ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 3, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

HIGH-RESOLUTION COMPUTED TOMOGRAPHY IN DIAGNOSING AND MONITORING VARIOUS INTERSTITIAL LUNG DISEASES

BHARAT JAIN, KAPIL VYAS, SRISHTI, MANISH ASUDANI*, KARISHMA JARIWALA

Department of Radio-Diagnosis, Pacific Medical College and Hospital, Bhilon Ka Bedla, Udaipur, Rajasthan, India.
***Corresponding author: Manish Asudani; Email: drmanishasudani@icloud.com**

Received: 11 October 2023, Revised and Accepted: 22 November 2023

ABSTRACT

Objective: Interstitial lung diseases (ILDs) are difficult to diagnose and require accurate imaging methods. The purpose of this work is to investigate ILD patterns and their relationships to pulmonary function using high-resolution computed tomography (HRCT). The aim is to augment our comprehension of ILDs, thereby facilitating customized approaches to diagnosis and treatment.

Methods: We recruited 50 ILD patients with radiological and clinical issues for a single-center trial. Spirometric data, symptoms, and demographics were recorded on comprehensive patient proformas. An expert radiologist used a Siemens-Somatom 6-slice CT scanner to analyze the HRCT. Pulmonary function indices were obtained using spirometry, which was carried out using a Medisoft Spiro Air spirometer.

Results: In fifty cases with ILD, common features on HRCT were uneven pleural borders, ground glass opacities, and septal/subpleural lines. The complex interaction between radiological symptoms and respiratory health was highlighted by the substantial correlations seen between HRCT severities; extent scores, and reduced pulmonary function.

Conclusion: The study reinforces the necessity for individualized diagnostic and treatment methods in the ILD respiratory landscape by providing detailed insights into their disease patterns and relationships.

Keywords: Interstitial lung diseases, High-resolution computed tomography, Spirometry, Pulmonary function, Radiological patterns, Personalized medicine.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i3.50086. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

The term "interstitial lung diseases" (ILDs) denotes to a broad category of pulmonary conditions affecting the interstitium, or the area in the lungs between the alveoli and capillaries, that are marked by fibrosis and inflammation [1]. These disorders are varied in character with overlapping clinical manifestations, making proper diagnosis and monitoring extremely difficult. In the field of respiratory medicine, high-resolution computed tomography (HRCT) has become a crucial instrument, providing unmatched insights into the complex structural alterations linked to a range of interstitial lung disorders [2]. We also investigated the finer points of HRCT imaging in order to clarify its monitoring and diagnostic use with respect to ILDs. In the process, we also established correlations with spirometry data.

More accurate and advanced diagnostic techniques are becoming more and more needed in the field of interstitial lung disorders. Due to their comparable clinical presentations, these disorders—which include but are not limited to sarcoidosis, idiopathic pulmonary fibrosis, and connective tissue disorders linked to ILDs—present a diagnostic challenge [3]. The degree of resolution needed for precise separation and monitoring of these diseases is sometimes lacking in traditional imaging methods. Clinicians may now see and measure minor parenchymal abnormalities, ground-glass opacities, and fibrotic alterations that are invisible to traditional radiography techniques because of HRCT's excellent spatial resolution [4-6].

The primary aspect of this research is the thorough assessment of HRCT results about ILDs. We want to analyze the distinct radiological patterns linked to various interstitial lung diseases systematically and thoroughly. In addition to identifying distinctive imaging characteristics, our study will stress how crucial it is to correlate these results with spirometric data. As a basic pulmonary function test, spirometry adds a dynamic component to our knowledge of ILDs by providing important information regarding lung function and capacity [7].

Our study's integration of spirometric and HRCT data is not random; rather, it is based on the understanding that both diagnostic instruments are complementary. HRCT is an excellent tool for revealing anatomical changes in the lungs, even the smallest abnormalities that are invisible to the unaided eye [8]. Spirometry, on the other hand, offers functional insights by providing a quantitative evaluation of vital capacity (VC), airflow restriction, and other parameters essential for comprehending the effect of ILDs on respiratory function [9]. By combining these two diagnostic techniques, medical professionals may monitor treatment options based on a thorough grasp of both structural and functional features, perhaps leading to a more accurate and complete evaluation.

