APPROACH TO HRCT IN ILD
(IIP) Idiopathic Interstitial Pneumonias

- RB-ILD
- NSIP
- DIP
- LIP
- COP
- AIP
APPROACH TO HRCT (HIGH RESOLUTION COMPUTED TOMOGRAPHY) IN ILD (INTERSTITIAL LUNG DISEASE)
Goals:

- 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

No disclosures
**ILD ROUNDS RADIOLOGY TEMPLATE**

**Distribution:**

- **PATIENT**
  - **NAME:** ___________________________
  - **Pulm:** __________________________
  - **DOB:** ___________ **MRN:** ___________

- **Clinical Features:**
  - __________________________
  - __________________________
  - __________________________
  - __________________________

- **Features:**
  - Ground Glass Opacities
  - Consolidation
  - Reticulation
  - Traction bronchiectasis
  - ________________

- **Upper Lobe Predominant**
- **Basilar Predominant**
- **Diffuse**
- **Patchy**
- **Central**
- **Peripheral**
- **Sub-pleural sparing**
- **Other**
# 2013 ATS-ERS Classification of IIPs

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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.

© RSNA, 2008
Honeycombing

Emphysema

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
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

- Yes → 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

- NSIP
- 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
NSIP (cellular versus fibrotic)

- Further classified according to relative amounts of fibrosis vs inflammation
  - Cellular vs Fibrotic
NSIP – DDx

- UIP
- OP
- DIP
- HP

Diagram showing survival rates with percent living on the y-axis and survival (years) on the x-axis. There are two lines: Fibrotic NSIP and UIP, with DIP, Cellular NSIP included.
### Smoking Related ILDs

#### Continuum of Smoking-related Lung Diseases

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<tr>
<th>Condition</th>
<th>Symptoms and Physiologic Impairment</th>
<th>Pathologic Feature</th>
<th>CT Feature</th>
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<tr>
<td>RB*</td>
<td>Uncommon</td>
<td>Bronchiolocentric</td>
<td>Small patches</td>
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<td>Severe</td>
<td>Macrophages extend into peribronchioloar region</td>
<td>Extensive</td>
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- 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
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
DIP – Typical
DIP — DDx

- RB-ILD
- NSIP
- Hypersensitivity pneumonitis
- Atypical infections (e.g., PJP / PCP)
### 2013 ATS-ERS Classification of IIPs

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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
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*:
    - \( \frac{\text{PaO}_2}{\text{Fi O}_2} \) ratio Normal: \( \text{PaO}_2 \) 80-100mmHg, \( \text{FiO}_2 \) 0.21
    - < 300 (Mild), < 200 (Moderate), < 100 (severe)
    - Pulmonary capillary wedge pressure <18 mmHg (no cardiogenic pulmonary edema)
- Hamman-Rich Syndrome
- 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

- ARDS
- 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
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

- DIP
- NSIP
- Hypersensitivity Pneumonitis
- Langerhans Cell Histiocytosis (LCH)
- Lymphangiomatosis (LAM)
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Idiopathic Interstitial Pneumonias

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- NSIP
- DIP
- LIP
- AIP
- COP

Questions marks indicate overlap or uncertainty.
Summary

- 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
Your friendly chest radiologist, who is sometimes right