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RESEARCH ARTICLE

A STUDY OF ROLE OF HIGH RESOLUTION COMPUTED TOMOGRAPHY AMONG COPD PATIENTS IN A TERTIARY CARE CENTRE

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ABSTRACT

Background: From the last few years, high-resolution computed tomography (HRCT) has come up as a new diagnostic modality to diagnose emphysematous and chronic bronchitis components of chronic obstructive pulmonary disease (COPD). IN this study was undertaken to evaluate for HRCT features in patients with COPD, which include various qualitative and quantitative features of HRCT and to detect patients' characteristics that correlate with these HRCT features. HRCT allows direct visualization of areas of lung destruction, and allows detection of parenchymal changes 0.2-0.3 mm in size. HRCT is more sensitive than chest radiography and lung function tests in the detection of early smoking related lung damage and also to see disease progression in COPD. It is also help to identify the presence and to quantify the amount of emphysema present. **Material and Method**-after taking ethical approval informed consent is taken from 100 patient of COPD from OPD and IPD in GMC KOTA in a span of one year is selected by simple non purposive sampling spirometry done and HRCT done and various parameter is calculated. **Result**-in this study various parameter like age, DOI, pack year, spirometric parameter quality of life is taken as a study variable of patient and HRCT various quantitative and qualitative parameter is taken to find out relation between them in our study age, duration of illness, pack year, shows correlation with various CT features shows disease progression p value is below 0.01 (which is extremely significant).in this study %FEV1,AQ30 shows association with few CT features not all . **Conclusion:** In our study variable in COPD patients are shows significant relation with Various quantitative and qualitative HRCT features were found to correlate with patients' characteristics, spirometric indices, and health-related quality-of-life score, suggesting that HRCT is useful notonly in detecting emphysema and its various subtypes but also in predicting the extent and severity of COPD and find relation between high resolution computed tomography features and patients characteristics in chronic obstructive pulmonary disease .

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INTRODUCTION

The Global initiative for Obstructive lung disease describes (GOLD) Chronic Obstructive Pulmonary Airway Disease is a Preventable & Treatable Disease which is characterised by persistent airflow limitation that is usually progressive and COPD was underdiagnosed in India, but is now recognised in 4-10% of the adult male population in several Asian countries (2) pulmonary function test is the accepted and standardised method for the diagnosis and severity assessment of COPD. The two entities of COPD, namely chronic bronchitis and emphysema, often occur together, and it is difficult to

differentiate between the two clinically as well as with the pulmonary function test (PFT). In contrast to the PFT, radiological techniques allow for differentiation between different components of the obstructive lung disease on a regional basis [3]. HRCT is the most accurate imaging method for diagnosing emphysema [4,], The GOLD initiative defines COPD as "a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases. Chronic obstructive pulmonary disease (COPD) is a poorly reversible disease of the lungs that is one of the major causes of morbidity and mortality worldwide. In the United States, it is the fourth leading cause of death after heart disease, cancer, and cerebrovascular disease.(5 6)By 2022 , it is projected to become the third leading cause of death worldwide(5) Contrary to the trends for other major chronic diseases in the United States, the prevalence of and mortality from COPD have continued to rise(7) ; the death rates doubled between 1970 and 2002 (8) and for the first time in 2000, mortality figures for women surpassed those for men(6, 9)In the United States, 12 million patients are currently diagnosed with COPD, but there is believed to be at least an equal number of individuals with impaired lung function suggestive of COPD who are undiagnosed. (10) Given that the majority of COPD cases are caused by smoking, it is primarily a preventable disease.

Advantages of high resolution computed tomography: At present the diagnostic criteria recommended by the Global Strategy for the Diagnosis, Management and Prevention of Chronic Obstructive Lung Disease (GOLD guidelines) do not consider CT findings during initial diagnostic assessment (Pauwels & Buist 2001) and principally rely on spirometry. However, enough scientific literature suggests that HRCT is an important and indispensable tool for evaluation of COPD. Some of the uses of HRCT are described below in next sections.

