Atrial fibrillation (AF) is one of the most common tachyarrhythmias encountered in clinical practice. AF is associated with structural and electrical remodeling of the atrial myocardium. Atrial fibrosis, indicative of structural remodeling, is a complex multifactorial process that contributes to the initiation and maintenance of AF. Although the relationship between AF and fibrosis has been actively investigated for a considerable time in clinical and pathomorphological studies, this process is extremely complex and involves intricate neurohumoral, cellular, and molecular interactions that are not limited to the atria. The mechanisms by which atrial fibrosis contributes to the development of AF in euthyroid sick syndrome (ESS) remain insufficiently studied, which prompted this investigation.

Objective – to study the morphological substrate of AF onset in ESS in an experimental setting using outbred rats.

Materials and methods. The experiment was performed on 146 outbred rats. Hypothyroidism was induced by thiamazole administration, followed by restoration of euthyroidism with levothyroxine sodium under thyroid hormone level monitoring. Based on the assessment of thyroid hormone levels, the following types of hypothalamic-pituitary-thyroid axis response were identified: euthyroidism, thyrotoxicosis, and ESS. In animals with euthyroidism and ESS, the percentage of atrial fibrosis was evaluated.

Results. Regression analysis revealed that in euthyroid animals, the percentage of fibrosis in the zone of the inferior pulmonary veins had the greatest influence on the frequency of AF paroxysms (ß = 0.734, p = 0.015). Multiple regression results demonstrated that the maximum influence on AF paroxysm frequency in ESS-1 was exerted by the percentage of fibrosis in the inferior and superior pulmonary veins (ISPV) (p = 0.002); in ESS-2, by fibrosis in the ISPV (p = 0.021) and the right atrium (p = 0.015); and in ESS-3, by fibrosis in the ISPV (p = 0.023) and the right atrium (p = 0.040). Fibrosis was established as a morphological substrate of AF in ESS. It was found that the atrial fibrosis area in euthyroidism was 18.8%, whereas in ESS types 1, 2, and 3 it was 36.6%, 35.8%, and 38.3%, respectively.

Conclusion. This study demonstrated that varying atrial fibrosis areas in the setting of ESS constitute a morphological substrate for the formation of re-entrant excitation circuits in AF. The fibrosis area in ESS was found to be twice as large as that in euthyroidism.