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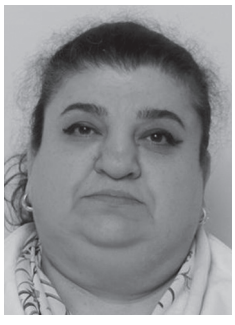

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# Clinical relevance and follow-up of incidental computed tomography imaging and magnetic resonance imaging findings for COVID-19 diagnosis

The outbreak of coronavirus disease 2019 (COVID-19) was officially recognized as a global health emergency by the World Health Organization in early 2020, subsequently escalating to a pandemic [1]. Clinically, COVID-19 most commonly presents with fever, cough, and dyspnea, although gastrointestinal manifestations occur less frequently. In severe cases, the disease may progress to complications such as acute respiratory distress syndrome, systemic inflammatory response, and circulatory shock. Given the wide variability and non-specific nature of symptoms, clinical assessment alone is often insufficient for reliable diagnosis [2, 3].

Imaging techniques, particularly chest computed tomography (CT), have played a pivotal role in detecting and monitoring pulmonary involvement. CT is characterized by high sensitivity for COVID-19-related changes and may reveal abnormalities even before laboratory confirmation in some cases. However, its diagnostic specificity remains limited due to overlap with other viral pneumonias, which restricts its use as a primary screening tool according to current recommendations. Despite these limitations, CT remains widely utilized owing to its accessibility and rapid acquisition [3-5].

An important but often underappreciated aspect of CT imaging in COVID-19 is the detection of incidental findings. These unexpected abnormalities, unrelated to the initial diagnostic indication, may carry clinical significance and require further evaluation. Their identification underscores the broader diagnostic value of imaging beyond the assessment of infectious pathology [5-8].

Magnetic resonance imaging (MRI) can serve as an alternative modality for the clinical evaluation of the lungs, particularly in cases requiring repeated imaging. Advanced MRI techniques are capable of providing imaging features comparable to those of chest CT, while avoiding exposure to ionizing radiation [9].

Based on these possibilities, a comparative evaluation of different imaging methods is of particular interest from the standpoint of clinical appropriateness.

The **aim of the study** was to assess the clinical significance and follow-up implications of incidental findings detected on CT and MRI in patients with COVID-19.

**Materials and methods.**

The study was performed at the basis of Azerbaijan Medical University. A total of 107 consecutive patients with laboratory-confirmed SARS-CoV-2 infection were included in the analysis. Patients were identified through the institutional radiology database between March 2020 and December 2023. The patients were involved according to inclusion and exclusion criteria.

Inclusion criteria: age between 25 and 71 years; positive RT-PCR test for SARS-CoV-2; availability of at least one chest CT scan performed for clinical indication; complete clinical and radiological records.

Exclusion criteria: incomplete imaging data; poor image quality limiting interpretation; pre-existing advanced interstitial lung disease or malignancy affecting lung parenchyma; non-COVID-related primary indication for imaging.

A subset of 32 patients underwent additional magnetic resonance imaging examination as part of follow-up assessment.

Chest CT examinations were performed using multidetector scanners (64–128 slice systems) with standardized protocols. Scans were acquired in the supine position during end-inspiration. Technical parameters

included: tube voltage: 100–120 kVp, automatic tube current modulation, slice thickness: 1–1.5 mm, reconstruction algorithm: high-resolution lung kernel. Both non-contrast and contrast-enhanced studies were included depending on clinical indication (e.g., suspicion of pulmonary embolism). Radiation exposure followed the ALARA principle, with estimated effective dose ranging from 2 to 5 mSv.

Findings were categorized according to standardized COVID-19 imaging patterns:

1) Typical pattern — bilateral peripheral ground-glass opacities (GGO), with or without consolidation;

2) Atypical pattern — non-specific or uncommon features;

3) Indeterminate pattern — equivocal findings;

4) Negative — absence of imaging signs suggestive of COVID-19

Incidental findings were defined as unexpected abnormalities unrelated to COVID-19 and categorized based on clinical relevance:

Category 0: No clinical significance

Category 1: Minor findings without need for follow-up

Category 2: Findings requiring additional imaging or monitoring

Category 3: Clinically significant findings requiring intervention

Follow-up imaging was performed in a subset of patients at 3–6 months after the initial examination. The following parameters were assessed: extent of ground-glass opacities; presence of consolidation; fibrotic-like changes; resolution or progression of lesions.

Residual abnormalities were defined as persistent radiological findings after the acute phase of infection.

MRI examinations were performed using 1.5T and 3T systems. Imaging protocols included axial and sagittal T2-weighted HASTE sequences, fat-suppressed T2 sequences, diffusion-weighted imaging (DWI), balanced steady-state free precession sequences. Patients were examined in the supine position using thoracic coils. Breath-hold and respiratory-triggered sequences were applied where feasible to reduce motion artifacts. MRI was primarily used for follow-up evaluation, assessment of inflammatory activity. All imaging studies were independently reviewed by two experienced radiologists (with >8 years of thoracic imaging experience), blinded to clinical outcomes.