- Identifying causes of airway obstruction other than COPD
- Identification of emphysema before appearance of clinical symptoms
- Identifying and quantifying emphysema in patients with COPD
- Detection of co-existing bronchiectasis
- Evaluation of large airways

There are two methods for assessing and quantifying the amount of emphysema on HRC High-resolution computed tomography (HRCT) of the chest helps determine which structures are more involved (airways or lung parenchyma) and to quantify the damage. Besides, some authors have been using the method to propose a tomography phenotyping of COPD.
Three different phenotypes of emphysema. A. Centrilobular. B. Paraseptal. C.panacinar.

AIMS AND OBJECTIVES

- A prospective study of correlation between high resolution computed tomography features and patients characteristics in chronic obstructive pulmonary disease in a tertiary care centre.
- To identify disease progression and severity of disease

MATERIAL AND METHOD

SOURCE OF DATA: This is a open label , prospective study was conducted in the new medical college and hospital on patient admitted and attending pulmonary OPD in span of one year since July 2020 to July 2021.

STUDY DESIGN: This is a Cross-Sectional study

STUDY POPULATION: Sample Size A total of 100 patients who were selected and recruited for this study between the age group of 40 to 90 years.

ETHICAL APPROVAL: The study received approval of the ethics review committee of new medical college and hospital kota date letter no written informed consent was obtained from each patient after explaining them about study.

INCLUSION CRITERIA: Eligible male and female patients with COPD, aged 40 years or more, and who provided informed written consent, attending the OPD and IPD In GMC HOSPITAL KOTA during the period from july 2020 to june 2021 were included. The diagnosis of COPD was based on the criteria defined by 'Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2021 '. All included patients had a smoking history and had airflow limitation that was not fully reversible (postbronchodilator FEV1 less than 80% of the predicted value in combination with FEV1/FVC not more than 70%).

Criteria of exclusion: The patients were not included in the study if they had any evidence of coexisting bronchiectasis, cystic fibrosis, tuberculosis, bronchial asthma, interstitial lung disease, bronchogenic carcinoma, previous lung surgery, or coronary artery disease.

Data collection: After taking an informed consent a thorough history is taken including cardinal symptoms of the patient. Age ,gender ,sex and weight ,The socio-demographic history, family history, smoking history and past history were recorded .Degree of breathlessness was measured by using Medical Research Council (Mmrc) dyspnea scale, Smoking pack years were based on the mode of smoking (bidi, cigarette,)daily consumption, and total years smoked. One pack year was 20 cigarettes smoked/day for 1 year.

SPIROMETRY: The spirometry was Performed following graphs called spirograms were noted . All patients were required to withhold inhaled short-acting bronchodilators 6 hours before test, long-acting β-2 agonists 12 hours before test, and sustained-release Theophylline 24 hours before test. The following parameters were recorded: PEFR (peak expiratory flow rate) in liters/ min FEV1 (forced expiratory volume in the first second) in liters FVC (forced vital capacity) in liters, FEV1/FVC% (forced expiratory volume in first second/forced vital capacity %)

AQ 30 QUESTIONNAIRE: A questionnaire, Airways Questionnaire 30, validated by previous studies was used to assess the health-related quality of life in the present study. The positive responses were scored and then summed to provide a total score out of 30 (AQ30).

HRCT High-resolution computed tomography (HRCT) was carried out. No contrast was used. Following features were evaluated using HRCT. The following parameter was assessed in our study population.

- Tracheal index: A ratio of transverse to anteroposterior diameter at a plane 1 cm above aortic arch.
- Distance from posterior surface of sternum to anterior margin of aorta at carinal level.
- Thoracic cross-sectional area: Thoracic cross-sectional area (TCSA) was measured on HRCT images made 1 cm below the top of aortic arch. The ratio of TCSA to the square of height (TCSA/height2) was calculated for each patient.
- Vascular attenuation: Vascular attenuation was considered when there was thinning of pulmonary vessels and reduction in their number.
- Vascular distortion: Vascular distortion was described as increased branching angles and /or excessive straightening of pulmonary vessels.
- Mosaic attenuation pattern: Mosaic attenuation meant nonhomogeneous lung density; the latter was described as areas that remain relatively lucent interspersed with areas of normal or higher lung density.
- Directly visible small airways: The airways with internal diameter not more than 2mm.
- Air trapping.

STUDY METHOD: The study method is applied on this is Pearson correlation coefficient and correlation test is applied to find association between quantitative variable of HRCT and patient study variables. Chi square test is used to find relation between qualitative variable of HRCT and study variable.

