prevalence show the highest age-standardized incidence rates [3]. Encouragingly, incidence rates in men are declining or stabilizing due to successful tobacco control initiatives, whereas in women, rates are increasing or stabilizing in most regions [6]. Historically, lung cancer was rare, constituting less than 0.5% of all cancer cases in a 1916 autopsy review in the U.S. and Western Europe [5]. Landmark studies in 1950 by Doll and Hill in the UK [6] and Wynder and Graham in the U.S. [7] established the causal link between smoking and lung cancer. Subsequent reports from the Royal College of Physicians (1962) [8] and the U.S. Surgeon General (1964) [9] confirmed smoking as the major cause of lung cancer. Cigarette smoke contains over 50 carcinogens, including TSNAs and PAHs, which contribute to DNA mutations and lung cancer risk [10]. Screening for lung cancer aims to reduce mortality through early detection. Criteria for effective screening include significant disease burden, a detectable preclinical phase, a test that identifies cancers earlier than symptomatic detection, and improved outcomes from early treatment.

However, biases such as lead time bias can affect the perceived efficacy of screening. Lung cancer screening using chest X-rays and sputum cytology began in the 1940s [11], but CT-based screening has shown greater promise. Low-dose CT (LDCT) is more sensitive than chest X-rays for early-stage lung cancer detection [12]. The National Lung Screening Trial (NLST) demonstrated a 20% reduction in lung cancer mortality and a 6.7% reduction in overall mortality with LDCT compared to chest X-rays [13]. Despite the benefits, LDCT screening has a high false-positive rate, leading to unnecessary diagnostic procedures and associated risks [13]. Professional organizations recommend discussing LDCT screening with high-risk individuals, defined as those aged 55 to 74 years with a significant smoking history, who currently smoke or have quit within the past 15 years [14]. Effective screening programs should be conducted in specialized institutions to minimize risks and maximize benefits. The Lung-RADS classification system aids in standardizing follow-up and management decisions in LDCT screening, with categories ranging from 0 (incomplete) to 4X (highly suspicious) [15]. Aim of this study: to assess the detective value of low dose CT scan.

Methods

Study Design: This analytic retrospective cross-sectional study evaluates an LDCT scan screening program conducted at the Oncology Teaching Hospital in Medical City from July 31, 2018, to June 17, 2019. The study targets asymptomatic high-risk individuals (smokers or former smokers).

Inclusion Criteria

1. Individuals aged 50-74 years.
2. Current smokers with at least a 15-pack-year history or former smokers who quit within the last 15 years.
3. Participants capable of lying on their back with arms raised overhead.

Exclusion Criteria

1. History of lung cancer.
2. Presence of metallic implants or devices in the chest or back, such as pacemakers.
3. Recent hemoptysis.
4. Underwent conventional CT scan within the past 12 months.

Data Collection

Data were collected from the radiology department records at the Oncology Teaching Hospital. The collected information included age, pack years, marital status, workplace, and RADS results from the LDCT scans conducted during the study period.

Study Instrument

The LDCT scans were performed using a Siemens AG, Somatom Definition AS system (© 2015 Germany) with the following settings: 1.5 millisieverts (mSv), 120 kilovolts (kV), 22 milliampere seconds (mAs), and a pitch of 1.2. Participants were examined in a supine position within 5 seconds.

Ethical Considerations: The study protocol was approved by the Iraqi Board for Medical Specializations. Legal authority was obtained to access the data for research purposes. Confidentiality of participant names and identification information was maintained, and data were not disclosed to unauthorized individuals.

Statistical Analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS version 23). Descriptive statistics were presented in frequency tables. Continuous variables were expressed as mean ± standard deviation, and categorical variables as numbers and percentages. The positive predictive value (probability that subjects with a positive screening test truly have a positive confirmatory test) was calculated.

Results

Total of 197 participants (174 employees at ministry of oil and other 23 at ministry of transport) were enrolled in this study, the age ranged from 50-71 years with a mean 56 years, the majority 147(74.6%) were 50-59 years, table 1.

Table 1: Distribution of participants on age group.

Age at screening (years)	Participants	
	Number	Percentage
50- 59	147	74.6%
≥ 60	50	25.4%
Total	197	100%

Other than 2 single participants all of the remaining ones were married. Smoking status in the studied group was shown in table 2.

Table 2: Distribution of participants on smoking history.

Smoking history (pack/years)	Participants	
	Number	Percentage
15-30	32	16.2%
30-45	70	35.6%
46-60	50	25.4%
>60	45	22.8%
Total	197	100%

The result of Opportunistic screening with low dose CT was lung RADS 1 for 173(87.8%) participants 8 of them discovered as lung disease other than malignancy and considered as RADS -S and referred to pulmonologist, lung RADS II for 14 (7.1%) participants, lung RADS III for 7(3.6%) participants and lung RADS IV for 3 (1.5%) participants (1 was 4a and 2 were 4b), table 3.

Table 3: The result of Low dose CT.

