

# HRCT Thorax in Diffuse Parenchymal Lung Disease

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## ABSTRACT

**Introduction:** Interstitial Lung Disease (ILD) represent heterogeneous group of disorders of lower respiratory tract that are characterised by both acute and chronic inflammation and a generally irreversible and relentless process involving the interstitium.

**Aim:** To classify and characterise Diffuse Parenchymal Lung Disease (DPLD) in the state of Goa, using high Resolution CT (HRCT) scan.

**Materials and Methods:** HRCT of thorax was performed on 128 Slice CT scanner (SOMATOM Definition AS; Siemens) with 1 mm collimation at full inspiration. Scan was taken at 10 mm interval in supine as well as prone position and images were reconstructed using high spatial

frequency algorithm.

**Results:** Amongst ILD most prevalent was NSIP (19), followed after UIP (15), IPF (8), Sarcoidosis (6), COP (3), HP (3), Combined pulmonary fibrosis and emphysema (2), Silicosis (3) and LCH (1). DIP and LIP are very rare interstitial pneumonias.

**Conclusion:** HRCT of lungs helps to identify and quantify anatomic distribution and pattern of various ILD and also to evaluate different phases, disease activity and progression of diseases in relation to prognosis and therapy. Histopathological diagnosis can be reached in most cases of idiopathic interstitial pneumonias based on HRCT findings, obviating the need for biopsy.

**Keywords:** Idiopathic pulmonary fibrosis, Interstitial lung disease, Trans-bronchial biopsy

## INTRODUCTION

There are (over 100) distinct entities of ILD, but only 10-12 account for more than 90% of them. Current explanation of the pathogenesis and natural history of ILD are controversial and multiple hypotheses have been put forward. Around 15-20% of the patients with connective tissue disorder presents with ILD. ILD is characterised by slow and progressive destruction of interstitium often followed by respiratory failure and death. Most of the ILD remain undiagnosed and not treated for a long time, because of their smoldering evolution and non-specific symptoms (cough and exertional dyspnea). Chest X-ray is relatively insensitive and is normal in about 10-20% of patients with histologically proven ILD [1]. Here lies the importance of HRCT, in aiding an early diagnosis. We have made a humble attempt in our study to identify the prevalence of ILD in state of Goa where mining is the most prevalent industry and to evaluate role of HRCT in DPLD and its clinical utility.

## MATERIALS AND METHODS

This is a cohort descriptive and observational study. The study was carried out in the Department of Radiology, Goa Medical

College, Bambolim, India, over a period of 2 years (2014-16). All the patients (out patient as well as in patient) referred for HRCT of chest study constituted the study population. Patients with positive findings of ILD constituted sample size. Sixty patients with clinically suspected ILD were evaluated with HRCT.

HRCT diagnosis was made by two radiologists independently. Both the radiologists were blinded to clinico-pathological findings. Some of the HRCT diagnoses (21 out of 60 cases) were confirmed on biopsy. Rest of the HRCT diagnosis were confirmed based on history, examination findings, pulmonary function tests and clinical follow-up. Patients showing worsening of lung fibrosis on follow-up scan were confirmed as UIP pattern. Patients having ground glass opacity which shows improvement on follow-up scan after steroid treatment were classified as NSIP.

This hospital is a tertiary care centre equipped with 128 Slice CT scanner (SOMATOM definition AS; Siemens Medical Solutions, Germany). All the patients with clinically suspected ILD referred for HRCT were included in the study [Table/Fig-1,2].

Age (Years)	Number	Percentage (%)
20-29	1	1.7
30-39	6	10.0
40-49	6	10.0
50-59	17	28.3
60-69	20	33.3
70-79	9	15.0
90-99	1	1.7
Total	60	100.0

**[Table/Fig-1]:** Showing distribution of 60 patients who had underwent HRCT according to age group.

Haemodynamically unstable, unconscious patients and patients with associated lung pathology like consolidation or mass were excluded from the study. Ethical clearance for the study was obtained from Institutional Ethics Committee, before commencement of the study. Each patient underwent a thorough clinical evaluation including a detailed history and physical examination.

All the patients were made to undergo HRCT scan as the radiological examination after taking an informed consent for the same. The Statistical Analysis was done using SPSS Software Ver. 14.

