Imaging findings in Hypersensitivity Pneumonitis - a pictorical review.

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Learning objectives

Review and discuss the physiopathology and clinical aspects of hypersensitivity pneumonitis.

To describe and review the typical and atypical imaging findings in hypersensitivity pneumonitis.

Background

In 1713, Ramazzini provided the first account of what is now called hypersensitivity pneumonitis (HP)\(^{(1)}\), an inflammatory lung disease caused by inhalation of airborne organic particulate matter that include microbes, animal and plant proteins and low-molecular-weight chemicals, that produce an immune-mediated inflammatory response in sensitized individuals as they deposit in distal air spaces. Furthermore, HP may result from exposure to multiples agents present in the same environment.\(^{(2)}\)

In general, only 5%-15% of exposed individuals develop HP and depends of the amount of allergen inhaled, the duration of exposure, the nature of the antigen and host factors. Most cases of HP occur after months or years of continuous or intermittent inhalation of the agent. Tobacco appears to protect, as most patients (80%-95%) with HP are nonsmokers\(^{(3)}\), but when present, in smokers is associated with higher mortality.\(^{(4)}\)

The presentation varies and symptomatic disease is usually divided in acute, subacute and chronic types. Although no classification system is entirely satisfactory, the symptomatic disease can be divided in acute, with dyspnea and constitutional symptoms episodes and improvement between attacks; or insidious (gradual) onset of dyspnea, cough and weight loss with or without superimposed acute episodes.\(^{(5)}\)

Pulmonary function tests demonstrate classically restriction often with decreased diffusing capacity. Bronchoalveolar lavage (BAL) usually shows increased white blood cell count, with lymphocytes accounting for at least 20%-30% of white blood cells, but commonly more than 50%.

Findings and procedure details
Although imaging findings can be nonspecific, characteristic patterns and findings are described in acute and insidious onset, and in chronic disease with fibrosis.

Chest radiographs are often normal. Findings include ground glass (patchy or diffuse) or rarely consolidation, often with a central distribution. (Fig. 1 on page 3) When fibrosis is present a reticular pattern and honeycombing may be present, sometimes more severe in upper lobes. (Fig. 2 on page 5)

Most patients (90%) present abnormalities in high-resolution CT. Ground glass opacity can be secondary to acute inflammation but usually represents chronic interstitial inflammation and may be homogeneous or patchy, involving the middle part and base of the lungs with a bronchovascular distribution. (Fig. 3 on page 5) Hypoattenuation and hypovascular of scattered secondary lobules due to air trapping is also common - mosaic perfusion. (Fig. 4 on page 6) The differential diagnosis of patchy ground glass pattern with a mosaic distribution includes HP, bronchiolitis and thromboembolic disease. Expiratory HRCT scans to demonstrate air trapping (Fig. 5 on page 7), clinical history and BAL findings usually define the diagnosis of HP. Another characteristic finding is numerous round centrilobular opacities, usually less than 5mm, indistinct borders and ground glass attenuation, representing cellular bronchiolitis and peribronchiolar inflammation. (Fig. 6 on page 8, Fig. 7 on page 9) It's important to differentiate from RB-ILD, which can have similar imaging findings but is seen in smokers and usually associated with centrilobular emphysema.

The combination of patchy ground-glass opacities, normal parenchymal regions and air trapping (mosaic perfusion) is common and referred as "headcheese" sign. (Fig. 8 on page 10) Cysts are sometimes present (14%). (Fig. 9 on page 11)

With fibrosis, reticulation appears, mainly in the middle portion of the lungs or fairly widespread but with relative sparing of the extreme apices and bases. (Fig. 10 on page 12) Other findings include traction bronchiectasis and honeycombing, sometimes resembling UIP or NSIP. (Fig. 11 on page 13) In patients with fibrosis, the concomitant presence of ground glass opacities (centrilobular or generalized) and air trapping is common. And is the presence of lobular air trapping, centrilobular ground-glass opacities and absence of lower predominance that favours HP when compared with other differential diagnosis as UIP. (Fig. 12 on page 14)

Images for this section:
**Fig. 1:** Subacute hypersensitivity pneumonitis. Posteroanterior (PA) chest radiograph shows areas of patchy ground glass attenuation, resembling a nodular pattern with
a central distribution. Note also the areas of reticulation, suggesting the presence of interstitial disease.

