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**THE SIGNIFICANCE OF ULTRASOUND RESEARCH METHODS  
IN THE DIAGNOSTICS AND CHOICE OF TREATMENT PATIENTS  
WITH PATHOLOGICAL DEFORMATION OF THE INTERNAL  
CAROTID ARTERY**

**Summary.** Pathological deformation of the internal carotid artery is the second most common cause of the development of symptoms of cerebrovascular insufficiency, second only to atherosclerotic lesions of the main arteries of the head. According to color duplex scanning, PD of the ICA occurs in 12-67.6% of patients with cerebrovascular insufficiency. In the literature, there are single studies on the "natural" course of PD ICA, and, in accordance with the results, PD is characterized by a progressive course of the disease with a tendency to increase in hemodynamic disorders and symptoms of cerebrovascular insufficiency. In turn, surgical correction of PD leads to the disappearance or decrease in the severity of symptoms of cerebral ischemia after surgery.

**Key words:** Arterial hypertension, blood pressure, circle of Willis, internal carotid artery, posterior cerebral artery, computed tomography, linear blood flow velocity, cerebral circulation, magnetic resonance angiography.

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## **ЗНАЧЕНИЕ УЛЬТРАЗВУКОВЫХ МЕТОДОВ ИССЛЕДОВАНИЯ В ДИАГНОСТИКЕ И ВЫБОРЕ ТАКТИКИ ЛЕЧЕНИЯ БОЛЬНЫХ С ПАТОЛОГИЧЕСКОЙ ДЕФОРМАЦИЕЙ ВНУТРЕННЕЙ СОННОЙ АРТЕРИИ**

**Резюме.** Патологическая деформация внутренней сонной артерии является второй по частоте причиной развития симптомов сосудисто-мозговой недостаточности, уступая лишь атеросклеротическим поражениям магистральных артерий головы. По данным цветового дуплексного сканирования ПД ВСА встречается у 12-67,6% больных с клиникой цереброваскулярной недостаточности. В литературе встречаются единичные исследования по «естественному» течению ПД ВСА, и, в соответствии с результатами, для ПД характерно прогрессирующее течение заболевания с тенденцией к нарастанию гемодинамических нарушений и симптомов сосудисто-мозговой недостаточности. В свою очередь, хирургическая коррекция ПД приводит к исчезновению или уменьшению выраженности симптомов ишемии мозга после операции.

**Ключевые слова:** Артериальная гипертензия, артериальное давление, Виллизиев круг, внутренняя сонная артерия, задняя мозговая артерия, компьютерная томография, линейная скорость кровотока, мозговое кровообращение, магнитно-резонансная ангиография.

**Relevance.** The need for surgical intervention in patients with PD implies the presence of clear indications for surgical treatment, primarily based on determining the hemodynamic significance of tortuosity. The leading role in the study of blood flow in pathological tortuosity is played by CDS, the information

content of which exceeds 90%. To date, there are no clear criteria for the hemodynamic significance of PD. The most commonly used criterion for the hemodynamic significance of AP is the maximum linear blood flow velocity at the deformity focus, however, the opinions of the authors regarding the critical value of LBF, above which AP can be considered hemodynamically significant, differ. Other researchers take as a criterion of hemodynamic significance an increase in LBF at the bend by more than 2 times from the values determined before it, as well as turbulent blood flow in the area of tortuosity. Some scientists draw an analogy between deformation and atherosclerotic stenosis of the carotid artery and measure the degree of narrowing in percent. brain reactivity is carried out on the basis of special tests, one of the most common is hypercapnic. The results of studies on the functional state of the cerebral circulation reserve in patients with PD ICA converge in a decrease in reactivity in this category of patients, but comparisons of the parameters of the cerebral circulation reserve with the structure of the circle of Willis, the form of deformity, the degree of cerebrovascular insufficiency, and blood flow indicators at the flexure in this category we did not meet patients in the studies presented in the literature. In addition, to date, in the modern literature available to us, there have been no studies devoted to a comprehensive study of the elastic properties of the arterial wall in patients with PD of the ICA according to ultrasound diagnostic methods. It remains an open question to what extent such ultrasound criteria as endothelial dysfunction and elasticity indices can be used to resolve the issue of the pathogenesis of this disease.

**Purpose of the study.** Improve the criteria for complex ultrasound examination carotid arteries in patients with pathological deformity of the internal carotid arteries to develop indications for surgical treatment.

