Subfractional Composition of Blood Plasma in Benign Tumors and Breast Cancer Studied by Laser Correlation Spectroscopy

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High-molecular albumins and globulins, lipoproteins, and immune complexes are involved in the homeostasis system of the blood plasma. Alterations in the physiological state of the organism, and, particularly, pathological processes are accompanied by shifts in parameters of these subfractions. Traditional methods of investigations generally provide for measurements in preparatively separated subfractions, while ignoring the effects of intermolecular interactions in the native homeostasis system. This limitation may be avoided by using the method of laser correlation spectroscopy (LCS) adapted for investigations of heterogeneous biological fluids [8]. Methods of regularization developed for LCS make it possible to reconstruct the initial molecular-weight ratios between ingredients in the system of plasma homeostasis in a range of molecular light scatterers from 1 to 10^4 nm. LCS makes it possible to interpret the shiftes in the integral system of homeostasis on the molecular level, thus paving the way for solving virological and immunological problems [3,4].

The studies require a minimal plasma volume and no preparation procedures, and mathematically processed results may be obtained within 6-8 min [6].

The aim of the present study was an LCS examination of plasma samples obtained from patients with benign tumors and breast cancer.

MATERIALS AND METHODS

Blood plasma from 35 healthy subjects (blood bank donors) 59 patients with benign tumors, and 33 patients with breast cancer were examined (38 samples were obtained from Odessa and 89 from St. Petersburg residents). The blood sample (0.2 ml) was obtained from a finger, transferred to a tube containing 0.5 ml 4% sodium citrate solution, and centrifuged at 1500 g. The supernatant was transferred to a plastic Eppendorf tube, sealed hermetically, and frozen at -12°C. The tubes were placed in an incubator at 37°C for 30 min immediately before testing. The plasma was then centrifuged at 1500 g, and a 0.2 ml sample was placed in the measuring cell of a spectrometer designed at the Department of Molecular and Ra-

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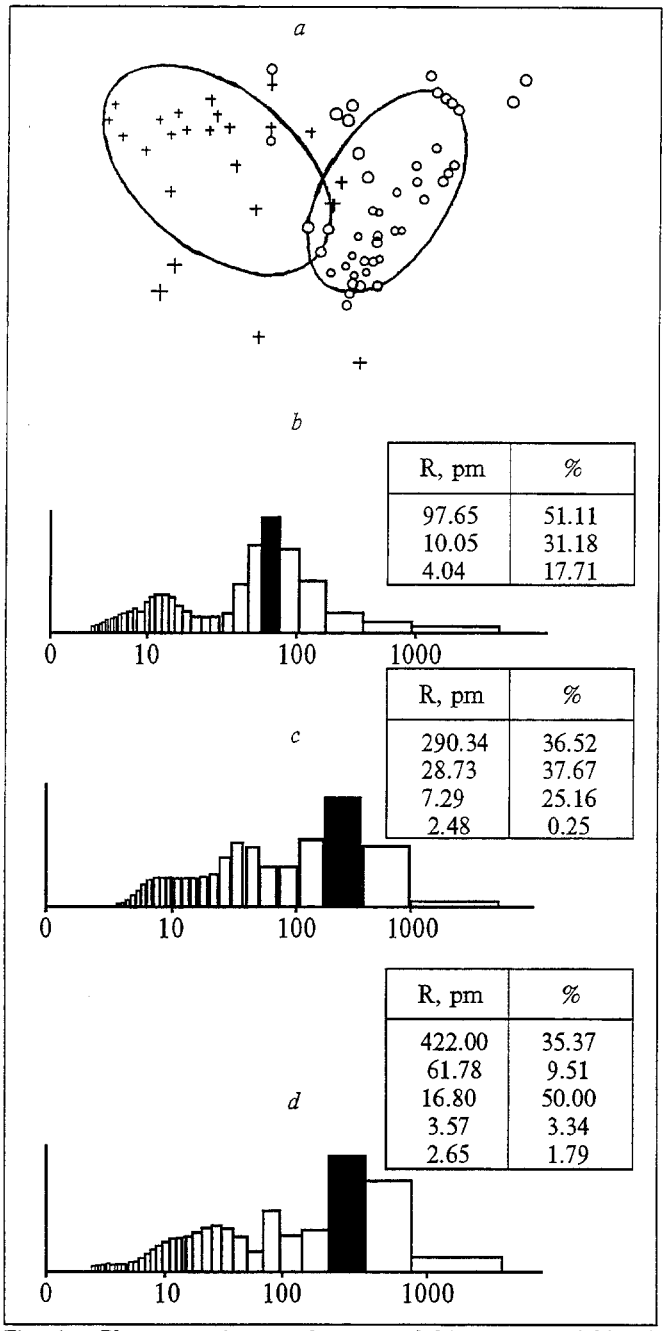

Fig. 1. Planar sections and averaged histograms of blood plasma samples. *a*) planar section graph of the distribution of groups of plasma spectra from healthy donors residing in Odessa (crosses) and St. Petersburg (circles); *b*) averaged histograms and numerical values of the contribution of particles with a certain hydrodynamic radius of plasma particles from healthy donors residing in Odessa (*I*) and St. Petersburg (*II*). The data in the tables are the number of plasma spectra which fell within a certain confidence interval.

diation Biophysics, Research Institute of Nuclear Physics, St. Petersburg; then spectrum accumulation was performed with simultaneous regularization using special software on an IBM PC/AT-286. The data were stored in the computer. The spectra were statistically processed using multivariate analysis.

