SPECIFICS OF HEMODYNAMIC AND NEUROIMAGING CHANGES IN ETIOPATHOGENETIC FORMS OF VERTEBROBASILAR INSUFFICIENCY

Abdulakhad Khamidov,
Farrukh Saidvaliev
Tashkent State Medical University,
Department of Neurology and Medical Psychology

Introduction. *Impaired blood flow in the vertebrobasilar basin can result from atherosclerotic stenosis, functional vasomotor changes, or congenital structural anomalies of the vertebral artery. In cases presenting with similar clinical signs, duplex scanning and angiographic verification play a crucial role in identifying the pathogenetic mechanism.*

Research objective. To comparatively evaluate vertebral artery hemodynamic parameters and neuroimaging changes across various etiopathogenetic forms of vertebrobasilar insufficiency (VBI), and to identify form-specific instrumental criteria.

Research materials and methods. The study examined 160 patients with vertebrobasilar insufficiency (VBI) and 30 healthy control subjects. The study population comprised 82 patients in the atherosclerotic-hypertensive group, 46 in the migraine-associated group, and 32 in the vertebral artery anomaly group. All participants underwent duplex scanning of the brachiocephalic arteries. Parameters evaluated in the V2 segment included vertebral artery diameter, peak systolic velocity (PSV), end-diastolic velocity (EDV), resistance index, and volumetric blood flow. A diameter of ≤2.0 mm was adopted as the criterion for hypoplasia. MR angiography was performed on the 32 patients in the anomaly group and in 8 additional cases where duplex scanning raised suspicion of an anomaly.

Results. In the vertebral artery anomaly group, the diameter of the artery on the smaller side was 1.76±0.16 mm, differing significantly from the 3.57±0.32 mm observed in the control group. The diameter of the contralateral artery was dilated to 4.47±0.51 mm, and the diameter asymmetry coefficient was 2.57±0.42. In this same group, PSV, EDV, and volumetric blood flow on the smaller side decreased to 28.8±6.0 cm/s, 9.8±3.2 cm/s, and 28.6±8.3 ml/min, respectively. Total bilateral volumetric flow was 109.2±23.9 ml/min, which was significantly lower than the 159.1±27.3 ml/min observed in the control group. In the atherosclerotic-hypertensive form, hemodynamically significant stenosis was detected in 28.0% of cases, while

atherosclerotic changes without stenosis were found in 85.4%. In the migraine group, while the artery diameter did not differ significantly from the control, patterns of angiospasm or hyperperfusion were observed in 30.4% of cases. MR angiography confirmed 20 cases of hypoplasia and 12 of aplasia in the anomaly group; an incomplete Circle of Willis was noted in 34.4% of cases, and termination of the vertebral artery at the posterior inferior cerebellar artery was recorded in 15.6%.

Conclusion. The etiopathogenesis of vertebrobasilar insufficiency (VBI) is distinguished by hemodynamic profiles: the atherosclerotic-hypertensive form is characterized by stenotic-atherosclerotic changes, the migraine form by functional vasomotor disturbances, and the anomaly-related form by marked anatomical asymmetry and reduced blood flow. Duplex scanning is appropriate for initial differential assessment, while MR angiography is suitable for verifying structural anomalies.

References

1. Iacob G., Nica A. et al. The vertebral artery: a systematic review. Diagnostics. 2023;13(12):2036. DOI: 10.3390/diagnostics13122036.
2. Montemurro N. et al. The vertebrobasilar trunk and its anatomical variants. Diagnostics. 2024;14(5):534. DOI: 10.3390/diagnostics14050534.
3. Zarrinkoob L., Ambarki K., Wåhlin A. et al. Blood flow distribution in cerebral arteries. J Cereb Blood Flow Metab. 2015;35(4):648–654. DOI: 10.1038/jcbfm.2014.241.
4. Valenzuela-Fuenzalida J.J. et al. Anatomy of vertebral artery hypoplasia and its relationship with clinical implications: a systematic review and meta-analysis of prevalence. Surg Radiol Anat. 2024;46(7):963–975. DOI: 10.1007/s00276-024-03377-y.
5. Gulli G., Marquardt L., Rothwell P.M., Markus H.S. Stroke risk after posterior circulation stroke/transient ischemic attack and its relationship to site of vertebrobasilar stenosis. Stroke. 2013;44(3):598–604. DOI: 10.1161/STROKEAHA.112.669929.
6. Dinç Y. et al. Vertebral artery hypoplasia as an independent risk factor of posterior circulation atherosclerosis and ischemic stroke. Medicine. 2021;100(38):e27280.
7. Hu X.Y. et al. Relationship between vertebral artery hypoplasia and posterior circulation stroke in Chinese patients. Neuroradiology. 2013;55(3):291–295.
8. Gaigalaite V. et al. Association between vertebral artery hypoplasia and posterior circulation stroke. BMC Neurol. 2016;16:118.
9. Thierfelder K.M., Baumann A.B., Sommer W.H. et al. Vertebral artery hypoplasia: frequency and effect on cerebellar blood flow characteristics. Stroke. 2014;45(5):1363–1368. DOI: 10.1161/STROKEAHA.113.004188.
10. Khan S., Cloud G.C., Kerry S., Markus H.S. Imaging of vertebral artery stenosis: a systematic review. J Neurol Neurosurg Psychiatry. 2007;78(11):1218–1225. DOI: 10.1136/jnnp.2006.111716.