Clearing the haze: a guide to diffuse groundglass differentials on CT

Dr Matthew Morgan, Dr Vaishnavi Gnanananthan, Dr Jonathan Dunbar
University Hospital Southampton, Cardiothoracic Radiology Department

University Hospital Southampton NHS Foundation Trust

Introduction

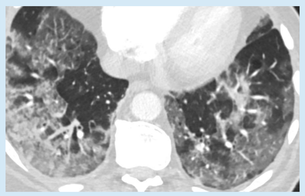
Differentiating causes of diffuse ground-glass opacities in the acute setting is a challenge often faced by the on call Radiologist, with a broad differential that includes both acute pathologies such as pulmonary oedema and haemorrhage but also a broad spectrum of infective and inflammatory causes. Understanding key distinguishing features and grouping these into broad categories allows simplification of this task and aids in providing a clinically useful differential. Clinical history, particularly that of an unwell or immunocompromised patient remains key.

Causes

Infection

Pneumocystis Jiroveci Pneumonia
- Symmetrical perihilar distribution
- Interlobular septal thickening
- Pneumatoceles
- Absence of pleural effusions

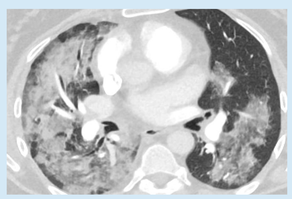
Axial section at the carina highlights symmetrical perihilar distribution



Lower zone subpleural groundglass change and consolidation with relative central sparing in a patient with acute COVID pneumonitis

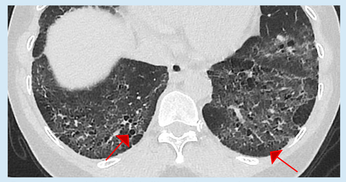
COVID-19
- Bilateral peripheral subpleural distribution OR multifocal rounded foci
- Inter and intra lobular septal thickening (crazy paving)
- Peri-bronchovascular interstitial thickening

Other viral pneumonitis
- Heterogenous appearances depending on organism and patient immune status
- Always within differential of unwell and/or immunocompromised patient



Asymmetrical bilateral groundglass change in a patient presenting acutely unwell with sepsis. Causative organism not established

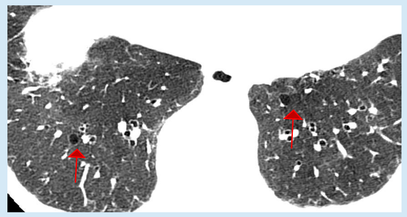
Inflammation/ILD



Basal groundglass with fibrosis in a patient with connective tissue disease and NSIP pattern fibrosis. Red arrows highlight subpleural sparing and traction bronchiectasis

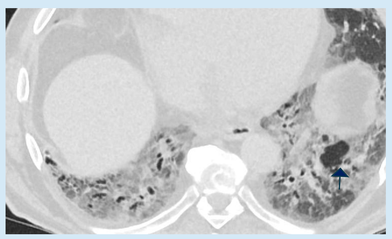
Non specific interstitial pneumonia (NSIP)
- Usually symmetrical or diffuse
- Commonly basal predominant
- Immediate subpleural sparing is specific but uncommon
- Subpleural reticulation and traction bronchiectasis indicate fibrosis

Lymphoid Interstitial Pneumonia (LIP)
- Mid to lower zone predominant ground glass
- Thin walled cysts
- Peri-bronchovascular/ peri-lymphatic interstitial thickening
- Lymphadenopathy common



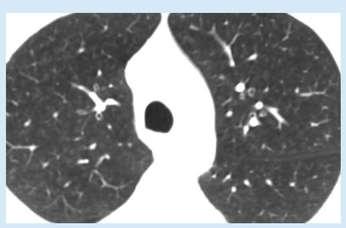
Diffuse lower zone groundglass change. Red arrows highlight scattered thin walled cysts

Hypersensitivity Pneumonitis (HP)
- Diffuse symmetrical groundglass: may be upper zone predominant
- Air trapping: geographic areas of low density
- Mosaic attenuation/ triple density: air trapping, normal lung and ground glass interposed
- When fibrotic: coarse reticulation and honeycombing



Mosaic attenuation in the left lower lobe in a patient with biopsy proved fibrotic HP. Blue arrow highlights geographic low density of air trapping

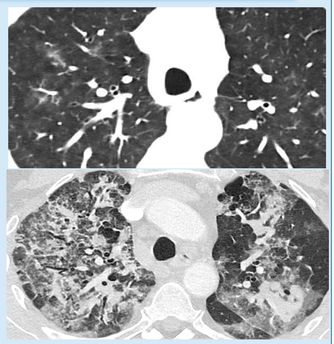
Smoking related ILD
- Respiratory bronchiolitis ILD (RB-ILD) and Desquamative interstitial pneumonia patterns with some overlap
- RB-ILD characterised by centrilobular ground glass opacities. Centrilobular nodules and airway wall thickening. Upper zone predominant
- DIP pattern characterised by basal predominant patchy ground glass +/- reticulation
- Other features of smoking e.g. emphysema and airways disease



Ill defined centrilobular ground glass opacities in a patient with RB-ILD. The imaged airways show wall thickening

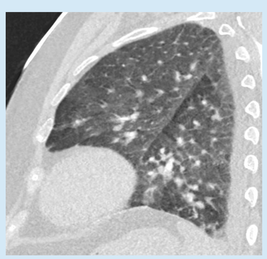
Haemorrhage

- History of haemoptysis is key
- Variable pattern dependent of aetiology and acuity: difficult to distinguish from infection or oedema on CT alone
- Consolidation common
- Subacute/ late stage interlobular septal thickening due to intra-lymphatic accumulation of haemosiderin



Initial patchy groundglass progressing to widespread groundglass , consolidation and septal thickening in patient with known small vessel vasculitis

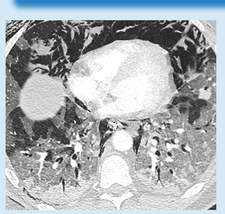
Pulmonary Oedema



Often basal predominant
Interlobular septal thickening
Thickening of bronchovascular bundles
Pleural effusions common

Sagittal reconstruction highlighting prominent septal thickening and pleural effusions in a patient with pulmonary oedema

ARDS



- Anteroposterior gradient with dense consolidation dependently and overlying ground glass
- Late phase: reticulation and cystic change
- History is key: often critical care and ventilated

ITU patient on NIV for COVID-19 infection. AP gradient of dependent consolidation with overlying groundglass suggests superimposed ARDS. Arrows highlight ventilation associated pneumomediastinum

References

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