Opinion

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Interstitial Lung Diseases: Clinical Classification and Diagnostic Challenges

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Introduction

Interstitial lung diseases (ILDs) represent a heterogeneous group of disorders characterized by varying degrees of inflammation and fibrosis of the lung parenchyma. These diseases affect the interstitium, alveoli and small airways, ultimately leading to impaired gas exchange and progressive respiratory insufficiency. The clinical spectrum ranges from relatively benign, reversible conditions to progressive fibrosing diseases with poor prognosis. Understanding ILDs is challenging due to their diverse etiologies, overlapping symptoms and variable clinical outcomes. The classification and diagnosis of ILDs have evolved considerably over the past decades with the integration of high-resolution imaging, pathology and molecular tools. Despite these advances, accurately distinguishing between different subtypes remains complex because of clinical similarities and nonspecific presentations. Identifying the underlying disease type is crucial for selecting appropriate treatment strategies, predicting prognosis and improving patient survival. As research continues to advance, clinicians face the dual challenge of refining diagnostic methods while ensuring precise classification of this broad disease group [1].

Description

The classification of interstitial lung diseases is primarily based on etiology, clinical presentation, radiological findings and histopathology. Broadly, ILDs are divided into known-cause ILDs, idiopathic interstitial pneumonias (IIPs), granulomatous ILDs and rare or unclassifiable forms. Known-cause ILDs are often linked to occupational exposures, drug-induced reactions and connective tissue diseases such as systemic sclerosis and rheumatoid arthritis. Idiopathic pulmonary fibrosis (IPF), the prototypical form of IIP, is one of the most studied and severe ILDs, characterized by progressive scarring and poor survival rates. Sarcoidosis represents a granulomatous ILD, which can mimic other diseases due to its diverse systemic involvement. This diversity underscores the complexity of ILD classification and the importance of multidisciplinary evaluation [2].

Radiologic imaging, particularly high-resolution computed tomography (HRCT), plays a central role in diagnosing ILDs. HRCT provides detailed visualization of parenchymal patterns such as ground-glass opacities, reticulations, honeycombing and nodules. For instance, the usual interstitial pneumonia (UIP) pattern on HRCT strongly supports a diagnosis of idiopathic pulmonary fibrosis. However, radiological overlap between different ILDs often complicates interpretation. Radiologists, pulmonologists and pathologists must collaborate closely to correlate imaging findings with clinical and histological data. Even with HRCT advancements, distinguishing between conditions such as nonspecific interstitial pneumonia (NSIP), hypersensitivity pneumonitis and early IPF remains a diagnostic challenge [3].

Histopathological evaluation through lung biopsy is often necessary when noninvasive methods fail to yield a conclusive diagnosis. Surgical lung biopsy has been the gold standard, but due to its invasiveness and associated risks, transbronchial cryobiopsy has emerged as a safer and less invasive alternative. Histological analysis can reveal specific features such as granulomas, cellular infiltrates, or fibrotic changes that help classify ILDs. However, sampling errors and interobserver variability may lead to misclassification and certain patients are not candidates for invasive procedures due to advanced disease or comorbidities. These limitations highlight the ongoing need for novel biomarkers and molecular tools to improve diagnostic accuracy in ILDs [4].

Another major diagnostic challenge in ILDs arises from their overlapping clinical manifestations. Common symptoms like progressive dyspnea, dry cough and fatigue are nonspecific and frequently attributed to other pulmonary or cardiac diseases. Pulmonary function tests often reveal restrictive patterns and impaired gas exchange, but these findings are not unique to ILDs. Moreover, the heterogeneity of disease progression complicates early recognition and timely intervention. Emerging approaches such as genetic testing, serum biomarkers and machine learning algorithms applied to imaging data are being investigated to enhance diagnostic precision. Despite progress, timely and accurate classification of ILDs continues to be a pressing clinical challenge that directly impacts therapeutic outcomes.

The future of interstitial lung disease research lies in integrating advanced molecular diagnostics, genomics and artificial intelligence to achieve more precise classification. Novel biomarkers and liquid biopsy techniques are expected to provide earlier, noninvasive detection and prognostic insights. Personalized medicine approaches, including targeted antifibrotic and immunomodulatory therapies, hold promise for improving outcomes in different ILD subtypes. Digital health tools and remote monitoring may also transform long-term disease management and patient adherence. As these innovations mature, they will likely shift ILD care toward earlier diagnosis, individualized treatment and improved survival rates [5].

Conclusion

Interstitial lung diseases encompass a broad and diverse spectrum of disorders that pose significant challenges in classification and diagnosis. While HRCT imaging, histopathology and multidisciplinary approaches have improved diagnostic accuracy, the overlapping clinical, radiological and pathological features often complicate differentiation. Advances in biopsy techniques, molecular diagnostics and biomarker research hold promise for more precise classification and early recognition. However, until these innovations become widely accessible and standardized, ILD diagnosis will continue to rely heavily on integrated clinical judgment. Ultimately, refining diagnostic strategies for ILDs is essential to enable tailored therapies, improve patient prognosis and guide future research into these complex and life-altering diseases.

Acknowledgment

None.

Conflict of Interest

None.

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