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Research Paper

Lung Density Measurement Among Smokers Versus Non-Smokers Through Ct-Recontruction

Medical Science

KEYWORDS : Lung Density, Emphysema, Smoking, COPD

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ABSTRACT

In recent years, much attention has been given to the role of CT in detecting and quantitating respiratory health problems. Approximately 1.25 billion people smoke cigarettes daily worldwide (2). Lung density changes are expected for smokers over a period of time. Medical imaging comprises different imaging modalities and processes to image human body for diagnostic and treatment purpose and therefore has a significant role in the improvement of public health in all population growth. With the advancement of technology in medical imaging we can diagnose and evaluate various lung diseases. The purpose of this study is to evaluate CT lung density in a group of patients who are smokers versus non- smokers. Changes in the lung density measured by the CT can help diagnose lungs' functional level and empower people to understand lung diseases due to smoking and improve their quality of life. According to this study CT reconstruction helps in diagnosing that the clinical symptoms such as cough, sputum and breathlessness shows a significant difference between smokers and non-smokers, where these symptoms were more prevalence's among smokers as compared to non-smokers. Lung density and lung emphysema shows a strong correlation where lung density and emphysema were higher among the smokers than in non-smokers. The demographic value i-e weight also shows significant correlation with lung density for both smokers and non-smokers.

Introduction:

In recent years, much attention has been given to the role of CT in detecting and quantitating respiratory health problems. Lung density changes are expected for smokers over a period of time. Study conducted by Herman et al among 45 patients undergoing a diagnostic work-up and compared this with pulmonary function tests through CT, identified lung densities which was measured comparing the sector method with the whole lung method which were highly correlated with each other (r = 0.96, p less than 0.001), concluding that CT lung-density gives a good reflection of the degree of hyperinflation [(1)]

Approximately 1.25 billion people smoke cigarettes daily worldwide [(2)] .Cigarette smoking is responsible for 90% of all lung cancers, the leading cause of cancer deaths in the United States. Smoking is the major cause of chronic obstructive pulmonary disease (COPD), the fourth leading cause of death in the United States [(3)]. 90% of all deaths from COPD are caused by cigarette smoking. 90%of lung cancer deaths in men and almost 80% of lung cancer deaths in women are caused by smoking, as the toxic substances contained in cigarette smoke can cause cells in the airway to become malignant. Smoking not only damages the lungs, but also many other vital parts of your body.

Medical imaging comprises different imaging modalities and processes to image human body for diagnostic and treatment purpose and therefore has a significant role in the improvement of public health in all population growth. With the advancement of technology in medical imaging we can diagnose and evaluate various lung diseases.

With increasing prevalence of smoking, lung cancer has reached epidemic proportions

in India. It has surpassed the earlier commonest form of cancer, that of oropharynx, and now

it is the commonest malignancy in males in many hospitals.

Being a smoker for a period of time, one will begin to experience smokers cough, because your body uses this as a way to try and get rid of the toxins you inhale while smoking. Airways then get narrower and this makes it more difficult for air to flow in and out. Therefore one will have problems breathing and will often feel short of breath, which is an important symptom of chronic obstructive pulmonary disease (COPD). Lung density is a radiologic term used to describe the appearance of the lungs in their entirety or a specific portion of lung. It shows up as an increase or a decrease in the lightness or darkness of the lung "shadow" on a routine chest X-ray or a lung CT scan. Either decreased density (as with emphysema) or increased density (in the presence of inflammation or increased lung water) in comparison with the expected density of normal lungs can be indicative of diseased lung.

The density alone is not characteristic of a specific disease but, when used with other features of the radiologic lung image, can be suggestive of a disease or a category of lung disease.

The physical density of the lung as measured by CT scan will be determined by three components that is the lung tissue, blood and air. These components are not homogeneously distributed in the lung and their relative proportion changes continuously during normal physiologic events. The degree of inflation can change the density of the lung rapidly and markedly. Gravity causes regional differences in density by increasing the vascular component and decreasing alveolar expansion in dependent areas. On the other hand smoking for a period of time can have changes in the lung density.

Aim of the Study:

Lung density measurement among smokers versus non-smokers through CT -reconstruction.

Need of The Study:

The purpose of this study is to evaluate CT lung density in a group of patients who are smokers versus non- smokers. Changes in the lung density measured by the CT can help diagnose lungs' functional level and empower people to understand lung diseases due to smoking and improve their quality of life.

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Objectives Of The Study:

- To evaluate the lung density of smokers and non-smokers through CT
- To associate lung density measurements and their demographic variables
- To study the lung density and their dyspnoeic level through dyspnoeic scale

Hypothesis:

- H1: There will be a significant difference between the lung densities of smokers and non-smokers in terms of CT evaluations
- H2: There will be significant association between the lung density measurements and smokers' demographics

Assumptions:

The study assumes that the lung density measured through plain CT will show variations among smokers and non-smokers.

