

Microhemodynamics Disorders in the Lung Microcirculatory System in Rheumatoid Arthritis Patients Living in the North Caucasus

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Abstract – Rheumatoid arthritis is a systemic autoimmune disease of unknown etiology, characterized by the development of chronic erosive arthritis and systemic inflammatory lesions of the internal organs. A significant number of patients have interstitial lung damage. 70 patients with rheumatoid arthritis were examined. In order to study the hemodynamics of the microcirculatory bed of the pulmonary circulation, the lungs were scanned using a scanner with a Scintiscan-Numbering registration system. Blood flow disorders in the microvasculature of the lungs were identified in 67.1 % of patients. The severity of hemodynamic disturbances in the pulmonary capillaries did not depend on the duration of the disease and accompanying pathological processes of the respiratory system. Damage probability for the microvasculature of the pulmonary circulation increases with the degree of disease activity.

Key words – *microhemodynamics, dynamics, lungs, arthritis*

I. INTRODUCTION

According to the 2016 clinical guidelines, pulmonary hypertension (PH) is a group of diseases and syndromes characterized by a progressive increase in pulmonary vascular resistance causes development of right ventricular heart failure and premature death of patients [1].

The prognosis of patients with PH is associated with the functional class of respiratory failures. Pulmonary arterial hypertension (PAH) associated with systemic connective tissue diseases (SSTV) is a syndrome that is pathogenetically similar to idiopathic PAH which develops as a clinical manifestation of MCTD [2]. Among patients with PAH, rheumatic diseases (RD) account for 15–20 % [3]. The pathogenetic mechanisms of PH in RD are different. Regardless of the nosological form of RD, the main cause of PH is vascular wall remodeling due to endothelial dysfunction, excessive cell proliferation, intimal hyperplasia, muscular hypertrophy, apoptosis disorders, vascular wall fibrosis, thrombosis [4]. Early finding of PAH contributes to early treatment [5].

Rheumatoid arthritis (RA) is one of the systemic autoimmune rheumatic diseases whose etiological factors are unknown and characterized by the development of chronic erosive arthritis and systemic inflammatory lesions of the internal organs. [1, 6, 7].

A significant number of patients have various extra-articular manifestations. Interstitial lung lesion (IPL) is widespread [3].

The term "rheumatoid lung" was proposed in 1961 [8]. Later descriptions demonstrate the relationship of RA and IPL, but the diagnostics of this pathology was limited by sensitive research methods. The relationship of these diseases was the subject of discussion [9, 10].

A number of authors tried to identify risk factors for the development of IPL in RA patients, since it is known that the risk of IPL in RA patients is about 8 %, while in other people it is 1 % [5]. The main risk factors for the development of IPL in RA are as follows: smoking, male gender, high titers of rheumatoid factor (RF), genetic predisposition and severe clinical course of RA [3]. A number of researchers believe that smoking is one of the most powerful RFs [11, 12]. In a cohort of 336 RA patients with IPL, smoking was the most significant independent predictor of radiologic and functional pulmonary disorders typical of IPL [13]. In other works, the male sex was associated with the development of IPL [13, 14], but this relationship is not confirmed in all studies [15]. In some studies, high titers of the Russian Federation are among risk factors [4, 15].

II. PROBLEM STATEMENT

Early involvement of the lungs in the pathological process is characteristic of DCTD which include RA. The microcirculatory channel is considered as a target organ and a springboard of aggression, where pathological processes that determine the systemic nature of the lesion are developing. The issue of in vivo diagnosis of the degree of microhemodynamic disturbances in the microvasculature system is relevant, since there are still no pronounced morphological changes in the tissues and internal organs.

III. MATERIALS AND METHODS

We analyzed cases of 70 RA patients who were examined and treated in the rheumatology department of the NOSMA clinical hospital, Vladikavkaz. The patients were young and middle-aged people which have been suffering from the disease for 1–10 years. Women prevailed over men 4.2: 1 [1, 7, 16].