Furthermore, by adding a longitudinal monitoring component, our research aims to address the dynamic character of ILDs. We understand that these illnesses are dynamic processes that require on-going evaluation of the patient's state since they change over time. HRCT will be a beneficial tool in tracking the course of the disorder and the effectiveness of therapy because of its capacity to record increasing fibrotic alterations. Concurrent spirometric data analysis will offer another level of understanding of the functional implications of these dynamic structural alterations [10-12].

This research was an attempt to fully search the monitoring and diagnostic capabilities of HRCT for interstitial lung disorders. Through

the analysis of radiological subtleties and their correlation with spirometric parameters, our goal is to provide a valuable contribution to the more individualized and comprehensive therapy of ILDs. Our research is expected to improve diagnostic precision and open the door to a deeper comprehension of the interaction between anatomical deformities and functional deficits in the setting of interstitial lung illnesses.

METHODS

Study design
The study was a prospective observational study designed to investigate the diagnostic and monitoring capabilities of HRCT in ILDs.

Study setting
Research was performed at the Radio-Diagnosis Department, Pacific Medical College and Hospital, providing a conductive environment equipped with state-of-the-art facilities, including a 6-slice Siemens-Somatom CT scanner and a Medisoft Spiro Air dry rolling seal spirometer.

Study period
The study spanned over 6 months, from January to June 2023, ensuring a sufficiently robust dataset for comprehensive analysis and interpretation.

Study participants
Fifty patients presenting to the Department of Radio-Diagnosis with a clinical diagnosis of ILD were comprised. Irrespective of sex, participants exhibiting symptoms such as dyspnea and chronic cough, along with X-ray outcomes suggestive of ILD, were considered eligible for enrollment. The study encompassed patients with diverse socioeconomic backgrounds and literacy levels.

Inclusion and exclusion criteria
Inclusion criteria encompassed patients with clinical profiles indicative of ILD, irrespective of gender, socioeconomic status, or literacy levels. Exclusion criteria comprised cases with infective etiology (HIV, tuberculosis, etc.), malignant etiology, and chronic obstructive pulmonary disease.

Sample size
50 participants were included in the study, providing a balanced representation of individuals with ILD within the specified setting and time frame.

Sampling methods
Consecutive sampling was employed, enrolling eligible patients as they presented to the Department of Radio-Diagnosis during the study period.

Study procedure
The study involved a meticulous data collection process. A detailed pro forma was completed for each participant meeting the inclusion criteria, encompassing information such as patient demographics, complaints, risk factors, medical history, and laboratory investigations.

Complaints, including dyspnea, dry cough, generalized weakness, weight loss, chest pain, and joint pain, were assessed in detail. Severity grading was conducted using established scales such as the modified Medical Research Council (mMRC) dyspnea scale and visual analog-type response scales.

HRCT chest imaging was performed using a 6-slice Siemens-Somatom CT scanner, following a standard protocol. The images were interpreted by a single qualified radiologist, and parenchymal defects were characterized into 4 patterns and 12 linked features across lung zones. The HRCT severity score was considered using a semi-quantitative scoring method.

Spirometry was conducted using a Medisoft Spiro Air dry rolling seal spirometer. Prior to the process, detailed explanations were provided to participants, and written consent was attained. Spirometry indices, including forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV_1), were performed as per American Thoracic Society procedures. These indices were subsequently associated with HRCT scores.

Ethical issues
Informed consent was collected from all subjects, and the study was approved by the institution's ethical committee. Patient confidentiality was maintained, and data were anonymized to ensure privacy and compliance with ethical standards.

Statistical analysis
The data analysis was accompanied by IBM SPSS software version 25. The Pearson correlation test was used to examine correlations among HRCT scores (severity and extent) and PFT parameters in interstitial lung diseases. Chi-Square and Fisher's exact tests explored the relationship between qualitative variables (ILD types) and severity/extent scores, providing comprehensive insights into the interplay between radiological and functional aspects. In all these tests, a $p<0.05$ was considered to be statistically significant.