Outcome measures were performed according to following endpoints: primary endpoints — prevalence of incidental findings on CT and distribution of CT imaging patterns. As secondary endpoints the changes in MRI findings before and after treatment and rate of residual pulmonary abnormalities at follow-up were considered.

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 29.0.1.0 (IBM Corp., USA). Continuous variables were expressed as mean (M) ± standard deviation (SD). Categorical variables were presented as frequencies and percentages. In addition, Chi-square test for categorical variables, McNemar test for paired categorical data (pre- and post-imaging comparison) and independent t-test or Mann–Whitney U test for continuous variables were used. Effect sizes were calculated: Cohen's d for continuous variables, Cramér's V for categorical associations. A two-tailed p-value <0.05 was considered statistically significant.

This retrospective observational study was conducted in accordance with the principles of the Declaration of Helsinki (2013 revision). The study protocol was reviewed and approved by the institutional ethics committee. Due to the retrospective nature of the study and anonymization of patient data, the requirement for informed consent was waived.

**Results and their discussion**

A total of 107 patients were included (mean age 48.3±11.6 years; 61% male). Moderate-to-severe disease was observed in 58 patients (54.2%), while 49 (45.8%) had mild clinical presentation. No statistically significant age difference was observed between patients with and without incidental findings (p=0.21).

Typical COVID-19 patterns were identified in 67 patients (62.6%; 95% CI: 53.1–71.4), atypical findings in 18 patients (16.8%; 95% CI: 10.5–25.6), indeterminate findings in 9 (8.4%), and no radiological evidence in 13 patients (12.1%).

Ground-glass opacities were the most prevalent feature (78%; 95% CI: 69.1–85.1), followed by bilateral lung involvement (64%; 95% CI: 54.5–72.5) and peripheral distribution (59%; 95% CI: 49.4–68.1). Patients with moderate-to-severe disease demonstrated a significantly higher prevalence of bilateral involvement compared to mild cases (OR = 2.34; 95% CI: 1.12–4.89; p=0.02).

Incidental findings were identified in 20 of 107 patients (18.7%; 95% CI: 12.1–27.3). Distribution by category was as follows: Category 0: 12 patients (60%); Category 1: 4 patients (20%); Category 2: 3 patients (15%); Category 3: 1 patient (5%). Clinically relevant incidental findings (categories 2–3) were present in 3.7% of the total cohort (95% CI: 1.2–10.4).

Logistic regression analysis revealed that increasing age was independently associated with the presence of incidental findings (adjusted OR=1.05 per year; 95% CI: 1.01–1.09; p=0.01). No significant association was observed between disease severity and incidental findings (p=0.34).

Among the 32 patients who underwent MRI: lung involvement >25% was observed in 56% at baseline vs. 28% at follow-up, presence of GGO decreased from 72% to 41%, consolidation decreased from 44% to 31%

Paired analysis using McNemar test demonstrated, that significant reduction in lung involvement (p=0.01), significant reduction in GGO (p=0.02) were observed. The change in consolidation (p = 0.08) was not significant. Effect size analysis showed Cohen's d=0.72 (moderate-to-large effect) for reduction in inflammatory involvement. These findings indicate a meaningful radiological response during follow-up.

Follow-up CT (n=68 patients) at 3–6 months demonstrated complete resolution in 33 patients (48.5%), residual abnormalities in 26 patients (38.2%) and fibrotic-like changes in 9 patients (13.2%). Patients with initial severe lung involvement were significantly more likely to develop residual abnormalities (OR=3.12; 95% CI: 1.41–6.89; p=0.004). Multivariate regression confirmed

baseline extent of lung involvement as an independent predictor of residual changes (adjusted OR = 2.87; 95% CI: 1.25–6.54; p = 0.01).

**Discussion.**

The present study demonstrates that chest CT remains a highly sensitive tool for detecting pulmonary involvement in COVID-19, with typical findings identified in more than 60% of patients. These results are consistent with previously reported data indicating high sensitivity but limited specificity of CT imaging [6, 7].

The predominance of ground-glass opacities and bilateral peripheral distribution observed in our cohort aligns with established radiological patterns of COVID-19 pneumonia [8]. These imaging characteristics reflect underlying diffuse alveolar damage and inflammatory processes.

A key finding of this study is the relatively high prevalence of incidental findings (18.7%), which is slightly higher than previously reported rates (~13–14%) [6]. This difference may be attributed to broader inclusion criteria and comprehensive whole-body evaluation. Importantly, although the majority of incidental findings were clinically insignificant, a subset required further diagnostic workup, emphasizing their potential impact on patient management.

