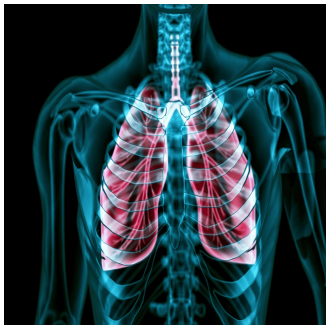
HealthManagement
Promoting Management and Leadership

Imaging Lung Microvasculopathy in CTEPH with PCD-CT



Chronic thromboembolic pulmonary hypertension (CTEPH) is a multifaceted condition characterised by chronic obstruction of the pulmonary arteries and associated microvascular disease. While central and peripheral thromboembolic lesions are accessible through surgical or interventional procedures, the microvasculopathy affecting the small pulmonary vessels remains elusive to conventional imaging. This gap in visualisation has limited understanding and treatment planning, particularly in residual or inoperable cases of CTEPH. The development of photon-counting detector computed tomography (PCD-CT), with its ultra-high spatial resolution, provides a promising avenue for visualising microvascular abnormalities. A recent study has investigated the detectability of lung microvasculopathy in CTEPH using PCD-CT, highlighting morphological distinctions in lung regions of varied perfusion.

Microvasculopathy and Mosaic Perfusion Patterns
The study involved 29 patients with confirmed CTEPH who underwent chest CT with PCD-CT technology. Analysis focused on areas of mosaic perfusion—defined by alternating zones of hyper- and hypo-attenuation—within the subpleural lung. These areas were examined in 86 paired zones to evaluate the morphology of pulmonary arterioles and venules and detect features indicative of microvasculopathy.

Must Read: ***The Role of DL Reconstruction in Spectral CT Pulmonary Angiography***

In hyperattenuating regions, dilated arterioles and venules predominated, whereas hypoattenuating areas were more likely to exhibit thin arterioles and venules. Hypoattenuated areas also showed a significantly higher prevalence of ill-defined micronodules, lobular ground-glass opacities (GGO) and haziness, markers associated with microvascular disease. These findings suggest that areas of reduced perfusion may correspond with more pronounced microvascular changes, potentially reflecting the redistribution of blood flow and the impact of chronic vascular obstruction.

CT Findings by Disease Extent and Hemodynamic Pressure
Further analysis stratified the data by the extent of chronic clots (central and peripheral) and mean pulmonary artery pressure (PAPm). In patients with both central and peripheral CTEPH, similar differences in vessel morphology were observed as in the full cohort, with a consistent pattern of dilated vessels in better-perfused regions and thin vessels in underperfused zones. Additionally, lobular GGO and haziness were more common in the hypoattenuated areas of this subgroup.

In patients with exclusively peripheral CTEPH, the hypoattenuated zones still exhibited markers of microvasculopathy, but these were absent in hyperattenuated zones, possibly reflecting limitations in the detectability of subtle changes when perfusion appears relatively preserved.

When analysing by PAPm, patients with values at or below the median (42 mmHg) displayed more frequent microvascular abnormalities in hypoattenuated areas, including increased systemic-to-pulmonary anastomoses. However, in patients with higher PAPm, these differences between hypo- and hyperattenuated regions diminished, suggesting a possible homogenisation of pathological changes in more severe disease.

Clinical Implications and Imaging Insights
The high spatial resolution of PCD-CT enabled the detection of previously elusive features of lung microvasculopathy in CTEPH. The visualisation of dilated, tortuous vessels and systemic-to-pulmonary anastomoses adds anatomical context to the haemodynamic burden observed in these patients. Moreover, subtle parenchymal abnormalities such as micronodules and GGO may serve as imaging biomarkers for the severity of microvascular involvement, particularly in underperfused regions.

These insights carry potential implications for the management of CTEPH. By distinguishing between operable and inoperable vascular lesions and identifying patients who may benefit from pharmacological interventions targeting the pulmonary microvasculature, PCD-CT may support more precise and personalised treatment strategies. The findings also underscore the value of integrating high-resolution imaging into the diagnostic workup of pulmonary hypertension, particularly when conventional modalities offer limited insight into distal vessel pathology.

The study demonstrated the capability of photon-counting detector CT to reveal morphological signs of lung microvasculopathy in patients with chronic thromboembolic pulmonary hypertension. Through the detailed analysis of perfusion patterns and vascular morphology, PCD-CT provides a non-invasive window into the distal pulmonary circulation. The correlation of CT findings with perfusion status and haemodynamic severity suggests its potential utility in refining the assessment and management of CTEPH. Advancements in imaging technologies enhance the potential for improving outcomes in patients with complex pulmonary vascular diseases.

Source: **European Radiology**

Image Credit: **iStock**

Published on : Fri, 25 Apr 2025