## RESULTS

Out of 60 patients, 30 patients were male and 30 patients were female. In these maximum number of patients had NSIP (19), followed after UIP (15), IPF (8), Sarcoidosis (6), COP (3), HP (3), Combined pulmonary fibrosis and emphysema (2), Silicosis (3) and LCH (1) was seen in only one patient. DIP and LIP are rare interstitial pneumonias [Table/Fig-2].

Out of total of 60 patients, 28(46.7%) had honeycombing and 32(53.3%) were not associated with honeycombing. All UIP and IPF were associated with honeycombing. Only two NSIP

HRCT Diagnosis	Sex		
	Female	Male	Total
CPFE	0 (0%)	2 (6.7%)	2 (3.3%)
COP	1 (3.3%)	2 (6.7%)	3 (5%)
HSP	2 (6.7%)	1 (3.3%)	3 (5%)
IPF	3 (10%)	5 (16.7%)	8 (13.3%)
LCH	1 (3.3%)	0 (0%)	1 (1.7%)
NSIP	12 (40%)	7 (23.3%)	19 (31.7%)
Sarcoidosis	3 (10%)	3 (10%)	6 (10%)
Silicosis	0 (0%)	3 (10%)	3 (5%)
UIP	8 (26.7%)	7 (23.3%)	15 (25%)
Total	30(100%)	30(100%)	60(100%)

**[Table/Fig-2]:** Showing association of 60 patients who underwent HRCT between HRCT diagnosis and sex.

cases were associated with honeycombing [Table/Fig-3].

Out of total of 60 patients, 38 (63.3%) had bronchiectasis and 22 (36.7%) were not associated with bronchiectasis. Maximum number of patients with UIP 14 (36.8%) and NSIP 11 (28.9%) associated with bronchiectasis [Table/Fig-4].

HRCT Diagnosis	Honeycombing		
	No	Yes	Total
CPFE	0 (0%)	2 (7.1%)	2 (3.3%)
COP	3 (9.4%)	0 (0%)	3 (5%)
HP	3 (9.4%)	0 (0%)	3 (5%)
IPF	0 (0%)	8 (28.6%)	8 (13.3%)
LCH	0 (0%)	1 (3.6%)	1 (1.7%)
NSIP	17 (53.1%)	2 (7.1%)	19 (31.7%)
Sarcoidosis	5 (15.6%)	1 (3.6%)	6 (10%)
Silicosis	3 (9.4%)	0 (0%)	3 (5%)
UIP	1 (3.1%)	14 (50%)	15 (25%)
Total	32 (100%)	28 (100%)	60 (100%)

**[Table/Fig-3]:** Incidence of honeycombing in patients with idiopathic interstitial pneumonia.

HRCT Diagnosis	Bronchiectasis		
	No	Yes	Total
CPFE	0 (0%)	2 (5.3%)	2 (3.3%)
COP	2 (9.1%)	1 (2.6%)	3 (5%)
HP	3 (13.6%)	0 (0%)	3 (5%)
IPF	2 (9.1%)	6 (15.8%)	8 (13.3%)
LCH	0 (0%)	1 (2.6%)	1 (1.7%)
NSIP	8 (36.4%)	11 (28.9%)	19 (31.7%)
Sarcoidosis	4 (18.2%)	2 (5.3%)	6 (10%)
Silicosis	2 (9.1%)	1 (2.6%)	3 (5%)
UIP	1 (4.5%)	14 (36.8%)	15 (25%)
Total	22 (100%)	38 (100%)	60 (100%)

**[Table/Fig-4]:** Incidence of bronchiectasis in patients with idiopathic interstitial pneumonia.

Out of total of 60 patients, 53 (88.3%) had reticulation and 7 (11.7%) were not associated with reticulation. Predominantly UIP 14 (26.4%), NSIP 18 (34%) and IPF 8 (15.1%) were associated with reticulation [Table/Fig-5].

Out of total of 60 patients, 25 (41.7%) had ground glass opacities and 35 (58.3%) were not associated with ground glass opacities. Maximum number of patients with HP 3 (12%), NSIP 18 (72%) and COP 3 (12%) were associated with ground glass opacities [Table/Fig-6].

Out of total of 60 patients, 12 (20%) had consolidation and 48 (80%) were not associated with consolidation. Maximum number of patients with COP 3 (25%), associated with consolidation [Table/Fig-7].

