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THE SPECIFICS OF ULTRASOUND EXAMINATION IN THE DIAGNOSIS AND CHOICE OF TREATMENT TACTICS FOR PATIENTS WITH PATHOLOGICAL DEFORMITY OF THE INTERNAL CAROTID ARTERY

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ABSTRACT

Currently, the most commonly used criterion for the hemodynamic significance of PD is the maximum LSC in the focus of deformation, however, the authors' opinions on the critical value of LSC, above which PD can be considered hemodynamically significant, differ. Thus, some authors cite specific values of LSC at the bending height, which vary in a wide range of values: from 100 cm/s to 240 cm/s, while other researchers take an increase in LSC in the knee of tortuosity at the inner radius more than 2 times from the values determined before it as a criterion of hemodynamic significance, and there is also a turbulent blood flow in the tortuosity area. Some scientists draw an analogy between deformity and atherosclerotic stenosis of the carotid artery and measure the degree of narrowing as a percentage. Quantitative assessment of the reactivity of the brain is carried out on the basis of special tests, one of the most common is hypercapnic. The results of work on the study of 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 we did not find a comparison of the indicators of the cerebral circulation reserve with the structure of the Willis circle, the form of deformation, the degree of cerebrovascular insufficiency and indicators of blood flow at the bend in this category of patients in the studies presented in the literature. Based on the above, we see that the concept of "hemodynamic significance" of PD is very vague. The data from various surgical schools are extremely contradictory and are based on a variety of criteria that are not unified.

Keywords: blood pressure, atherosclerotic plaque, Willis circle, size of the intima-media complex, duplex scanning, computed tomography.

INTRODUCTION

In 1940, E. Moniz, based on the analysis of angiographic images, for the first time attempted to systematize the identified anomalies of the course of the ICA and identified three variants of the course of the extracranial segment of the ICA. A straight or slightly twisted course of the artery was regarded as the norm and was found in 68% of cases, the second type - pronounced bending (tortuosity) of the artery - was found in 23% and the third - a significantly pronounced deformation of the artery, resembling a siphon in shape, was found in 9%.

Proposed by N. Metz et al. graduation has not been widely used as an independent classification due to the fact that it describes only one of the types of PD ICA (kinking ICA) and, basically, it was used in combination or as an addition to other classifications. In addition,

the shape of the modified ICA is characterized based on a two-dimensional radiopaque image of the vessel obtained only in the frontal projection, that is, without taking into account the shape of deformations of other projection images. However, it is worth noting that in this work, for the first time, a hypothesis is presented about the influence of the bending angle on the decrease in perfusion pressure distal to the deformation zone and, the smaller the angle, the more pronounced the pressure drop.

It should be noted that, despite the many proposed classifications of pathological deformity of the ICA, there is no generally accepted classification that would meet all the requirements of vascular surgeons. Different surgical schools choose the most appropriate option for themselves, which makes it difficult to conduct multicenter randomized trials and evaluate the results of surgical treatment.

This assumption is based on the fact that the forms of tortuosity encountered are the same in all age groups and in the embryonic period. The most likely explanation is offered by A. Kelly (1925). ICA are formed from two embryological arteries. The lower part of the ICA is formed from the third aortic arch and the upper part from the dorsal aorta. When these two parts are connected, a vessel bends, and at this level the artery is crossed by a more superficially located lingual nerve. During the development of the lungs, the heart sinks into the chest and usually this bend straightens. Incomplete completion of this process and/or a mismatch between the growth of the cervical spine and the lengthening of the ICA leads to insufficient straightening and the formation of various configuration anomalies.

A sharp slowdown in blood flow or its stoppage can cause the development of thrombosis of the middle cerebral artery and intracranial ICA (Vereshchagin N.V., Levina G.Ya., 1972, 1977). The mechanism of hemodynamic disorders in these cases is due to the periodic decrease or complete closure of the artery lumen in the area of kinks, which leads to a decrease, slowdown or stop of blood flow in areas of the artery distal to the inflection and the appearance of turbulent blood flow, the formation of vortex flows or even the occurrence of reverse blood flow. As a result of restriction, unevenness, inversion of blood flow and collision of blood flows in the areas of junction of stenotic and retrograde blood flow, conditions are created that promote thrombosis and, as a result, distal thromboembolism (Mukherjee D., Inahara T., 1985). This was evidenced by the identification of a special type of "stagnated" blood clots, the structure of which, as well as the absence of atheromatous plaques at the site of their development, gave reason to believe that blood clots here were not a complication of atherosclerotic vascular damage, but arose as a result of hemodynamic disorders (Vereshchagin N.V., 1980). G.Yu. Sokurenko et al. (2001) believe that the pathogenesis of cerebral circulatory disorders in pathological tortuosity involves two mechanisms similar to those in stenotic lesions of the carotid arteries: the first is the formation of septal stenosis at the site of inflection with a reduction in blood flow distal to the stenosis; the second is the formation of parietal thrombi at the sites of inflections and loops with the development of arterio-arterial embolism.

The purpose of the study. To improve the criteria for comprehensive ultrasound examination of the carotid arteries in patients with pathological deformity of the internal carotid artery to develop indications for surgical treatment.

Materials and methods of research. The present work is based on the results of ultrasound examinations of 50 patients with pathological deformity of the internal carotid artery.
The ultrasound examination included. Dopplerography of the carotid artery, ultrasound will be examined at the ASMI clinic using VIVID-600 ultrasound machines.

