



FEATURES OF CEREBRAL HEMODYNAMICS IN PATIENTS WITH CERVICOGENIC HEADACHE

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Abstract: -

Aim. The aim of this study was to conduct a Doppler study of arterial and venous hemodynamics in young patients with various types of cervical headache.

Materials and Methods. Sixty-five patients (38 women, 27 men) aged 18-35 years with headaches secondary to cervical spine instability were studied. Two groups of patients were identified: those with cervicocranialgia (CCA) and those with posterior cervical sympathetic Barré-Lieou syndrome (BLS). The time-averaged maximum blood flow velocity (TAMX) indices were studied in the middle cerebral arteries (MCA), anterior cerebral arteries (ACA), posterior cerebral arteries (PCA), vertebral arteries (VA), and basilar arteries (BA). The state of venous hemodynamics was studied with the study of maximum blood flow velocity (Vmax) in the vertebral veins (VV), basal veins (BV) of Rosenthal, and straight sinus (SS).

Results. Generalized vasospastic reactions predominated in the group of patients with CCA. The development of BLS in the overwhelming majority of cases was due to vasospasm in one VA, as well as a combination of vasospasm in the BA and one VA. In most cases, patients with CCA had impaired venous hemodynamics. Increased blood flow in the BV and SS was predominant. The greatest changes in blood flow velocity parameters in patients with BLS were observed in the VV; these changes were most often unilateral and associated with asymmetry in Vmax along the VV. Analysis of the obtained data suggests the presence of Doppler signs of cerebral venous dyschemia in the majority of patients with CH. Blood flow parameters in the VV proved to be the most informative.

Conclusions: Headache in cervicocranialgia is associated with diffuse changes in hemodynamics in the arteries of the vertebrobasilar basin, VV and SS. In patients with Barré-Lieou syndrome, regional changes in arterial hemodynamics were observed in the form of local vasospastic reactions in the VA and BA, as well as, to a lesser extent, local venous disorders, mainly in the VV. Examination of patients with cervicogenic headache should include mandatory Doppler ultrasound examination of the arterial and venous links of cerebral and vertebral blood flow.

Keywords: Cervicogenic headache, cervicocranialgia, Barré-Lieou syndrome, Doppler ultrasound examination, venous hemodynamics.

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Introduction:

Cervicogenic headache (CH), along with tension headache, is currently one of the most common causes of headache in young patients. The primary pathogenetic mechanism of this process is biomechanical dysfunction, primarily manifested by impaired mobility of the three upper cervical spinal joints, which has a reflex effect on the trigeminocervical nucleus. Irritation of the autonomic plexus of the vertebral arteries also plays a significant role in this process [2,3]. Another cause of cervical headache is degenerative diseases of the cervical spine (osteocondrosis, osteoarthritis). Cervicogenic headache is characterized by unilateral or bilateral pain localized in the cervical spine and the back of the head, which can project to the head and/or face. The pain can be aggravated or triggered by neck movements or a certain head position and is associated with changes in the configuration of the cervical spine, range of motion, tone and relief of the neck muscles, and their tension [3,4]. A headache is considered cervicogenic if there is clinical, laboratory, and/or radiographic evidence of disorders in the cervical spine, according to the classification of the International Headache Society (IHS). Pain associated with degenerative changes in the cervical spine consists of myofascial, radicular, and vascular components. The role of muscle tension in cervical spine disorders is similar to that in tension headache. It is impossible to draw a clear distinction between tension headache and cervicogenic headache, as spinal changes create conditions conducive to muscle tension, which can be triggered by even the most minor factors (an uncomfortable bed, physical exercise, or awkward head movements) [4]. It is logical to assume that tension headache most often occurs in the context of existing cervical spine lesions. Long-term functional biomechanical disorders in the cervical spine lead to impaired blood circulation in the vertebrobasilar system (impaired arterial inflow), obstructed venous outflow from the cranial cavity, and the development of intracranial hypertension syndrome. The causes of circulatory impairment in cervical osteochondrosis include vasomotor changes in the vertebral artery trunk or distal vessels of the vertebrobasilar system, as well as compression of the vertebral artery due to tonic contraction of the inferior oblique capitis and anterior scalene muscles [5].

