ISSN : 2466-0744

MULTIDISCIPLINE PROCEEDINGS OF

DIGITAL FASHION CONFERENCE

KOREA, REPUBLIC OF

Multidiscipline Proceedings of

DIGITAL FASHION CONFERENCE

July 2025 *(Volume 5, No.4)*

Available at digitalfashionsociety.org
Published:
서울 합정역
파주출판도시
ISSN 2466-0744
Seoul
Rebuplic of Korea (ROK),

EDITORIAL BOARD

UDK: 616.831-005.4-036.11:616.155.2-07

MORPHOMETRIC INDICATORS OF THE CIRCLE OF WILLIS IN CEREBROVASCULAR DISEASES

Abduolimov Abdumani Abdunabiyevich
Head of the Neurosurgery Department,
Fergana Regional Multidisciplinary Children's Medical Center.
Fergana Institute of Public Health and Medical Sciences
abduolimov727@gmail.com

Abstract: Morphometric studies were carried out as follows. The morphometric analysis of cerebral blood vessels, including their structural and geometric features, is typically conducted during autopsy. This research is aimed at obtaining detailed information about intracerebral vascular morphology and its influence on the architecture of cerebral vessels in cerebrovascular diseases. Based on the obtained numerical data, it becomes possible to assess the most frequently affected areas of the cerebral arterial circle and to validate important anamnestic data for therapeutic purposes.

Keywords: cerebrovascular disease, epidemiology, morphogenesis.

Relevance of the Issue:Somatic complications associated with post-COVID syndrome are observed in approximately 20% of the global population and are characterized by severe progression and potentially fatal outcomes. In the United States, Europe, the United Kingdom, and Canada, a trend has been identified showing a 3.2-5.1% increase in newly diagnosed diabetes mellitus and type 2 diabetes induced by post-COVID syndrome. In the Russian Federation and CIS countries, the incidence of ischemic heart disease has increased by 4.2-7.3%. This indicates the exacerbation of somatic diseases during post-COVID syndrome, their progression into severe clinicomorphological forms, atypical clinical manifestations, and other aspects that necessitate further in-depth study.

According to the International Diabetes Federation, in 2019 more than 4 million people worldwide died prematurely due to complications associated with diabetes. By 2021, this figure had decreased to between 2.2 and 3.1 million, with most cases involving comorbid ischemic heart disease. This indicates that, in the post-COVID-19 period, the incidence of metabolic disorders increased by approximately 1.8 times. One of the key findings is that in 2022, the average number of deaths due to various complications reached approximately 5.8 million, with diabetes mellitus diagnosed in 78.3% of these cases. Notably, 89.81% of this population had a documented history of COVID-19 infection. In the last year, the rate of disability among the working-age population (aged 28 to 54) increased by 26.1% due to severe secondary complications of metabolic disorders triggered by post-COVID syndrome. These data confirm that mortality in diseases involving simultaneous COVID-19 infection and somatic-metabolic comorbidities has increased by 3 to 5 times.

Discussion and Results:To carry out the morphometric analysis of cerebral blood vessels, pre-prepared micro-samples were examined using the NanoZoomer (REF C13140-21.S/N000198/HAMAMATSU PHOTONICS/431-3196 JAPAN) system and analyzed via Hamamatsu software (QuPath-0.4.0, NanoZoomer Digital Pathology Image). The vascular structures were measured in micrometers at various magnifications. The resulting microimages were further analyzed using a confocal multiplex morphometry technique.The primary two-dimensional measurements were used to assess the area

occupied by blood vessels in the horizontal plane. To visualize the structural components of vessel walls in 3D volume, confocal 3D rendering was performed using QuPath-0.5.0 - Digital Pathology Image Pro software. This allowed for the acquisition of both point-based spatial and wide-field volumetric images. The obtained data were compared with a control group. To ensure a high level of reliability in these assessments, no fewer than 10 micro-samples were prepared from each case, scanned using a histoscanner, and analyzed in a stepwise manner. This approach was implemented to minimize the need for re-evaluation of the parametric indicators of the examined vessels.

Table 4.1.

The morphometric parameters of the vessel walls of the Circle of Willis in cerebrovascular diseases (CVD) are presented in micrometers (ҳm) and square millimeters.

№	Measured Vascular Region	Control Group	Untreated Group	Treated Group	P≤
1.	Diameter of the internal carotid artery (mm)	5,55±2,01	3,01±1,09	4,21±1,03	0,01
2.	Diameter of the anterior cerebral artery (mm)	3,46±0,62	2,77±0,9	3,2±0,51	0,01
3.	Diameter of the posterior cerebral artery (mm)	4,11±0,65	3,01±0,43	3,73±0,28	0,05
4.	Diameter of the anterior communicating artery (mm)	3,28±0,12	2,55±0,13	2,79±0,49	0,05
5.	Wall thickness of the internal carotid artery (μm)	445,52±5,23	919,21±5,19	605,18±4,91	0,01
6.	Wall thickness of the anterior cerebral artery (μm)	312,21±1,15	562,02±1,73	451,13±1,22	0,01
7.	Wall thickness of the posterior cerebral artery (μm)	345,15±1,02	474,01±1,69	395,05±1,23	0,01
8.	Wall thickness of the anterior communicating artery (μm)	284,16±0,11	372,02±0,43	313,01±0,22	0,05

Morphometric parameters of the vessels of the Circle of Willis at the base of the brain were found to differ significantly across various pathologies. Specifically, the volumetric area occupied by the vessels was calculated using specialized software employing dedicated formulas.