HRCT Diagnosis	Reticulation		
	No	Yes	Total
CPFE	0 (0%)	2 (3.8%)	2 (3.3%)
COP	0 (0%)	3 (5.7%)	3 (5%)
HP	2 (28.6%)	1 (1.9%)	3 (5%)
IPF	0 (0%)	8 (15.1%)	8 (13.3%)
LCH	0 (0%)	1 (1.9%)	1 (1.7%)
NSIP	1 (14.3%)	18 (34%)	19 (31.7%)
Sarcoidosis	2 (28.6%)	4 (7.5%)	6 (10%)
Silicosis	1 (14.3%)	2 (3.8%)	3 (5%)
UIP	1 (14.3%)	14 (26.4%)	15 (25%)
Total	7 (100%)	38 (100%)	60 (100%)

**[Table/Fig-5]:** Incidence of reticulation in patients with idiopathic interstitial pneumonia.

HRCT Diagnosis	Ground Glass Opacity		
	No	Yes	Total
CPFE	2 (5.7%)	0 (0%)	2 (3.3%)
COP	1 (2.9%)	2 (8%)	3 (5%)
HP	0 (0%)	3 (12%)	3 (5%)
IPF	8 (22.9%)	0 (0%)	8 (13.3%)
LCH	1 (2.9%)	0 (0%)	1 (1.7%)
NSIP	1 (2.9%)	18 (72%)	19 (31.7%)
Sarcoidosis	4 (11.4%)	2 (8%)	6 (10%)
Silicosis	3 (8.6%)	0 (0%)	3 (5%)
UIP	15 (42.9%)	0 (0%)	15 (25%)
Total	35 (100%)	25 (100%)	60 (100%)

**[Table/Fig-6]:** Incidence of ground glass opacity in patients with idiopathic interstitial pneumonia.

HRCT Diagnosis	Consolidation		
	No	Yes	Total
CPFE	2 (4.2%)	0 (0%)	2 (3.3%)
COP	0 (0%)	3 (25%)	3 (5%)
HP	3 (6.3%)	0 (0%)	3 (5%)
IPF	7 (14.6%)	1 (8.3%)	8 (13.3%)
LCH	1 (2.1%)	0 (0%)	1 (1.7%)
NSIP	18 (37.5%)	1 (8.3%)	19 (31.7%)
Sarcoidosis	4 (8.3%)	2 (16.7%)	6 (10%)
Silicosis	0 (0%)	3 (25%)	3 (5%)
UIP	13 (27.1%)	2 (16.7%)	15 (25%)
Total	48 (100%)	12 (100%)	60 (100%)

**[Table/Fig-7]:** Incidence of consolidation in patients with idiopathic interstitial pneumonia.

## DISCUSSION

A total number of 60 patients who were clinically suspected of having ILD were studied by HRCT over a period of 24 months.

HRCT scans were performed by obtaining 1mm thick section at every 10 mm interval from thoracic inlet to diaphragm using high spatial frequency algorithm on full inspiration. Whenever, necessary expiratory scans were obtained to see for air trapping. Scans were also obtained with patient positioned prone to differentiate dependent density from true pathology [Table/Fig-8-11].

### Idiopathic Pulmonary Fibrosis (IPF)

Present study included eight (13.3%) cases of IPF, five (62.5%) were males and three (37.5%) were females.

In the present study all eight (100%) patients' had honeycombing with sub pleural and basal predominance, consistent with the study done by Lim MK et al., in which they assessed predominant pattern and site of involvement of HRCT findings in 33 patients of IPF and found that predominant HRCT pattern was honeycombing with involvement of sub pleural and basal regions [2].

There were six (75%) patients of IPF who had traction bronchiectasis within areas of reticulation in present study. Similar results were obtained in Nishiyam O et al., where 7(78%) out of nine patients of IPF had traction bronchiectasis [3].

Nishiyam O et al., also found that all 9 (100%) patients had intralobular reticular opacities and irregular thickening of interlobular septa [3]. In the present study all eight (100%) had intralobular interstitial thickening. These correspond to areas of irregular fibrosis.

