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"To Evaluate HRCT Spectrum in COPD Patients and its Correlation with Spirometric Indices"

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ABSTRACT: Chronic Obstructive Pulmonary Disease (COPD) is a multifactorial disease and a major cause of mortality and morbidity worldwide. The Global Initiative for chronic obstructive lung disease (GOLD 2020) defines COPD as "a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases and influenced by host factors including abnormal lung development." In this study we have correlated various imaging parameters with the spirometric indices and formed a clinicoradiological assessment.

KEY WORDS: **HRCT** : High Resolution Computed tomography, **COPD** : Chronic Obstructive Pulmonary Disease, **GOLD :** Global Initiative for Chronic Obstructive Lung Disease, **FEV :** Forced Expiratory Volume, **TI :** Tracheal Index, **FVC :** Forced Vital Capacity
SAD : Sterno-Aortic DiameteR, **TCR :** Thoracic Cage Ratio

I. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a multifactorial disease and a major cause of mortality and morbidity worldwide. The Global Initiative for chronic obstructive lung disease (GOLD 2020) defines COPD as "a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and / or alveolar abnormalities usually caused by significant exposure to noxious particles or gases and influenced by host factors including abnormal lung development." [1]

According to GOLD criteria, spirometry is required to make the diagnosis of COPD. A post-bronchodilator ratio of FEV1/FVC < 0.70 is considered confirmatory. The forced expiratory volume in one second (FEV1%) is used to classify COPD patients into different grades. While having the advantage of this value being simple to obtain, it suffers from inherent measurement variability while also being nonspecific.[5]

Chronic respiratory symptoms may precede the development of airflow limitation. Thus, individuals with normal spirometry, may present with chronic respiratory symptoms. Some studies found that a significant number of smokers may have varying presence of emphysema, airway wall thickening and gas trapping without any evidence of airflow limitations.[6]

HRCT chest is an extremely useful modality in assessing patients with parenchymal lung disease. HRCT uses thinly collimated slices of 0.5-1.5 mm thickness with a sharp algorithm that enhances edge detection and provides excellent spatial resolution and anatomical details. The lung parenchyma is delineated to the level of secondary pulmonary lobules. Thin collimation ensures less partial volume averaging and better detection of abnormalities. Different structural changes may be seen in the lungs as the disease progresses. These changes are not evident through spirometry or by assessment through clinical tests and scales. HRCT may help monitor the disease progress and plan a much more comprehensive management plan for patients.

By 2060, it is estimated that there may be over 5.4 million deaths from COPD and associated co-morbidities annually.[3] There is a need for better assessment of COPD patients. Therefore, this study was carried out to evaluate the role of HRCT in COPD patients presenting with different grades of severity and correlate the various CT parameters with spirometry values.

AIMS AND OBJECTIVES

AIMS

- To assess and evaluate the HRCT chest findings in patients of COPD.

OBJECTIVES

- To correlate the HRCT chest findings with spirometric indices.

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II. MATERIALS AND METHODS

The study was conducted in the Department of Radiodiagnosis in collaboration with the Department of Pulmonary Medicine at MMIMSR, Mullana, Haryana. The study was approved by the Institutional Board of Studies and by the Ethical Committee. Fifty clinically stable COPD patients diagnosed on the basis of GOLD criteria were referred from the Department of Pulmonary medicine over a period of 2 years. The cases were based on the following criteria:

INCLUSION CRITERIA:

- Patients of the age group 35-55 years
- Patients of both sexes
- Cases diagnosed with COPD by the criteria defined by the Global Initiati
- for Chronic Obstructive Lung Disease (GOLD) 2017 report'.

EXCLUSION CRITERIA:

- Patients requiring mechanical ventilation
- Patients having co-existing cardiac disorder
- Patients with any evidence of tuberculosis, bronchial asthma, bronchogenic carcinoma, previous lung surgery
- Patients with concomitant disorders like diabetes mellitus, chronic alcoholism, uremia, or sarcoidosis
- Pregnant women and post-surgical cases

III. METHODS

Thirty-five patients diagnosed as COPD on the basis of GOLD criteria were referred from the Department of Pulmonary medicine and HRCT scans of the chest were taken for all the patients in the study. The criteria used for diagnosis was established by the Global Initiative for Obstructive Lung Disease (GOLD) classification, which defines COPD as FEV1/FVC (forced expiratory volume in 1 second/ forced expiratory volume) <70% and categorizes severity into mild, moderate, severe, and very severe categories based on post bronchodilator FEV1> 80%, < 80%, < 50%, and < 30%, respectively.