Lung RAD	Participants	
	Number	Percentage
I	173	87.7%
II	14	7.1%
III	7	3.6%
IV	3	1.5%
Total	197	100%

Among 50-59 years' age group 95.9% were Lung RADS I-II, compare to 92% in more than 60 years' age group, table 4.

Table 4: Lung RADS classification to age groups

Age at screening (years)	Lung RADS classification		
	Lung RADS I-II	Lung RADS III	Lung RADS IV
50- 59	141(95.9%)	5(3.4%)	1(0.7%)
≥ 60	46(92%)	2(4%)	2(4%)
Total	187(94.9%)	7(3.6%)	3(1.5%)

All 15-29 pack/ year participants were Lung RADS I-II and there were a decreasing percentage with the increase in severity of smoking, table 5.

Table 5: Lung RADS classification according to smoking status

Smoking history at screening (pack/years)	Lung RADS classification		
	Lung RADS I-II	Lung RADS III	Lung RADS IV
15-29	32(100%)	0	0
30- 45	66(94.3%)	2(2.9%)	2(2.9%)
46- 60	45(90%)	4(8%)	1(2%)
> 60	44(97.8%)	1(2.2%)	0
Total	187(94.9%)	7(3.6%)	3(1.5%)

Biopsy was done for two participants with lung RADS 4b and both showed malignant finding, The positive predictive value for Low dose CT was 100% and the percentage of malignant finding in screened groups was 1%, figure 1.

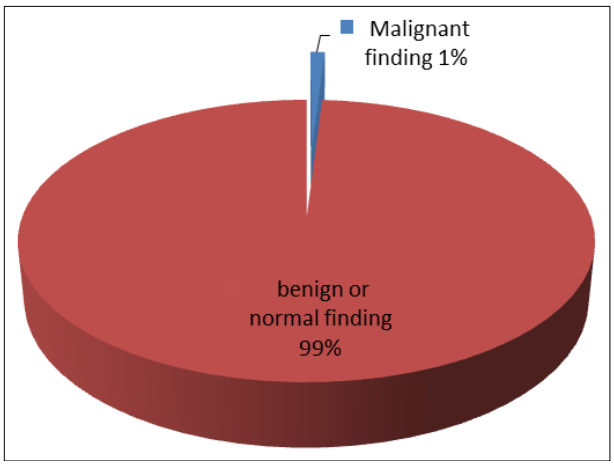

Fig 1: Distribution of screened group on findings

Both of them sent for cardiothoracic surgeon and biopsied and diagnosed with lung CA and start treatment with curative intent as early stage lung CA.

Discussion

Lung cancer is the leading cause of cancer-related mortality worldwide [37, 38]. Numerous investigations typically show a 10-fold or greater increase in the risk of this cancer among smokers compared with those who have never smoked [16, 17]. The purpose of screening is to prevent or delay the development of advanced disease in patients with preclinical disease through early detection and treatment [18]. This opportunistic lung cancer screening program using LDCT scans has been applied in Iraq by the Ministry of Health at the Medical City - Oncology Teaching Hospital since July 2018. The program targets asymptomatic individuals with high-risk factors. In our study, 197 male participants were screened from July 31, 2018, to June 17, 2019. The age range was 50 to 71 years, with a mean age of 56 years. Most participants (174) worked in the Ministry of Oil, while 23 were employed by the Ministry of Transport. Nearly all participants were married, except for two individuals. The screening results showed that 173 participants (87.7%) were categorized as Lung-RADS 1. Eight participants (Lung-RADS S) were found to have lung diseases other than cancer and were referred to a pulmonologist for further management. Fourteen participants (7.1%) were categorized as Lung-RADS II, seven (3.6%) as Lung-RADS III, and three (1.5%) as Lung-RADS IV. Among those categorized as Lung-RADS IV, one participant was Lung-RADS IVa, and the remaining two (1%) were Lung-RADS IVb. The latter two were referred to a cardiothoracic surgeon, biopsied, diagnosed with lung cancer, and started treatment with curative intent at an early stage. Our results are comparable to those of a Korean lung cancer screening (K-LUCAS) study [19], which involved 256 participants undergoing LDCT scans. The K-LUCAS study showed that 57%, 35.5%, 3.9%, and 3.5% of participants were categorized as Lung-RADS 1, 2, 3, and 4, respectively, with lung cancer diagnosed in one participant. However, the lung cancer detection rate in our study was lower than in previously published studies [20-23], likely due to the smaller sample size. Additionally, our study showed a correlation between smoking history (pack years) and Lung-RADS categories. Participants with 15-29 pack years all fell into Lung-RADS 1 and 2 (100%) and none into Lung-RADS 3 and 4 (0%), highlighting the need to consider screening for individuals in this category. The limitations of our study include the small number of participants, short duration, and lack of follow-up.

Conclusion

An opportunistic program of LDCT scan screening for asymptomatic individuals at high risk is beneficial for detecting lung cancer at an early stage, allowing for curative treatment and reducing mortality. This study marks the first analysis of the screening outcomes in Iraq.

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