Summary

Background: Long-COVID affects approximately 10% of individuals following SARS-CoV-2 infection, with a significantly higher risk of persistent symptoms in patients who experienced severe disease requiring hospitalization. Computed tomography (CT) remains the gold standard for pulmonary imaging; however, ionizing radiation exposure limits its use in repeated follow-up examinations. Magnetic resonance imaging (MRI) using the T2-TSE SPIR sequence represents a potentially safe alternative whose diagnostic value in post-COVID cohorts requires validation.

Aim: (1) To evaluate the detection rate and typological concordance of specific pulmonary abnormalities (atelectasis, pleural effusion, nodules, ground-glass opacities, fibrotic changes) on MRI relative to CT. (2) To assess the discrepancy between subjective exercise tolerance and objective parenchymal changes on MRI.

Materials and methods: The study enrolled 1,037 patients with a history of SARS-CoV-2 infection who underwent pulmonary MRI (T2-TSE SPIR sequence, 1.5T scanner) and completed a custom questionnaire assessing subjective exercise tolerance. An independent validation group comprised 27 patients with prior chest CT who underwent chest MRI within one month of the CT examination. Radiological assessment was performed by consensus of two experienced radiologists, using standardized morphological criteria based on the Fleischner Society glossary and a five-point Likert scale for diagnostic confidence. All MRI examinations underwent manual segmentation on each axial slice, yielding objective quantitative parameters: percentage of parenchymal involvement by ground-glass opacities and linear dimensions of the remaining abnormalities (atelectasis, nodules, fibrotic changes, pleural effusion). Statistical analysis included non-parametric tests, logistic regression, and Bland-Altman agreement analysis.

Results: Overall MRI detection rate was 92.0% (95% CI: 84.3–96.0%), with typological concordance of 88.5%. Atelectasis and pleural effusion were detected with 100% sensitivity. Detection of nodules ≥ 6 mm reached 94.7%, whereas nodules < 6 mm were detected in only 69.2% ($p = 0.010$). Size measurement agreement between CT and MRI was near-perfect ($r = 0.991$; bias = 0.59 mm). Ground-glass opacities were present in 92.9% of patients. Deterioration in exercise tolerance was reported by 79.9% of subjects. The only MRI parameter with independent prognostic significance was the ground-glass opacity percentage (OR = 1.101; $p = 0.002$). The MRI-only model showed limited discriminative ability (AUC = 0.560), whereas the full model (MRI + clinical variables) achieved AUC = 0.752.

Independent predictors of impaired exercise tolerance included female sex, older age, higher BMI, asthma, higher baseline physical activity, and severe acute COVID-19.

Conclusions: (1) MRI using the T2-TSE SPIR sequence may constitute an effective and safe alternative to CT for imaging atelectasis, pleural effusion, fibrotic changes, and ground-glass opacities, particularly in patients requiring repeated follow-up imaging, while CT remains the modality of choice for detecting nodules < 6 mm. (2) Subjective decline in exercise tolerance in Long-COVID is only marginally reflected by structural pulmonary changes on MRI. Ground-glass opacity is the sole imaging parameter with an independent, albeit weak, association with impaired exercise capacity, suggesting an extrapulmonary or microvascular basis for dyspnoea. (3) Impaired exercise tolerance in Long-COVID is predominantly associated with the patient's clinical and phenotypic profile rather than the extent of structural pulmonary changes on MRI. Identification of these predictors enables targeted selection of patients requiring enhanced diagnostic attention. (4) Combining imaging data with the patient's clinical profile enables more accurate prognostic assessment than relying on either component alone.