Acute respiratory diseases were dominant in their history. Two patients were diagnosed with chronic non-obstructive bronchitis. To exclude the influence of the cardiovascular system pathology, the patients did not have clinical signs of heart failure. When making a diagnosis, the criteria proposed by the ARA were used. The classification of RA developed by the Institute of Rheumatology was used to formulate the diagnosis.

All patients were examined in the first 10–15 days. To study the hemodynamics of the microcirculatory bed of the pulmonary circulation, patients' lungs were scanned using a Hungarian scanner with a Scintiscan-Numbering color registration system. The data were compared with the clinical picture of the disease, laboratory and radiological data. The method is based on thromboembolism of the capillaries of the pulmonary circulation by macroaggregates of human plasma albumin, labeled J131. Lung segments 1, 3, 4, 5 and 8 were analyzed.

Clear lung contours and uniform distribution of the radiopharmaceutical in the lung tissue are visually determined. In the anterior projection, the lung image is divided by the region of the mediastinum organs. The accumulation of the drug in the lower and middle segments is higher than in the middle one with some rarefaction in the apex and lower edges of both lungs. This technique allows for a more detailed visualization of the extent of vascular lesion in each lung.



Fig. 1. Front scanogram within the norm

IV. DISCUSSION

All the identified changes were divided into three groups:

1. Patients with a normal lung scan image: a uniform line image of both lungs with a shading dilution zone corresponding to the mediastinum, single isotope accumulation defects in the I and VIII segments of both lungs.
2. Moderate changes: defects in one or two segments of both lungs, or in 2–3 segments of the left lung.
3. Pronounced changes: diffusing defects in the accumulation of isotopes are determined in most segments of both lungs on the front scan.

Blood flow disorders were identified in 67.1 % patients. Only in 32.9 % patients, the indicators were within the norm.



Fig. 2. Distribution of patients by severity of changes in the lungs, %. Q. 1. Patients with pronounced changes. Q. 2. Patients without changes. Q. 3. Patients with moderate changes.

V. CONCLUSION

The analysis made it possible to identify more significant violations of the microhemodynamics of pulmonary capillaries depending on the duration of the disease. The severity of hemodynamic disturbances in the pulmonary capillaries did not depend on the accompanying pathological processes of the respiratory system. In some cases, it was more significant in RA patients without broncho-pulmonary pathology. In addition, the results showed that the degree of microhemodynamic disturbances in pulmonary capillaries does not depend on changes in the lungs detected by X-ray examinations. It was found that the percentage of probable lesions of the microvasculature of the pulmonary circulation in RA patients increases with the degree of activity and is more pronounced in patients with a high degree of disease activity. Changes in the microdynamics in all patients were more pronounced in the upper and lower segments of both lungs which corresponds to the literature data on the prevalence of septo-alveolar sclerosis increasing in the apico-caudal direction [6] (Fig. 3).

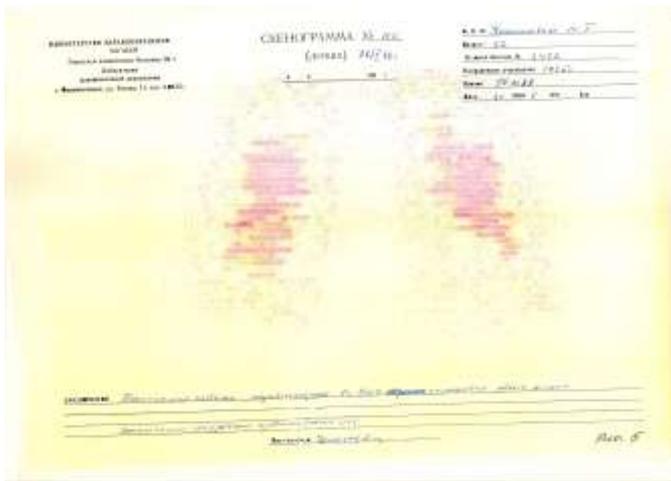


Fig. 3. 52-year old patient scanogram

The patient's scan is presented. K. aged 52. Has been suffering from RA for four years. Pulmonary fields lack fresh infiltrative changes. The roots are structural. The pulmonary pattern is strengthened in the lower pulmonary belts. The sinuses are free. The diaphragm mobility is preserved. There is a moderate increase in the heart boundaries due to the left ventricle; the aorta is elongated and deployed.

