APPROACH TO HRCT IN ILD

H. Henry Guo, M.D. Ph.D. CTS January 26, 2018

(IIP) Idiopathic Interstitial Pneumonias



APPROACH TO HRCT (HIGH RESOLUTION COMPUTED TOMOGRAPHY) IN ILD (INTERSTITIAL LUNG DISEASE)

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- Learn findings and terms in lung CT
- Apply a consistent approach to imaging diagnosis of fibrosing lung diseases
- Role of the radiologist in multidisciplinary team in care of the patient with ILD



ILD ROUNDS RADIOLOGY TEMPLATE

Distribution:

PATIENT	Di
NAME:	Up
Pulm	Ba
	Dif
DOB:MRN:_	Pa
	Ce
	Pe
Clinical reatures:	Su
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	Co
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	Tra

Distribution:
Upper Lobe Predominant
Basilar Predominant
Diffuse
Patchy
Central
Peripheral
Sub-pleural sparing
Other
Features:
Ground Glass Opacities
Consolidation
Reticulation
Traction bronchiectasis







2013 ATS-ERS Classification of IIPs

CATEGORY	MORPHOLOGIC PATTERN	CLINICAL- RADIOLOGIC- PATHOLOGIC DIAGNOSIS
Chronic Fibrosing IP	UIP	Idiopathic Pulmonary Fibrosis
	NSIP	Idiopathic NSIP
Smoking Related IP	Respiratory Bronchiolitis	Respiratory Bronchiolitis ILD
	Desquamative IP	Desquamative IP
Acute / Subacute IP	Organizing Pneumonia	Cryptogenic OP
	Diffuse Alveolar Damage	Acute Interstitial Pneumonia (AIP)
Rare entity	Lymphoid IP pattern	Idiopathic LIP
	Pleuroparenchymal Fibroelastosis	Idiopathic PPFE

Chest radiologists' common language

Radiology

Fleischner Society: Glossary of Terms for Thoracic Imaging¹

David M. Hansell, MD, FRCP, FRCR Alexander A. Bankier, MD Heber MacMahon, MB, BCh, BAO Theresa C. McLoud, MD Nestor L. Müller, MD, PhD Jacques Remy, MD

Members of the Fleischner Society compiled a glossary of terms for thoracic imaging that replaces previous glossaries published in 1984 and 1996 for thoracic radiography and computed tomography (CT), respectively. The need to update the previous versions came from the recognition that new words have emerged, others have become obsolete, and the meaning of some terms has changed. Brief descriptions of some diseases are included, and pictorial examples (chest radiographs and CT scans) are provided for the majority of terms. reviews and commentary 🔳 SPECIAL REVIEW

© RSNA, 2008

Honeycombing



Emphysema



Reticulation



Fibrotic NSIP

Traction Bronchiectasis



Ground glass



Consolidation



Mosaic attenuation





HRCT technical clarification

- High Resolution Computed Tomography
 - Traditionally non-volumetric, skipped thin (~1mm) axial slices with 1cm gaps
 - Lower radiation dose, and allows for
 - Inspiratory, expiratory, and prone imaging
- Volumetric imaging
 - Modern CT scanners allow for thin (~1mm) axial slices through entire chest
 - Higher radiation dose, multiphase imaging
 - But coronal reconstructions enable better visualization of disease distribution

Algorithmic approach to HRCT Evaluation

Predominant finding

Distribution

Clinical history

Pathology

Idiopathic Interstitial Pneumonia patterns

Usual Interstitial Pneumonia (UIP)

- Nonspecific Interstitial Pneumonia (NSIP)
- Respiratory Bronchiolitis associated Interstitial Lung Disease (RB – ILD)
- Desquamative Interstitial Pneumonia (DIP)
- Cryptogenic Organizing Pneumonia (COP)
- Acute Interstitial Pneumonia (AIP)
- Lymphoid Interstitial Pneumonia (LIP)

UIP – Imaging features

- Confident diagnosis of UIP pattern—
 - Basal / subpleural dominance
 - Reticulation >> ground glass opacities
 - HONEYCOMBING with or without traction bronchiectasis
 - Absence of features inconsistent with UIP pattern
- Possible diagnosis of UIP pattern—
 - NO HONEYCOMBING
 - Basal / subpleural dominance
 - Reticulation >> ground glass opacities
 - Absence of features inconsistent with UIP pattern





