УДК 612.42.612.15

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INVESTIGATION OF DOPPLEROGRAPHY IN VASCULAR ISCHEMIA OF THE ORGANISM (LITERATURE REVIEW)

Laser dopplerography represents the registration of doppler blood flow signals in the form of analog velocity curves (which allows qualitative and quantitative analysis of blood flow velocity in the vessels under study. The review provides information on the principles and possibilities of a new technology for ultrasound vessels. The history of its development is touched upon. The main attention is paid to the characteristics of doppler ultrasound regimes.
***Keywords**: dopplerography, ischemia, blood flow*

Introduction.History dopplerography begins in 1842, when the Austrian scientist, professor of mathematics Christian Doppler was first discovered, analyzed and described the principle of changing the wavelength reflected from a moving object. In cardiology, the essence of the Doppler effect is that when the ultrasound signal is reflected from moving objects, its frequency changes and the frequency of the ultrasound signal shifts.

The tissue Doppler analyzes the low-frequency signal that passed the filter, which cuts off the high-frequency spectrum. TMD doppler is essentially a modification of the Doppler method, it selectively analyzes the signals emanating from the tissues (<10 cm / s and low frequency), which then undergo autocorrelation and high-speed converters. Settings of frequency filters (0-50 Hz) are used, allowing to distinguish movement of the myocardium. In Japan, in the mid-1980, color Doppler visualization of the dynamics of the movement of a rigid atherosclerotic plaque was performed for the first time. Since this moment, despite technical limitations, the method of color Doppler flow has been recognized as an unusually significant technology in the field of echocardiography and cardiology.

In 1989, Karl Isaaz first attempted to quantify the function of the left ventricle in the motion of the myocardial wall, using the method of pulsed research.

In 1992, a group of scientists (G. Sutherland, W. McDicken and others) developed the first software. This work was continued by another group of scientists, headed by A. Fleming.

Transcranial Doppler (TKD) is a safe and clinically useful method for evaluating cerebral hemodynamics. Observation on the TCD was first performed in 1982 on intracranial arteries[1].

In general, the advantages of dopplerography lies in its repeatability, mobility, non-invasiveness and its timely calculation. TCD can detect intracranial hemodynamic disorders, such as arterial stenosis, arterial occlusion, microembolism. A laser dopplerometer is sensitive for the measurement of peripheral blood flow, to assess the development of functional collateral vessels. [2]

TKD arteries of the lower extremities is a valuable noninvasive method of diagnosis in the pathology of vascular diseases and an important step in diagnosis and for obtaining subsequent hemodynamic and morphological characteristics. The method consists of analyzing images and analyzing Doppler information in real time. Doppler information based on the Doppler effect can determine the pulse waves ie. Form of flow velocity (hemodynamic characteristics). Spectral analysis is the most important element of Doppler study of peripheral arteries of the lower limb. Based on spectral analysis, examination of the iliac arteries is performed at a frequency of 3.5 MHz, other peripheral arteries of the lower limbs are examined with a 7, 5 or 5 MHz sensor. [3]

The revealed magnitude of hyperemia depends on the duration of arterial occlusion and the measurement of time after the release of the occluder. After the ligation of the common iliac artery, while the blood flow was restored, there was a persistent deficit in the reserve of blood capacity, which persisted for at least 14 days. Thus, the use of a non-invasive vascular occluder and images of laser dopplerometry is a sensitive and consistent technique for measuring peripheral blood flow for evaluation functions. These findings will enhance the ability to effectively investigate pharmacological therapy aimed at promoting growth and development. [4] In studies of local cerebral blood flow in the occlusion of carotid arteries in rats by a laser method on each side, a 0.1-mm Doppler sensor was moved along the surface of the brain. Local cerebral blood flow was expressed in units of LD. The scanned data was used to calculate the histogram frequency with a class 5 flow width and LD range from 0 to 150 LD. Frequency observation was calculated mathematically.

After a stabilization period of 15 minutes, the base scan was performed on two hemispheres. The data stream was saved online on a computer. Each scan lasted about 7 minutes. Left and right were occluded. During this procedure, the head was fixed in a stereotactic frame, thereby providing identical positions of the scanned point for subsequent measurements. In the control group, the sutures were not tightly stretched and were removed at the end of the experiment. [5]

Observation performed on patients with light craniocerebral trauma, with craniocerebral trauma on the background of osteochondrosis-doplerografic examination of the spine and internal carotid artery, was found in almost 40% of patients with borderline and pathological symmetrical and asymmetric narrowing of the arteries, and in 12% of the pathology of the tortuosity. This proves the violation of blood flow in the vertebrobasilar basin.

According to the literature, it is known that the blood flow decreases on day 7 after the operation, reaching the lowest level at week 4, is restored by almost 90% at day 49. Blood pressure, which was the lowest on day 14, recovered by day 49 [31]. It has been proven that successful revascularization of the mouse limb occurs within 30 to 35 days after the induction of severe ischemia of the hind limbs.

