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STATE OF BRACHIOCEPHALIC ARTERIES IN ACUTE SENSORINEURAL HEARING LOSS ACCORDING TO COLOR DUPLEX SCANNING

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ABSTRACT: 95 patients with acute sensorineural hearing loss (ASHL) were studied. The functional state of the main vessels of the head and neck was assessed using color duplex mapping. Common carotid artery (CCA), internal carotid artery (ICA), external carotid artery (ECA), and vertebral artery were examined. Thus, in patients with ASHL of vascular etiology, occurring against the background of stage I and II dyscirculatory encephalophaty (DE), there are violations in the systems of brain and peripheral hemodynamics, which can be detected by duplex scanning with color mapping of CCA, ICA, ECA and vertebral arteries. The degree of severity of violations is directly correlated with the duration of the disease, its complications and the age of the patient. The revealed violations of cerebral hemodynamics in most cases are directly proportional to the auditory stage. Duplex scanning allows you to detect organic disorders, as well as functional and qualitative changes in both the vessels themselves and the blood flowing through them. In order to assess the state of cerebral hemodynamics and the degree of rheological disorders with their subsequent adequate correction, patients with vascular ASHL need to conduct a study of platelet aggregation and color duplex scanning.

KEYWORDS: Acute sensorineural hearing loss, Dyscirculatory encephalopathy, Color duplex scanning, Brachiocephalic arteries, Hemodynamics.

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I. INTRODUCTION

The problem of hearing loss is currently becoming increasingly relevant in the medical and social aspects. Despite some advances in otorhinolaryngology in recent years, the number of people with hearing disabilities is increasing largely due to sensorineural hearing loss (SHL) [21]. Of particular importance, both medical and social, is the problem of acute sensorineural hearing loss, which occurs in young and most able-bodied people [5,9]. The number of patients suffering from this pathology is steadily growing. This is due to the early diagnosis of SHL (widespread introduction of audiometric equipment in outpatient practice), as well as an increase in the number of hearing disorders as a result of vascular disorders [7,10,13,25]. As the literature analysis shows, the development of sensorineural hearing loss in the vast majority of cases is due to the development of disorders of cerebral circulation. SHL in patients with vascular etiology is based on the anatomical features of the auditory analyzer, in particular, the blood supply to the cochlea. The inner ear is fed from the labyrinth artery, the final branch of the basilar artery system. Note that the labyrinth artery is the only and final artery that supplies blood to the cochlea, that is, the vascular network of the inner ear is terminal and, therefore, from these positions, extremely unfavorable for the vital activity of receptor cells. A. auditivaeinterna has several variants of divergence from the main artery, and it is characterized by variability of division into terminal branches. It departs from the lower anterior cerebellar artery in 65%, from the main one-in 29%, from the posterior and lower cerebellar artery - in 6% of cases [11,24]. The labyrinth artery enters the internal auditory passage and, having reached the modiolus, divides into 3 main branches - the cochlea, the vestibular-cochlea, and the vestibule. The cochlear branch penetrates the central canal and is divided into three groups of capillaries in the modiolus: one group supplies blood, a vascular strip, a spiral ligament, and a spiral protrusion; the second group branches in the

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bony spiral plate, main membrane and limbus; the third group of capillaries supplies blood to the cells of the spiral ganglion. The basal part of the cochlea receives blood supply due to the vestibular-cochlear artery. The labyrinth artery has smooth muscles in the walls and therefore the blood flow in the cochlea depends on the total blood pressure and the state of cerebral circulation. [15,17,18,20].A differential diagnosis and evaluation of the effectiveness of treatment measures for ASHL conducted in 1982 using the ABC-80 computer showed that circulatory disorders are of primary importance in the development of acute hearing loss. Experimentally and clinically it has been proved that violation of arterial inflow and venous outflow causes the most severe degenerative and sclerotic changes in the cochlea [3,19,22,23]. Thus, based on anatomical, physiological and pathophysiological data, the role of vascular factor in the etiology and pathogenesis of ASHL is not in doubt. Therefore, the study of the functional state of brachiocephalic arteries is important for assessing the state of hemodynamics in patients with ASHL.