**Materials and research methods.** The present work is based on the results of an ultrasound examination of 50 patients with pathological deformity of the internal carotid artery.

Ultrasound examination included: dopplerography of the carotid artery, ultrasound will be examined in the ASMI clinic using VIVID-600 ultrasonic devices.

**Research results.** This paper presents an analysis of the results obtained with complex ultrasound examination of 78 patients with isolated PD ICA in aged 15 to 82 years (mean age  $50.6 \pm 17.7$  years). Patients with combined hemodynamically significant atherosclerotic lesion of the arteries of the carotid and/or the vertebrobasilar basin were not included in the study. AT the study was dominated by females - 47 (60.3%), there were 31 men (39.7%). The study of patients was carried out at the Institute of Surgery. A.V. Vishnevsky for the period 2008-2011. the comparison group included 20 patients without signs of damage cardiovascular system at the age of 25 to 63 years (average age -  $33.2 \pm 10.6$  years). The lesion was bilateral in 71 (91%) patients, unilateral - in 7 (9%). Depending on the clinical manifestations of the disease, according to the classification of A. V. Pokrovsky (1976), patients were distributed as follows: 12 (15.4%) had a history of ischemic stroke patients, transient disorders of cerebral circulation - 9 (11.5%) people, asymptomatic course of the disease was diagnosed in 16 (20.5%) patients. Most a large group consisted of patients with clinical manifestations dyscirculatory encephalopathy - 41 (52.6%). The main complaints of patients during hospitalization were manifestations vertebrobasilar insufficiency and cerebral symptoms that observed in 57 (73)% and 46 (59%) patients, respectively. Effects stroke in the carotid pool was noted in 6 (7.7%) patients. Most of the examined patients had arterial hypertension - 52 (66.7%), coronary heart disease was noted in 24 (31%) patients. Statistically significantly more often (86%) AH occurred in patients older than 40 years. years ( $p < 0.05$ ).

To study the functional capabilities of cerebral circulation a hypercapnic test was performed to quantify the reserve cerebral circulation. When performing the test, the initial systolic blood flow velocity in the middle cerebral artery and the magnitude of the velocity blood flow in the MCA when the concentration of CO<sub>2</sub> in the exhaled air reaches 5 volume percent, which was recorded using a

capnograph. Percent changes in blood flow in the MCA were calculated using the initial values systolic blood flow velocity over 100%.

In a group of practically healthy individuals during a hypercapnic test as a result of the vasodilatory effect of carbon dioxide, an increase in linear velocity of blood flow in the MCA, which is in the range from 17.5 to 39%, in by an average of  $28.9 \pm 7.5\%$  compared with the baseline. All investigated persons had a closed VC.

**Conclusion.** 1. In patients with pathological deformity of the ICA, the indicators of flow-dependent brachial artery vasodilatation and elastic properties of the CCA wall statistically significantly differ from the indicators in the group of healthy individuals, which indicates functional changes in the arterial wall and an increase in its rigidity. The level of functional disorders has a statistically significant inverse correlation with the patient's age, direct correlation dependence on the level of arterial hypertension and does not depend on the form pathological deformity.

2. Ultrasonic characteristics of blood flow in the ICA have differences in various forms of pathological deformation:

- at ICA kinks, signs of turbulence were registered in 54.6% cases, the maximum LBF at the bend was  $121.3 \pm 42.5$  cm/s, the BFB was  $2.5 \pm 0.71$ ;
- with C- and S-shaped deformation of the ICA, signs of turbulence registered in 40% of cases, the maximum LBF at the bend was  $111.9 \pm 18.7$  cm/s, OLSC -  $2.5 \pm 0.5$ ;
- signs of turbulence in case of loop-like deformation of the ICA registered in 20.9% of cases, the maximum LSF at the bend was  $102.5 \pm 44.3$  cm/s, OLSC -  $2.1 \pm 0.66$ .

3. In patients with pathological deformity of the ICA with clinical manifestations of focal neurological symptoms signs of turbulence registered statistically significantly more often in comparison with asymptomatic patients (50% vs 39%),  $p < 0.05$ . Turbulence in patients with kinky deformation of the ICA and clinical manifestations of focal neurological symptoms were detected in 9.1%

of cases, while with tortuosity of the type kinking in 72.7%, C- and S-shaped - in 18.2%.

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