ORIGINAL RESEARCH PAPER

Management

ROLE OF MULTI-DETECTOR COMPUTED TOMOGRAPHY (MDCT) IN EVALUATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) AND SPIROMETRY CORRELATION

KEY WORDS: : COPD, MDCT, SPIROMETRY, LAV, EMPHYSEMA

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ABSTRACT

Background: Quantitative computed tomography can effectively characterize and quantify the extent of emphysema and air trapping related to small airways disease. Here we highlight computed-tomography findings of COPD and correlation with spirometric values. **Aim:** To describe and analyse the morphology of lung on HRCT in patients with COPD and correlate the findings of MDCT by volumetric analysis and densitometry with pulmonary function tests and severity of the disease. Methods: The study group included a total of 86 adult patients of either sex with a clinical suspicion of COPD and those who undergone MDCT of thorax. **Results:** There was a preponderance of male patients with highly significant correlation between values of mean lung density and low attenuation values (r=-0.707, p<0.000l) .Linear regression curve analysis reveal (R2=0.445) 44.5 % of the patients to have strong linear correlation between values of mean lung density , LAV and spirometric values. **Conclusion:** The present study concludes that Multi detector computed tomography is an invaluable tool in defining and quantifying COPD and characterization of emphysematous changes

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity and is the 12th leading cause of disability in the world.1 It is defined in functional terms as a slowly progressive disorder characterized by airflow limitation that does not change markedly over several months. The limitation of airflow is associated with an inflammatory response of the lungs to various noxious particles or gases.[2]

The primary parameters of diagnostic assessment with spirometry are Forced Expiratory Volume in the 1st second (FEV1) and Forced Vital Capacity (FVC). Reductions in FEV1, FVC and the ratio of FEV1 to FVC are hallmarks of airway obstruction. The criterion for a diagnosis of COPD is an FEV1/FVC ratio of less than 70% and a post bronchodilator FEV1 less than 80% of the predicted value confirms airflow limitation.[3]

Computed Tomography (CT) demonstrates the presence, distribution, and extent of emphysema and is superior to chest radiography.4 Three different approaches have mainly been used for objective quantification of emphysema on CT scanning: (1) use of a threshold value below which emphysema is considered to be present [density mask or pixel index (PI)], (2) assessment of the range of lung densities represented in a lung slice (histogram analysis) and (3) assessment of overall lung density, often in combination with volumetric imaging(LAV).[5]

AIMS & OBJECTIVES

1. To describe and analyse the morphology of lung on HRCT in patients with COPD.
2. To correlate the findings of MDCT by volumetric analysis and densitometry with pulmonary function tests and severity of the disease.
3. To correlate the radiological findings with the symptomatology of patient.

MATERIALS AND METHODS:

SOURCE OF DATA

The study was conducted in Department of Radio diagnosis, Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry in association with Department of Medicine and Chest & TB.

The study group included a total of 86 adult patients of either sex with a clinical suspicion of Chronic Obstructive Pulmonary disease (COPD) and those who undergone MDCT of thorax.

Inclusion criteria

Patients showing clinical signs and Symptoms consistent with the diagnosis of COPD and those who undergone MDCT of thorax. Patients who were willing to participate in the study and gave written consent.

Exclusion criteria

Any coexistent lung pathology or lung malignancy.Patients who were not willing to participate in the study and did not give written consent.

Duration of Study: The study was conducted for a period of 2 years
Study design- Cross sectional Study

Consent- Informed written consent in vernacular language was obtained in every case.

Study Method:

All the patients were evaluated and the following findings were recorded on a separate proforma.

1. Clinical assessment

All relevant symptoms, past history of smoking and findings of general and systemic examination were documented in each patient.

2. Pulmonary Function tests: Pulmonary function tests were performed by an EasyOne spirometer (Ndd Medical Technologies) with the patients in a seated position. The Spirometric data were collected on the same day when CT scan was acquired.

3. Radiological evaluation

(a) Plain radiography

Standard postero-anterior chest radiographs of the patients were obtained in all patients using Fujifilm Dry Pix CR System. Radiographs were evaluated to detect the presence of emphysema.

(b) Computed Tomography

Computed tomography of the thorax were performed for all patients on a 32 slice multi detector CT scanner system (Siemens Somatom Scope) in the helical mode without intravascular contrast material. Densitometric measurements were performed with PULMO CT software.

