Imaging of Hypersensitivity Pneumonitis

Andrea L. Magee, MD[a,*], Steven M. Montner, MD[a], Aliya Husain, MD[b], Ayodeji Adegunsoye, MD[b], Rekha Vij, MD[c], Jonathan H. Chung, MD[a]

KEYWORDS

• Hypersensitivity pneumonitis • Interstitial lung disease • Parenchymal lung disease • High-resolution computed tomography

KEY POINTS

- Hypersensitivity pneumonitis (HP) is a complex syndrome of diffuse parenchymal lung disease caused by inhalation of and sensitization to an ever-expanding list of aerosolized antigens. Notably, environmental exposures, including metal dusts, wood dust, avian antigens, and vegetable and animal dusts are also associated with an increased risk of developing idiopathic pulmonary fibrosis.
- Lower rates of HP occur in smokers as compared with matched nonsmokers.
- Histopathologically, HP features a triad of predominantly lymphocytic interstitial infiltrate, cellular bronchiolitis, and poorly formed non-necrotizing granulomas.
- There is a lack of consensus regarding diagnostic criteria for HP, and diagnosis requires a multidisciplinary approach involving clinicians, radiologists, and pathologists.
- The classic high-resolution computed tomography appearance of HP features upper-lung–predominant pulmonary changes including ground-glass opacities, poorly defined centrilobular nodules, and lobular areas of decreased attenuation representing air-trapping. The characteristic constellation of findings is termed the headcheese sign.

INTRODUCTION

Hypersensitivity pneumonitis (HP) is a diffuse parenchymal lung disease caused by inhalation of and sensitization to an ever-expanding list of aerosolized antigens.[1] HP develops in a minority of antigenic exposure cases, and although the factors responsible for such highly variable susceptibility remain elusive, genetic predisposition and misdirected immune modulatory processes have been long suspected in the pathophysiology of HP. Animal studies using in vivo and in vitro techniques have provided clues to some of the alterations in the function of alveolar macrophages, respiratory epithelial cells, and lymphocytes, which contribute to the pathogenesis of HP.[2–5]

Robust epidemiologic information is severely lacking in HP, in part due to nonconsensus regarding diagnostic criteria as well as the complex nature of collecting data on a disease that varies with the changing seasons, and that is heavily influenced by local customs, including

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[a] Department of Radiology, The University of Chicago, 5841 South Maryland Avenue, MC2026, Chicago, IL 60637, USA; [b] Department of Pathology, The University of Chicago, 5841 South Maryland Avenue, #6101, Chicago, IL 60637, USA; [c] Department of Pulmonology & Critical Care, The University of Chicago, 5841 South Maryland Avenue, MC6076, Chicago, IL 60637, USA
* Corresponding author.
E-mail address: Andrea.Magee@uchospitals.edu

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smoking and occupational practices.[6] In 1994, Coultas and colleagues[7] estimated that the annual incidence of interstitial lung diseases (ILDs) in the Bernalillo County, New Mexico, population to be approximately 30 per 100,000 per year, with HP accounting for fewer than 2% of these cases. In 2001, these data were compared with those collected by ILD registries in Belgium, Germany, and Italy, with this aggregate analysis suggesting that HP may represent anywhere between 1.5% and 13.0% of all ILD cases.[8]

Epidemiologic data suggest that HP shows a slight female preponderance and occurs more frequently in nonsmokers, with one study demonstrating a smoking rate of only 2% in the HP population.[9,10] A large cohort study found that patients with HP are less likely to be current smokers but are equally likely to be former smokers when compared with the general population.[11] This is in opposition to idiopathic pulmonary fibrosis, which is more common in men and in smokers.

Antigens reported to cause HP are categorized by antigen subtype in **Table 1**.[6,12–18] Most of the inciting antigens in HP are smaller than 5 μm in size, a diameter that permits inhalation into the tracheobronchial tree and deposition at the alveolar level.[14] Inhaled particles larger than 10 μm are retained by the oropharyngeal and nasopharyngeal mucous membranes, and conversely, particles smaller than 0.1 μm are small enough to be inhaled and subsequently exhaled without being deposited.[19]

NORMAL ANATOMY AND IMAGING

High-resolution computed tomography (HRCT) is the imaging modality of choice for examination of patients with ILD. Thin-section CT images (0.625-mm to 1.5-mm slice thickness) are

Table 1
Antigens reported to cause HP

Antigen Subtype	Examples	Exposure Sources	Resultant Disease
Bacteria	*Saccharopolyspora rectivirgula*	Moldy hay, grain, silage	Farmer's lung
	Thermoactinomyces vulgaris, Absidia corymbifera		
Fungi, yeast	*Aspergillus* sp	Moldy hay, grain	Farmer's lung
		Moldy compost and mushrooms	Mushrooms worker's lung
	Trichosporon cutaneum	Contaminated homes	Summer-type HP
	Penicillium sp	Moldy cork	Suberosis
		Moldy cheese or cheese casings	Cheese washer's lung
		Dry sausage dust in salami factories	Chacinero lung
	Alternaria sp	Contaminated oak, cedar, and mahogany dust; pine and spruce pulp	Woodworker's lung
Mycobacteria	*Mycobacterium avium* complex	Mold on ceiling or walls, tub water	Hot tub lung
		Mist from pool water, sprays and fountains	Swimming pool lung
Animal proteins	Proteins in avian droppings and serum and on feathers	Parakeets, pigeons, parrots, cockatiels, ducks, chickens, turkeys	Pigeon breeder's lung Bird fancier's lung
	Animal fur dust	Animal pelts	Furrier's lung
	Rats, gerbils	Urine, serum, pelt proteins	Laboratory worker's lung
	Avian proteins	Feather beds, pillows, duvets	Feather duvet lung
	Silkworm proteins	Dust from silkworm larvae and cocoons	Silk production HP
Chemicals	Diisocyanates, toluene, trimellitic anhydride	Polyurethane foams, spray paints, dyes, glues, varnishes, lacquer	Chemical worker's lung
	Pyrethrum	Insecticide	Pyrethrum pneumonitis

Abbreviation: HP, hypersensitivity pneumonitis.