When L-arginine was used at a dose of 30 μ / kg once a day against the background of ischemia, the level of microcirculation increased by 28 days of the experiment, and at a dose of 200 μ / kg once a day resulted in complete restoration of the limb muscle tissue by 28 days. The introduction of pentoxifylline in a dose of 60 μ / kg once a day did not lead to an increase in microcirculation and did not affect the rate of reparative processes in muscles [6]

Laser Doppler perfusion (LDPI) was used to obtain a subsequent reduction in the blood flow of the hind limbs of the rat, which usually persists for 7 days. In the LDPI studies, the blood flow of the hind limbs was gradually restored within 14 days, eventually reaching normal levels between 21 and 28 days. The normal value of the LDPI index was 1.00 ± 0.03 in this study. [7]

It was established that the proximal ligation of the femoral artery in the hind limbs of the mouse resulted in a decrease in 80% of the arterial blood flow within 24 hours after the operation compared with the normal contralateral lower limb. Beginning at about 48 hours, after an active recovery phase, an increase in blood flow begins in the ischemic limb. As a result, the blood flow stabilized by approximately 66% of the contralateral non-ischemic limbs. The blood flow in the ischemic limb remains relatively stable from 14 to 28 days after injury. Laser doppler imaging of ischemic hind limbs was performed after surgical dressing of the femoral artery. Mice from 6 to 8 weeks of age underwent surgical dressing of the femoral artery. Inflow of blood decreased. There was a slight change in the restoration of blood flow during the 8-week period after the arterial bandaging. These data have been previously studied. [8]

It was found that the color of dopplerography is 86% sensitive, 100% specific and 97% accurate when diagnosing ischemia in a painful scrotum. The color of Doppler ultrasound is an accurate, non-invasive tool for rapid evaluation of testicular perfusion in the painful scrotum [9]. Red means normal perfusion, and blue means a marked decrease in the blood flow of the ischemic hindlimb. [10]

In studies on rabbits with ischemia of the lower extremities, a pulse of blood flow after four months of ischemia in the peripheral limb decreased 15 cm below the level of arteriovenous anostomosis.

When comparing chronic ischemia and acute ischemia of the lower extremity, the restoration of skin blood flow was slower and less complete than in acute ischemia 0.66 ± 0.02, with chronic ischemia of lower limbs 0.76 ± 0.04, P <0.5. Chronic ischemia caused blood flow, when measuring by scanning with a laser dopplerometer and supplying oxygen in the muscles gradually decreased within 1 to 2 weeks after the operation. [11]

Under normal conditions, pO_2 in muscles is not significantly affected by blood flow, immediately after arterial occlusion, pO_2 correlates linearly with the blood flow. Within two weeks, the occlusion of pO_2 is restored to 45% of the baseline. [12]

In the study of blood flow after complete occlusion, the absence of spectra was observed. For partial occlusion, systolic velocity increased and systolic flow decreased in the distal side of the anastomosis. From the diastolic side, a decrease in flow in the proximal side of the anastomosis. [13]

At Doppler: the blood flow in Doppler modes (CFM, PWD, CWD, PD) is not locked. The lumen of the occluded artery is filled with echomasses of different intensity. [14]

When studying laser doppler against the background of a chronic primer CCl_4, the blood flow velocity in the mesenteric artery was 33.4 ± 0.59 at a norm of 28 ± 0.02 cm / s), in reducing the linear velocity of blood flow in the portal vein, is 17.2 ± 0 , 03cm (in control 20.3 ± 0.04 cm / s). According to the literature data, this is associated with an increase in the diameter of the vessels of the portal vein. The pulsation index and the index of peripheral resistance decreased in the portal vein and in the mesenteric artery by 10-15%. The detected disorders of venous blood flow correlate with the activity of the pathological process [15].

The results of doppler studies in ischemia of lower extremities of different duration showed a tendency to decrease the blood flow of the femoral arteries. After 14 days the blood flow decreased to 7.38 ± 1.2 cm / s. After 1 month of ischemia, the pulsation index increased to 1.63 ± 0.01 and two months of ischemia to 0.1 ± 0.02. An increased index of pulsation, characterizes the arterial lesion in the lower extremity of the rat. According to the literature, it is shown that with an increase in the degree of ischemia, the pulsation index decreases [16].

Conclusions.

TCD provides insight into a wide range of intracranial and extracranial vascular pathologic conditions and their deleterious effects on cerebral hemodynamics in a way not possible with other imaging or diagnostic techniques. TCD is available for non-invasive examination of intracranial arteries for the detection and quantification of stenosis. Newer developments in TCD have established the role of ultrasound in diagnostic,. With rapid advancements being made in technology, we are likely to witness better, wider and newer applications of TCD for quantitative assessment of cerebral blood flow in the near future.

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АҒЗАНЫҢ ҚАН ТАМЫРЛАРЫНЫҢ ИШЕМИЯСЫНЫҢ ДОПЛЕРОГРАФИЯ ЗЕРТТЕУІ (ӘДЕБИЕТ ШОЛУЫ)

Түйін: Лазерлік доплерография зертелетін тамырдың қан айналымындағы ұқсас қисық жылдамдық бойынша сапалық және сандық жылдамдығы бойынша талдау көрсетеді. Мақалада қан тамырларының ультрадыбыстық зерттеу жаңа технологияларының принципі және мүмкіндіктері берілген.Дамуына қысқаша ақпарат берілген. Негізгі назар аудару доплерографияның сипаттамасына арналған.
Түйінді сөздер: допплерография, ишемия, қан айналуы.

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ИССЛЕДОВАНИЕ ДОПЛЕРОГРАФИИ ПРИ ИШЕМИИ СОСУДОВ ОРГАНИЗМА (ОБЗОР ЛИТЕРАТУРЫ)

Резюме: Лазерная доплерография представляет регистрацию допплеровских сигналов кровотока в виде аналоговых кривых скорости (допплерограмма) дает возможность провести качественный и количественный анализ скорости кровотока в исследуемых сосудах. В обзоре представлена информация о принципах и возможностях новой технологии ультразвукового исследования сосудов. Затронута история ее развития. Основное же внимание уделено характеристике режимов допплерографии.
Ключевые слова: допплерография, ишемия, кровоток