Mueller-Mang C, Radiographics. 2007

UIP – Confident Diagnosis



UIP – Possible Diagnosis



UIP – Imaging features

- Confident diagnosis of UIP pattern—
 - Basal / subpleural dominance
 - Reticulation >> ground glass opacities
 - HONEYCOMBING with or without traction bronchiectasis
 - Absence of features inconsistent with UIP pattern
- Possible diagnosis of UIP pattern—
 - NO HONEYCOMBING
 - Basal / subpleural dominance
 - Reticulation >> ground glass opacities
 - Absence of features inconsistent with UIP pattern

Usual Interstitial Pneumonia (UIP)

Is it a UIP pattern? Confident, Possible, Inconsistent

 \Box Yes \rightarrow No need for surgical biopsy

- Positive predictive value of confident dx of UIP based on CT 95 – 100% (by expert thoracic radiologists)
- □ Maybe/No → Are there features of another IIP or other interstitial lung process?
 - Give ordered differential
 - Correlate with clinical history
 - Probably will need surgical lung biopsy

UIP – DDx

□ Chronic HP

Upper or mid lung zone predominance

- Micronodules
- No honeycombing

Airtrapping

Minority of cases indistinguishable from UIP on CT

Asbestosis

Rheumatoid

Sarcoidosis

Hypersensitivity pneumonitis (HP)



Findings Inconsistent with UIP pattern

- Upper or mid lung predominance
- Peribronchovascular predominance
- Extensive ground glass abnormality
- Profuse micronodules
- Discrete Cysts
- Diffuse mosaic attenuation / air-trapping
- Consolidation in bronchopulmonary segments

Raghu et al, ATS/ERS/JRS/ALAT official statement, Am J Respir Crit Care Med 2011

NSIP – Imaging

- Distribution basilar and peripheral,
 peribronchovascular, or both
- Specific finding is immediate subpleural sparing (up to 40%)
- Findings
 - Groundglass (cellular) > reticulation (fibrotic) > consolidation
 - Traction bronchiectasis
 - Architectural distortion
 - Minimal honeycombing (in up to 27% of pts)





NSIP (cellular versus fibrotic)



Cellular Fibrotic

Further classified according to
relative amounts of fibrosis vs inflammation
Cellular v Fibrotic

NSIP – DDx



Smoking Related ILDs

Continuum of Smoking-related Lung Diseases

	Symptoms and Physiologic Impairment		CT Feature	
Condition		Pathologic Feature	Ground-Glass Opacification	Centrilobular Nodules
RB*	Uncommon	Bronchiolocentric	Small patches	Mild
RB-ILD	Severe	Macrophages extend into peribronchioloar region	Extensive	Extensive
DIP	Severe	Diffuse intraalveolar macrophages	Extensive	Uncommon

- Respiratory Bronchiolitis (RB)
- Respiratory Bronchiolitis Interstitial Lung Disease (RB-ILD)
- Desquamative interstitial pneumonitis (DIP)

RB and RB-ILD – Imaging

- Distribution multifocal, often upper lobe
- Findings
 - Groundglass centrilobular nodules
 - Patchy groundglass
 - Airway thickening
 - Emphysema

RB and **RB-ILD**



Mueller-Mang C, Radiographics. 2007

RB – Typical



RB and RB-ILD – DDx

- Hypersensitivity pneumonitis (but most of these patients are nonsmokers)
- Atypical infection
- Siderosis
- Follicular Bronchiolitis
- Vasculitis

DIP – Imaging

- Distribution Diffuse or multifocal; lower lung zone, often peripheral
- Findings
 - Ground glass
 - Reticulation (mild)
 - Centrilobular nodules uncommon
 - Honeycombing uncommon and, when present, minimal
 - Emphysema





DIP – Typical



DIP – DDx

- Hypersensitivity pneumonitis
- Atypical infections (e.g., PJP / PCP)