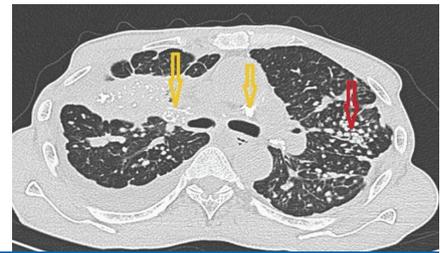
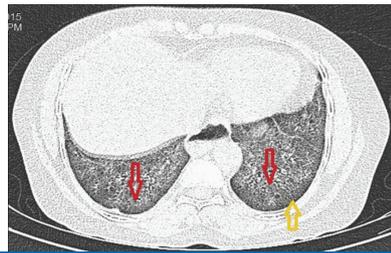
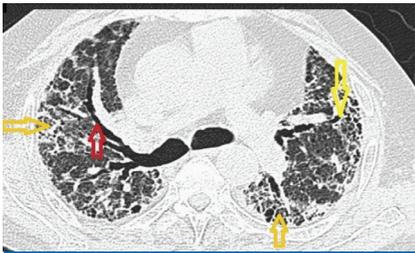
Muller NL et al., showed that 8(80%) patients of IPF had patchy distribution of fibrosis (mild and severe) with areas of normal lung in the same patient, in the same lung and in the same lobe [4]. In the present study all eight (100%) patients had patchy distribution of fibrosis and normal lung, in agreement with results obtained in latter study.

There were two patients (25%) patients who had linear/small nodular foci of calcification seen within areas of fibrosis in present study. Similar findings were observed by Kim et al., where 5 out of 75 patients (6%) of IPF had foci of calcification within areas of calcification. These areas represent pulmonary ossification [5].

### Non Specific Interstitial Pneumonia (NSIP)

NSIP were identified in 19 (31.7%) cases, 12(63.1%) were females and 7(36.8%) were males.

Elliot TL et al., assessed 25 cases of NSIP and found that 24 (96%) patients had no honeycombing and 1 (4%) patient



**[Table/Fig-8]:** UIP: Extensive bilateral sub pleural intra/interlobularseptal thickening (yellow arrow) and traction bronchiectasis (red arrows).

**[Table/Fig-9]:** NSIP: Diffuse bilateral ground glass opacities (red arrows) with relative sparing of subpleural lung (yellow arrows).

**[Table/Fig-10]:** Silicosis: Numerous sharply marginated nodules (red arrow) and egg shell calcification in hilar and mediastinal lymph nodes (yellow arrow) (images from left to right).



**[Table/Fig-11]:** COP bilateral areas of sub-pleural consolidation (Red arrows) showing air bronchogram.

had honeycombing [6] comparatively in the present study 17 (89.4%) patients had no honeycombing and 2 (10.5%) patient had honeycombing.

In the present study 18 (94.7%) patients had ground glass opacity with basal and sub-pleural predominance, similar to findings observed by TS Kim et al. who retrospectively analyzed 23 patients of NSIP and found that all 23 (100%) patients had ground glass opacity [5].

The study included two patients of fibrotic NSIP which were confirmed with histopathology. Both had honeycombing on HRCT together with reticulation and traction bronchiectasis. Honeycombing is not a predominant feature of NSIP and more often associated with IPF. These findings are consistent with as reported by Johkoh T et al., who also showed presence of honeycombing in fibrotic NSIP. The study also included five patients of cellular NSIP proved with lung biopsy, none of these cases showed presence of honeycombing. They also stated that there was no appreciable difference in extent of ground glass opacity, consolidation or interlobular septal thickening between cellular and fibrotic NSIP [7]. Similar findings were obtained in seven biopsy proven cases of NSIP in present study.

Silva et al., showed that in 64% of patient with NSIP, there is relative sparing of the immediate sub pleural lung in the dorsal regions of lower lobes [8]. Similarly, in the present study 11(57.8%) patients showed relative sparing of sub-pleural lung.

In the study done by Kim EY et al., 13 patients of biopsy proven NSIP, the initial CT showed ground glass opacities. On follow up HRCT there was significant reduction in ground glass opacity [5]. Similar results were obtained in present study i.e. all seven biopsy proven cases of NSIP showed decrease in ground glass opacity on follow-up scan.

### Sarcoidosis

Sarcoidosis was identified in 6 (10%) cases. Three (50%) were females and three (50%) were males.

Honeycombing with upper and mid lobar predominance with relative sparing of lung bases is characteristic of end stage sarcoidosis. Primack SL et al., studied 61 patients with end stage lung disease and made correct diagnosis of sarcoidosis in 83% of cases, based on pattern of distribution of honeycombing and conglomerate fibrosis [9]. In the present study one (16.6%) patient of sarcoidosis had honeycombing with upper and mid lobar predominance with relative sparing of lung bases.

