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DURATION OF STRUCTURIZATION OF BIOLOGICAL FLUIDS IN NON-INVASIVE DIAGNOSTICS OF THE INFLAMMATORY PROCESS OF THE NASAL CAVITY AND PARANASAL SINUSES

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Abstract: A new method for non-invasive diagnosis of chronic rhinosinusitis has been developed. The time of structurization of the solid phase of biological fluid was used as a diagnostic criterion**.**

Key words: chronic rhinosinusitis, biological fluid, time of structuring of biological fluid.

The secretion of the mucous membrane of the respiratory tract is the second integral component of the mucociliary system and mucociliary clearance after the respiratory epithelium. Together with the cilia, it takes part in maintaining the homeostasis of the internal environment of the body by removing metabolic products, foreign particles, and microorganisms from the respiratory tract. According to the chemical composition, the secretion consists of: water (95%), proteins (1-3%), carbohydrates - mucoglycoproteins (1%), lipids - phospholipids, nucleic acids (1%), surfactant (0.8%), electrolyte ions (Na, CL, Ca), antiproteases, antioxidants (1%). The two-phase structure of the secretion serves as the environment and basis for the motor activity of the cilia. The cilia are located and move in a deeper layer, the so-called periciliary fluid - sol. The surface layer is a gel, located above the sol and above the cilia and is in direct contact with the air. The sol, which has a low viscosity close to that of water, acts as an auxiliary medium that coordinates the movement of cilia that transport the gel layer, the viscosity of which is approximately 1000 times greater than the viscosity of the sol layer. It is known that changes in the physical properties of the epithelial secretion and the viscosity ratio of the sol and gel layers are one of the main reasons for the disruption of the protective function of the mucociliary system and mucociliary transport. During inflammation, the production of mucous secretion by goblet cells and glands of the submucosal layer increases, and an increase in the viscosity of the secretion is observed.

Biological fluids, performing a wide range of vital functions in the human body, when transitioning into the solid phase, form crystalline structures, the morphotype of which represents an integral picture of molecular and atomic interaction in the liquid phase of a biological fluid. Analysis of the structures of the solid phase of biological fluids makes it possible to diagnose the physiological and pathophysiological state of the body even at the early (preclinical) stages of the disease [2, 4].

Until now, the diagnosis of a pathological process using “functional morphology” has been predominantly descriptive, based on a visual assessment of the structures of the solid phase of biological fluids [2]. However, the visual descriptive characteristics of the structures of biological fluids are subjectivity. Currently, the morphology of biological fluids is used in several areas, which include tezigraphy, chromography and others. At the same time, the prospect of developing the direction of “functional morphology of biological fluids” is aimed, first of all, at objectifying the assessment of research results with their further computer mathematical processing [1-4].

Material and research methods. We studied the time parameters of the dynamics of the drying process of a drop of biological fluid (nasal secretion) on a standard glass slide using the wedge-shaped dehydration method. Nasal cavity secretions were obtained using the method we developed [3]. The resulting secretion was mixed with 0.5 ml of physiological sodium chloride solution and centrifuged for 15 minutes at 900 g. The supernatant in a volume of 2.0–2.5 µl was applied to the surface of a glass slide in the form of a drop and dried by wedge dehydration until a solid phase structure was obtained. We observed the pattern of drop drying using a BIMAM R-13 optical microscope at a magnification of 3 to 10, respectively, and recorded using a digital video camera.

Research results. We studied and used as criteria for assessing the process in normal and pathological conditions, the following time parameters of key moments in the process of dehydration of a drop of biological fluid:

– duration (time) of formation of the peripheral marginal zone – t 1 (Fig. 1);

– duration (time) of formation of arcades, radial cracks and sectors – t 2 (Fig. 2);

– duration (time) of the formation of transverse cracks with the formation of sections and the formation of crystallization centers (nodules) in them – t3;

– duration (time) of the entire period of dehydration with the formation of the final facies pattern – t total = t 1 + t 2 + t 3.

It has been experimentally established that:

– time period t 1 is normally up to 30 minutes, with pathology up to 50 minutes;

– period time t 2 is normally from 30 to 50 minutes, with pathology t 2 is from 50 to 90 minutes;

– period time t 3 is normally from 40 to 60 minutes, with pathology t 3 is from 60 to 90 minutes;

– time ttot is normally from 2 to 2.5 hours, with pathology ttot is from 2.5 to 4.5 hours.

Our studies have proven that the time parameters of the drying process of a drop of biological fluid (nasal secretion) during inflammation of the nasal cavity and paranasal sinuses are higher than when drying a similar biological fluid of a healthy person.

Conclusion. Time parameters for the formation of structures are used as criteria for assessing the process in normal conditions and in pathology. The duration of the complete period of dehydration with the formation of the final facies pattern is determined by the formula: t total = t 1 + t 2 + t 3, where t 1 is the time of formation of the peripheral marginal zone, t 2 is the time of formation of radial cracks and sectors, t 3 is the time of formation transverse cracks with the formation of sections and the formation of crystallization centers in them.

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