RESULTS

The present study included 100 patients with COPD. The patients' characteristics were as shown in TABLE 1

The mean age of the COPD patients was is 58.87 and SD is 8.89years, and The mean duration of illness was 9.56 SD =5.78 years. The smoking pack years ranged from Mean =13.3 SD =11.13 years. The mean and SD of fev1% are 53.2 SD =17.47. The mean and SD oxygen saturation was 89.39 SD= 7.81 questionnaire 30 (AQ30) score Mean =18.3 SD=4.66 the mean and SD of tracheal index 0.66 and 0.1 mean and SD of sterno aortic distance 3.83 and 0.82 mean and SD of TCSA are 79.19 ,5.52

Table 1. Mean And Sd of Study Popula Tion

STUDY PARAMETER	MEAN	SD
AGE	58.87	8.89
DOI	9.56	5.78
PACK YEAR	13.3	11.13
AQ30	18.3	4.66
%FEV1	53.2	17.47
TA	0.66	0.1
SA	3.83	0.82
TCSA	79.19	5.52

Table 2. P values of study variable and HRCT quantitative parameter

P VALUE	TI	SA	TCSA
AGE	0.0001	.0001	.0001
DOI	.0002	.0003	.0155
PACK YR	.0001	.0001	.0001
%FEV1	0.6999	0.0350	0.0712
AQ30	0.6404	0.6904	0.9716

The pearsons coefficient corelation test is applied to detect relation between study variable and CT quantitative parameter.

RELATION BETWEEN QUANTITATIVE HRCT FEATURES AND STUDY VARIBLE: Age variable is very significantly associated with quantitative parameter all three p value of correlation is below 0.0001 in our study this result shows age variable significantly associated with age and quantitative variable and all three R value Is have strong positive strong correlation.

DURATION OF ILLNESS WITH QUANTITATIVE PARAMETER: All three HRCT parameter have significant correlation with COPD parameter and all Three R value shows three variable have significant correlation between DOI and CT parameter.

%FEV1 AND CT QUANTITATIVE VARIBLE CORRELATION: In our study CT variable have association with SA distance p value between CT and SA distance and %fev1 association p value is 0.035 which is significant. In our study according to this value we found no association between %fev1 and tracheal index diameter and very week correlation with TCSA

PACK YR AND QUANTITATIVE PARAMETER: The correlation between pack year and tracheal index p value =0.0001 which is extremely significant R value =18.27

The correlation between pack year and SA distance p value =0.0001 which is extremely significant R value=19.958 The correlation between pack year and TCSA p valve is <0.001 which is extremely significant.

AQ30 AND CORRELATION BETWEEN HRCT FEATURES

tracheal index and AQ30 p value is 0.64 not significant , AQ30 and SA distance p value is 0.69 not significant correlations between AQ30 and TCSA p value is 0.97 not significant.

ACCORDING to this calculation in our study no CT parameter is associated with AQ30 parameter.

Table 3. Correlation between hrct qualitative variable and study variable

P VALUE	La area	Visible small airway	VA	VD	MA
Age	0.0531	0.0095	0.0007	0.0668	0.71
DOI	0.026	0.0001	0.0001	0.0241	0.2341
PACK YEAR	0.0061	0.0001	0.5646	0.0001	0.0001
%fev1	0.0124	0.1076	0.4237	0.062	0.5344
AQ30	0.0155	0.4985	0.4407	0.4778	0.7527

In this study **chi-square test** is applied between patient study variable and HRCT qualitative variable.(visible small airway ,LA area(area showing emphysema),vascular attenuation, vascular distortion, mosaic attenuation.

TABLE NO 3 P VALUES OF STUDY VARIBLE WITH HRCT QUALITATIVE VARIABLE 1 Relation between age and qualitative parameter LA area (emphysema) visible small airway ,vascular attenuation ,vascular distortion ,mosaic attenuation.1 in this study age is significantly associated with all CT parameter except mosaic attenuation. 2. duration of illness study parameter is significantly associated with all qualitative parameter except mosaic pattern. 3. smoking pack year is significantly shows association with emphysema ,small airways ,vascular distortion and attenuation pack year shows no association with visible small airways. 4. study variable %fev1 shows association with emphysema (LA AREA) only no relation with other CT variable. 5 AQ30 parameter shows association with LA area rest CT parameter shows no association with AQ30.