The association between increasing age and incidental findings is clinically plausible and consistent with general radiological practice, where incidental pathology accumulates with age. However, the lack of association between COVID-19 severity and incidental findings suggests that these findings are largely independent of the infectious process.

MRI demonstrated a significant reduction in inflammatory lung involvement during follow-up, supporting its role as a viable alternative imaging modality. These results are in agreement with previous studies showing that MRI can reliably detect pulmonary changes and monitor disease progression without radiation exposure [9].

From a longitudinal perspective, residual pulmonary abnormalities were observed in approximately 38% of patients, with fibrotic-like changes in 13%. These findings are consistent with emerging evidence indicating that post-COVID lung abnormalities may persist for several months and correlate with clinical symptoms [10].

The identification of baseline disease severity as an independent predictor of residual abnormalities highlights the importance of early risk stratification. This supports current recommendations for follow-up imaging in patients with persistent symptoms or severe initial disease [10].

**Conclusions.**

Thus, the integration of CT and MRI findings provides a more comprehensive understanding of disease evolution. CT remains indispensable for acute assessment, while MRI offers a valuable radiation-free alternative for follow-up, particularly in younger or vulnerable populations.

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# Клінічна значимість та подальше спостереження за випадковими знахідками, виявленими при комп'ютерній томографії та магнітно-резонансній діагностиці, для діагностики COVID-19

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Візуалізація відіграє центральну роль у виявленні та моніторингу ураження легень при COVID-19. Мета: Оцінити клінічну значущість та наслідки для подальшого спостереження випадкових знахідок, виявлених на КТ та МРТ у пацієнтів із COVID-19. Матеріали та методи: Ретроспективний аналіз 107 пацієнтів (25–71 років). КТ грудної клітки проводилася з використанням багатодетекторних сканерів. Підгрупа із 32 пацієнтів пройшла додаткове магнітно-резонансне дослідження в рамках подальшого спостереження. Результати: Типові знахідки на КТ було виявлено у 62,6%; випадкові знахідки – у 18,7%. МРТ-дослідження показало значне зменшення вогнищ ураження (p<0,05 коефіцієнт Коена d=0,72). КТ-дослідження (n=68 пацієнтів) через 3–6 місяців продемонструвало повний дозвіл у 33 пацієнтів (48,5%), залишкові зміни у 26 пацієнтів (38,2%) та фіброзні зміни у 9 пацієнтів (13,2%). У пацієнтів з вихідним тяжким ураженням легень значно частіше розвивалися залишкові зміни (ЗШ = 3,12; 95% ДІ: 1,41–6,89; p = 0,004). Багатофакторна регресія підтвердила, що вихідний ступінь ураження легень є незалежним предиктором залишкових змін (скоригований ЗШ = 2,87; 95% ДІ: 1,25-6,54; p = 0,01). Висновок. Таким чином, інтеграція даних КТ та МРТ забезпечує більш повне розуміння еволюції захворювання. КТ залишається незамінним методом для оцінки гострого стану, тоді як МРТ пропонує цінну альтернативу без радіаційного опромінення для подальшого спостереження, особливо у молодих чи вразливих груп населення.

**Ключові слова:** COVID-19, комп'ютерна томографія, магнітно-резонансна томографія, наступне спостереження.

# Clinical relevance and follow-up of incidental computed tomography imaging and magnetic resonance imaging findings for COVID-19 diagnosis

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Imaging plays a central role in the detection and monitoring of pulmonary involvement in COVID-19. Aim: To assess the clinical significance and follow-up implications of incidental findings detected on computed tomography (CT) and magnetic resonance imaging (MRI) in patients with COVID-19. Materials and Methods: Retrospective analysis of 107 patients (25–71 years). Chest CT examinations were performed using multidetector scanners. A subset of 32 patients underwent additional magnetic resonance imaging examination as part of follow-up assessment. Results: Typical CT findings in 62.6%; incidental findings in 18.7%. MRI follow-up showed significant reduction of lesions (p<0.05, Cohen's d=0.72). Follow-up CT (n=68 patients) at 3–6 months demonstrated complete resolution in 33 patients (48.5%), residual abnormalities in 26 patients (38.2%) and fibrotic-like changes in 9 patients (13.2%). Patients with initial severe lung involvement were significantly more likely to develop residual abnormalities (OR = 3.12; 95% CI: 1.41–6.89; p = 0.004). Multivariate regression confirmed baseline extent of lung involvement as an independent predictor of residual changes (adjusted OR = 2.87; 95% CI: 1.25–6.54; p = 0.01). Conclusion: Thus, the integration of CT and MRI findings provides a more comprehensive understanding of disease evolution. CT remains indispensable for acute assessment, while MRI offers a valuable radiation-free alternative for follow-up, particularly in younger or vulnerable populations.

**Key words:** COVID-19, computed tomography, magnetic resonance imaging, follow-up

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