Goal of the Research

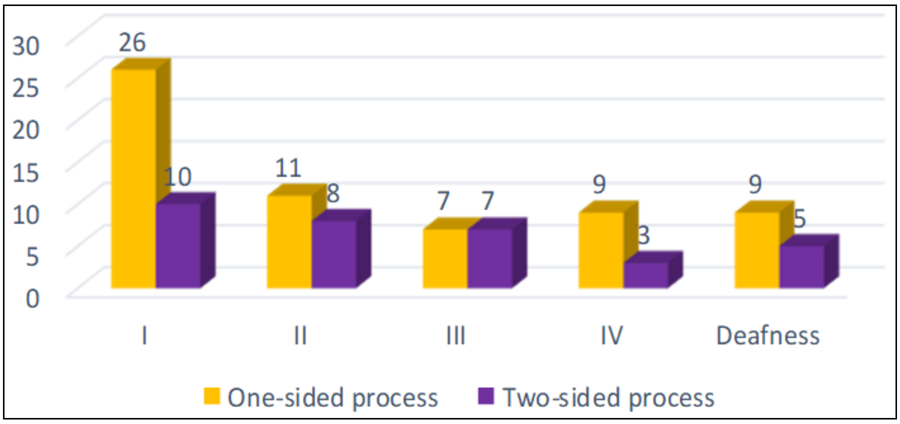
To study the functional state of the main vessels of the head and neck in patients with ASHL.

II. MATERIAL OF RESEARCH

From 2016 to 2020, 95 patients with acute sensorineural hearing loss of vascular origin, in particular dyscirculatory encephalopathy, were examined and treated at the Department of otorhinolaryngology of the Tashkent state dental Institute. Out of the total number of women surveyed, there were 54 (56.8%) and 41 (43.2%) men. The age of patients ranged from 20 to 70 years, and the majority were young people of the most able-bodied age from 30 to 50 years. The ratio of men to women was 1: 1.3.

The control group consisted of 20 healthy individuals aged 20 to 60 years who did not complain of hearing impairment and had not previously suffered from ear diseases.

When distributing patients by stages of dyscirculatory encephalopathy, we used the classification proposed by N. N. Yakhno (2002).Of 95 patients with acute sensorineural hearing loss, 61 (64.2%) had complications in the form of stage I dyscirculatory encephalopathy, and 34 (35.7%) had stage II complications. Patients with stage III DE were excluded from the study, since in this group, concomitant diseases and their complications come to the fore, and therefore they are more in need of observation by a neurologist or cardiologist. All patients had a hearing test and color duplex scanning of the brachiocephalic arteries. For tonal threshold audiometry, a clinical audiometer "Qualitone" (USA) was used. Perception thresholds were determined based on air conductivity (AC) and bone conductivity (BC) over the entire tone scale (from 125 Hz to 8000 Hz) according to the generally accepted method. The volume was adjusted in steps of 5 dB. To avoid eavesdropping, the non-investigated ear was masked with narrow-band noise. When analyzing tonal audiograms, age-related features of hearing thresholds were taken into account. To assess the degree of hearing loss we calculated the average values of sound perception thresholds for air conduction in the frequency range from 500 to 2000 Hz according to the International classification of hearing loss.



Impedance audiometry was performed by us on the MAICO-24 impedance meter (Germany). With the help of impedancometry, the compliance of the eardrums (static impedance), the acoustic reflex (AR) of the stirrup, and the function of the auditory tube were studied. The frequency of the probing signal used was 226 Hz. Stimulation

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of the acoustic reflex was performed by tonal air signals of 500, 1000, 2000 and 4000 Hz with an intensity of 75-100 dB and a step of 5 dB. Acoustic reflex thresholds were determined by ipsilateral stimulation with a tone frequency of 226 Hz. The duration of sound stimulation was 1.5 seconds. Tympanograms were recorded when the pressure in the external auditory canal changed in the range from + 200 to -200 daPa and interpreted according to the classification proposed by Jerger (1970) - tympanograms of the type "A”," B”, "C", "Ad" and "As".