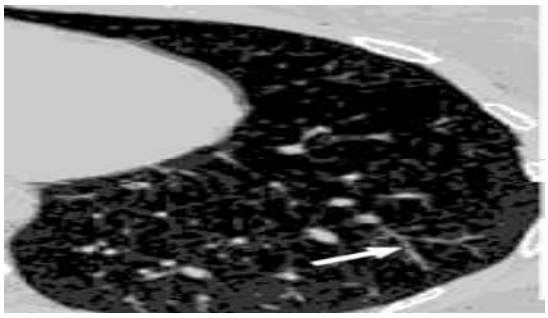

Fig.1. Vascular attenuation

FIG 2. Air trapping

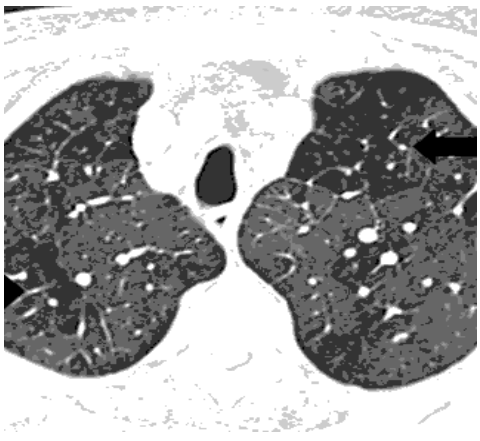

Fig 3. Mosaic attenuation

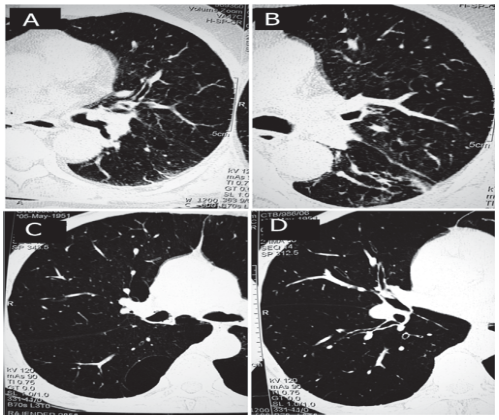

Fig 4. Vascular distortion

DISCUSSION

This is an open label ,prospective ,cross sectional study done in the department of respiration medicine ,new medical college hospital ,kota during period of1 year .on the basis of history ,clinical examination and various investigation 100 COPD patient from OPD and IPD were taken from respiratory department gmc kota. Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease. It is a disease state that has seen significant changes in defining and excluding criteria over the past 50 years[1] and as a result, some of the earlier studies are not expected to have inclusion criteria of COPD patients as per recent guidelines. Many studies in past selected patients with emphysema only.[11,12] Some studies[13–17] did not have reversibility criteria in accordance with Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines. In the present study, all subjects included were smokers and had irreversible or partially reversible airflow limitation, as required for the diagnosis of COPD. The patients having poorly reversible airflow limitation observed in bronchiectasis, cystic fibrosis, tuberculosis, or asthma were not included. This might have led to some variation in the outcome of our study, but the present study has clinical relevance as the diagnosis of COPD was based on the clinical and the spirometric criteria that are invariably used in clinical practice

In a study by J P HYPERLINK "https://pubmed.ncbi.nlm.nih.gov/?term=Trigaux+JP&cauthor_id=8192961"Trigaux [(18)] 1994 signs of COPD were compared between a series of 20 patients with a saber-sheath trachea at CT (tracheal index < or = 66%) and a group of 20 pneumologic control patients without saber-sheath trachea (tracheal index > or = 70%). These signs included clinical and standard radiographic indices of COPD, sternum-spine distance and 3 functional tests of COPD: forced expiratory volume in one second, carbon monoxide diffusing lung capacity, and functional residual capacity (FRC). A significant difference was found between the 2 groups, concerning the values of FRC ($p < 10(-4)$) and of sternum-spine distance ($p < 10(-2)$). The tracheal index was significantly correlated with the FRC values ($r = -0.611$; $p < 10(-5)$) and with the sternum-spine distance ($r = -0.322$; $p < 0.05$). In a study by Arakawa (19) tracheal index, thoracic cage ratio, and sterno-aortic distance were significantly correlated with FEV_1/FVC ratio in 74 patients 45 patients showed air trapping on expiratory HRCT scans. Of these 45 patients, inspiratory high-resolution CT scans showed abnormal findings in 36 (bronchiectasis,

