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# COMPREHENSIVE EVALUATION OF SUBCLINICAL PULMONARY INVOLVEMENT IN RHEUMATOID ARTHRITIS USING MULTIMODAL DIAGNOSTIC METHODS

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**Abstract:** This study evaluated pulmonary involvement in patients with rheumatoid arthritis using clinical and multimodal instrumental methods. The study included 70 patients aged 24–83 years, of whom 63 were women and 7 were men, while clinically evident pulmonary disease was present in only 10%. Pulmonary complaints were reported by 65% of patients, whereas high-resolution computed tomography demonstrated abnormalities in 92%, including ground-glass changes in 62.2% and bronchial obstruction in 37.8%. Pulmonary function testing revealed obstructive abnormalities in 70%, restrictive abnormalities in 30%, and reduced diffusion capacity in 41% of patients. The combination of high-resolution computed tomography, single-photon emission computed tomography, and pulmonary function testing provided sensitive detection of subclinical pulmonary involvement.

**Keywords:** rheumatoid arthritis; pulmonary involvement; high-resolution computed tomography; pulmonary function; diffusion capacity.

# КОМПЛЕКСНАЯ ОЦЕНКА СУБКЛИНИЧЕСКОГО ПОРАЖЕНИЯ ЛЕГКИХ ПРИ РЕВМАТОИДНОМ АРТРИТЕ С ИСПОЛЬЗОВАНИЕМ МУЛЬТИМОДАЛЬНЫХ МЕТОДОВ ДИАГНОСТИКИ

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**Аннотация:** Целью исследования была оценка поражения легких у пациентов с ревматоидным артритом с использованием клинических и комплексных инструментальных методов. В исследование включили 70

пациентов в возрасте 24–83 лет, среди которых было 63 женщины и 7 мужчин, при этом клинически манифестное поражение легких выявлено только у 10%. Пульмонологические жалобы отмечались у 65% больных, тогда как компьютерная томография высокого разрешения выявила изменения у 92%, включая усиление интерстициального рисунка по типу «матового стекла» у 62,2% и бронхообструкцию у 37,8%. По данным исследования функции внешнего дыхания, обструктивные нарушения выявлены у 70%, рестриктивные — у 30%, а снижение диффузионной способности легких — у 41% пациентов. Сочетанное применение КТ высокого разрешения, ОФЭКТ и функционального исследования дыхания позволило повысить выявляемость субклинического поражения легких при ревматоидном артрите.

**Ключевые слова:** ревматоидный артрит; поражение легких; компьютерная томография высокого разрешения; функция внешнего дыхания; диффузионная способность легких.

**Introduction:** Rheumatoid arthritis is a systemic autoimmune disease that can affect organs beyond the joints, with pulmonary involvement representing an important extra-articular manifestation. Respiratory abnormalities may involve the lung parenchyma, bronchi, pleura, and pulmonary circulation, and their clinical expression does not always correspond to the anatomical severity of disease. In many patients, lung injury remains clinically silent and can therefore be missed when assessment relies only on symptoms, physical examination, or conventional radiography. This discrepancy is important because pulmonary complications contribute substantially to adverse outcomes in rheumatoid arthritis. High-resolution computed tomography provides detailed visualization of structural abnormalities, including interstitial changes, bronchial lesions, rheumatoid nodules, pleural abnormalities, and fibrotic remodeling. Functional assessment adds information about ventilation and gas transfer that cannot be obtained from imaging alone. Pulmonary function testing can reveal obstructive or restrictive abnormalities, while diffusion capacity may identify impaired alveolar-capillary

gas exchange. Single-photon emission computed tomography provides additional information about regional pulmonary perfusion and may demonstrate functional abnormalities extending beyond visible structural lesions. A comprehensive assessment combining clinical findings with anatomical and functional methods may therefore identify subclinical disease earlier. These observations support a multimodal diagnostic strategy for recognizing respiratory abnormalities, assessing severity, and selecting patients who require closer pulmonary clinical monitoring.

**Aim of the study:** To assess the clinical and instrumental characteristics of pulmonary involvement in patients with rheumatoid arthritis and to determine the diagnostic contribution of high-resolution computed tomography, single-photon emission computed tomography, pulmonary function testing, and diffusion capacity measurement for detection of subclinical lung abnormalities.

