

VASCULAR ANATOMY OF THE VILLISIAN CIRCLE IN CEREBROVASCULAR PATHOLOGY

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Abstract. Variants of the structure of the vessels of the circle of Willis are currently gaining relevance, since the adequacy of blood circulation in the brain is provided not only by local regulation of blood flow, but also by the peculiarities of the morphological structure of the vessels of the arterial circle of the large brain. The obtained results of intravital brain imaging methods in 250 patients made it possible to determine the anatomical features of the vessels of the circle of Willis, which can be used in the prevention of cerebrovascular pathology.

Keywords: cerebrovascular pathology; circle of willis; anatomical variants of the vessels of the circle of willis.

Relevance

Cerebrovascular diseases still occupy a leading position among all neurological pathologies, lead to long-term disability, decrease in the quality of life and are the leading cause of death in the world. Cerebrovascular diseases include conditions in which the cerebral vessels are pathologically altered, causing disorders of cerebral blood flow. Features of the anatomical structure of the vessels of the Willis circle is of indisputable importance in the diagnosis of cerebrovascular pathology, which allows you to make a timely decision in therapeutic tactics, prevention of complications and rehabilitation of patients.

The purpose of the study

Determination of the anatomical features of the vessels of the Willis circle using *in vivo* imaging methods as a method for effective diagnosis of cerebrovascular pathology. In addition, it is of interest to determine the ratio of the Willis circle anomaly to the frequency of occurrence of cerebrovascular diseases, in particular, acute cerebral circulatory disorders in the studied patients in the catamnesis. To achieve this goal, you need to solve the following **tasks**:

1. Consider the anatomical structure of the Willis circle using in vivo visualization methods.
2. To distinguish the anatomical structure of the classical and modified Willisian circle using in vivo visualization methods.
3. Consider the relationship of clinical symptoms in the classical structure of the Willis circle and its modified variants.

Materials and methods

The study was conducted for 5 years on the basis of the regional state budgetary health institution of Vladivostok. A sample of the able-bodied urban population aged 65 ± 3 years was formed using a random number table. The response of patients exceeded more than 70%, as is customary in epidemiological studies. The study used a developed questionnaire to determine the prevalence of cerebrovascular pathology and the number of patients with various "cerebral complaints". The identification of patients with cerebrovascular complaints was carried out as part of the medical examination of the adult population. The study included 250 patients who went to a neurologist with the presence of cerebral complaints. The patients were divided into gender-age and clinical-statistical groups with the same category of ICD-10. All patients underwent intravital imaging methods - ultrasound Dopplerography of the main arteries of the head (USDG). In case of changes in the parameters of USDG, radiation neuroimaging methods of research were performed – magnetic resonance imaging with contrast, cerebral angiography. Patients complaining of dizziness underwent an otoneurological examination in accordance with clinical guidelines or standards of care for cerebrovascular pathology.

Results and discussions

In the classical anatomical description, the Willis circle is an anastomosis between the internal carotid and vertebral arteries of the right and left sides. The existence of the Willisian circle makes it possible to compensate for the decrease or absence of blood flow in one of the arteries at the expense of other vessels responsible for feeding the brain. According to most researchers, the structure of the Willisian circle is subject to numerous variations, its "classic" version is found in more than half of the cases [1, 3].

In the classic version, the arterial circle of the large brain is divided into 2 sections: anterior and posterior. The anterior part includes the initial sections of the anterior cerebral arteries that branch off from the cerebral part of the internal carotid arteries, and the anterior connective artery. The posterior part includes the initial segments of the posterior cerebral arteries (the final branches of the basilar artery) and the posterior connective arteries. The left and right vertebral arteries merge and form the main one (its multiple branches feed the brain stem and cerebellum). It then forms two posterior cerebral arteries that supply blood to the

mediabasal parts of the temporal lobes and most of the occipital lobes. [2] In more than 65% of cases, the vessels of the Willisian circle have a classical structure. Moreover, in the anterior part of the arterial circle of the large brain in an adult, the classical structure of its vessels is noted according to various researchers more than 55%, in the posterior-about 50% [3, 4].

According to a number of authors [1, 3], the uneven distribution of blood flow in certain variants of the structure of the arterial circle of the large brain can lead to the occurrence of vascular aneurysms, the rupture of which ends in such a terrible complication as hemorrhagic stroke, and with a pathologically caused decrease or cessation of blood flow through the supply vessels, it can cause the development of transient transient cerebral ischemic attacks and ischemic stroke.

The results of the neuroimaging study were evaluated in 250 patients, including 150 female patients (60%) and 100 male patients (40%). The median age was 65 ± 3 years.