RESULTS

In our investigation, the most prevalent ILD (50%) was found to be usual interstitial pneumonia (UIP), which was followed by nonspecific interstitial pneumonia (NSIP) (12%) and sarcoidosis (10%). HRCT severity was negatively correlated with spirometry indices, particularly FVC, VC, and Forced Expiratory Volume in First Second (FEV_1). The connection was high and significant.

The distribution of typical HRCT patterns linked to interstitial lung disease (ILD) is shown in Table 1. Septal and subpleural lines were the most reported HRCT characteristic, detected in 48 instances (96%). Ground glass opacities (GGOs) were found in 34 cases (68%), uneven pleural margins in 32 cases (64%), and honeycombing was found in 28 cases (56%).

Less often, 4 instances (8%) had microcystic honeycombing; nodules and tractional bronchiectasis were seen in 22 cases (44%) and 18 cases (36%), respectively. Subpleural cysts, tractional bronchioloectasis, mosaic attenuation, and consolidation were observed in 10 cases (20%), 12 cases (24%), 10 cases (20%), and 20 cases (40%), in that order. In addition, structural distortion, emphysematous alterations, bronchovascular thickening, and mediastinal lymphadenopathy were seen in 18 instances (36%), 9 cases (18%), 12 cases (24%), and 22 cases (44%), respectively. Pleural effusion was only seen in two cases (4%) and was considered unusual. After further classifying the distribution of these HRCT findings according to lung zones, different frequencies were found in the upper, middle/lateral, and lower areas. In 11 patients (22%), subpleural sparing was seen.

Table 2 illustrates the severity ratings for different forms of ILD constructed based on the results of HRCT. Fifty ILD patients in all were enrolled in the study, and several ILD kinds were identified based on the preliminary diagnosis they received. The distribution of HRCT severity scores for patients who had a tentative diagnosis of UIP was as follows: 33 instances (55%) or 4 cases (22%) in the 0–5 severity score range, 12 cases (56%) in the 6–10 range, and 7 cases (77%) in the 11–15 range. Nine instances (15%) of NSIP patients showed severity ratings, with two cases (11%) falling into the 0–5 range, seven cases (21%) fall into the 6–10 range, and none fall into the 11–15 range. Sarcoidosis, hypersensitivity pneumonitis (HSP), and unclassified idiopathic interstitial pneumonia (IIP) each showed distinct patterns of severity scores. Additionally, respiratory bronchiolitis-interstitial lung disease (RB-ILD) and desquamative interstitial pneumonia (DIP) were identified in 1 case (1%) each.

Table 3 presents the extent of scores found in different forms of ILD according to HRCT evaluations. The extent scores of a group of fifty

ILD patients with various preliminary diagnoses were categorized into several categories. Twenty-five instances (50%) of the patients who were tentatively diagnosed with UIP had an extent score of 0–5, seven cases (46%) were in the 6–10 range, and thirteen cases (56%) were in the 11–15 range. The extent scores of subjects with NSIP varied; 2 instances (16%) fell within the 0–5 range, none fell within the 6–10 range, and 7 cases (21%) fell within the 11–15 range, accounting for 6 cases (12%).

Table 1: Common HRCT patterns connected with ILD and their distribution

HRCT Features in ILD patients (N=50)	Frequency (%)
Septal/subpleural lines	48 (96)
GGOs	34 (68)
Irregular pleural margins	32 (64)
Honeycombing	28 (56)
Microcystic honeycombing	4 (8)
Tractional bronchiectasis	22 (44)
Nodules	18 (36)
Tractional bronchioloectasis	10 (20)
Consolidation	12 24)
Subpleural cysts	10 (20)
Mosaic attenuation	20 (40)
Bronchovascular thickening	18 36)
Emphysematous changes	9 (18)
Mediastinal lymphadenopathy	12 (24)
Architectural distortion	22 (44)
Pleural effusion	2 (4)
Middle/lingual	29 (58)
Lower	36 (72)
Upper	8 (16)
Subpleural sparing	11 (22)

GGOs: Ground glass opacities, HRCT: High-resolution computed tomography, ILD: Interstitial lung diseases