Cervicocranialgia (CCA) and Barré-Lieou syndrome (BLS), also known as posterior cervical sympathetic syndrome and vertebral artery syndrome, are among the main clinical variants. Both variants are quite similar in terms of clinical symptoms, which allows the authors of some classifications to consider them practically synonymous [4]. Typically, the pain begins in the back of the head and neck and spreads to the parietal-temporal region, the forehead, the eye, and the ear. It is most often localized to one side and can be intermittent or constant. The pain clearly intensifies with neck movement. Scalp tenderness often occurs even with light touch or combing the hair, which the patient interprets as worsening headache. When turning or tilting the head, a "crunching" sound is often heard, sometimes a burning sensation, and sometimes dizziness with nausea or vomiting, a sensation of noise or ringing in the ears (often synchronous with the pulse) [3,7].

CCA characterized by pain that occurs after working in an awkward position with twisting or tilting the head, as well as after sleeping on the stomach with a high pillow. The pain is localized in the neck, occipital, and parietal-occipital regions, often radiating to the frontal-orbital region, and is sometimes accompanied by dizziness. BLS plays a significant role in the structure of vertebrogenic pain syndromes. The disease typically begins between the ages of 20 and 30 [4,7]. With BLS, headaches can be pulsating or shooting, beginning in the cervical-occipital region and spreading to the parietal, temporal, and frontal areas. The pain intensifies when turning the head, at night, and after sleep. In patients with BLS, as in patients with CCA, headaches may be accompanied by cochleovestibular disorders [3,4]. Visual disturbances are also possible: decreased visual acuity, spots, blurring, fog, and double vision. Paroxysmal autonomic dysfunction associated with head movements is common. Autonomic and visual disturbances associated with irritation of the vertebral sympathetic plexus in patients with BLS is the main clinical distinguishing feature of these headache types [8,9]. In the vast majority of cases, the development of BLS is caused by uncovertebral exostoses and extension subluxation of the vertebrae.

The use of Doppler sonography allows us to assess the nature and extent of hemodynamic disturbances in these patients [10].

The aim of the study

The aim of this work is a Doppler sonography study of arterial and venous hemodynamics in young patients with various types of CH.

Materials and Methods

The study involved 65 patients (38 women, 27 men) of young age (18-35 years) with headaches associated with cervical spine instability.

Based on the nature of the headache, two syndromes were identified: cervicocranialgia (CCA) and posterior cervical sympathetic Barré-Lieou syndrome (BLS). The control group (CG) consisted of 25 apparently healthy volunteers of the same gender and age.

Transcranial Doppler sonography (TCD) was performed using the Ultima PA (RADMIR, Ukraine) ultrasound devices. The time-averaged maximum blood flow velocity (TAMX) indices were studied in the middle cerebral arteries (MCA), anterior cerebral arteries (ACA), posterior cerebral arteries (PCA), vertebral arteries (VA), and basilar arteries (BA).

The state of venous hemodynamics was studied with the study of maximum blood flow velocity (Vmax) in the vertebral veins (VV), basal veins (BV) of Rosenthal, and straight sinus (SS).

Results and Discussion

In patients with CCA and BLS, the blood flow velocity parameters in the ICA, MCA, ACA, and PCA did not differ significantly (Table 1).

Table 1. TAMX values (cm/s) in intracranial arteries in patients with CH.

	ICA	MCA	ACA	PCA	VA	BA
CCA	46.1± 3.2	63.4± 5.4	46.1±3.9	40.8± 4.3	58.1± 5.3*	45.9± 6.2
BLS	46.1± 6.2	64.1± 5.8	45.4±4.2	39.1± 6.2	43.7± 6.2	57.4± 4.6*
CG	43.1 ± 8.2	62.6 ± 8,1	46.9 ± 6.7	36.5 ± 7.7	36.7 ± 5.3	38.2 ± 4.4

*p <0.05

In the group of patients with CCA, blood flow asymmetry in the VA (25-30%) was observed in 33.4% of patients, vasospastic reactions of the 3M in one VA - in 29.6%, vasospasm in both VA in 58.4%, vasospasm in the BA - in 63.2%, hyperreactivity in rotational tests - in 49.7%. In contrast to this group, blood flow asymmetry in the VA was observed in 43.7% of patients with BLS, vasospasm in one VA - in 47.8%, vasospasm in both VA in 31.3%, vasospasm in the BA - in 65.4%, hyperreactivity in rotational tests - in 52.6 %, vasospasm in both VA - 26.2%, vasospasm in one VA and / or BA - 20.8%, blood flow asymmetry (25-30%) in VA - 17.6%. Thus, in the group of patients with CCA, the prevalence generalized vasospastic reactions. The occurrence of BLS in the overwhelming majority of cases, it was caused by vasospasm in one VA, as well as a combination of vasospasm in the BA and one VA.