RESULTS

We reported previously [5] that LCS is able to register differences in the integral homeostatic system which depend on environmental adaptogenic influences. Here, therefore we studied the spectra of plasma obtained from two groups of donors and patients, residents of Odessa and St. Petersburg.

Figure 1, *a* shows the graph of a planar cross-section of the distribution of groups of spectra in dimensionless coordinates. Closed ovals demarcate the dispersion areas for each group within 2σ. The graph clearly illustrates the differences between the groups of plasma spectra from residents of the two cities. Overlapping of the dispersion areas suggests the existence of spectra which may belong to either population. The quantitative characteristics of similarity and difference between the spectra may be obtained by multivariate analysis. It was found that just 4% of the Odessa spectra are similar to the St. Petersburg spectra, while 23% St. Petersburg spectra resemble the typical spectra from healthy donors from Odessa.

The essence of the similarity and dissimilarity of these groups of spectra may be clarified by inspecting the averaged plasma histograms (Fig. 1, *b*). A feature common to both groups was the presence of macromolecular structures with hydrodynamic radii of 8-12 nm and 60-120 nm. The differences lay in the fact that particles with a radius of 20-40 nm were abundant in the Odessa plasma, while their content was significantly lower in the St. Petersburg spectra. Macromolecules with a mean radius of 392.23 nm contributed more than 15% to light scattering in the St. Petersburg plasma, but were almost absent in the Odessa plasma.

Thus, the averaged histograms, while retaining some common features, differ from each other, implying that the homeostatic parameters are a function of the ecological environment of the population. This dictates a regional approach to the development of differential diagnostic criteria of pathological states and the formation of reference groups.

Figure 2 depicts graphs of cross-sections and tables of classification of the spectra according to the results of volumetric analysis of samples from healthy donors and breast cancer patients from Odessa and St. Petersburg. Just one donor from Odessa and one from St. Petersburg had plasma spectra similar to those of patients with benign neoplasms. One donor from Odessa and four from St. Petersburg had plasma spectra similar to those of patients with breast cancer. On the other hand, only 2 patients with benign neoplasms from Odessa

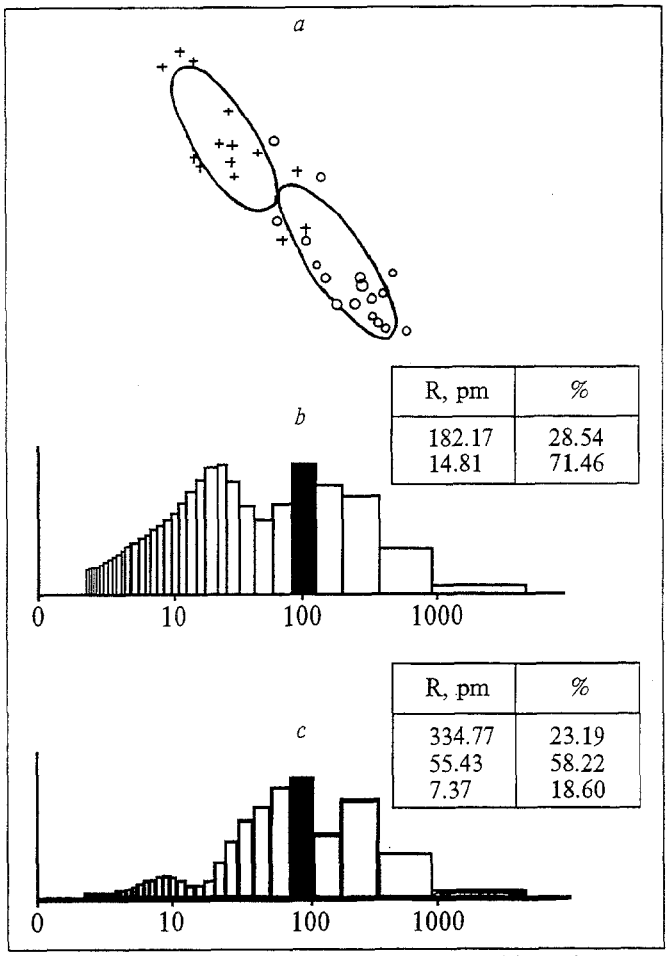

Fig. 2. Planar sections and classification tables of spectra from volumetric analysis of plasma samples from healthy donors (circles) and patients with benign neoplasms (crosses) and breast cancer (crosses) residing in Odessa (*a*) and St. Petersburg (*b*).

and one from St. Petersburg had plasma spectra similar to those of healthy donors, and only one breast cancer patient from St. Petersburg had a spectrum resembling that of a healthy donor. In the group from Odessa no patients with such spectra were revealed.

