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Microcirculation disorders, limitations of diagnosis.

Pathology of the microvasculature has been a fundamental problem of experimental and clinical medicine for a long time. The urgency of this problem stems from the fact that the microcirculation is a place where, eventually, the transport function of the cardiovascular system is realized and transcapillary exchange is provided, creating the tissue hemostasis essential for life. Prevention and treatment of various microcirculation disorders are one of the most important problems of medical practice. They are very diverse both in their pathogenesis, and clinical manifestations. Practically there is no pathology in which microcirculatory disorders would not be met. The correction of microcirculation is especially important in the area of cardiology, diabetology, pulmonology, vascular surgery and emergency medicine. In addition, the human body's aging process is inextricably linked with progressive disorders of microcirculation of organs and tissues.

Difficulties in studying the microcirculation are connected with a very small size of microcirculatory vessels and strong branching of intraorganic vasculatures. Currently, various methods for studying human blood microcirculation with laser doppler flowmetry are actively used in clinical practice. This method allows to analyse functional disorders in the microvasculature. It is based on optical noninvasive catheterization of tissues with the laser radiation and analysis of diffused and reflected radiation from moving erythrocytes in tissues. The result of the study is to provide a composite signal of a large number of oscillations (figure 1, figure 2).

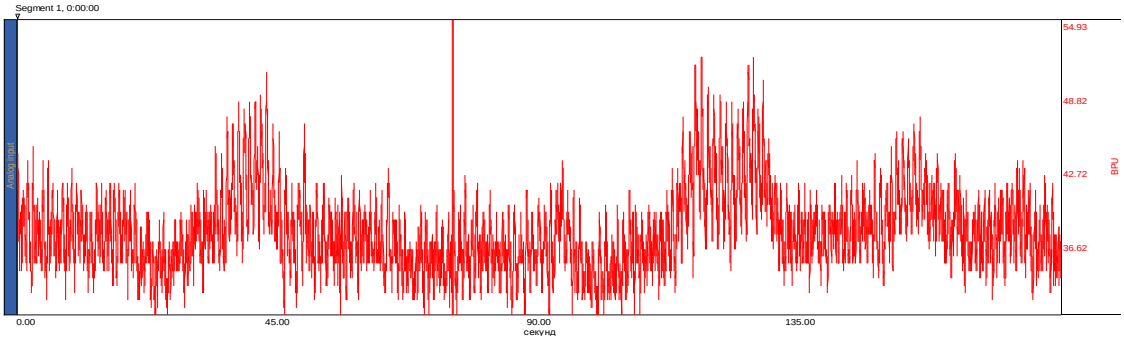

Figure 1. A 3-minute oscillogram record (variation of the norm)

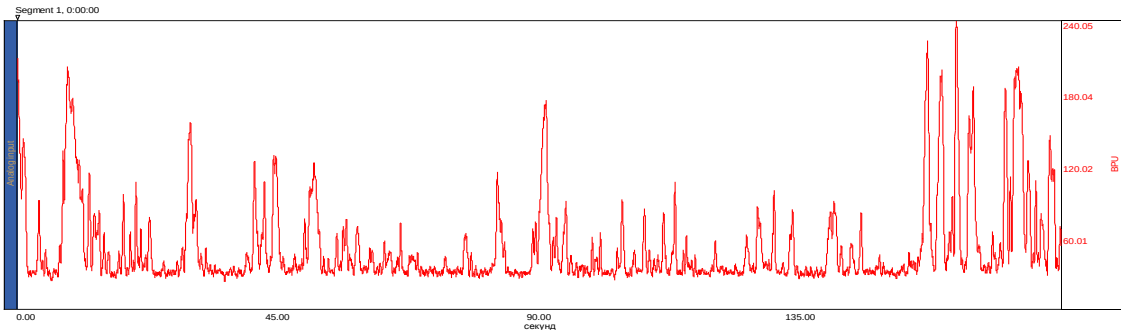

Figure 2. A 3-minute oscillogram record in disease (irregular high-amplitude waves are noticed on the background of low amplitude of the basal blood flow)

With the help of fast Fourier transform software (FFT) a graphical representation of the amplitude-frequency spectrum is received, in which the contribution of different frequencies in the received signal, the amplitude of these frequencies, the dominance of ones over the others, rhythmic oscillatory process in the microcirculation system can be analysed (figure 3, figure 4).

