ALGORITHM FOR DIAGNOSING PANCREATIC ENDOCRINE DYSFUNCTION BASED ON BIOCHEMICAL AND LASER POLAR

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ABSTRACT

The weight researchers focused on studying the pathogenesis ogy pancreas (ON) Functional and failure swhich causes the development of hyperglycemia, insulin resistance, metabolic syndrome and diabetes mellitus type 1 or 2. Methods of optical diagnostics of biological tissues using sources of coherent radiation, in particular, laser polarimetry, are promising in this direction. The indicated methods of studying the phenomena light scattering of biological tissues and their macroneodority make it possible to search for relationships between changes in the studied tissues of the body or other organs with a set of objective photometric, polarization, spectral and correlation parameters of their optical images.

RESEARCH OBJECTS

The studies were carried out on white sexually mature outbred rats 2.5-3 months old and weighing 110-130 g.
The animals are divided into 4 groups:
1 - intact rats, which were kept on a complete semi-synthetic diet AIN-93, developed by the American Institute of Nutrientology ;
2 - animals that consumed a low-protein diet containing 1/3 of the generally accepted daily protein requirement for 28 days ;
3 - rats, which were simulated toxic damage by per os administration of acetaminophen at the rate of 1250 mg / kg of animal weight in the form of a suspension in a 2% solution of starch gel once a day for 2 days ;
4 - animals and, which were administered toxic doses of the drug against the background of alimentary protein deficiency.

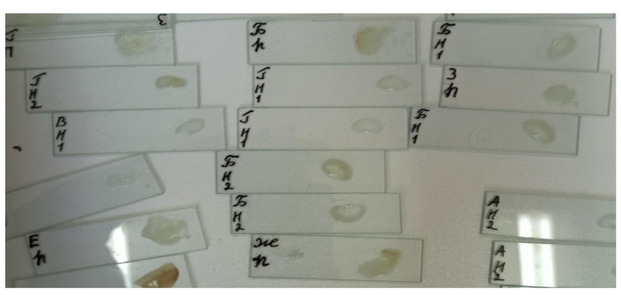

Fig. 1 Images of 4 groups of samples

The cervical dislocation of rats was carried out on 28 and 31 days of the experiment using diethyl ether to create drug sleep.
The material of the study is represented by blood serum samples and a histopreparation of the rat pancreas. For histological examination, we used native sections of PO, stored at a temperature of 4 ° C.
To assess the endocrine function of PO in the blood, the following was determined:

- the concentration of glucose and glycosylated hemoglobin;
- C-peptide level
- the index of insulin resistance (HOMA index – Ho meostasis M odel A ssessment of I nsulin R esistance) was calculated .

The glucose content in the blood serum was determined by the glucose oxidase method using the "Philist-D diagnostics" test system (Ukraine) .
Statistical analysis of biochemical parameters was performed using the Statistica 6.0 software . The values obtained in the groups of experimental animals were compared with the control using the Student's t -test. The level of significance, or the probability of error, is $p \le 0.05$ [1] .

POLARIZATION-MICROSCOPIC RESEARCH METHODS

Polarization measurements were carried out with a polarizing microscope.