The results of the study. Assuming that in patients with the most severe deformations of the ICA (such as looping), the elastic properties of the OCA wall and the values of the flow-dependent dilation index underwent greater changes than in other forms of tortuosity, patients with loop-shaped deformation of the ICA were separately isolated in these age groups and compared the obtained values of these indicators with those in the norm group. However, this theory was not confirmed, the results were similar to those already obtained when a group of patients with PD ICA was considered as a whole without gradation in form.
In addition, in order to determine the degree of influence of arterial hypertension on the elastic properties of the OSA wall and the function of the brachial artery endothelium, we compared these indicators in patients under 40 years of age who have arterial hypertension and whose systolic blood pressure does not exceed 140 mmHg with those in the control group.
As follows from table 15, arterial hypertension affects the structural and functional properties of the arterial wall, although a statistically significant difference was obtained only in the case of the PD index ($p<0.05$).
Thus, in the vast majority of patients with pathological deformation of the ICA, there is a tendency to decrease the coefficient of extensibility and the coefficient of compliance of the OCA wall in combination with an increase in the stiffness index, which increases with the age of the patient and acquires statistical significance, which primarily indicates age-related changes in the arterial wall, rather than the effect of the duration of the disease on the wall structure and, as a result, its functional properties. There was no correlation between the elasticity of the OSA wall and the blood pressure level. The correlation dependence of the PD index on age is less strong and a significant difference in the values of this indicator between the norm group and the group of patients with PD ICA at any age indicates that endothelial dysfunction is the most sensitive indicator and is the earliest phase of vessel damage, which further leads to structural changes in the vascular wall as under the influence of arterial hypertension and age.
When performing the BCA CDS, the shape of the deformation, the distance from the mouth of the ICA to the beginning of the bend, the type of blood flow, and its velocity characteristics throughout the carotid artery were evaluated.
Since LSC has a direct dependence on the magnitude of the exposed angle, to objectify the data in the study, the concept of LSC (ratio of linear blood flow velocities) was introduced, which was calculated as the ratio of the maximum systolic blood flow velocity at the bending height to the systolic velocity to the level of arterial deformation.
Due to the fact that bilateral deformation of the internal carotid artery was detected in the vast majority of patients (91%), then, as mentioned earlier, the deformation of the ICA on each side will be considered as a separate case. Depending on the shape of the deformation, according to the classification of J. Weibel and W. Fields (1965), the ICA were divided into 3 groups.

The distance from the bifurcation of the OCA to the deformation of the ICA ranged from 8 to 72 mm, Me = 38 mm (29; 48) . It was revealed that the loop-like tortuosity (Me=4.2) and kinking-type tortuosity (Me=3.85) were located higher than the S-shaped deformation (Me=2.95), ($p<0.05$).

In the course of our work, we conducted a comparative analysis of LSC and OLSC in various forms of deformation. In the group with kinking of the internal carotid artery, the average values of LSC before the deformation site were 49.7 ±11.5 cm/s, at the site of maximum bending - 121.3 ±42.5 cm/s, LSC - 2.5 ±0.71. In this group of patients, turbulent blood flow was most often recorded at the height of the bend - in 36 (54.6%) cases, which indicated the hemodynamic significance of the deformation.

Slightly different data were obtained by analyzing the state of blood flow in the group with loop-shaped deformation of the ICA. If, with loop-like deformation of the ICA, the average value of the LSC before the deformation site practically did not differ from that of other forms of tortuosity and amounted to 49.5±10.2 cm/s, then at the bending height the maximum LSC and OLSC were significantly lower and amounted to 102.5±44.3 cm/s and 2.0±0.66, respectively. Signs of blood flow turbulence were recorded in only 9 (20.9%) cases and appeared at values of maximum bending velocity on average 160.9±43.3 cm/s and OLSC 2.7±0.66 and were not determined at maximum velocity at the deformation site 86.09±27.9 cm/s and OLSC 1.85±0.52.

The analysis of the clinical picture showed that among all patients with PD ICA with clinical manifestations of focal neurological symptoms in the form of transient cerebral circulatory disorders and ischemic stroke in the anamnesis, the proportion of patients with loop-shaped deformation of ICA on one or both sides, despite the least pronounced hemodynamic changes in the deformed artery area in this group, It was 38.1%. Thus, out of 8 people with clinical manifestations of focal neurological symptoms, only 1 (12.5%) showed signs of blood flow turbulence at the height of the bend.

In the group with S- or C-shaped deformation of the ICA, the average values of LSC before the deformation site were 46.2 ±8.48 cm/s, at the maximum bending site - 111.9 ±18.7 cm/s, LSC - 2.5 ± 0.5. Signs of blood flow turbulence were recorded in 16 (40%) cases and were determined at the maximum velocity at the bending height, averaging 125.2±16 cm/s and an OLSC value of 2.8±0.45. The laminar nature of the blood flow was maintained at the maximum blood flow rate at the bend - on average 101.9 ±14.3 cm/s and OLSC 2.3± 0.55.

CONCLUSIONS

In patients with pathological deformation of the ICA, the indicators of flow-dependent vasodilation of the brachial artery and the elastic properties of the OCA wall differ statistically significantly from those 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 age of the patient, a direct correlation with the level of arterial hypertension and does not depend on the form of pathological deformity.

Ultrasonic criteria for the hemodynamic significance of pathological deformation of the ICA are the registration of signs of turbulence at the height of the deformation site and/or the values of the OLSC index 2.7 or more. Patients with loop-shaped deformity should be included

in the risk group for ischemic stroke, regardless of hemodynamic parameters at the site of deformation.

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