bronchiolitis obliterans, asthma, chronic bronchitis, and cystic fibrosis). In the remaining nine patients, inspiratory HRCT had normal findings; conditions in these nine patients included bronchiolitis obliterans (n = 5), asthma (n = 3), and chronic bronchitis (n = 1). Results of pulmonary function tests in patients with air trapping and normal findings on inspiratory scans were intermediate, falling between those of patients with normal findings on inspiratory and expiratory HRCT scans and those of patients with air trapping and abnormal findings on inspiratory scans. (44 with normal lung function, 30 with COPD). Another Study by kasai [20] showed a good correlation between thoracic cross-sectional area and total lung capacity, functional residual capacity, residual volume, scale of dyspnea.

A study by PREM P gupta (21)2008 shows significant correlation to our study the study variable of COPD patients shows significant correlation to CT parameter. study by Kuwano and co-workers, CT score was assessed by examining low attenuation areas, vascular attenuation, and distortion;[22] correlated the HRCT scan of emphysema and the destructive index (DI) of lung specimens from 42 patients undergoing thoracotomy for a solitary pulmonary nodule. The CT scores using 1-mm and 5-mm collimation correlated significantly with the pathology scores (r = 0.68 and 0.76, respectively, p less than 0.001), and with the DI (r = 0.62 and 0.74, respectively, p less than 0.001). The pathology scores correlated significantly with the DI (r = 0.72, p less than 0.001). it correlated significantly with DL_{CO}, FEV_1/VC ratio, maximum mid-expiratory flow rate, and residual volume/total lung capacity. a study by MacNee *et al.(23),* vascular attenuation and distortion on CT scans of 32 patients correlated significantly with DL_{CO}, FEV_1% predicted, and FEV_1/FVC%. Low attenuation areas due to emphysema were seen by us in 64/100 (64 %) patients. The presence of this feature correlated significantly with age of patient, cduration of illness, smoking pack years, dyspnea score, and spirometric indices. The emphysematous features had upper lobe predominance, explained by the fact that all patients were moderate-to-heavy smokers.

In a study by Miniati *et al. (24)* the HRCT score based on the extent of emphysema correlated with FEV_1, FVC, forced mid-expiratory flows, maximum flows at 50% and 75% of FVC, residual volume, total lung capacity, and diffusion constant.[24] Klein *et al.*[12] observed that centriacinar emphysema was the dominant parenchymal abnormality and was strongly correlated with DL_{CO} . Srinakarin j Thammaroj HYPERLINK "http://europepmc.org/search? query= AUTH:%22Jureerat%20Thammaroj%22" et al HYPERLINK "http://europepmc.org/search?query=AUTH:%22Jureerat%20Thammaroj%22" HYPERLINK "http://europepmc.org/search?query= AUTH: %22Jureerat%20Thammaroj%22"(28) The HRCT of all 17 patients (17/17; 100%) were typical of centrilobular emphysema; with a mean score of 12.88+/-9.18 (range, 4 to 34). Decreased FEV1 (<80% predicted) was found in 8 patients (47%), decreased FEV1/FVC (<70% predicted) in 13 patients (76%) and decreased DLCO (<80% predicted) in 3 patients (18%). The severity of emphysema revealed by HRCT was inversely correlated with the pulmonary function test: DLCO (r=-0.842, p=0.000) and FEV1 (r=-0.597, p= 0.011), but not FEV1/FVC (r=-0.400, p=0.112 Singh A et al. **(29)** Fifty patients of COPD (confirmed on spirometry as per the GOLD guidelines 2014 guidelines) were enrolled, out of which 35 patients got a HRCT done. smoking index and anteroposterior tracheal diameter (P = 0.036). Tracheal index was found to be decreasing with increasing disease severity which was statistically significant (P = 0.037).

CONCLUSION

To conclude, in the present study, we were able to detect significant correlations between various quantitative HRCT features and patients' characteristics, spirometric indices, as well as health-related quality-of-life score.in this study Moreover, significant correlations were observed using qualitative HRCT features. This suggests that HRCT is helpful not only in detecting emphysema and its various subtypes but also in predicting the extent and severity of the COPD and also useful in disease progression AND to see other coexisting illness.

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