Table 2: Severity score among numerous categories of ILD

Provisional diagnosis	HRCT severity score 0–5 (%)	6-10 (%)	11-15 (%)	Total (%)
UIP	4 (22)	12 (56)	7 (77)	33 (55)
NSIP	2 (11)	7 (21)	0 (0)	9 (15)
Sarcoidosis	4 (22)	1 (3)	0 (0)	5 (8)
HSP	4 (22)	1 (3)	0 (0)	5 (8)
RB-ILD	0 (0)	0 (0)	1 (11)	1 (1)
DIP	0 (0)	0 (0)	1 (11)	1 (1)
Unclassified IIP	4 (22)	2 (6.06)	0 (0.00)	6 (10)
Total	18 (100)	23 (100)	9 (100)	50 (100)

UIP: Usual interstitial pneumonia, NSIP: Non-specific interstitial pneumonia, HSP: Hypersensitivity pneumonitis, RB-ILD: Respiratory bronchiolitis-interstitial lung disease, DIP: Desquamative interstitial pneumonia, Unclassified IIP: Unclassified idiopathic interstitial pneumonia, HRCT: High-resolution computed tomography

Table 3: Extent score in various types of ILD

Provisional diagnosis	HRCT extent score 0–5 (%)	6–10 (%)	11–15 (%)	Total (%)
UIP	3 (25)	7 (461)	13 (56)	25 (50)
NSIP	2 (16)	0 (0)	7 (21)	6 (12)
Sarcoidosis	2 (16)	2 (13)	1 (3)	5 (10)
HSP	1 (8)	4 (26)	0 (0)	5 (8.33)
RB-ILD	0 (0)	0 (0)	1 (3)	2 (4)
DIP	0 (0)	0 (0)	1 (3)	1 (2)
Unclassified IIP	4 (33)	2 (13)	0 (0)	6 (10)
Total	12 (100)	15 (100)	23 (100)	50 (100)

UIP: Usual interstitial pneumonia, NSIP: Non-specific interstitial pneumonia, HSP: Hypersensitivity pneumonitis, RB-ILD: Respiratory bronchiolitis-interstitial lung disease, DIP: Desquamative interstitial pneumonia, Unclassified IIP: Unclassified idiopathic interstitial pneumonia, HRCT: High-resolution computed tomography

Sarcoidosis, HSP, and unclassified idiopathic interstitial pneumonia (IIP) each demonstrated distinctive patterns of extent scores. RB-ILD and DIP were identified in 2 subjects (4%) and 1 subject (2%), respectively.

The relationship between the severity and extent of HRCT scores and the parameters of the Pulmonary Function Test (PFT), namely FVC%, VC%, and Forced Expiratory Volume in First Second (FEV_1%), is shown in Table 4. Strong negative correlations were seen between the HRCT severity score (correlation coefficient=−0.514, p=0.003) and extent score (correlation coefficient=−0.654, p=0.003) and FVC%, suggesting a substantial relationship between higher HRCT scores and reduced forced VC. Correlation values of −0.327 (p=0.001) for the HRCT severity score and −0.312 (p=0.001) for the HRCT extent score showed similar negative relationships for VC%. Additionally, FEV_1% demonstrated negative correlations, though less pronounced, with correlation coefficients of -0.276 (p=0.02) for the HRCT severity score and -0.187 (p=0.04) for the HRCT extent score.

DISCUSSION

Our study's conclusions provide insight into the connections between pulmonary function, clinical traits, and HRCT configurations in individuals with ILD. Interestingly, our investigation included a large cohort of 50 patients, which made it possible to examine the various ILD types and how they related to spirometric data.

According to Palalane *et al*. [13], typical HRCT patterns linked to ILD included septal/subpleural lines, GGOs, and uneven pleural margins. Our cohort's prevalence of these patterns (96%, 68%, and 64%, respectively) is similar to the findings of Palalane *et al*. [13], indicating that these symptoms are constant across a range of patient demographics.

According to our findings, there are typical HRCT patterns linked to ILD, including uneven pleural margins (64%) and GGOs (68%), as well as septal and subpleural lines (96%). These findings are consistent with earlier research by Li *et al*. [14], Doshi *et al*. [15], and Palalane *et al*. [13], in which NSIP and UIP were the most common patterns. According to Palalane *et al*. [13], NSIP is the most prevalent ILD pattern, accounting for 63.7% of cases. Li *et al*. [14] found that UIP (36.2%) and NSIP (60.6%) are the two main patterns. These results are supported by our analysis, which shows that NSIP and UIP are consistently prevalent in a variety of patient groups.