It is well known that there is not one traditional diagnostic method powerful enough to determine reliably the nature of a mammary tumor. The reliability of clinical, thermographic, ultrasound, and x-ray techniques varies between 80 and 90% [2,7,9]. The accuracy of cytological examination of a puncture bioptate is 80-96% [1]. Hence, the prospect of using plasma LCS for differential diagnosis between benign neoplasms and breast cancer is very interesting.

The graphs of planar sections and classification tables of the plasma spectra from the volumetric analysis (Fig. 3) suggest that there are some differences between the spectra from patients with benign tumors and breast cancer, although there are

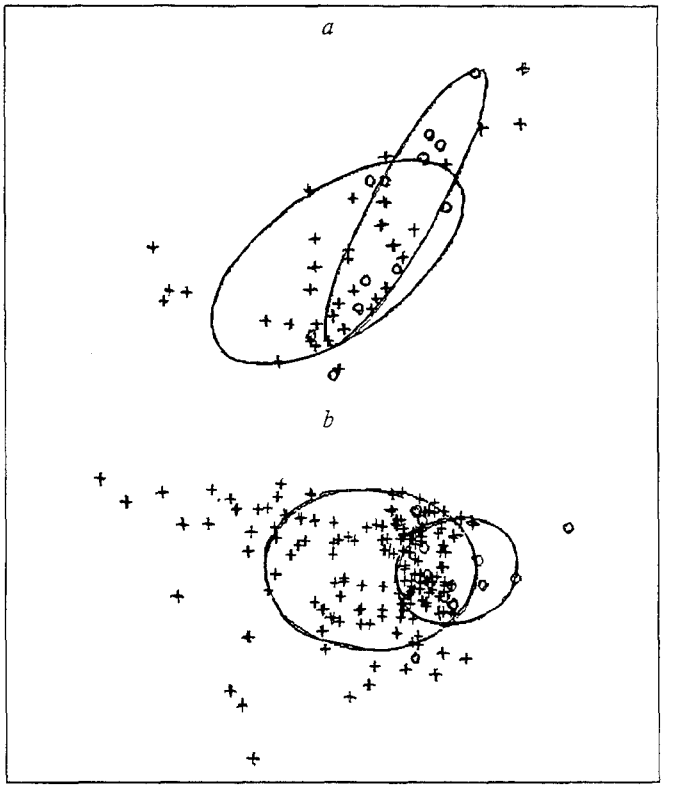

Fig. 3. Planar sections and classification tables of spectra from volumetric analysis of plasma samples from patients with breast cancer (crosses) and benign neoplasms (circles) residing in Odessa (*a*) and St. Petersburg (*b*).

less pronounced than the differences between healthy donors and patients with mammary tumors. This may be due to the fact that the development of both benign and malignant hormone-dependent tumors of the breast is accompanied by hormonal shifts which affect the indexes of subfractional composition of the plasma.

The data allow us to conclude that LCS reveals the differences between blood samples from healthy donors and patients with benign neoplasms and breast cancer. Further data gathering will prove the value of LCS as a screening method for risk groups and its benefits in the differential diagnosis of breast tumors.

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EXPERIMENTAL BIOLOGY

Dynamics of Hematological Indexes in Alcoholic Intoxication in Relation to Ecological Factors

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In recent years investigations in the field of narcology have increasingly had to take into account the steadily deteriorating ecological situation. This has led to the emergence of a new area of research: ecological narcology [9]. A model for the development of diseases under the impact of intensive anthropogenic activity is provided by the alcoholization of those working in hydrolysis-based ethyl alcohol production. Some workers take to imbibing the alcohol produced, and the effect is often compounded by the effect of inhaling furfural and methanol, the chemical by-products, in elevated concentrations and under unstable temperature conditions.

Obviously, a detailed study of alcoholization under ecologically unfavorable and at times highly detrimental conditions calls for experimental confirmation of the results by using laboratory animals. As is well known, the clinical picture of alcoholic intoxication does not depend on the paths by which alcohol enters the body [4]. Ethanol, methanol, and furfural are substances of a resorptive nature, exerting their influence after they have been absorbed into the blood-stream. Thus, the purpose of our investigation was to compare the reaction of the blood system in the case of ordinary alcoholic intoxication with that in the case of the imbibing of ethanol combined with the inhaling of methanol and furfural in surroundings with elevated temperatures.

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MATERIALS AND METHODS

In our experiments we used 8 groups of 80 conventional male white rats with an initial weight of 170-180 g. The first four groups (1a-4a) took part in experiments lasting 14 days, while the other four groups (1b-4b) participated in experiments lasting 28 days. The animals in group 1 were sub-

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