In most cases, patients with CCA had venous hemodynamic disturbances.

Blood flow in the VV in the horizontal position was detected in 68.9% of patients, and in the overwhelming majority of them (92.3%), with an increase in Vmax up to 30 cm/s (unilateral - 37.2%, bilateral - 55.1%). Asymmetry of flow in the VV (25-30%) was observed in 32.4% of patients, Increased blood flow in the SS was observed in 47.2% of patients. Also in this group, an increase in flow in the BV up to 25-35 cm/s (18.6%) was detected. The greatest changes in blood flow velocity in patients with BLS were noted in the VV (31.5%), more often these changes were unilateral (23.7%) and, as a rule, (19.4%), combined with a symmetry of Vmax in the PV (25-30%). A moderate increase in flow velocity (25-35 cm/s) was observed in 42.3% of patients, and a pronounced increase (more than 45 cm/s) was observed in 11.2%. Blood flow disturbances in the cerebrospinal fluid and the large ventricle were observed in 17.6% and 11.4% of patients, respectively (Table 2).

Table 2. Vmax values (cm/s) in cerebral veins in patients with CH.

	CCA	BLS	CG
Vertebral veins	28.5±5.2	31.4±3.3 *	20.2 ±2.7
Basal veins	32.1 ±4.3 *	24.4±3.3	21.3 ±2.6
Straight sinus	38.4 ±3.1 *	27.6±3.3	24.1 ±2.8

*p <0.05

Analysis of the obtained data allows us to conclude that Doppler ultrasound signs of cerebral venous dyschemia are present in most patients with cerebral hypertension. Blood flow parameters in the PV were the most informative. Changes in blood flow in the PV were observed primarily in patients with a clinical picture of intracranial hypertension, primarily due to the venous component. Venous hemodynamic disturbances in the basal veins were more often observed in patients with initial intracranial hypertension.

Conclusions

1. Headache in cervicocranialgia is associated with diffuse changes in hemodynamics in the arteries of the vertebrobasilar basin, VV and SS.

2. In patients with Barré-Lieou syndrome, regional changes in arterial hemodynamics were observed in the form of local vasospastic reactions in the VA and BA, as well as, to a lesser extent, local venous disorders, mainly in the VV.

3. Examination of patients with cervicogenic headache should include mandatory Doppler ultrasound examination of the arterial and venous links of cerebral and vertebral blood flow.

Conflict of interest

The authors of the manuscript consciously declare that there is no actual or potential conflict of interest regarding the results of this work with pharmaceutical companies, biomedical device manufacturers, other organizations whose products, services, financial support may be related to the subject of the materials provided, or who sponsored the research conducted.

Compliance with ethical standards

The authors of the manuscript consciously certify that the study was conducted using data from primary medical records and included clinical observations of patients. The study was conducted in accordance with the ethical standards of the Declaration of Helsinki of the World Medical Association on the ethical principles of conducting scientific medical research involving human subjects, the European Society Directive 86/609 on the participation of humans in biomedical research, as well as the Order of the Ministry of Health of Ukraine No 690 of September 23, 2009. Informed consent to participate in the study was obtained from all participants after providing them with clear, complete and accessible information about the purpose, design and methodology of the study, its potential risks, expected benefits and possible alternatives. All participants confirmed their voluntary participation by signing an informed consent document. Participants had the right to refuse participation at any time without giving reasons. In accordance with confidentiality regulations, all data was collected anonymously and processed in compliance with applicable data protection legislation. All information was used exclusively for this study and was summarized for further analysis of the results.

Primary data and materials

The authors of the manuscript consciously declare that the work uses the results of their own clinical studies, which were systematized and analyzed by the authors. Primary data include generalized patient indicators, laboratory results, protocols and obtained quantitative characteristics. All materials are stored in the archive of the research group and can be provided upon reasonable request to the corresponding author, taking into account the requirements of confidentiality and ethical norms.

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