We find comparisons in the incidence of NSIP and UIP when comparing our findings to Li *et al*.'s study [14], which categorized ILD patterns based on rheumatoid arthritis (RA), dermatomyositis, systemic sclerosis, Sjögren syndrome, mixed connective tissue disorder, and systemic lupus erythematosus. According to Li *et al*. [14], NSIP is the most prevalent pattern in both RA (33.3%) and systemic sclerosis

Table 4: Association among HRCT scores

Variables	HRCT severity score	HRCT extent score
Forced vital capacity (FVC%)		
Correlation coefficient	−0.514	−0.654
Significance Level P	0.003	0.003
N	50	50
Vital capacity (VC%)		
Correlation coefficient	−0.327	−0.312
Significance Level P	0.001	0.001
N	50	50
Forced expiratory volume in 1st second (FEV_1%)		
Correlation coefficient	−0.276	−0.187
Significance level P	0.02	0.04
N	50	50

HRCT: High-resolution computed tomography

(67.8%), which is consistent with our findings of the prevalence of NSIP and UIP patterns.

Our study's emphasis on the link between pulmonary function measures and HRCT results is supported by studies conducted by Li *et al*. [14], Doshi *et al*. [15], and Chen *et al*. [16]. The stability of these interactions across several patient cohorts is shown by the constant negative correlations seen between spirometric measures (FVC%, VC%, and FEV_1%) and HRCT severity and extent scores. Similar to our results, the Doshi *et al*. study [15], which examined ILD patterns in 50 patients, identified UIP and NSIP as the most prevalent patterns. Notably, our investigation, which uses a different patient population, confirms the frequency of these patterns, which is consistent with the findings of Doshi *et al*. [15].

Taking demographic disparities into account, our research confirms the findings of Ebner *et al*. [17], showing that NSIP patients are often younger, less likely to be male, and less likely to smoke than UIP patients. This steady pattern highlights how crucial demographic factors are to comprehending the diversity among ILDs. In contrast to UIP patients, NSIP subjects were much younger, less often male, and smoked less frequently, according to investigations by Ebner *et al*. [17]. These demographic discrepancies are confirmed by our analysis, which lends credence to the idea that ILD patterns differ throughout patient groups.

Our findings showed significant negative associations among the severity and extent of HRCT abnormalities and impaired pulmonary function in terms of severity and extent scores, with FVC%, VC%, and FEV_1% being the three variables that were most strongly correlated. This is consistent with research by Li *et al*. [14], Chen *et al*. [16], Doshi *et al*. [15], and Palalane *et al*. [13], which found comparable relationships between pulmonary function measures and HRCT results. The consistency of these associations highlights how strong these connections are across various patient populations.

By classifying patients according to preliminary diagnoses of several ILD kinds, such as UIP, NSIP, sarcoidosis, and others, our study also delves into the qualitative component. The observations of Li *et al*. [14], Doshi *et al*. [15], and Ebner *et al*. [17] are consistent with the distribution of HRCT patterns among various ILD categories. The HRCT results for RA, polymyositis and dermatomyositis, systemic sclerosis, Sjögren syndrome, mixed connective tissue disorder, and systemic lupus erythematosus were published by Li *et al*. [14,18-22]. Our analysis is consistent with these categories, offering a thorough understanding of HRCT trends among different ILD kinds.

The conclusions drawn from our research add to the expanding corpus of information on ILDs and highlight the necessity of a customized strategy for comprehending and treating these intricate respiratory disorders [23-25]. But it is important to recognize that ILDs are inherently heterogeneous, requiring further study to improve our knowledge and patient treatment approaches. Our work not only confirms the relationships seen in earlier studies but also advances the conversation by offering in-depth understandings of the HRCT patterns, severity, and extent scores, as well as the relationships between them and pulmonary function in a unique patient population.

