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MICROCIRCULATION EVALUATION CAPABILITIES USING CAPILLAROSCOPY

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Annotation: Questions about methods of diagnostics of microcirculatory disorders and detection of small changes of blood circulation are considered. The use of capillaroscopy makes it possible to diagnose the pathology at an early stage of its development, but at the same time, insufficient research in this field and low prevalence of the method in practice do not allow to establish clear quantitative criteria for pathology for various diseases.

Keywords: blood circulation, microcirculation, capillaroscopy, diagnostics, microvessels.

Topicality. The urgent issue of modern medicine is the search for new diagnostic methods that allow to detect the smallest changes at the preclinical stage [1, 2]. The study of the microcirculation system is very important for the diagnosis, assessment of the severity and nature of the pathological processes in the human body, forecasting their dynamics, monitoring the effectiveness of treatment. For the study of microcirculation traditionally used biomicroscopic methods for the study of capillary blood flow. The main advantage of these methods is the ability to evaluate such indicators as the diameter of the microvessels, the passage of blood on them, the aggregate state of the blood, the density of capillaries, which is impossible with any

other non-invasive method. One of the most relevant and promising methods is capillaroscopy [2, 3].

The purpose of the study is to evaluate microcirculation indicators such as microvascular diameter, perivascular zone size, and capillary blood flow velocity by capillaroscopy [1, 2].

Materials and methods. The work uses devices for visualization of blood flow: a portable capillaroscope, a capillaroscope created in the USSR some decades ago and a modern imported capillaroscope. The physical model of the capillary is considered.

Introduction. Capillaries play a key role in maintaining homeostasis in the body, ensuring the exchange of oxygen, nutrients and products of metabolism between the tissues and the bloodstream. At the same time, they are the first to respond to the influence of environmental factors, providing adaptation of local hemodynamics to the needs of the body. Changes in the capillary link are closely correlated with shifts in central hemodynamics, which allows the use of microcirculation parameters as prognostic and diagnostic criteria to assess the general physical condition and health of the subjects.

Own research. Known classification of microcirculatory disorders for the formation of a medical report on the severity of hemodynamic disorders [3]. It is based on quantitative characteristics such as the size of the perivascular zone and the speed of blood flow.

The initial stage of this analysis is to estimate the size of the vessels, the ratio of their departments. A calibration micrometer slide was used for this purpose. Removing the micrometer scale, each working magnification of the microscope and specifying the known distance in the calibration mode, sets the conversion factor to real units of length in the international SI system [4].

In capillaroscopy, a calibration slide is used to calibrate the digital microscope imaging system for further automatic distance measurement. By taking a picture of the micrometer scale, with each working magnification of the microscope and specifying a known distance in calibration mode, you set the conversion factor to

real units of length in the international SI system (meter, millimeter, micrometer, nanometer, etc.).

The key points of the methodology are the following:

- photographing the eyepiece-micrometer scale with the selected magnification of the microscope and fixed shooting parameters;
- Determining the cost of splitting it with the selected micrometer shooting parameters;
- resizing the image by any graphic editor so that the price of dividing the eyepiece-micrometer scale at the selected shooting parameters coincides with the nearest whole and easy-to-use value;
- introduction of a number scale indicating the price of the split into the image.

The following results were obtained. The portable capillaroscope is not suitable for calibration and carrying out of this experiment, it can be used solely for the purpose of demonstrating blood flow, but not for obtaining parameters. The next capillaroscope, which is of high quality but not timely, is already calibrated and has sufficient magnification for qualitative consideration of the measuring scale and scale setting. But the magnification of this device is not enough to fully examine the patient's capillaries - they are not clearly visible and too small.

When conducting an experiment with the most modern capillaroscope, positive results were obtained. This measuring device is subject to calibration and has a corresponding magnification, which makes it possible to set various parameters of the capillary, such as the radius, length, size of the perivascular zone, the ratio of sections - arterial and venous.

Considering capillaries in dynamics, measurements of speed of capillary blood flow are made. The main mechanisms of regulation of hemodynamics are aimed precisely at the fact that the volumetric rate of blood flow meets the needs of organs in blood flow and is calculated by the formula

$$Q = (P_1 - P_2) / R, \quad (1)$$

where Q - the velocity velocity, P_1 - the pressure at the beginning of the pipe, P_2 - the pressure at the end of the pipe, R - the resistance of the fluid to the pipe.

According to the general laws of hemodynamics, the resistance to blood flow in the vessels depends on the length of the vessels, their diameter and blood viscosity:

$$R = (8hl)/\pi r^4 \quad (2)$$

where R – the resistance of the fluid to the pipe, h – the blood viscosity, l – the length of vessels, r – the radius of the vessels.

Another important indicator of hemodynamics is the linear blood flow velocity, which is the distance that a portion of blood passes per unit of time in a particular vessel.

Conclusions. Thus, the study helped to establish that the study of microcirculation using such a method as capillaroscopy allows to identify the initial morphological and functional changes in the development of a number of diseases [4, 5]. During the study, the most important indicators of microcirculation were evaluated and visualized [6]. Assessing these parameters, we can judge the presence and stage of microcirculation disorder. The first stage of the calibration was performed and it was found that several capillaroscopes could only be used for imaging purposes, since using them in the study could not obtain bleeding parameters. The perspectives of this study are the evaluation of the perfusion index and the processing of qualitative indicators of bleeding such as transparency, color of perivascular background, brightness, saturation of the vessel.

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