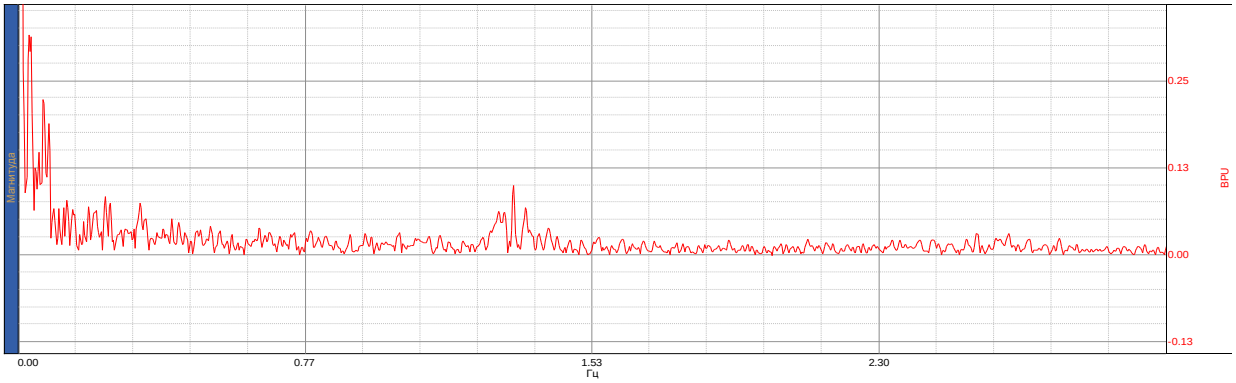

Figure 3. The normal amplitude-frequency spectrum of the LDF signal

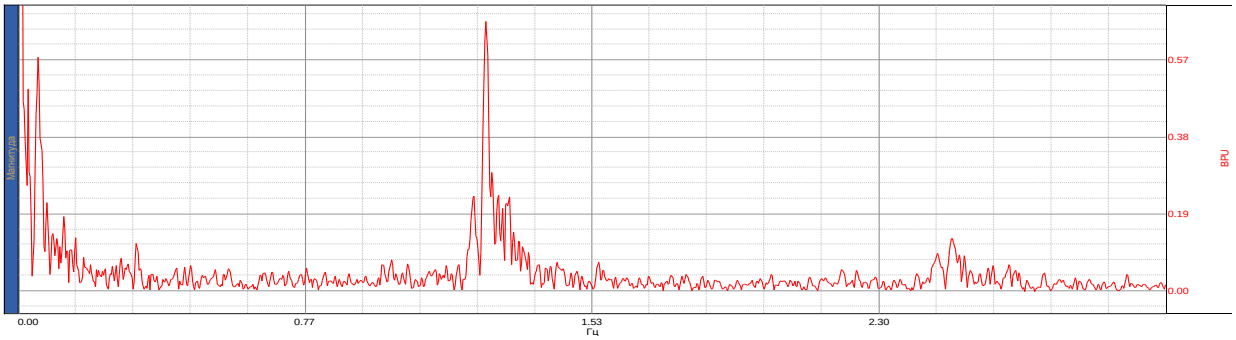

Figure 4. Amplitude-frequency spectrum of the LDF signal in disease (decrease in slow-wave amplitude of the spectrum in reference to the pulse harmonics)

The use of laser doppler flowmetry with the performance of functional tests (cold, heat, occlusion) in conjunction with the method of capillaroscopy (figure 4), also evaluating the structural changes of microvessels, provides a fairly detailed information about microcirculatory disorders in various diseases.

Figure 4. The capillaries in norm Figure 5. The capillaries in diabetes

Among the factors that determine haemocirculation in the body, one of the most important is the strict correspondence between the amount of functioning of the vascular bed and the volume of blood circulating through it. The balance of energy metabolism and oxygen delivery to the tissues is achieved under condition of effective redistribution of blood flow in the micro-region authority. Aerobic metabolism is supported by such a redistribution of blood flow to organs and tissues, as a result of which high priority and adequate supply of functionally loaded structures is achieved at the expense of those which at this time are in a less active state.

The redistribution of the blood flow in the tissue is carried out by active rhythmic contractions of the microvessel wall, called vasomotions. Vasomotions are also connected with a change of hydrostatic pressure in the capillaries, which reduces in constriction phase and increases in the phase of dilation, thereby determining the orientation of transmural fluid flows between the blood and the interstitium. When braking vasomotions that is observed in virtually all disorders of microcirculation, microvessels are transformed into passive blood conductors.

As a result, a number of vascular tracts are strategically more preferable. Such microvessels are those which have a larger diameter, a smaller number of branch nodes, a smaller length or more divergence sloping angle from the parent barrel. Under these morphofunctional features a larger volume of blood enters there. Thus, the reduction of the amplitude of vasomotions leads to a so-called bypass blood flow, as a result of which most of the blood flowing in the microvasculature, is moving through the smaller capillary part, "robbing" in the metabolic relation the neighboring areas of the micro-region.

However, in chronic diseases (coronary heart disease, cerebrovascular disease, diabetes, asthma, chronic lymphovenous failure, etc.) as a result of the study of peripheral microvasculature the specific microcirculation disorders are identified, indicating their systemacity.

The appearance and principle of operation of dynamic inversion table.

The dynamic inversion table is a robotic bed that works with a twenty-minute cycle, carrying out smooth, slow reciprocating motion in two planes of the cradle-like type, with a special orthopedic mattress, a comfortable U-shaped pillow and lumbar bandage for fixation (figure 6). It is also equipped with a patient monitor which during the time of the procedure fixes the basic indicators of central hemodynamics (heart rate, blood pressure, SP02, breathing rate, ECG). All data about the patient's condition is automatically recorded in the personal account by using the original software that allows to assess objectively the changes in clinical status from session to session.

Very slowly and smoothly moving, by reciprocating movements the recumbent surface gradually reaches the tilt toward the head portion up to 30 degrees for 10 minutes and in the same rhythm returns back. During the procedure the patient lies on his right side with legs bent at the knees, with his left foot on the long side of a pillow. This position is necessary for the maximum patient’s comfort during the procedure, it is also the most profitable for hemo and lymphocirculation (unpaired organs pressure to adjacent organs and great vessels is excluded, the possibility of gastroesophageal reflux during cephalic tilt is prevented).

Figure 6. Complex «Dynamic inversion table»