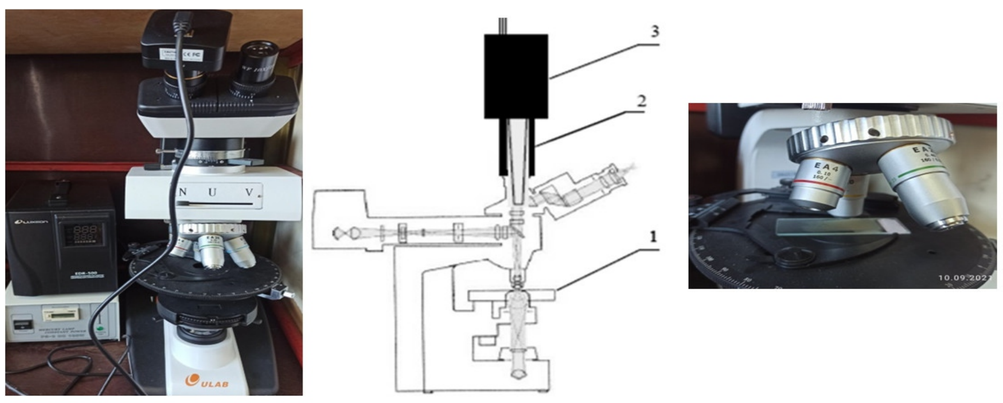

Fig. 2. Images and optical layout of a polarizing microscope

Images are formed by passing (display in the case of a dark field) a light beam through the specimen. The television camera takes the image formed by the beam and transmits it as an electronic signal to a frame grabber, which digitizes it and forms an image.
These and systems and provides an opportunity obsessed with you and hold Qi in the soil tillage in the polarization non-homogeneous image of the surface structure of single or multiple scattering biological layers.
Measurements coordinate distributions and calculation values $S_i(m \times n)$, $\alpha(m \times n)$, $\beta(m \times n)$, carried out in an experimental arrangement of an optical circuit is shown in Fig. (2).
Calculation of the elements of the Stokes vector, and Mueller matrix elements , characterizing the state of polarization of optical radiation transmitted through the object and accordingly the optical properties of the samples, was carried out according to the following algorithm:

$$\begin{aligned} S_{i=1}^{0;45;90;\otimes} &= I_{0}^{0;45;90;\otimes} + I_{90}^{0;45;90;\otimes}; \\ S_{i=2}^{0;45;90;\otimes} &= I_{0}^{0;45;90;\otimes} - I_{90}^{0;45;90;\otimes}; \\ S_{i=3}^{0;45;90;\otimes} &= I_{45}^{0;45;90;\otimes} - I_{135}^{0;45;90;\otimes}; \\ S_{i=4}^{0;45;90;\otimes} &= I_{\otimes}^{0;45;90;\otimes} + I_{\oplus}^{0;45;90;\otimes}. \end{aligned} \quad (1)$$

$$\begin{aligned} &f_{11} = 0.5(S_1^0 + S_1^{90}); \quad f_{21} = 0.5(S_2^0 + S_2^{90}); \quad f_{31} = 0.5(S_3^0 + S_3^{90}); \quad f_{41} = 0.5(S_4^0 + S_4^{90}); \\ &f_{12} = 0.5(S_1^0 - S_1^{90}); \quad f_{22} = 0.5(S_2^0 - S_2^{90}); \quad f_{32} = 0.5(S_3^0 - S_3^{90}); \quad f_{42} = 0.5(S_4^0 - S_4^{90}); \\ &f_{13} = S_1^{45} - f_{11}; \quad f_{23} = S_2^{45} - f_{21}; \quad f_{33} = S_3^{45} - f_{31}; \quad f_{43} = S_4^{45} - f_{41}; \\ &f_{14} = S_1^{\otimes} - f_{11}; \quad f_{24} = S_2^{\otimes} - f_{21}; \quad f_{34} = S_3^{\otimes} - f_{31}; \quad f_{44} = S_4^{\otimes} - f_{41}. \end{aligned} \quad (2)$$

$$\begin{aligned} \alpha^* &= 0{,}5 arctg \frac{S_{i=3}}{S_{i=2}}; \\ \beta^* &= 0{,}5 \arcsin \frac{S_{i=4}}{S_{i=1}}. \end{aligned} \quad (3)$$

BIOCHEMICAL RESEARCH RESULTS

The research results showed that in the group of tvarines, which were kept on a low-protein diet, an increase in glucose concentration up to 9.6 mmol / L was observed in comparison with the control values (Fig. 3)

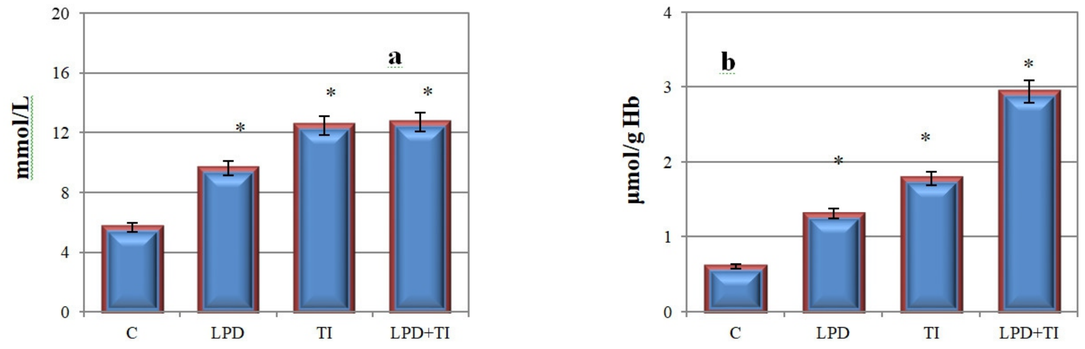

Fig. 3 . The content of glucose (a) and glycosylated hemoglobin (b) in the blood of rats under conditions of toxic damage with acetaminophen against the background of alimentary protein deficiency