References

- [1] E.L. Nasonov, "Rheumatoid arthritis as a general medical problem", *Ter. Archive*, no. 5, pp. 5–7, 2004.
- [2] M.Z. Kanevskaya, "Pulmonary arterial hypertension in systemic rheumatic diseases: algorithms for treating patients with breast cancer", *RMJ*, no. 14, pp. 1026–1032, 2017.
- [3] D.V. Bestaev, D.E. Karateev, E.L. Nasonov, "Interstitial lung disease as an extra-articular manifestation of rheumatoid arthritis (lecture)", *Sci.-pract. rheumatology*, no. 51(3), pp. 290–295, 2013.
- [4] G.W. Hunninghake, M.B. Zimmerman, D.A. Schwartz et al., "Utility of a lung biopsy for the diagnosis of idiopathic pulmonary fibrosis", *Am. J. Respir. Crit. Care. Med.*, no. 164, pp. 193–196, 2001.
- [5] P.J. Charles, M.C. Sweatman, J.R. Markwick et al., "HLA-B40: a marker for susceptibility to lung disease in rheumatoid arthritis", *Dis. Markers*, no. 9, pp. 97–101, 1991.
- [6] T.N. Kopyeva, *Pathology of Rheumatoid Arthritis*. Moscow: Medicine, 1980.
- [7] E.L. Nasonov, *Rheumatology: Clinical guidelines*. Moscow: GEOTAR-Media, 2010.
- [8] L. Cudkowicz, I.M. Madoff, W.H. Abelmann, "Rheumatoid lung disease. A case report which includes respiratory function studies and a lung biopsy", *Br. J. Dis. Chest.*, no. 55, pp. 35–40, 1961.
- [9] A. Aronoff, E.G. Bywaters, G.R. Fearnley, "Lung lesions in rheumatoid arthritis", *Br. Med. J.*, no. 2, pp. 228–232, 1955.
- [10] J.A. Talbott, E. Calkins, "Pulmonary involvement in rheumatoid arthritis", *JAMA*, no. 189, pp. 911–913, 1964.
- [11] B.R. Gochuico, N.A. Avila, C.K. Chow et al., "Progressive preclinical interstitial lung disease in rheumatoid arthritis", *Arch. Intern. Med.*, no. 168, pp. 159–166, 2008.
- [12] A.G. Jurik, D. Davidsen, H. Graudal, "Prevalence of pulmonary involvement in rheumatoid arthritis and its relationship to some characteristics of the patients A radiological and clinical study", *Scand. J. Rheumatol.*, no. 11, pp. 217–224, 1982.
- [13] K.G. Saag, S. Kolluri, R.K. Koehnke et al., "Rheumatoid arthritis lung disease: determinants of radiographic and physiologic abnormalities", *Arthr. Rheum.*, no. 39, pp. 1711–1719, 1996.
- [14] B.W. Kinder, H.R. Collard, L. Koth et al., "Idiopathic nonspecific interstitial pneumonia: lung manifestation of undifferentiated connective tissue disease?", *Am J Respir Crit Care Med.*, no. 176, pp. 691–697, 2007.
- [15] J.K. Dawson, H.E. Fewins, J. Desmond et al., "Fibrosing alveolitis in patients with rheumatoid arthritis as assessed by high resolution computed tomography, chest radiography, and pulmonary function tests", *Thorax*, no. 56, pp. 622–627, 2001.
- [16] T. Bongartz, C. Nannini, Y.F. Medina-Velasquez et al., "Incidence and mortality of interstitial lung disease in rheumatoid arthritis: a population-based study", *Arthr Rheum*, no. 62, pp. 1583–1591, 2010.