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Radiology

COMPARISON STUDY BETWEEN CONVENTIONAL RADIOLOGY (CHEST RADIOGRAPHS) AND LOW DOSE COMPUTED TOMOGRAPHY (LDCT) IN LUNG PATHOLOGIES IN CHRONIC SMOKERS

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INTRODUCTION

The tobacco epidemic is one of the biggest public health threat the world has ever faced, killing around 6 million people a year. More than 5 million of those deaths are the result of tobacco.

SMOKING RELATED LUNG DISEASES

Smoking affects the lungs in numerous ways, and the diseases can be classified under the following headings:

Smoking related interstitial lung diseases (SR-ILD)

- Respiratory bronchiolitis.
- Respiratory bronchiolitis interstitial lung disease (RB-ILD)
- Desquamative interstitial pneumonitis (DIP).
- Pulmonary Langerhans cell histiocytosis (PLCH).
- Acute eosinophilic pneumonia (AEP).
- Combined pulmonary fibrosis and emphysema (CPFE)

Neoplasms

- Lung cancer
- Tracheal tumours

Chronic obstructive pulmonary diseases

- Emphysema.
- Chronic bronchitis.
- Constrictive bronchiolitis.

LUNG CANCER:

It is one of the most dreaded out come of chronic smoking and leading causes of cancer death. It carries a greater mortality than colorectal , breast and prostate cancers collectively! Approximately 85% of lung cancer patients in India are diagnosed at an advanced stage that is not amenable to surgical intervention. Owing to the disease burden , screening of chronic smokers assumes prime importance.

Standardized assessment methodologies of lung cancer:

Lung cancer is frequently suggested from chest X-ray findings: e.g. a solitary pulmonary nodule, pulmonary or hilar mass, poorly resolving pneumonia or pleural effusion.

Histological or cytological confirmation of the diagnosis is desirable, though not always possible, and can be achieved by a variety of methods: image guided thoracoscopy. Tissue diagnosis should be followed by subtyping of the cancer according to the current WHO classification. It may not be possible to use this classification fully if biopsy specimens or cytology samples are small, and in most instances designation as small cell lung cancer or non small cell lung cancer is sufficient for planning further management.

Chest X-ray

Chest radiography is a simple, cost-effective measure and it imparts very little radiation to the patient.

Early investigation in lung pathologies.

CT/ MRI scanning

CT is now become mainstay of staging chest malignancies.
Superiority of MRI over CT scan for detection of bronchial and chest wall invasion or nodal staging is unestablished. As CT is less expansive more commonly used.

CT scan has high sensitivity (89% to100%), but relatively low specificity and poor negative predictive value.

PET scanning

PET scanning has diagnostic sensitivity (96%), the diagnostic studies indicate negative predictive values as low as 47%.

The considerable cost of instrument imaging agent as well as the short half life of positron emitting isotopes has prevented widespread acceptance. Hence these units are available only at few specialized centres.

Bronchoscopy

Bronchoscopy has overall diagnostic yield of bronchial forceps biopsy and brushing for central lesions depending on the site and visibility if the lesion. Peripheral tumours in sub segmental bronchi may not visible.

FNA/ Percutaneous biopsy

Fine needle aspiration biopsy is highly sensitive. There is high false negative value.

It can be done blindly, guided by fluoroscopy, ultrasound, CT or MRI.

Sputum cytology

High sensitivity is only achieved by the use of specific and carefully controlled protocols for sample collections.

Thoracoscopy/Mediastinoscopy

Thoracoscopy is to be considered for patients with suspected lung cancer where less invasive means have not achieved histological and cytological confirmation of diagnosis.

If the CT scan of the chest does not reveal any mediastinal lymph node greater than one centimetre in size, the likelihood of N2 disease is small and mediastinoscopy or mediastinotomy is not required before surgery.

- **AIMS AND OBJECTIVES**
- To study and compare the findings on two modalities- digital X-ray chest and LDCT(low dose computed tomography).
- To calculate the risk benefit ratio of using either modalities in terms of its sensitivity, specificity, patient dose of ionizing

radiation and affordability.

- **MATERIALS AND METHODS**

LDCT scan of 50 patients who fulfilled below mentioned inclusion criteria were analysed and correlated with conventional chest radiograph. Relevant clinical history/ investigations pertaining to patient's complaint was evaluated for diagnosis from the case records/ registers.

Data acquisition

Description tools

- Digital x-rays(PA view of chest).
- Non- contiguous low dose Computed tomography axial cuts with reformation produced through 16 slice MDCT machine(Philips MX)

Inclusion criteria:

- Age: 35 year or more
- Sex: male/ female.
- Active smoking history of 10 years or more.

Exclusion criteria:

- Known case of primary/ secondary lung cancer or any chronic lung diseases.
- No previous CT imaging for lung pathologies.