RESULTS

A total of 86 patients with clinical suspicion of Chronic Obstructive Pulmonary Disease were included in the study. Our study group consisted of 78 males and 8 females with ages ranging from 31-70 years. The patients were evaluated by chest x-ray, pulmonary function tests and Multi Detector CT of thorax. There is highly significant correlation between values of mean lung density and low attenuation values (r=-0.707, p<0.000l) suggesting that as low attenuation value increases mean lung density decreases. Linear regression curve analysis reveal (R2=0.445) 44.5 % of the patients to have strong linear correlation between values of mean lung density and LAV.

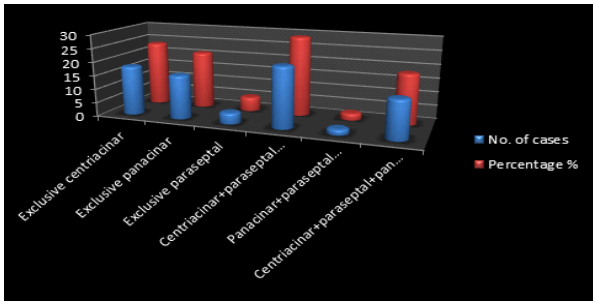

Chart 1: Distribution of type of emphysema on CT*

TABLE 1Correlation between mean FEV1 (%) and low attenuation value (%). (n=84)

	Mean ± SD	Spearman's correlation(r)	p value
FEV1 (%)	60.93 ± 30.34	-0.452	0.002
Low attenuation value (%)	12.96 ± 9.66		

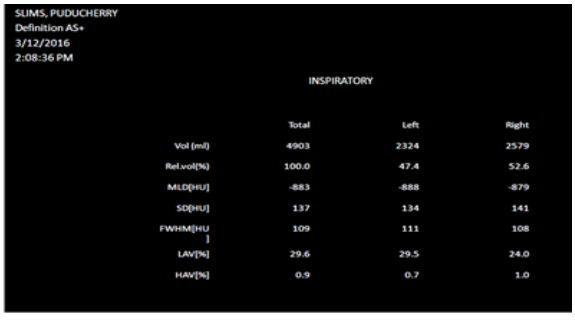

Chart -2: General intensity statistics showing MLD of -883 HU with LAV occupying 26.6% of the total lung parenchyma in a elderly known COPD male patient .

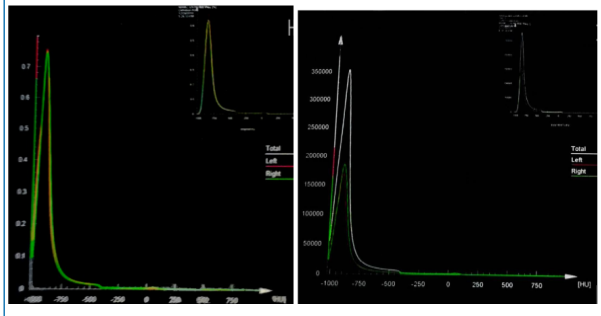

Chart 3 & 4 : Relative and absolute frequency histogram showing the curve is skewed towards left(graph on the right upper corner showing curve of a normal person)

DISCUSSION:

The present study was undertaken to evaluate the role of multi detector computed tomography in chronic obstructive pulmonary disease and its correlation with severity of disease.

Eighty six patients with clinical diagnosis of COPD based on the clinical profile and pulmonary function tests underwent MDCT chest in the Department of Radiodiagnosis, Sri Lakshmi Narayana Institute Of Medical Sciences, Puducherry.

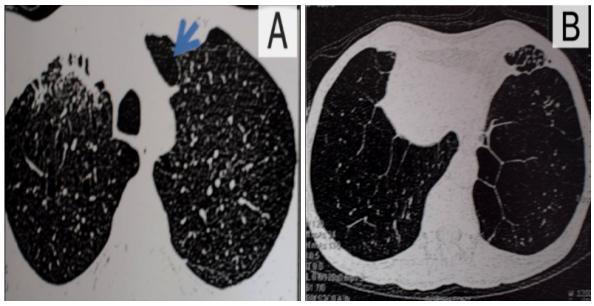

Fig A&B: HRCT(A) reveals few foci of low attenuation areas without discernable wall in upper lobes suggestive of centriacinar emphysema.Arrow shows paraseptal emphysematous changes in left upper lobe anterior segment and fibrotic opacities in right upper lobe. Areas of low attenuation and vascular deficiency diffusely involving the lower lobes consistent with appearance of panacinar emphysema (B).