Variables:

- Independent variable: Plain CT scan
- Dependent variable: Lung density of smokers Vs non smokers

Delimitation:

The study is delimited to both in-patients and out-patients that will undergo CT lung for their respiratory health problems as advised by their physicians.

Methodology:

Research approach: Evaluative approach
Research design: Perspective observational design
Research setting: MDCT Brilliance 64slice Phillips,

Radio- diagnostic and imaging department, Kasturba Hospital, Manipal.

Population: Patients Scheduled for CT lungs or chest during the data collection period

Sample: 126 Samples (smokers + non-smokers)
Sampling technique: non-probability sampling technique

Sampling Criteria:

Patients who has smoking history as well as patients with no history of smoking

- Patients who will consent to participate in the study
- Patients within the age group of 20-60 years
- Patients who can follow instructions either in Kannada / Malayalam/ English/ Hindi
- Patients with major injuries or trauma will be excluded from the study
- Ventilated patients will be excluded from the study

Selection and development of study instruments, including validity, pretesting and reliability of the instruments: Study instruments will be prepared by the researcher such as-

Demographic proforma of patients

CT scan of lung or chest using calibrated or tested by authorized agency

Method:

The patient were given to fill the informed consent form and to answer few selected questions, then CT scan of thorax was performed on MDCT Brilliance 64 slice Phillips with a scan time of 4.341 sec at an interval time of 0.75sec, from the apex to the lungs to the diaphragm with 350mm of FOV, using collimation of 64 x 0.625. The slice thickness of 5mm with a filter of Sharp C, producing standard resolution.

During the scan, the patient is instructed to breathe at full inspiration and hold his /her breath for a few sec during scanning time in-order to reduce motion artefacts. The consent form was obtained from the patient before the start of the examination.

The original series of non-contrast scan is selected for calculation of the lung density. In the EBW (Extended Work Station) using the reconstruction software Lung Density Analysis we can evaluate the right and left lung density as well as the emphysema density can also be calculated using the software. The readings were noted and tabulated.

Discussion:

In the present study CT thorax scan was performed in a group of patients with smoking habits and non-smoking habit in-order to evaluate the lung emphysema analysis. The result of this study was based on the patients who have been evaluated with plain CT scan for lung emphysema. The report of this study suggested that smoking is the risk factor for lung emphysema. The lung density was calculated using automated application which provides a quantitative lung emphysema measurement and visual representation. The calculation was done in a particular threshold unit of -770HU. In patients with chronic bronchitis and hyper-inflation, the presences of emphysema are a poor prognostic sign therefore it is important to access how much emphysema is contributed to the hyperinflation. According to the study the decrease in lung density measurement is seen in a group of patients with emphysema. It is also observed that older patients had reduced lung density which is age related. The degree of inflation of lung will influences in density, so the measurement will be taken with full inspiration while acquiring the images. The severity of emphysema also shows increased in aging both in smokers and non-smokers. The present study also shows that some patients with emphysema developed functional abnormality similar to COPD.

The study also confirms that patients with history of smoking, the factors such as age, sex and height plays a significant role in diagnosing emphysema level per individual. These factors strongly suggest that that the host and the environmental factors other than smoking make a major contribution to this form of airway disease.

In a study conducted by Per Wolimer, 1986 where Measurement of Pulmonary Density by Means of Computerized Tomography in Relation to Pulmonary Mechanics among smokers versus non smokers, concluded that Pulmonary volumes has no statistically significant difference between nonsmokers and Smokers (Pulmonary function Test) whereas the Pulmonary density, measured in CT showed significant difference between non-smokers and Smokers but did not correlate with age, height & weight. Pulmonary density decreased with increasing pulmonary volume significantly higher in smokers than in nonsmokers. Smokers showed higher values of pulmonary density than non-smokers [(3)] .Later in 1992 AndrHeremans conducted a Correlation study between pulmonary function test with CT scan of thorax and concluded that CT lung density can be reliably measured on CT scanner during routine CT examination of the thorax. Significant correlations with pulmonary function tests that indicate airway obstruction and hyperinflation, but no significant correlations with pulmonary function tests that indicate emphysematous destruction [(5)]. In the present study Measurement of lung density and lung emphysema though standard protocol of CT thorax and analyzed through reconstruction in EBW Lung density analysis software keeping attenuation threshold at -770HU , it reveals reveals that there is a strong correlation between lung density and lung emphysema. Lung density and lung emphysema is higher among smokers as compared to non-smokers. The demographic value i-e weight

also shows significant correlation with lung density.