- **Methods**

- Clinical: all the candidates will subject to detailed clinical history as outlined in Performa.
- Radiological investigation:

1. Plain radiograph of chest(PA view)
2. Low dose Computed tomography scan with 1.5 mm thickness axial cuts

Scanning protocols

For conventional radiography

- kvp: 40-60,
- mAs: 20-30
- exposure dose on an average 0.02 mSv

For low dose Computed tomography :

- Number of detectors: 16,
- kvp: 80,
- mAs: 22.5-37.5,
- second/ rotation:0.75,
- collimation: 1mm x 16,
- reconstruction slice thickness: 1.5mm,
- slice interval: 3mm,
- pitch factor: 1.438,
- exposure dose:1.5- 3.4 mSv,
- area covered: from apex of lung to base of diaphragm,
- lung field: 1600/-600,
- mediastinal: 400/35.

- **TECHNIQUE:**

- The comparison study between chest radiograph and LDCT in lung pathologies in chronic smoker was carried out in Smt.S.C.L.Hospital, Smt.NHL Medical College, Ahmedabad.
- Total no. of study patients were 50.

Written consent was taken and procedure was properly explained to the patient.

- Patient was placed on gantry table in supine position with both armed raised above the heads. He/she taught prior to procedure to hold breath in deep inspiration and expiration whenever required.
- A digital AP scanogram was obtained in suspended full inspiration.
- Prone scan were taken to determine whether the opacities in the dependent lung are abnormal or not.
- Scan were also taken at the end of deep inspiration to detect air trapping.

- **RESULTS:**

The results obtained from the study are as follows:

1:Distribution of common radiological findings associated with smoking and chest x-ray and LDCT

Radiological findings	Chest radiograph (n=50) No.	%	LDCT(n=50) No.	%
Bronchial thickening	28	56	34	68
Interstitial thickening	20	40	30	60
Emphysema	21	42	33	66
Pulmonary nodules	16	32	25	50
Areas of air space opacification	7	14	9	18
Consolidation	6	12	5	10
Ground glass opacities	0	0	4	8
Mediastinal lymphadenopathy	10	20	16	32
Pleural effusion	2	4	2	4

Table 2: distribution of positive findings in chest x-ray and LDCT

	Normal(n=50)		Abnormal(n=50)	
	No.	%	No.	%
Chest radiograph	18	36	32	64
LDCT	6	12	44	88

Table 3: % of patients having benign and malignant nodules/ areas of air space opacification on chest radiograph versus LDCT

Modality(n=50)	Benign	%	Malignant	%
Radiograph (X-Ray)	14	28	10	20
LDCT	17	34	15	30
Confirmatory diagnosis	20	40	10	20

Table 4: Sensitivity and specificity of chest radiograph and LDCT in diagnosing malignant lesions.

Type of lesion	TP	FP	TN	FN	Sensitivity%	Specificity%
Chest radiograph	5	5	35	5	50	87.5
LDCT	8	7	33	2	80	82.5

Table 5: Comparison of dose exposure in X-ray versus LDCT

Dose range (X-ray) (mSv)	No. of patients	Dose range (LDCT) (mSv)	No. of patients
0.18	7	1.4	1
0.19	7	1.5	10
0.2	11	1.6	9
0.21	7	1.7	8
0.22	11	1.8	11
0.23	4	1.9	9
0.24	3	2	2
Total	50	-	50

- **DISCUSSION:**

In our study, chest x-ray and LDCT revealed Bronchial thickening in 56% & 68%, interstitial thickening in 40% &60%,emphysema in 42% & 66%, pulmonary nodules in 32% & 50%, areas of sir space opacification in 14% & 18%, consolidation in12% &10%, ground glass opacities in 8%, mediastinal lymphadenopathy in 20% & 32% and pleural effusion in 4% & 4%, respectively.

Our study demonstrates that only a small proportion of total smokers had absolutely normal lung parenchyma on chest x-ray and LDCT. However, LDCT was able to detect subtle findings in 24% of patients whose x –rays were considered normal.

The proportion of benign lesions in smoker were higher than malignant lesions diagnosed by both chest X-ray and LDCT. LDCT could diagnose more benign and malignant lesions than chest X-ray.

LDCT was sensitive in diagnosing malignant lesions as compared to chest X-Ray, its specificity was slightly lower as compare to chest X-Ray. With modern multi -detector CT, pulmonary nodules are detected at size of less than 2 mm. small nodules are extremely common, but the vast majority of these nodules are benign. Given this fact , the definition of positive screening result determines the number of false positive results.

In our study , the average dose range for X Ray was between 0.18 to 0.24 mSv and for LDCT was between 1.4 to 2 mSv , implying that LDCT delivers almost 7 times more radiation dose than conventional

chest radiograph.

• SUMMARY AND CONCLUSIONS

Tobacco smoke is the most important and widely prevalent causative factor for the development of chronic bronchitis, bronchial cancer and emphysema.

The most common finding in smokers was the presence of bronchial thickening on both chest x-ray and LDCT.

The second most common finding on both chest x-ray and LDCT was the presence of emphysema. All types of emphysema associated with smoking.

LDCT was superior in diagnosing early emphysematous changes as compared to X-rays. It also diagnose malignant lesion much earlier and provides a better graphical pictures of pathology under study.

The effective radiation dose was approximately 7 times higher in LDCT as compare to chest X-ray. However, since the baseline risk of development of lung cancer is low (0.8-2.2%), the risk benefit ratio is very favourable.

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