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FEATURES OF HEMODYNAMIC INDICATORS OF CEREBRAL VESSELS IN PATIENTS WITH CHRONIC KIDNEY DISEASE

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Abstract: The work is based on the results of a study of 97 CKD patients with neurological disorders of varying severity. It was revealed that in comparison with patients with stage C2, with C3a there was a tendency to a decrease in systolic blood flow velocity and a significant decrease in diastolic blood flow velocity,as a result, there was a significant increase in RI and PI in the cerebral vessels ($p < 0.05$), which indicated a direct connection between CKD and the development of neurological disorders, as a result of which the appearance of vascular encephalopathies was observed based on CKD.

Key words: chronic kidney disease, encephalopathy, linear blood flow velocity, resistance and pulsatility index.

Relevance. The study of somatogenously caused neurological disorders is one of the pressing problems of modern neurology. In 52.4% of cases, pathology of the nervous system is determined in patients with chronic kidney disease (CKD), which is the most common kidney disease in the adult population, which very often occurs in a latent form, especially in its early stages. CKD is a pathology that is becoming a non-infectious epidemic due to its significant prevalence in the population, a sharp decrease in the quality of life and high mortality of patients. The prevalence of CKD is comparable to such socially significant diseases as diabetes mellitus (DM), obesity, and cardiovascular diseases (CVD). According to the literature, signs of kidney damage and/or a decrease in glomerular filtration rate (GFR) are detected in at least every tenth representative of the general population [1] and much more often - up to 40-50% - in risk groups, which include patients with diabetes, however, hypertension, atherosclerosis, obesity, coronary heart disease, etc. play an important role in the development of CKD [2, 3]. The advent of renal replacement therapy (RRT) has made long-term life-saving treatments possible for patients with terminal CKD. The number of patients receiving RRT worldwide exceeds 2.5 million and is projected to double by 2030 to 5.4 million [4], of which about half are patients with diabetes. However, the costs of CKD go far beyond the burden on healthcare systems due to the high costs of dialysis services and kidney transplants. CKD is an independent risk factor for CVD and mortality, increasing cardiovascular (CV) risks already at the very initial stages of the pathology.

Materials and methods: the work is based on the results of a study of 97 CKD patients with neurological disorders of varying severity who received outpatient and inpatient

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treatment in the nephrology department of the Bukhara Multidisciplinary Medical Center. The diagnosis of CKD was verified by a nephrologist of the highest qualification category based on the results of a clinical and laboratory examination of the patient using ultrasound diagnostics and x-ray urological examination. The study of cerebral hemodynamics was carried out using Doppler ultrasound (USDG) of intracranial and extracranial vessels, as well as renal vessels.

Research results. The age of the patients ranged from 19 to 53 years, averaging 44.5±4.5 years. Among those observed, there were 19 men (19.6%) and 78 women (80.4%) (table 1).

Table 1
Distribution of patients by gender and age

age	men		woman		total	
	abs	%	abs	%	abs	%
20-30	4	21,1	21	26,9	25	25,8
31-45	6	31,6	25	32,1	31	31,9
46-53	9	47,4	32	41,0	41	42,3
total	19	100	78	100	97	100

Depending on the course of CKD according to the classification of the National Kidney Foundation, according to which CKD is divided into 5 stages according to the level of glomerular filtration rate (GFR) of the kidneys. Based on this classification, all patients were divided into 2 groups: Group 1 – patients with CKD stage C2 (GFR - 60-89 ml/min/1.73 m2), 60 (61.8%) patients, of which -14 (23.3%) men and 46 (76.7%) women; Group 2 included patients with CKD stage C3a (GFR - 45-59 ml/min/1.73 m2), 37 (38.1%) patients, of which 5 (13.5%) were men and 32 (86, 5%) women. The control group included 26 people (9 men, 17 women), whose average age was 42.8 + 4.3, who had no somatic complaints and no history of diseases of the urinary and nervous systems. Patients with CKD were comparable to the control group by age and gender.

The study of cerebral hemodynamics was carried out using Doppler ultrasound (USDG) of intracranial and extracranial vessels, as well as renal vessels. Ultrasound imaging assessed the position, shape, size, degree of tortuosity, and thickness of the vessels. Qualitative characteristics included the shape of the Dopplerogram, the ratio of its elements, the direction of blood flow, the distribution of frequencies in the spectrum, and the sound characteristics of the signal. When comparing spectrograms in patients with CKD and healthy subjects, a deterioration in cerebral blood flow parameters was

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revealed. In patients with stage C2 CKD, a significant decrease in the values of systolic (SSC) and diastolic (DSC) blood flow velocities in both internal carotid arteries (ICA), accompanied by an increase in peripheral resistance indicators, was revealed. In patients with stage C3a CKD, compared with the control and group C2, a significant deterioration in the listed blood flow parameters in both internal carotid arteries was revealed. When comparing data on the location of vessels in the vertebrobasilar region, a significant decrease in diastolic blood flow velocity was revealed in patients with stage C3a CKD compared with the control group and patients with stage C2.