The functional state of the main vessels of the head and neck was assessed using color duplex mapping, which was performed at the clinic of the Tashkent medical Academy on a Sono Scape SSI-6000 digital sonograph (China) using a standard method using a 7.5 MHz linear sensor. Position of the patient on the back, the head is turned at an angle of 30 ° in the direction opposite to the study. The common carotid (CCA), internal carotid (ICA), external carotid (ECA), and vertebral arteries (VA) were examined. The scanning was made polypositionally, first transversely and then longitudinally. The study began with an overview scan of the right half of the neck, with the head turned 45 degrees to the left. Sequentially, we obtained an image of the distal CCA segment, then switched to bifurcation and then to ICA and ECA. In a typical location, the ICA is laterally located and has a larger diameter than the ECA. VA location was started when the patient's head was positioned in the sagittal plane. The sensor was installed at an angle close to 90° between the trachea and the inner edge of the sternocleidomastoid muscle.

They evaluated the course of arteries, the level of bifurcations, measured the thickness of the intima-media complex, and also studied the ultrasound "morphology" of atherosclerotic lesions of the carotid arteries. After examining the arteries in B-mode, we switched to color duplex mapping, which allows us to identify arteries and veins, visualize anechogenic atherosclerotic plaques and areas of critical stenosis. It is assumed that mapping in red means the direction of blood flow from the sensor, and blue color codes the flows going to the sensor. When registering blood flow in pulsed Doppler mode with spectral analysis to obtain the correct speed parameters of hemodynamics, the angle of inclination of the sensor to the longitudinal axis of the vessel was set within the limits not exceeding 60°, the Doppler gate occupied no more than 2/3 of the lumen of the artery under study [1,2,8,14]. The maximum blood flow rate, linear blood flow rate (LBFR), and the resistivity index (RI), which characterizes the state of peripheral resistance, were studied.
In the study of vertebral arteries, special attention was paid to hypoplasia (diameter less than 2 mm), C-and S-shaped deviations in segments V1 and V2, high entry into the bone channel, speed indicators at all levels.

We evaluated the ratio of blood flow rates in the ICA and vertebral artery, since studying only the absolute speed of blood flow in the vertebral artery can lead to erroneous results. When performing duplex scanning with color mapping, the age characteristics of patients were taken into account. 20 conditionally healthy individuals with normal hearing aged from 30 to 60 years were examined as a control group.

III. RESULTS

Unilateral `hearing loss occurred in 62 people (65.3%), with right-sided and left-sided hearing loss, while the frequency of damage to the right and left ear was approximately the same and bilateral hearing loss was observed in 34.7%.The results of duplex scanning with color mapping in patients with stage I DE did not reveal violations of the geometry of the carotid arteries. The intima-media complex did not exceed 0.9-1.00 mm. In 60.4% of observations, C-shaped deviations of vertebral arteries in the V2 segment were noted without a significant velocity gradient, but with a tendency to decrease in the distal direction along the VA. In 41.6% of cases, venous vertebral plexuses were visualized, and in 55% of cases – bilaterally. Monophasic blood flow with MaxV within 15-23 cm / s was recorded.

Table 1: Vascular "Geometry" of Carotid and Vertebral Arteries in Patients with ASHL, Complicated by DE

Artery	I DE stage	II DE stage
CCA and ICA flow	linear	C- and S- shaped deviations
VA flow	linear	C- shaped deviations in segment V2

When analyzing the rates at different ICA sites, 35.4% of patients showed a decrease in blood flow in the distal segment. Apparently, this is due to the viscosity of the blood flow, and consequently, a decrease in blood flow, since there were no organic lesions of the arteries

Table 2: Indicators of Duplex Scanning with Color Mapping by PA in the Control Group

Age, years	Max V, cm/s	LBFV, cm/s	RI
30-40	45±7,5	55±6,1	0,54±0,04
41-50	66±5,1	46±4,2	0,58±0,03
P_1	<0,05	>0,05	>0,05
51-60	59±4,3	41±4,1	0,59±0,02
P_1	>0,05	>0,05	>0,05
P_2	>0,05	>0,05	>0,05

Note: P_1 - confidence compared to data and 30-40 years, P_2-compared to data of 41-50 years

The speed of blood flow depended on the age of the patients. Thus, the maximum systolic blood flow rate for VA in persons under 45 years of age averaged 45±7.5 cm / s versus 20±3.1 cm / s in elderly patients. Given that the elastic properties of the arterial wall decrease with age, there is a tendency to increase RI. In patients under 45 years of age, it was 0.54±0.04, and in elderly patients-0.6±0.02.

