

**CEREBRAL HEMODYNAMICS IN NEWBORNS WITH PERINATAL CENTRAL
NERVOUS SYSTEM LESIONS**

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Abstract. Perinatal central nervous system (CNS) lesions in newborns remain one of the most pressing issues in modern neonatology and pediatric neurology, determining a high risk of developing persistent neurological disorders. Hypoxic-ischemic and hemorrhagic mechanisms, accompanied by impaired cerebral hemodynamics and cerebrospinal fluid dynamics, play a leading role in the pathogenesis of these conditions. The aim of this study was to comprehensively examine the state of brain structures and cerebral blood flow indices in newborns with perinatal CNS lesions using neurosonography and Doppler ultrasonography of the cerebral vessels. The obtained results indicate that, in the absence of pronounced structural changes according to standard neurosonography data, this category of patients exhibits reliable functional disorders of cerebral hemodynamics, manifested by changes in vascular resistance indices. This emphasizes the need to include Doppler ultrasonography assessment of cerebral blood flow in the standard examination algorithm for newborns with perinatal CNS lesions.

Key words: newborns, perinatal CNS damage, neurosonography, Dopplerography, cerebral hemodynamics, resistance index, pulsatility index.

Introduction. Perinatal lesions of the central nervous system are a leading cause of morbidity, disability, and neuropsychiatric disorders in young children. According to numerous studies, the primary etiological factor for these conditions is hypoxia of various origins, leading to ischemic and hemorrhagic damage to brain structures, including intraventricular hemorrhages (IVH).

Hypoxic-ischemic brain injury is accompanied by disruption of cerebral blood flow autoregulation mechanisms, changes in vascular tone, increased vascular resistance, and secondary cerebrospinal fluid dynamics disorders. These changes may be subclinical, without significant morphological changes in the early stages, but later they can lead to the development of hydrocephalic syndrome, psychomotor retardation, and persistent neurological deficits.

In this regard, the use of non-invasive, safe, and accessible imaging methods that allow for dynamic assessment of the brain and cerebral blood flow in newborns is particularly important. Neurosonography combined with cerebral vascular Doppler is the method of choice in the early neonatal period, allowing for the assessment of not only structural but also functional changes.

The aim of the study was to comprehensively assess the state of brain structures and cerebral hemodynamic parameters in newborns with perinatal central nervous system damage.

Materials and methods. The study included 60 newborns, divided into two groups. The patients were examined at the Tashkent State Medical University (TSMU) Clinic in the Department of Radiology. The study group consisted of 30 newborns with perinatal CNS lesions. Of these, 22 infants were born to mothers with fetoplacental insufficiency and chronic intrauterine hypoxia; 8 newborns had cephalohematomas resulting from birth trauma. The control group consisted of 30 clinically healthy newborns with no signs of perinatal CNS pathology.

All children were in satisfactory condition at the time of examination, had normal anthropometric parameters and did not require intensive care.

The examination was carried out on the 4th–5th day of life under standard conditions: at the same time of day, 1 hour after feeding, in a state of physiological rest.

Study results. Standard neurosonography revealed no pathological changes in the brain structures of newborns in either group. The size of the ventricular system, the echogenicity of the parenchyma, and the anatomy of the midline structures were within age norms.

The absolute values of linear blood flow velocities in the anterior and middle cerebral arteries in newborns of the main and control groups did not have statistically significant differences.

In the anterior cerebral artery, systolic blood flow velocity in newborns of the study group ranged from 56.2 to 9.3 cm/s, in the control group - from 29.6 to 10.7 cm/s. Diastolic blood flow velocity ranged from 22.1 to 2.8 cm/s in the study group and from 13.0 to 4.1 cm/s in the control group.

In the middle cerebral artery, the systolic blood flow velocity values ranged from 31.2 to 8.2 cm/s in the main group and from 32.8 to 11.8 cm/s in the control group, and the diastolic velocity values ranged from 10.7 to 2.0 cm/s and from 8.4 to 3.5 cm/s, respectively.

Unlike linear blood flow velocities, the resistance index and pulsatility index demonstrated high stability and diagnostic significance. In the study group, these indicators were significantly higher than in the control group. Thus, in the anterior cerebral artery, the RI and PI values were 0.97 and 1.13 in the study group versus 0.63 and 1.03 in the control group ($p=0.03$). In the middle cerebral artery, they were 0.73 and 1.24 versus 0.65 and 1.10, respectively ($p=0.05$).

A repeat Doppler ultrasound examination on the 10th day of life in newborns with cephalohematomas revealed normalization of IR and PI, which may indicate the transient nature of the identified hemodynamic disturbances. However, the limited number of observations precludes definitive conclusions about the pattern of this process.

The data obtained indicate that in newborns with perinatal CNS damage, cerebral hemodynamic disturbances may be functional in nature and not accompanied by significant morphological changes in the early stages. Increased vascular resistance indices reflect a disruption in the mechanisms of cerebral blood flow autoregulation and may serve as an early marker of cerebral dysfunction.

The use of Dopplerography allows us to identify these changes at the preclinical stage, which is important for the timely prescription of therapeutic and preventive measures and dynamic monitoring of this category of patients.

Conclusions. Thus, in newborns with perinatal damage to the central nervous system, functional disturbances in cerebral hemodynamics are detected in the absence of structural changes according to neurosonography.

The resistance index and the pulsatility index are the most informative and statistically significant indicators for assessing cerebral blood flow.

A comprehensive ultrasound examination with the mandatory inclusion of Doppler ultrasonography of the cerebral vessels is advisable to use in the examination algorithm for newborns with perinatal CNS damage.

References

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