**Fig. 2:** Chronic hypersensitivity pneumonitis. Posteroanterior (PA) chest radiograph shows a diffuse reticular pattern, more severe in the upper lobes with a decrease of lung volume. Note also the ground glass opacity present in the inferior lobes, especially on the left inferior lobe.
**Fig. 3:** HRCT scan demonstrates diffuse ground glass opacities in the middle part of both lungs, with a bronchovascular distribution. Note the concomitant presence of areas of low attenuation secondary to air trapping. Some reticulation is seen but no there are no findings suggestive of fibrosis.
**Fig. 4:** HRCT in a 34 years old patient with HP shows multiple centrilobular ground glass opacities. Areas of low attenuation are also seen corresponding to areas of air trapping, a common feature of HP.
Fig. 5: Axial images of dynamic expiratory CT scan in a 42 years old patient with HP. There are areas of hypoattenuated lung parenchyma in the periphery of the upper right lobe. Expiratory scans are defines these areas as air trapping, an important finding in the correct diagnosis of HP.
Fig. 6: 30 years old female with HP after exposure to mold. HRCT demonstrates diffuse centrilobular ground glass nodular opacities, which can resemble respiratory bronchitis (RB). A peripheral area of air trapping can also be seen.
Fig. 7: 35 years old female with insidious HP with superimposed acute episodes due to bird exposure. Axial (left) and reformatted coronal (right) non-enhanced thoracic CT scan from two exams with 5 months interval. The later (from November 2012) show significant improvement with the resolution of most of the ground glass opacities with an upper predominance seen in the earlier examination (from June 2012). Some ground glass centrilobular opacities can still be seen in the more recent scan.
Fig. 8: HRCT scan shows a heterogeneous attenuation of the pulmonary parenchyma with areas of ground glass and air trapping, referred as "headcheese sign". Note also the peripheral honeycombing corresponding to fibrosis in the superior segment of the right lower lobe and lingula.
**Fig. 9:** 37 years old male with parakeet exposure presenting BAL and lung biopsy compatible with HP. HRCT scan shows areas of ground glass opacities and air trapping. Cysts are also present, an uncommon finding in patients with HP.
Fig. 10: Reformatted coronal non-enhanced thoracic CT scan image showing fibrosis and traction bronchiectasis with a central predominance. Note areas of sparing in the extreme apices and bases, common in fibrosis secondary to HP.
Fig. 11: HRCT scan image demonstrating diffuse peripheral honeycombing and some traction bronchiectasis. Although it could resemble UIP, the presence of air trapping suggests HP.
Fig. 12: 54 years old male with chronic HP and history of mold exposure. Reformatted coronal non-enhanced thoracic CT scan image demonstrating diffuse fibrotic changes with upper predominance, a feature common in HP but uncommon in UIP or NSIP. Note the presence of air trapping in left base, a common feature of HP.
Conclusion

HP is a frequent disease and the diagnosis relies on characteristic imaging features and lymphocytosis in BAL fluid (30% lymphocytes in nonsmokers, 20% in smokers), with a supplemental role played by typical histologic findings at lung biopsy in confusing or ambiguous cases.\(^{(13)}\)

Those characteristic imaging features include bilateral ground glass opacities or poorly defined centrilobular nodular opacities on high-resolution chest CT and air trapping. When fibrosis is present it can sometimes resemble UIP and NSIP.

It's important to know the imaging findings to define the correct diagnosis and distinguish it from other entities with different treatments and outcomes.

Personal information

References


