

Toward Safer Imaging in Common Variable Immunodeficiency: Preliminary Results of Low-Dose Chest CT with Visual and Automated Evaluation

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BACKGROUND AND AIMS

Pulmonary complications represent a major cause of morbidity in patients with common variable immunodeficiency (CVID), frequently requiring repeated imaging throughout the course of the disease. In a prospective study presented at the European Academy of Allergy and Clinical Immunology (EAACI) Congress, the authors evaluated whether low-dose chest CT can provide reliable structural assessment while substantially reducing the cumulative radiation exposure associated with long-term disease monitoring.¹

Respiratory involvement is one of the most clinically relevant manifestations of CVID and includes both acute and chronic airway and parenchymal diseases, such as bronchiectasis, interstitial lung disease, pulmonary nodules, and other

chronic structural abnormalities that may develop early in the disease course.² As chest CT remains the reference standard for evaluating these complications, visual assessment continues to represent the current standard in clinical practice. However, interest in automated quantitative image analysis is increasing, because it offers greater objectivity and reproducibility. Furthermore, patients with CVID often undergo repeated CT examinations over many years, making cumulative radiation exposure an important consideration during lifelong follow-up.^{3,4}

MATERIALS AND METHODS

To address this challenge, the authors prospectively enrolled 20 patients with CVID who underwent paired standard-dose and low-dose chest CT examinations between 2024–2026. Visual assessment was performed by an experienced thoracic radiologist using a dedicated semiquantitative CVID scoring system to evaluate parenchymal abnormalities, airway involvement, mediastinal findings, and overall disease burden. In parallel, automated quantitative image analysis was used to measure interstitial lung disease extent, emphysema, pulmonary nodules, and bronchial lumen and wall volumes, providing an objective assessment of structural lung disease.

RESULTS

The study demonstrated excellent agreement between standard-dose and low-dose CT across almost all evaluated parameters. Visual analysis showed comparable assessment of parenchymal abnormalities, mediastinal findings, and overall disease burden, with only a modest underestimation of airway abnormalities on low-dose examinations. Likewise, automated quantitative analysis showed

consistently high concordance, indicating that quantitative imaging biomarkers remain reliable despite the substantial reduction in radiation dose. Most notably, the low-dose protocol reduced radiation exposure by approximately 70% while preserving the structural information required for clinical evaluation, highlighting its potential role in the long-term follow-up of patients with CVID.^{3,4}

A major strength of the study is the integration of automated quantitative image analysis with conventional radiological assessment. Quantitative imaging biomarkers may improve reproducibility, reduce interobserver variability, and facilitate objective longitudinal monitoring of pulmonary disease, making them particularly valuable for chronic conditions such as CVID that require serial imaging.^{5,6}

CONCLUSION

Although these preliminary findings require validation in larger, multicentre cohorts, they provide encouraging evidence that low-dose chest CT may represent a safe and effective alternative to conventional-dose imaging. Future studies should determine whether the excellent agreement observed between acquisition protocols translates into comparable clinical decision-making and improved patient outcomes.

Overall, this study highlights the potential of combining modern low-dose CT acquisition protocols with automated quantitative image analysis to improve the safety and quality of imaging surveillance in patients with CVID. By substantially reducing radiation exposure without compromising structural assessment, low-dose chest CT may contribute to a more sustainable long-term imaging strategy for this vulnerable patient population.

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