POLARIZATION MEASUREMENT RESULTS

The obtained results of polarization mapping revealed information (diagnostic) relationships between :

- maps of the azimuth of polarization and the concentration of optically active molecular compounds of biological tissues and fluids of human organs;
- maps of ellipticity of polarization and the degree of ordering (crystallization) of fibrillar networks of biological preparations.

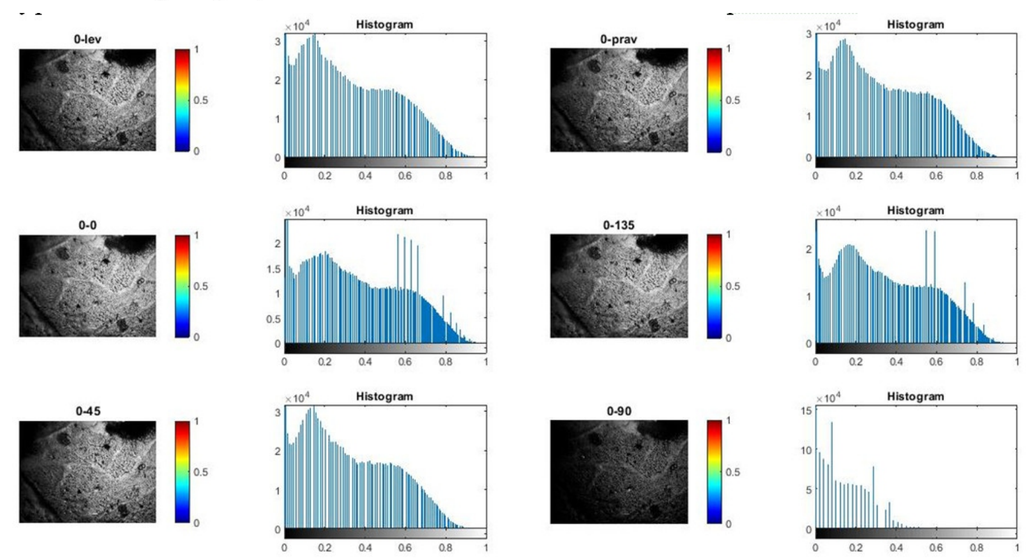

Fig . 5 . 2 - D polarized images of the pancreas.

Table 1 With the collection of statistical moments of the first-fourth orders

Statistical moments of 3-4 orders (Asymmetry (A), Kurtosis (E)) n polarization images of histological sections of biological tissues		
Monochrome polarized image		
Statistical moments	Azimuth (α)	Ellipticity (β)
Asymmetry (A)	0.8643332	2.2123331
Excess (E)	2.0485692	14.1314588

CONCLUSIONS

- Thus, it can be assumed that in the case of insulin deficiency under conditions of toxic damage against the background of alimentary protein deficiency, glucose utilization by insulin-sensitive tissues decreases. At the same time, the detection of insulin deficiency under these experimental conditions indicates the development of type 1 diabetes mellitus, most often accompanied by the activation of specific autoimmune processes that lead to the death of pancreatic insulinocytes.
- We found that in all experimental groups of animals, the HOMA index significantly exceeds the value of the control . It is known that pathologies that lead to insulin resistance can develop at the following levels: pre-receptor (abnormal insulin), receptor (decrease in the number or affinity of receptors), at the level of glucose transport (decrease in the number of GLUT4 molecules), post-receptor (impaired signal transmission and phosphorylation) ...
- Analyzing the results of polarization measurements, namely the statistics of 2 - D distributions of azimuth and ellipticity, a diagnostic criterion is revealed in a sharp increase in the statistical characteristic of kurtosis for distributions of ellipticity.

LITERATURE

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