Ideally prevention of smoking policies would concentrate on preventing people from taking up the habit or either assists them to cease entirely. However such policies are partially successful. Many Smokers have considerable difficulty in quitting and a substantial proportion of them will die prematurely and live for part of their lives with crippling diseases consequences of their habits.

Statistical Analysis:

Table I: Demographic Demonstration of sampled subjects

	Smoking status	N	Mean	SD
Age(yrs)	**Smokers**	63	39.95	9.608
	Non Smokers	63	39.49	9.510
Height(ft)	**Smokers**	63	171.95	6.878
	Non Smokers	63	166.41	8.485
Weight(kg)	**Smokers**	63	68.38	7.327
	Non Smokers	63	69.48	8.487

Table II: Comparison of symptoms in smokers and non-smokers

Symptom	Smokers	Non Smokers	Chi-square value	P value
Cough	37	12	20.872	<0.001
Sputum	34	22	4.629	0.024
Breathlessness	38	14	18.861	<0.001

Table III: Comparison of lung emphysema (cm^3) & lung density (cm^3) of smokers and non-smokers.

	Smokers		Non Smokers		MGD	CI	P-Value
	Mean	SD	Mean	SD			
Lung Density	3253.10	396.80	2831.56	285.44	-421.54	-543.43to -299.65	<0.001
Lung Emphysema	3253.10	396.80	2831.56	285.44	-421.54	-543.43to -299.65	<0.001

Table IV: Correlation between demographic variables, lung density and lung emphysema for smokers and non-smokers.

Age		Smokers			Non-smokers		
		Height	Weight	Age	Height	Weight	
Total Lung Density	Pearson Correlation	-0.055	-0.132	0.284	-0.085	-0.025	0.342
	Sig (2 tailed)	0.669	0.303	0.024	0.509	0.846	0.006
	N	63	63	63	63	63	63
Total lung emphysema	Pearson Correlation	-0.055	-0.132	0.284	-0.085	-0.025	0.342
	Sig(2 Tailed)	0.669	0.303	0.024	0.509	0.846	0.006
	N	63	63	63	63	63	63

Figure I: Histogram showing Comparison of lung emphysema (cm^3) & lung density (cm^3) of smokers and non-smokers.

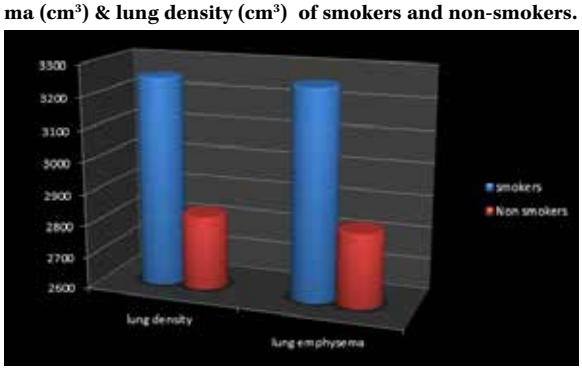
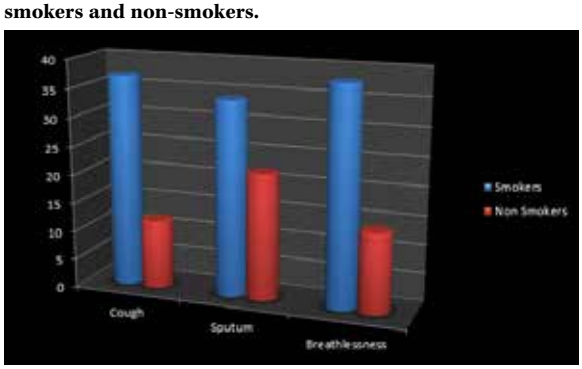


Figure II: Histogram showing comparison of symptoms in smokers and non-smokers.



Result:

In the present study, table I shows the demographic demonstration of sampled subjects of age, height and weight of both smokers and non-smokers. The clinical symptoms such as cough, sputum and breathlessness shows a significant difference between smokers and non smokers, where these symptoms were more prevalence's among smokers as compared to non-smokers. Lung density and lung emphysema shows a strong correlation where lung density and emphysema were higher among the smokers than in non-smokers.The demographic value i-e weight also shows significant correlation with lung density for both smokers and non-smokers.

Conclusion:

Respiratory disease is a common and significant cause of death around the world. Many people are affected by some form of chronic lung diseases most commonly chronic obstructive pulmonary disease which includes asthma chronic bronchitis and emphysema. The present study reveals that there is a strong correlation between lung density and lung emphysema. Lung density and lung emphysema were found correlated significantly with height and age of the patient.

In conclusion, smokers have denser lungs than non- smokers. The findings may help to interpret high resolution CT in the context of smoking and highlight the heterogeneity of structural changes in COPD. Our study has some limitations. Gender should be considered as one of the factors since lung density is highly associated with height and weight of the sample.

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