
Refining Pulmonary Calcification and Ossification Diagnosis



Pulmonary calcification and ossification are radiologically identifiable phenomena with diverse underlying causes and implications. Although both appear as areas of high attenuation on CT imaging, their origins, morphologies and clinical significance differ markedly. Calcification results from the deposition of calcium salts, either systemically or locally, while ossification involves true bone formation within the lung parenchyma. Recognising the type and pattern of these deposits is essential for accurate diagnosis and appropriate clinical management. Recent advances in imaging and understanding of pathophysiology have improved the ability to differentiate these conditions and link them to underlying diseases such as chronic renal failure, infections, interstitial lung disease and malignancies.

Pulmonary Calcification: Metastatic and Dystrophic Forms

Pulmonary calcification is broadly categorised into metastatic pulmonary calcification (MPC) and dystrophic pulmonary calcification (DPC), each with distinct aetiologies. MPC arises from systemic metabolic disturbances such as hypercalcaemia and hyperphosphataemia, commonly due to chronic renal failure, hyperparathyroidism or malignancy. In these cases, normal lung tissue becomes calcified due to elevated calcium-phosphate product levels. Imaging typically reveals diffuse, often upper lobe predominant, ground-glass or consolidative opacities with punctate or amorphous calcific foci.

By contrast, DPC occurs in previously injured lung tissue without systemic mineral imbalance. Common triggers include granulomatous infections (e.g., tuberculosis, histoplasmosis), chronic inflammation and inhalational exposures like silicosis. CT imaging in DPC reveals dense, nodular calcifications localised to areas of fibrosis, scarring or prior infection. These calcifications may be associated with calcified lymph nodes or residual cavities, as seen in fungal infections or healed varicella pneumonia. Differentiating MPC from DPC often requires correlation with clinical history and laboratory data, especially serum calcium and phosphate levels.

Pulmonary Ossification: Nodular and Dendriform Patterns

Unlike calcification, pulmonary ossification involves the formation of mature bone and is not driven by mineral imbalance. Instead, it is often a metaplastic response to chronic lung injury. Ossification appears in two primary patterns: nodular (NPO) and dendriform (DPO). NPO typically manifests as uniform, small high-attenuation nodules and is associated with chronic passive congestion due to cardiac conditions like mitral stenosis. These nodules, usually located in the lower lobes, may resemble healed granulomas but differ histologically by the presence of mature bone.

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DPO presents as branching, treelike calcifications aligned with the lung interstitium. It is most often observed in fibrosing interstitial lung disease, particularly idiopathic pulmonary fibrosis, but can also be linked to chronic aspiration or chronic obstructive pulmonary disease. CT imaging reveals fine linear opacities and ossific foci following the lung's structural framework. While both NPO and DPO may coexist, their distinction lies in distribution and histologic features—NPO within alveolar spaces and DPO within the interstitium, often containing marrow elements.

Specific Disorders and Differential Diagnostic Patterns

Several specific diseases present with calcification or ossification, offering diagnostic clues. Pulmonary amyloidosis, either systemic or localised, may exhibit calcified nodules or diffuse patterns with interlobular septal thickening. Pulmonary alveolar microlithiasis, a genetic disorder of phosphate metabolism, produces characteristic sandlike micronodules with lower lobe predominance and subpleural sparing.

Neoplastic causes span both benign and malignant lesions. Hamartomas frequently show internal popcorn-like calcifications, while chondromas lack fat but display dense calcification. Certain malignancies such as carcinoid tumours, mucinous adenocarcinoma and large cell neuroendocrine carcinoma can also calcify. Metastatic disease from osteosarcoma or papillary thyroid carcinoma often features dense

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pulmonary calcifications or ossifications, sometimes with psammomatous patterns.

A pattern-based diagnostic approach enhances clinical interpretation. For instance, diffuse micronodules suggest MPC, healed varicella pneumonia or occupational lung diseases, while focal large nodules raise suspicion for neoplasm or healed granulomatous infections. Upper lobe predominance is common in MPC and inhalational diseases, whereas lower lobe involvement suggests DPO, NPO, or amyloidosis. Recognising these patterns allows radiologists to generate focused differential diagnoses and reduce unnecessary invasive procedures.

Pulmonary calcification and ossification represent critical radiologic findings that reflect a broad range of systemic and local diseases. Despite their superficial similarity on imaging, their distinct pathophysiologic mechanisms and distribution patterns provide important diagnostic value. Understanding the clinical context, integrating laboratory data and recognising characteristic CT features enable clinicians to distinguish between these entities effectively. In doing so, radiologists can play a pivotal role in guiding diagnosis, monitoring disease progression and tailoring patient management strategies.

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