Spirometry was carried out using RMS Hello 401 PFT system. The parameters recorded included forced expiratory volume in the first second (FEV1) in liters, forced vital capacity (FVC) in liters and FEV1 /FVC.

The following parameters were assessed for all patients of the study-

- Sterno-aortic distance (SAD) – Distance measured from the posterior surface of the sternum to the line drawn along the anterior margin of the ascending aorta at the level of the carina.
- Thoracic cage ratio (TCR) - Obtained by calculating the ratio of the anteroposterior diameter to the transverse diameter of the inner thorax at

✓ At the level of the carina

✓ At a level 5cm below the carina

- Tracheal index (TI) – A ratio of the transverse diameter to the anteroposterior diameter of the trachea taken at the level of 1 cm above the aortic arch. Saber-sheath trachea was described as when the tracheal index was less than 2/3.
- Thoracic cross-sectional area) (TCSA) – The thoracic cross-sectional area (TCSA) was calculated using the area tool at a level 1cm below the top of the aortic arch. The ratio of the thoracic cross-sectional area to the square of the patient's height was taken for each patient.
- Type of Emphysema: Presence of centrilobular, paraseptal or panlobular subtype of emphysema.
- The presence or absence of the following:
- Mosaic attenuation pattern: was described as areas that remain relatively lucent interspersed with areas of normal or higher lung density.
- Small visible airways: The airways with internal diameter not more than 2 mm
- Atelectasis
- Bronchiectasis: was considered when there was lack of tapering of bronchi with the internal diameter of the bronchi being larger than that of the adjacent pulmonary artery, or when peripheral bronchi within 1 cm of the costal pleural surface were visualized.
- Bronchial wall thickening: was assessed subjectively.
- Vascular attenuation: was considered when there was thinning of pulmonary vessels and reduction in their number.
- Vascular distortion: was considered as increased angles and/or excessive straightening of pulmonary vessels.

The HRCT findings were correlated with the spirometry findings namely, the (FEV1) in liters, forced vital capacity (FVC) in liters and FEV1FVC (%).

IV. SUMMARY AND CONCLUSION

This was a prospective study conducted at Department of Radio-diagnosis, MMIMSR, Mullana, Haryana. The present study aimed to evaluate the HRCT findings in COPD patients and correlate the quantitative parameters with spirometry.

The key features of the present study-

- A total of 50 COPD cases were studied.
- Patients aged 35-55 years were included. The mean age of the patients was 46.98 ± 6.36 years. The mean age of the patients was seen to be increasing with GOLD stage severity.
- 41 (82%) of the patients were males and 9 (18%) were females.
- 4 (8%) of the participants were classified as Gold Criteria: Class 1, 20 (40.0%)patients were classified as Gold Criteria: Class 2, 20 (40.0%) patients were classified as Gold Criteria: Class 3 and 6 (12%) patients were classified as Gold Criteria: Class 4.
- Centrilobular type of emphysema was seen in 27 (54 %) patients. Paraseptal emphysema was seen in 20 (40%) patients and pan lobular emphysema was seen in 10 (20%) patients. Centriacinar emphysema was the most common subtype.
- Mosaic Attenuation was present in 14 (28%) patients and absent in 36 (72%) patients.
- Directly Visible small Airways were seen in 41 (82%) patients and absent in 9 (18%) patients.
- Atelectasis was seen in 13 (26%) patients and absent in 37 (74%) patients,
- Bronchiectasis was present in 24 (48%) patients and absent in 26 (52%) patients.
- Bronchial wall thickening was present in 26 (52%) patients and absent in 24 (48%) patients.
- Vascular Attenuation was present in 44 (88%) patients and absent in 6 (12%) patients.
- Vascular distortion was present in 20 (40.0%) patients and absent in 30 (60.0%) patients.
- The mean Tracheal Index (TI) was 0.81 ± 0.13 and was seen to decrease with increasing grade severity. TI showed a strong positive correlation with spirometry variables.
- The mean thoracic cage ratio (TCR) at carina was 0.72 ± 0.07 and at 5 cm below carina was 0.77 ± 0.06. TCR showed inverse correlation with spirometry variables.
- The mean Sterno-aortic Distance (SAD) at carina was 2.87 ± 0.98. SAD showed inverse corelation with spirometry variables however, this was not statistically significant.
- The mean of Thoracic Cross-sectional area / square of height were 96.08 ± 14.68 and showed an inverse correlation with spirometry variables.

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