The main complaints presented by patients were complaints of dizziness (76%), noise in the head (64%), memory impairment (46%), headache (21%), decreased performance (15%). In 98% of cases, there was an increase in blood pressure to 160 and 100 mm Hg and above. The above complaints were made equally often by male and female patients ($(p < 0,01)$). In the course of diagnostic measures, obesity 1-3 degrees (28%), fasting hyperglycemia (21%), an increase in triglycerides (56%), an increase in LDL cholesterol (62%), and an increase in the atherogenicity coefficient of more than 4 (32%) were detected. More than half of the patients had a combination of the above elements of the metabolic syndrome. According to the clinical recommendations for cerebrovascular pathology, all patients underwent MRI SCAN of the brain with contrast. The classical structure of the vessels of the Willisian circle was not revealed in any patient from the observed group. In 100% of cases, non-classical variants of the arterial circle of the large brain were determined (Fig.1).

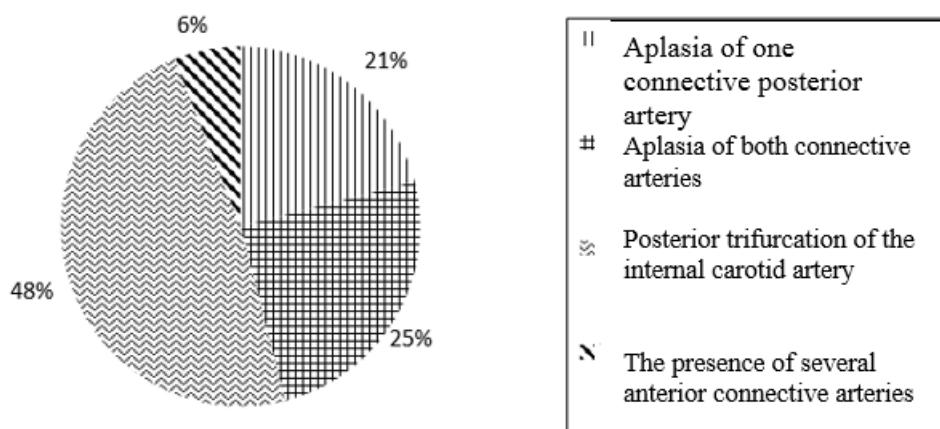


Fig. 1. Non-classical variants of the Willisian circle in the intravital brain imaging of patients with cerebrovascular pathology.

As can be seen from Figure 1, the most common changes are in the posterior parts of the Willisian circle, in the vessels of the anterior part - in 6 % of cases. Aplasia of one connective posterior artery was detected in 21% of patients, aplasia of both posterior connective arteries was detected in a quarter of the examined patients, posterior trifurcation of the internal carotid artery was noted in 48 % of patients; the presence of several anterior connective arteries was detected in 6% of cases.

When studying the five-year history, it was revealed that acute cerebral circulatory disorder of the type of ischemic stroke occurred in 14% of the subjects, hemorrhagic stroke-in 5 patients (2%), repeated stroke was diagnosed in 4 patients. The most common stroke was observed in male patients (82%). All patients were obese, systolic blood pressure was elevated, and lipid metabolism was beyond the reference values in 65% of the subjects. Ischemic stroke most often occurred in patients with posterior trifurcation of the internal carotid artery (58%), hemorrhagic stroke was suffered by patients with aplasia of both posterior connective arteries (100%).

Conclusions

The study allows us to draw the following conclusions.

1. More than half of the examined patients presented cerebrovascular complaints – the most common were dizziness (76%) and noise in the head (64%). Almost all the subjects had elevated systolic and diastolic blood pressure (160 and 100 mm Hg and higher). More than half of the patients had a combination of symptoms of the metabolic syndrome: obesity of 1-3 degrees, excess of the reference values of lipid metabolism, fasting hyperglycemia.

2. In the five-year history, acute cerebrovascular accident of the type of ischemic stroke was diagnosed in 14% of the subjects, hemorrhagic stroke - in 2% of patients, repeated stroke was diagnosed in 4 patients.

3. The use of intravital imaging in cerebrovascular pathology, namely, MRI of the brain with contrast, cerebral angiography, allows us to determine non-classical anatomical variants of the arteries of the vessels of the brain. These neuroimaging techniques were performed in patients with altered parameters of ultrasound dopplerography of the main arteries of the head.

4. The most common changes are in the posterior parts of the Willisian circle (95%), only in 6% of cases changes were detected in the anterior parts of the Willisian circle. Patients with a non-classical variant of the arteries of the vessels of the large brain presented cerebral complaints in 100 % of cases. Ischemic stroke most often occurred in patients with posterior

trifurcation of the internal carotid artery (58%), hemorrhagic stroke was suffered by patients with aplasia of both posterior connective arteries (100%).

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