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OP – Imaging

- Distribution peripheral and/or peribronchovascular; more commonly lower lobe
- □ Findings of OP
 - Consolidation > groundglass > nodules
 - Air bronchograms with mild cylindrical bronchial dilatation
 - Pleural effusions uncommon
 - Spontaneous resolution or migration





Mueller-Mang C, Radiographics. 2007





OP – Reverse Halo / Atoll sign



OP – DDx

- OP pattern found in association with:
- CVD (esp RA or polymyositis)
- Adenocarcinoma, minimally invasive
- Lymphoma
- Vasculitis
- Sarcoid
- Chronic eosinophilic pneumonia
- Infection

Acute Interstitial Pneumonia (AIP)

Clinical –

- Hypoxemia that rapidly progresses to respiratory failure
- Usually requires mechanical ventilation
- Most fulfill clinical criteria for ARDS
- 2011 Berlin definition* :
- **PaO**₂ / Fi O₂ ratio Normal: PaO_2 80-100mmHg, FiO₂ 0.21
- 300 (Mild), < 200 (Moderate), < 100 (severe)</p>
- Pulmonary capillary wedge pressure <18 mmHg (no cardiogenic pulmonary edema)
- Hamman-Rich Syndrome
- \Box Mortality > 50%

* JAMA, June 20, 2012 – Vol 307, No. 23

AIP / Diffuse Alveolar Damage (DAD) Imaging

- Distribution bilateral multifocal or diffuse; no clear lung zone predominance though consolidation is often dependent
- Early exudative phase
 - Geographic groundglass with areas of focal sparing
 - Consolidation in dependent areas
 - Bronchial dilatation
- Later organizing phase
 - Fibrosis in nondependent areas

DAD – Exudative Phase



DAD – Organizing Phase



DAD – DDx

- Widespread infection
- Extensive Aspiration
- Hydrostatic pulmonary edema
- Acute eosinophilic pneumonia
- Pulmonary hemorrhage

Lymphocytic Interstitial Pneumonia (LIP)

 Histology – alveolar interstitium infiltrated by lymphocytes and plasma cells, forming large lymphoid aggregates



LIP – Imaging

Findings –

- Ground glass and Nodules
 - Centrilobular ground glass nodules
 - Multifocal areas of ground glass
- Nodules and consolidation in perilymphatic distribution
- Thickening of bronchovascular bundles and interlobular septal thickening
- Perivascular cysts

LIP – Typical



LIP – Evolution



LIP – DDx

- Hypersensitivity Pneumonitis
- Langerhans Cell Histiocytosis (LCH)
- Lymphangiomatosis (LAM)

Summary

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Idiopathic Interstitial Pneumonias





- UIP peripheral, basilar, reticulation, HONEYCOMBING
- NSIP peripheral, basilar, peribronchovascular, ground glass, SUBPLEURAL SPARING
- RB-ILD upper lobe CENTRILOBULAR GROUND GLASS
 DIP lower lobe peripheral or DIFFUSE GROUND GLASS
- OP –CONSOLIDATION: peripheral, peribronchovascular, mass-like, variant features (perilobular, reverse halo)
- □ AIP acute presentation, DAD/ARDS pattern
- LIP ground glass, interlobular thickening, CYSTS, CVD

Summary

- Know typical pattern of UIP
- If it's not a typical pattern of UIP, likely will need lung biopsy
- AIP clinically not difficult to differentiate from the others, basically looks like ARDS
- NSIP and OP patterns are commonly associated with various entities (drug reaction, collagen vascular disease, etc)

Future:

Lower CT radiation dose

Quantitative imaging

Artificial Intelligence

Artific on E

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Al's Impact Will Be Monumental—Will Radiologists Go Along for the Ride or Be Left in the Dust?

/ Thorac Imaging • Volume 28, Number 5, September 2013

One day soon, machines powered by artificial intelligence (AI) will interpret even the most complex clinical images as accurately as today's most experienced radiologists. These robot radiologists will automatically generate final reports, uniformly structured and with no need for preliminary reads. Their interpretations will take



Quantitative CT Imaging of Interstitial Lung Diseases

Resources:

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Your friendly chest radiologist, who is sometimes right