Our study group consisted of 78 male and 8 female patients. The age of the patients ranged from 31 to 70 years, with 75% of the patients being more than 50 years of age. Patients less than 40 years constituted only 4.6% of total patients. Our findings are consistent with previous studies done to estimate the prevalence of emphysema in the general population where it was found that the emphysema prevalence rate is very low under 45 years of age and prevalence rate increases dramatically above 45 -50 years of age with 94% patients being 45 years or older.[6]

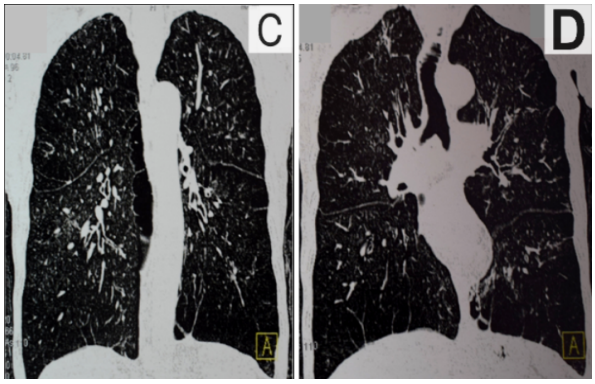

Fig C-D: Coronal MPR images depicting the type of distribution of emphysematous changes. Centriacinar emphysematous changes are seen as irregular low attenuation areas in upper lobes with paraseptal bullous emphysematous changes along the mediastinal and visceral pleura. Low attenuation areas with vascular deficiency seen diffusely involving lower lobes suggestive of panacinar emphysema.

All of the patients in our study except two consumed tobacco either in the form of cigarettes or bidi. Patients having normal spirometric indices, on an average smoked less number of pack years i.e. 7.75 as compared to patients with deranged spirometric indices. Patients with mild and moderate airflow obstruction on an average smoked 10.6 and 14.7 number of pack years respectively whereas patients with severe airflow obstruction smoked 25 pack years. Two patient in the group were non smokers. Tobacco smoking remains the most important risk factor identified as the cause of COPD.7

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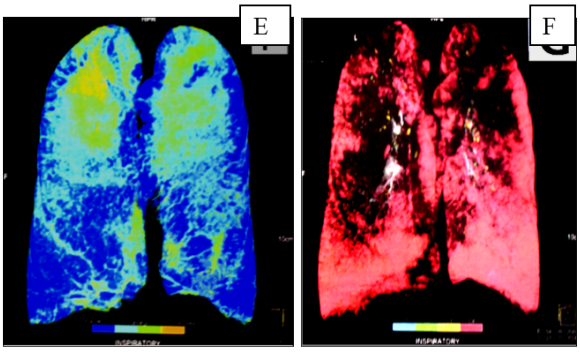

Fig E-F: Colour coded images showing sub ranges of [HU] distribution, with royal blue colour showing areas of lung parenchyma between values of -950 to -1000 HU indicative of severe emphysematous changes (E) with colour coded images of cluster class analysis with red colour areas showing LAV of volume greater than 167cc (Class4)(F).

Seventy eight patients were diagnosed as subtypes of emphysema by visual assessment on CT while in eight patients the emphysematous spaces were not visually appreciated. Exclusive centriacinar emphysema was seen in 23.6% of patients while panacinar type was seen in 21% of patients. Centriacinar and paraseptal emphysema were found together in 22 (29%) patients. Exclusively paraseptal emphysema was seen in only four patients. Panacinar and paraseptal emphysema were together seen in only two patients. Centriacinar, panacinar and paraseptal emphysema together were seen in 14 (18.4%) patients.

Twenty six patients with low attenuation values between 11-20% had an average mean lung density of -857.4 HU. Eighteen patients with low attenuation values between 21-30% had an average mean lung density of -871.2 HU. Four patients with low attenuation value above 31% had an average mean lung density of -886 HU. There is highly significant correlation between values of mean lung density and low attenuation values ($r=-0.707$, $p<0.000l$) suggesting that as low attenuation value increases mean lung density decreases.8 Linear regression curve analysis reveal ($R2=0.445$) 44.5 % of the patients to have strong linear correlation between values of mean lung density and LAV.

CONCLUSION

Pulmonary function tests are inexpensive and initial diagnostic tool to detect airflow limitation. Computed Tomography accurately depicts even minute changes in underlying lung parenchyma and can help quantify the severity of disease. The present study concludes that Multi detector computed tomography is an invaluable tool in defining and quantifying COPD and characterization of emphysematous changes.

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