Hamper TE et al., reviewed 36 patients of sarcoidosis and found that 8 (22.2%) patients showed calcification of hilar and mediastinal lymph node [10]. Whereas, in the present study there were four (66.6%) patients who had bilateral hilar and mediastinal adenopathy, out of these one (16.6%) showed presence of calcification in hilar and mediastinal lymph node.

Brauner MW et al., studied 44 patients of Sarcoidosis with 27 (61.3%) patients showing reticular opacities predominantly along parahilar and broncho-vascular bundles [11]. Similar features of para hilar and broncho vascular reticular opacities are noted in four (66.6%) cases of sarcoidosis in present study.

### Cryptogenic Organising Pneumonia (COP)

Organising pneumonia was identified in 3(5%) cases. One (33.3%) was female and two (66.6%) were males.

Muller NL et al., reviewed 14 patients of COP. Ten (70%) patients had patchy unilateral or bilateral air space consolidation and four (28.5%) had multiple nodules [12].

In the present study all three (100%) patients had patchy bilateral air space consolidation predominantly in sub pleural distribution and two (66.6%) patients also showed multiple small nodules, findings similar to that reported by Muller et al., [12].

In study conducted by Ujita M et al., demonstrated perilobular pattern giving characteristic arcade like or polygonal appearance on HRCT in 44% of patients with COP [13]. Similar perilobular pattern were also seen in one (33.3%) patient with COP in present study.

### Silicosis

Marchiori E et al., evaluated 25 patients of silicosis and found that 24 (96%) patients had calcification of hilar and mediastinal lymph node [14]. Similarly, in the present study all three (100%) patients showed typical egg shell calcification of hilar and mediastinal lymph nodes.

Ferreira AS et al., studied 44 patients of silicosis and found that 39 (88.6%) patients had nodular masses predominantly in upper and posterior third of lungs [15]. Similar findings of upper and posterior lung involvement were seen in 2 (66.6%) patients in present study.

Antao VC et al., assessed 41 patients of silicosis and found that 28 (68.3%) patients had branching centrilobular opacities and 13 (31.7%) patients had peri-lymphatic distribution of nodules [16]. In the present study two (66.6%) patient showed branching centrilobular opacity and one (33.3%) patient showed nodules in peri-lymphatic distribution.

In present study one (33.3%) patient showed right sided pleural effusion and was sputum AFB positive, indicating predisposition of silica particles to tuberculosis.

### Hypersensitivity Pneumonitis (HP)

HP was identified in three (5%) cases. Two were females and one was male.

DA lynch et al., evaluated 11 patients of HP. Ground glass opacity is seen in all 11(100%) patients and five (45.4%) patients showed ill-defined centrilobular nodules [17]. Similarly, in present study all three (100%) patients showed patchy bilateral ground glass opacity with small ill-defined centrilobular nodules.

In a study of 22 patients with HP, Hansell et al., found that 19(86%) patients had focal areas of decrease attenuation and 18 (82%) had ground glass opacity, giving characteristic mosaic perfusion [18]. In the present study two (66.6%) patients showed area of decrease attenuation along with ground glass opacity (Mosaic perfusion).

### Combined Pulmonary Fibrosis and Emphysema (CPFE)

Aduen et al., found that 13 (48%) of 27 patients of emphysema had changes of basilar pulmonary fibrosis (i.e. honeycombing, reticular opacities and traction bronchiectasis) representing CPFE, and 11 (84.6%) out of 13 patient of CPFE were either smoker/exsmoker [19].

In the present study two cases of CPFE identified. Both cases showed upper lobe pulmonary emphysema and basilar pulmonary fibrosis. All were males and had smoking history.

### LIMITATION

Biopsy could not be obtained in all 60 cases. We had to rely on patients history, clinical examination findings, pulmonary function tests, response to treatment and follow-up HRCT scans.

### CONCLUSION

HRCT of lungs helps to identify and quantify anatomic distribution and pattern of variousILD and also to evaluate different phases, disease activity and progression of diseases in relation to prognosis and therapy. Histopathological diagnosis can be reached in most cases of idiopathic interstitial pneumonias based on HRCT findings, obviating the need for biopsy.

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