**Materials and methods.** The analysis included 70 patients fulfilling the 1987 American College of Rheumatology criteria for rheumatoid arthritis. The study population consisted of 63 women (90%) and 7 men (10%), aged 24–83 years, with a mean age of 52 years. Patients with bronchial asthma, chronic obstructive pulmonary disease, other systemic rheumatic disorders, occupational exposure to pneumotoxic substances, or previous radiotherapy for malignant disease were excluded. Clinical assessment recorded respiratory complaints, antirheumatic treatment, and smoking history. Rheumatoid factor, anti-cyclic citrullinated peptide antibodies, C-reactive protein, and erythrocyte sedimentation rate were measured, while disease activity was characterized by DAS28. Chest radiography or fluorography was performed in all participants. High-resolution computed tomography assessed lung parenchyma, airways, pleura, and pulmonary vessels. In 62 patients, expiratory high-resolution computed tomography additionally evaluated air trapping and obstructive changes. Pulmonary perfusion was assessed using single-photon emission computed tomography. Lung diffusion capacity for carbon monoxide was measured using a standardized pulmonary function system. Spirometry evaluated obstructive and restrictive ventilatory abnormalities. Structural CT abnormalities were graded semiquantitatively, with findings scored

from 1 to 3 and a total score ranging from 0 to 14. Statistical analysis used SPSS Statistics 17.0, including parametric and nonparametric procedures, independent-samples t testing, and Pearson correlation analysis. Statistical significance was accepted at $p<0.05$. All procedures followed the study protocol.

**Results.** Respiratory complaints were reported by 65% of patients, most frequently exertional dyspnea (52%), cough (36%), and sputum production (30%); wheezing occurred in 13%, pleuritic chest pain in 4.5%, and hemoptysis in 1.5%. Objective examination showed abnormalities in 70%, including tympanitic percussion in 30%, harsh or bronchial breathing in 50%, and pleural friction rub in 20%. Nevertheless, clinically manifest pulmonary involvement was identified in only 10%. Conventional chest radiography or fluorography detected abnormalities in only 10%, mainly pulmonary fibrosis or focal changes. High-resolution computed tomography revealed abnormalities in 92%. Ground-glass or increased peripheral interstitial markings occurred in 62.2%, bronchial obstruction in 37.8%, bronchial wall thickening in 21.6%, rheumatoid nodules in 24.3%, pleural thickening or deposits in 21.6%, and bronchiectasis in 8.1%. Emphysema occurred in 5.4%, pulmonary hypertension in 8.1%, honeycomb-type fibrosis in 2%, and pleural effusion in 2.7%. The mean CT severity score was 5.05±3.65, ranging from 0 to 14. Single-photon emission computed tomography demonstrated diffuse pulmonary microcirculatory abnormalities in all examined patients, including severe impairment in 10%. Regional hypoperfusion was bilateral and unevenly distributed. Pulmonary function abnormalities were found in 80%: obstructive disorders occurred in 70%, restrictive disorders in 30%, and reduced diffusion capacity in 41%; significant diffusion impairment was present in 4.5%. Smoking duration correlated strongly ($r=0.827$, $p<0.01$). CT changes correlated with perfusion abnormalities ($r=0.510$, $p<0.01$), while reduced pulmonary blood flow correlated with lower diffusion capacity ($r=-0.537$, $p<0.01$).

**Conclusions:** Pulmonary involvement in rheumatoid arthritis frequently remains clinically inconspicuous despite substantial structural and functional abnormalities. Only 10% had clinically manifest lung disease, whereas high-resolution computed

tomography detected abnormalities in 92% and pulmonary function testing identified impairment in 80%. Obstructive abnormalities occurred in 70%, while diffusion capacity was reduced in 41%. SPECT demonstrated pulmonary perfusion abnormalities in all examined patients and correlated with structural and functional findings. The results support combined use of high-resolution CT and pulmonary function assessment, with SPECT providing additional information about regional perfusion. Such multimodal evaluation improves recognition of subclinical pulmonary involvement and supports earlier pulmonary monitoring.

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