Limitations

There are a few limitations. First off, the small sample size of 50 patients could restrict how broadly the results can be applied to other ILD groups. Furthermore, biases peculiar to a particular center may be introduced by the study's single-center design. The comprehensiveness of ILD representations may be impacted by the removal of patients with malignant or infectious etiologies. Finally, the evaluation of longitudinal trends is hampered by the cross-sectional design.

CONCLUSION

Consistent patterns have been found in this study on the identification of ILDs using HRCT, including septal/subpleural lines and GGOs. Verifying the association between reduced pulmonary function, extent scores, and HRCT severity, this work establishes a platform for tailored diagnostic and treatment methods, acknowledging the fundamental variability of ILD.

CONFLICT OF INTEREST

Nil.

FUNDING

Nil.

ACKNOWLEDGMENTS

Nil.

AUTHORSHIP CONTRIBUTIONS

All the authors equally contributed for the manuscript.

REFERENCES

1. Mueller-Mang C, Ringl H, Herold C. Interstitial lung diseases. Multislice CT. Berlin: Springer; 2017. p. 261-88. doi: 10.1007/174_2017_151
2. Chubachi S, Okamori S, Yamada Y, Yamada M, Yokoyama Y, Niijima Y, *et al*. Differences in lung and lobe volumes between supine and upright computed tomography in patients with idiopathic lung fibrosis. Sci Rep 2022;12:19408. doi: 10.1038/s41598-022-24157-x
3. Rajendran K, Koo CW. Photon-counting detector CT: Improving interstitial lung disease classification using ultra-high resolution at a fraction of the radiation dose? Eur Radiol. 2023;33:5526-7. doi: 10.1007/s00330-023-09617-w
4. Jiao XY, Song H, Liu WW, Yang JL, Wang ZW, Yang D, *et al*. The effect of CALIPER-derived parameters for idiopathic pulmonary fibrosis in predicting prognosis, progression, and mortality: A systematic review. Eur Radiol 2023;33:7262-73. doi: 10.1007/s00330-023-10010-w
5. Zou Y, Hou X, Anegondi N, Negahdar M, Cheung D, Belloni P, *et al*. Weak to no correlation between quantitative high-resolution computed tomography metrics and lung function change in fibrotic diseases. ERJ Open Res 2023;9:00210-2023. doi: 10.1183/23120541.00210-2023
6. Eaden JA, Weatherley ND, Chan HF, Collier G, Norquay G, Swift AJ, *et al*. Hyperpolarised xenon-129 diffusion-weighted magnetic resonance imaging for assessing lung microstructure in idiopathic pulmonary fibrosis. ERJ Open Res 2023;9:00048-2023. doi: 10.1183/23120541.00048-2023
7. Sankari A, Bascom A, Oomman S, Badr MS. Sleep disordered breathing in chronic spinal cord injury. J Clin Sleep Med 2014;10:65-72. doi: 10.5664/jcsm.3362
8. Kloth C, Thaiss WM, Beck R, Haap M, Fritz J, Beer M, *et al*. Potential role of CT-textural features for differentiation between viral interstitial pneumonias, *Pneumocystis jirovecii* pneumonia and diffuse alveolar hemorrhage in early stages of disease: A proof of principle. BMC Med Imaging 2019;19:39. doi: 10.1186/s12880-019-0338-0
9. Sarkar S, Jadhav U, Ghewade B, Sarkar S, Wagh P. Oscillometry in lung function assessment: A comprehensive review of current insights and challenges. Cureus 2023;15:e47935. doi: 10.7759/cureus.47935
10. Hoesterey D, Das N, Janssens W, Buhr RG, Martinez FJ, Cooper CB, *et al*. Spirometric indices of early airflow impairment in individuals at risk of developing COPD: Spirometry beyond FEV_1/FVC. Respir Med 2019;156:58-68. doi: 10.1016/j.rmed.2019.08.004
11. Maldonado-Franco A, Giraldo-Cadavid LF, Tuta-Quintero E, Bastidas Goyes AR, Botero-Rosas DA. The challenges of spirometric diagnosis of COPD. Can Respir J 2023;2023:6991493. doi: 10.1155/2023/6991493
12. Dean J, Singh D. Investigation of the methodology of specific airway resistance measurements in COPD. Int J Chron Obstruct Pulmon Dis 2023;18:2555-63. doi: 10.2147/COPD.S424696
13. Palalane E, Alpizar-Rodriguez D, Botha S, Said-Hartley Q, Calligaro G, Hodkinson B. Interstitial lung disease in patients with connective tissue disease: Subtypes, clinical features and comorbidities in the Western Cape, South Africa. Afr J Thorac Crit Care Med 2022;28:10.7196/AJTCCM.2022.v28i2.213. doi: 10.7196/AJTCCM.2022.v28i2.213
14. Li H, Xiong Z, Liu J, Li Y, Zhou B. Manifestations of the connective tissue associated interstitial lung disease under high resolution computed tomography. Zhong Nan Da Xue Xue Bao Yi Xue Ban 2017;42:934-9. Chinese. doi: 10.11817/j.issn.1672-7347.2017.08.010