A comparative analysis of data from the results of ultrasound examination of the middle cerebral artery (MCA) and anterior cerebral artery (ACA), the common carotid artery (CCA) on both sides and the internal carotid artery (ICA) revealed pathological indicators in comparison with healthy subjects.

In patients with C3a, compared with the control group, there was a significant decrease in maximum systolic and diastolic blood flow velocities, which led to a significant increase in resistance indices (RI) and pulsatility (PI) among the examined cerebral vessels. Compared with patients with stage C2, in patients with stage C3a, a tendency towards a decrease in systolic blood flow velocity and a significant decrease in diastolic blood flow velocity was revealed, as a result of which a significant increase in RI and PI was observed ($p<0.05$). As the course of CKD worsened, a significant increase in the index of resistance and pulsatility in the cerebral vessels was noted (Table 2).

Table 2

Comparative analysis of ultrasonography parameters of cerebral vessels depending on the stage of CKD (M±m).

Artery	Indicators		Group 1 (n=60) stage C2	Group 2 (n=37) stage C3a	control (n=26)
CCA	RI	D	0,68 ±0,01	0,72 ± 0,02	0,78 ± 0,09*
		S	0,66 ± 0,02	0,74 ± 0,03	0,82 ± 0,08**
	PI	D	1,3 ±0,07	1,2 ± 0,1	2,2 ±0,35**
		S	1,26 ±0,07	1,4 ±0,14	2,0 ± 0,25**
ICA	RI	D	0,5 ± 0,02	0,67 ± 0,01*	0,80 ± 0,01**
		S	0,55 ±0,01	0,63 ± 0,01	0,79 0,01*
	PI	D	0,7 ± 0,04	0,83 ± 0,05*	0,63 ± 0,01*
		S	0,86 ± 0,06	0,76 ± 0,06	0,62 ±0,01**
MCA	RI	D	0,47 ± 0,02	0,58 ± 0,03	0,70 ±0,01*
		S	0,5 ± 0,02	0,69 ± 0,02	0,85 ±0,01**
	PI	D	0,7 ± 0,04	0,71 ±0,08	0,82 ± 0,07*
		S	0,74 ± 0,04	0,78 ± 0,04	0,86 ±0,05*
ACA	RI	D	0,49 ± 0,02	0,53 ± 0,04	0,52 ± 0,05

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		S	0,5 ± 0,02	0,54 ±0,02*	0,49 ± 0,02
	PI	D	0,7 ± 0,04	0,76 ±0,05	0,84 ± 0,05*
		S	0,7 ± 0,05	0,73 ± 0,05	0,83 ± 0,02

*Note: *-significant compared to the control group (*-p<0,05, **-p<0,01)*

According to Table 2, when considering resistive indicators, intrarenal vascular resistance in patients of groups 1 and 2 compared with the control group was higher at all levels of renal blood flow, which apparently indicates total vasoconstriction of the renal vascular bed in patients with CKD, which was observed to a greater extent in group 2 with CKD stage C3a. An interesting fact is that these indicators changed almost in parallel with the hemodynamic indicators of cerebral vessels, both extracranial and intracranial arteries, indicating a close relationship between the cerebral-renal vascular circulation (Table 3).

Table 3

Comparative analysis of ultrasonography parameters of renal vessels depending on the stage of CKD (M±m).

Artery	Indicators	Group 1 (n=60)	Group 2 (n=37)	Control
		stage C2	stage C3a	(n=26)
ПА	RI	0,72±0,17*	0,82±0,17**	0,67±0,15
	PI	1,62±0,12*	1,72±0,12*	1,25±0,18
СА	RI	0,70±0,5	0,86±0,5*	0,65±0,11
	PI	1,45±0,11*	1,55±0,11*	1,16±0,12
МА	RI	0,69±0,21*	0,89±0,21**	0,63±0,14
	PI	1,38±0,16*	1,48±0,16*	1,09±0,20
ДА	RI	0,69±0,12	0,89±0,12*	0,61±0,12
	PI	1,24±0,14	1,20±0,14	1,04±0,14

*Note: *-significant compared to the control group (*-p<0,05, **-p<0,01)*

Conclusion. Thus, in CKD, according to ultrasound data, there is a unidirectional change in cerebral hemodynamics, but of varying degrees of severity. As the course of CKD worsens, the degree of cerebral dyscirculation increases, the degree of pulse blood filling, the speed of pulse and venous blood flow decreases in combination with an increase in peripheral resistance in small and medium-sized vessels. All these changes are consistent with ultrasound data - a decrease in the speed parameters of blood flow against the background of a decrease in the elasticity of the vascular wall in all studied areas and an increase in the numerical values of circulatory resistance indices, such as the Purcello and Gosling index. A decrease in the level of blood supply to the arterial bed, combined with an increase in vascular tone, is one of the cerebrovascular characteristics of the initial manifestations of cerebrovascular insufficiency.

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