In 11.7% of cases, signs of initial atherosclerotic lesions of the carotid arteries were detected, which were manifested by" blurring "of the intima-media complex or its thickening to 1.2-1.3 mm. in 23.5% of the examined patients, hemodynamically insignificant ICA stenoses were detected due to local stable atherosclerotic plaques localized mainly on the posterior wall. In 8.8% of patients, ICA stenosis was detected in combination with CCA stenosis. The echographic structure of the plaques was heterogeneous with a predominance of hyperechogenic component and mineralization sites that gave an acoustic shadow of different stages of expression. These signs allow us to conclude about a long-running atherosclerotic process. Areas of ulceration plaques or hemorrhages under the tire were not observed. In 2 (5.8%) patients, unilateral vertebral artery hypoplasia was diagnosed, and in 1 (2.9) – hemodynamically insignificant stenosis. In contrast to the patients of the first group, they had a decrease in blood flow through the carotid and vertebral arteries (table. 3). At a significant stage, this is not due to organic damage to the vascular wall, but to extravasal factors, in particular, with deviations of the arteries in the V2 segment.

Table 3: Index of Extracranial Artery Resistivity in Patients with ASHL Complicated by DE, M±m

DE	CCA	ICA	VA
I stage	0,70±0,03	0,54±0,02	0,56±0,03
II stage	0,75±0,02	0,60±0,03	0,61±0,02
P II-I	>0,05	>0,05	>0,05

Our observations show that individuals over 35 years of age often have a combination of unstable blood flow along the VA in combination with signs of venous discirculation in the vertebral venous plexuses. As a rule, this is due to extravasal factors that change the course of the VA mainly in the V2 segment and lead in turn to the appearance of a velocity gradient of various stages of severity between the proximal and distal sections of this zone (table 4).

Table 4: Indicators of Average Linear Blood Flow Rate (cm / s) along Extracranial Arteries in Patients with ASHL Complicated by DE, M±m

DE	CCA	ICA	VA
I stage	57,3±4,38	0,54±0,02	35,1±2,61
II stage	42,3±3,54	40,5±3,22	23,4±1,96
P II-I	<0,05	>0,05	< 0,01

In persons over 45 years of age, along with the above changes, the addition of atherosclerotic lesions of extracranial arteries is registered, as well as a significantly more frequent decrease in blood flow through the VA.

In the vast majority of observations, venous vertebral plexuses were visualized on both sides with monophasic low-speed blood flow, which suggests that venous outflow is difficult in these patients. We did not find any data confirming dilation of the internal jugular veins. In the mode of pulse dopplerography for the jugular veins, phase blood flow was recorded in 70.1% of the observations. Low-speed monophase flow was observed in 29.9 % of cases. Together with the visualization of vertebral venous plexuses this gave us reason to assume that the venous outflow from the cranial cavity is difficult.

IV. CONCLUSION

We came to the conclusion that patients with ASHL of vascular etiology, occurring against the background of stage I and II DE, have disorders in the systems of brain and peripheral hemodynamics, which can be detected by duplex scanning with color mapping of CCA, ICA, ECA and vertebral arteries [4,6,12,16]. The degree of severity of violations is directly correlated with the duration of the disease, its complications and the age of the patient. The revealed violations of cerebral hemodynamics in most cases are directly proportional to the auditory stage. Reduced blood flow in the distal segment of the internal carotid artery, detected by ultrasound duplex scanning, is found in 35.4% of patients with ASHL and DE stage I and 52.6 % of patients with ASHL and DE stage II, which, in the absence of organic lesions, indicates signs of increased blood viscosity with reduced flow. At the same time, it is necessary to conduct a study of platelet aggregation in patients with ASHL. Duplex scanning with color mapping allows you to detect organic disorders, as well as functional and qualitative changes in both the vessels themselves and the blood flowing through them. Thus, duplex scanning of the head and neck vessels is a fairly informative diagnostic method and is widely used to diagnose atherosclerotic lesions of the intracranial arteries, determine spasm of the cerebral arteries and monitor them during treatment, to objectively assess the functional reserve of the brain vessels and other changes. In order to assess the state of cerebral hemodynamics and the degree of rheological disorders with their subsequent adequate correction, patients with vascular ASHL need to conduct a study of platelet aggregation and color duplex scanning.

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