PATTERNS OF STRUCTURAL ORGANIZATION OF THE BRONCHOPULMONARY SYSTEM IN CLINICALLY HEALTHY WHITE OUTBRED RATS

Zharlykassynova G.J.

Boltaeva Z.F.

Bukhara State Medical Institute, Bukhara, Uzbekistan

Abstract. The study evaluates the structural and morphometric features of the bronchopulmonary system in clinically healthy white outbred rats to establish reference parameters. Thirty rats (6, 9, and 12 months) were examined using histological and morphometric methods. An age-dependent increase in bronchial epithelium height, basement membrane thickness, and interalveolar septa was identified, most pronounced in 12-month-old animals. The findings reflect physiological tissue maturation without pathological changes. The obtained data can serve as baseline values for experimental studies of respiratory pathology.

Keywords. bronchopulmonary system; morphometry; rats; lung histology; tissue remodeling; baseline values

Relevance. The global burden of chronic respiratory pathology continues to expand, driven by persistent exposure to environmental and anthropogenic risk factors, including tobacco-derived toxins, industrial emissions, and airborne pollutants. Current epidemiological data indicate that chronic lung diseases affect over 300 million individuals worldwide and remain among the leading causes of mortality. Notwithstanding advances in pulmonology, the structural basis and pathogenetic pathways underlying toxic injury to respiratory tissues are not yet fully clarified, particularly at the level of tissue remodeling and microarchitectural alterations.

Aim of the study. To determine the patterns of structural and morphometric organization of the bronchopulmonary system in clinically healthy white outbred rats,

with the establishment of baseline reference parameters for subsequent evaluation of experimentally induced pathological changes.

Materials and methods. The study was conducted on 30 clinically healthy white outbred rats of both sexes weighing 220–300 g, maintained under standard vivarium conditions at the Bukhara State Medical Institute. The animals were divided into three age groups: 6, 9, and 12 months. The lungs were fixed in 10% neutral formalin by intrathoracic perfusion through the trachea to preserve the natural alveolar architecture. Histological and morphometric analyses were performed to measure the height of the bronchial epithelium, basement membrane thickness, interalveolar septa, serous membrane, and vascular wall parameters.

Results: A comparative morphometric analysis revealed that the structural parameters of the bronchopulmonary system increase progressively with age, reflecting the physiological maturation and functional stabilization of the respiratory organs. The most significant increase was noted in 12-month-old rats: basement membrane thickness, muscular layer, and interalveolar septa grew by 11.1%, 5.4%, and 8.0%, respectively, compared with 6-month-old animals. The bronchial epithelial height increased by 3.2%, and the serous membrane thickness by 5.3%. These changes demonstrate adaptive tissue remodeling and enhanced structural stability of the bronchi and lungs during postnatal development. The obtained morphometric values can serve as reference standards for evaluating structural changes in experimental models of chronic intoxication and assessing the effectiveness of detoxification therapy.

Conclusion. The bronchopulmonary system of clinically healthy white outbred rats shows age-dependent structural maturation, characterized by moderate increases in key morphometric parameters reflecting adaptive tissue remodeling without pathological changes. The obtained values can be considered reference standards for evaluating structural alterations in experimental models.

Bibliography

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