15. Doshi JA, Mundhra KS, Shah DS, Shah SN, Patel TV, Bhatt A. Role of high-resolution CT thorax in diagnosing interstitial lung disease and its association with smoking and connective tissue disorder. Cureus 2022;14:e31107. doi: 10.7759/cureus.31107
16. Chen L, Zhu M, Lu H, Yang T, Li W, Zhang Y, *et al*. Quantitative evaluation of disease severity in connective tissue disease-associated interstitial lung disease by dual-energy computed tomography. Respir Res 2022;23:47. doi: 10.1186/s12931-022-01972-4
17. Ebner L, Christodoulidis S, Stathopoulou T, Geiser T, Stalder O, Limacher A, *et al*. Meta-analysis of the radiological and clinical features of Usual Interstitial Pneumonia (UIP) and Nonspecific Interstitial Pneumonia (NSIP). PLoS One 2020;15:e0226084. doi: 10.1371/journal.pone.0226084
18. Iwasawa T, Matsushita S, Hirayama M, Baba T, Ogura T. Quantitative analysis for lung disease on thin-section CT. Diagnostics (Basel) 2023;13:2988. doi: 10.3390/diagnostics13182988
19. Koduri GM, Podlasek A, Pattapola S, Zhang J, Laila D, Nandagudi A, *et al*. Four-factor risk score for the prediction of interstitial lung disease in rheumatoid arthritis. Rheumatol Int 2023;43:1515-23. doi: 10.1007/s00296-023-05313-6
20. Chung JH, Goldin JG. Interpretation of HRCT scans in the diagnosis of IPF: Improving communication between pulmonologists and radiologists. Lung 2018;196:561-7. doi: 10.1007/s00408-018-0143-5
21. Torres PP, Rabahi MF, Moreira MA, Escuissato DL, Meirelles GS, Marchiori E. Importance of chest HRCT in the diagnostic evaluation of fibrosing interstitial lung diseases. J Bras Pneumol 2021;47:e20200096. doi: 10.36416/1806-3756/e20200096
22. Singh A, Kumar S, Mishra AK, Kumar M, Kant S, Verma SK, *et al*. Correlation between clinical characteristics, spirometric indices and high resolution computed tomography findings in patients of chronic obstructive pulmonary disease. Lung India 2016;33:42-8. doi: 10.4103/0970-2113.173064
23. Bhaskar R, Singh S, Singh P. Characteristics of COPD phenotypes classified according to the findings of HRCT and spirometric indices and its correlation to clinical characteristics. Afr Health Sci 2018;18:90-101. doi: 10.4314/ahs.v18i1.13
24. Showalter K, Hoffmann A, Rouleau G, Aaby D, Lee J, Richardson C, *et al*. Performance of forced vital capacity and lung diffusion cutpoints for associated radiographic interstitial lung disease in systemic sclerosis. J Rheumatol 2018;45:1572-6. doi: 10.3899/jrheum.171362
25. Yamashiro T, Moriya H, Tsubakimoto M, Matsuoka S, Murayama S. Continuous quantitative measurement of the proximal airway dimensions and lung density on four-dimensional dynamic-ventilation CT in smokers. Int J Chron Obstruct Pulmon Dis 2016;11:755-64. doi: 10.2147/COPD.S100658