In our study, quantitative changes were observed in the structural components of the vessels forming the Circle of Willis at the base of the brain. These included alterations in the ratios between the endothelial layer, the medial layer, and the adventitial layer, confirming a disruption in the elasticity of the vessels. Accordingly, the diameter of the internal carotid artery in patients with cerebrovascular disease (CVD) who were continuously treated was 4.21 ± 1.03 mm, whereas the control group showed a diameter of 5.55 ± 2.01 mm.

In the untreated group, the average diameter of the internal carotid artery was 3.01 ± 1.09 mm, which is 1.84 times smaller compared to the control group and 1.4 times narrower than in the treated group. This indicates that morphometric assessment of treatment efficacy in cerebrovascular disease (CVD) allows for the early prediction of expected outcomes.

Regarding the anterior cerebral artery, the diameter in patients with CVD who were treated was 3.20 ± 0.51 mm, while in the control group, this parameter was 3.46 ± 0.62 mm. In untreated patients, the diameter was 2.77 ± 0.90 mm, representing a 1.25-fold reduction compared to the control group and a 1.15-fold decrease relative to the treated group. Clinically and morphologically, this suggests that the anterior cerebral artery is less severely affected in CVD.

The average diameter of the posterior cerebral artery in treated patients was 3.73 ± 0.28 mm, compared to 4.11 ± 0.65 mm in the control group. In patients with cerebrovascular disease (CVD) who were untreated, this parameter was 3.01 ± 0.43 mm, representing a 1.1-fold decrease relative to the control group. However, this reduction was not found to be statistically significant due to the low significance level.

The diameter of the anterior communicating artery of the Circle of Willis in patients with CVD who were treated was 2.79 ± 0.49 mm, while in the control group it was 3.28 ± 0.12 mm. In untreated patients with CVD, the diameter of the anterior communicating artery was 3.28 ± 0.12 mm, indicating a 1.3-fold narrowing. In treated patients, this parameter decreased by 1.17 times. Since the statistical comparison showed a difference of less than 5-10%, these changes were considered acceptable.

Based on the analysis of the data presented in Table 4.1, the main vessels affected by cerebrovascular disease (CVD) in the Circle of Willis are branches of the internal carotid artery. In patients with CVD who were untreated, the average narrowing of the vessel diameter was 1.21 times less compared to treated patients, and 2.55 times narrower relative to the control group. These findings are considered clinically and morphologically critical indicators and confirm that vessel diameter measurements are among the most important criteria for diagnosing patients with CVD and assessing the effectiveness of their treatment..

References:

1.Isakova, E. V. Algorithm for Diagnosis and Therapy of Cerebrovascular Diseases in Outpatient Practice. Consilium Medicum. 2017; Vol. 19, No. 2, pp. 84-89.

2.Kazakov, V. N., Shlopov, V. G., Volos, L. I. Criteria for Morphological Differential Diagnosis of Dementia States. Neurosciences: Theoretical and Clinical Aspects. 2006; Vol. 2, No. 1-2, pp. 20-27.

3.Kalashnikova, L. A. Cognitive Impairments and Dementia in Cerebrovascular Diseases. Nervnye Bolezni. 2005; No. 2, pp. 36-41.

4.Karimov, Sh. I., et al. Arterial Hypertension in Hyperaldosteronism: Diagnosis and Treatment. Diagnostic and Interventional Radiology. 2008; Vol. 2, No. 2, pp. 67-73.

5.Koltsov, I. A., et al. Influence of von Willebrand Factor on Common Pathophysiological Mechanisms of Cerebrovascular Pathology and Multiple Sclerosis. Neurology, Neuropsychiatry, Psychosomatics. 2021; Vol. 13, Suppl. 1, pp. 62-68.

6.Levin, O. S., Makotrova, T. A. Algorithm for Diagnosis and Treatment of Discirculatory Encephalopathy. Pharmateka. 2012; No. 11, pp. 57-62.

7.Lipovetsky, B. M., et al. Risk Factors for Cerebrovascular Disease and Most Common Morphological Variants of Brain Artery Atherosclerosis. International Scientific Research Journal. 2013; No. 12-3 (19), pp. 52-53.

8.Mistyukevich, D. P. Vascular Dementia: Etiopathogenesis, Clinic, Diagnosis, Treatment. Problems of Health and Ecology. 2012; No. 2 (32), pp. 27-34.

9.Mishchenko, T. S., et al. New Opportunities in Pathogenetic Therapy of Chronic Brain Ischemia. International Neurological Journal. 2011; No. 1, pp. 37-42.