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Experience in the Use of Neurosonography in the Diagnosis of Brain Abnormalities in Young Children

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Abstract: In recent years, brain damage in the early stages of ontogenesis has attracted increasing attention of a wide range of specialists. It is the leading cause of perinatal mortality and accounts for 60-70% of neurological pathology of childhood. According to literature data, brain development anomalies account for about 25% of all congenital malformations in newborn children. Numerous publications discuss the involvement of viral infections in the formation of congenital brain malformations, meningitis, meningoencephalitis and other structural lesions of the CNS. The etiological connection between congenital herpetic infection and intracranial haemorrhages has been established. Echoencephalography makes it possible to assess the degree of brain lesions in congenital viral infection. However, the issues of visualisation of structural changes of the brain in intrauterine viral infections are insufficiently covered in the literature.

Key words: Brain, neurosonography, congenital brain malformations.

Introduction. The high frequency of perinatal lesions of the central nervous system of hypoxic genesis, the severity of neurological consequences, the difficulty of topical diagnosis testify to the continuing relevance of early diagnosis and treatment of perinatal cerebral lesions. Morphological and functional immaturity of the newborn brain leads to considerable diagnostic difficulties, causing cerebral circulatory disorders with all the variety of structural lesions (hemorrhagic, ischemic, infectious). Since neurological symptomatology does not always reflect the nature and severity of the lesion, ultrasound methods of investigation have been introduced into clinical practice, which have opened new possibilities in the diagnosis of brain lesions.

The aim of the study was to investigate diagnostic possibilities of neurosonography, Doppler-rography of cerebral vessels and echoencephalography in the assessment of structural and functional state of the brain of healthy children of Samarkand and to compare the obtained results with conventional indicators.

Materials and methods of research: Visual diagnostics of 30 children born from healthy mothers with no indication of chronic diseases and bad habits in their anamnesis was carried out. The women were not ill during pregnancy and labour and had normal general clinical and laboratory parameters. Thirty children aged 2, 3 and 4 months of life were examined. Neurosonography was performed according to the standard technique in the coronal and sagital planes, in 10 standard sections, using a sector transducer with a frequency of 5.0 and 7.5 MHz, and two-dimensional Dopplerography of the anterior cerebral artery.

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Results of the study: neurosonography assessed the state of brain parenchyma, ventricular system and cisterns, and the expression of the gyrus. The interhemispheric slit, which divides the brain into right and left hemispheres, was well differentiated in the coronal section through the frontal lobes in all children. On both sides of the interhemispheric gap, bean-shaped areas of increased echogenicity created by the hemispheric centres were visualised; dorsally, hyperechogenic formations due to the frontal and lattice bones were seen.

When scanning through the anterior horns of the lateral brain ventricles in all children, we clearly saw symmetrical, "butterfly" wing-shaped thin anechogenic formations of the anterior horns of the lateral brain ventricles, between which we visualised a round-shaped cavity of the transparent septum. Above the anterior horns of the lateral ventricles and the transparent septum, the corpus callosum was clearly defined as a hypoechogenic horizontal line, above which the brain sickle, cingulate and interhemispheric sulci were located medially. Moderate hyperechogenic formations created by caudate nuclei were observed symmetrically under the lower walls of the lateral ventricles in the form of "commas". Medial to the caudate nuclei there were oval shaped, elongated downwards, symmetrical hyperechogenic formations represented by optic tubercles - thalamus. Hyperechogenic bone structures were caused by parietal bones and wings of the cuneiform bone.

At the level of interventricular foramen (Monroe's foramen) and the third ventricle of the brain, the anterior horns of the lateral ventricles in the form of symmetrically located narrow anechogenic formations, interventricular foramen in the form of a linear anechogenic structure connecting the lateral ventricles with the third ventricle were detected in all subjects. The third ventricle was visualised centrally as a thin vertically positioned anechoic structure located between the thalamus and the lateral ventricles. Echocomplex of the caudate nucleus (nucleus caudatus) was detected symmetrically under the lower wall of the anterior horns of the lateral ventricles, and below it - of the putamen and the pale globe (globus pallidum). Laterally, the sylvian furrows were visualised, which were represented as symmetrically located hyperechogenic structures of Y-shape. Bony structures were represented by hyperechogenic parietal and temporal bones.

When examining through the bodies of the lateral ventricles in all children, the bodies of the lateral ventricles, located symmetrically from the interhemispheric gap, were visualised. Above the bodies of the lateral ventricles, the corpus callosum was observed horizontally along the midline as a hypoechogenic structure. Heterogeneous, hyperechogenic formations formed by vascular plexuses were symmetrically located at the bottom of the lateral ventricles. Dorsally, moderately hyperechogenic symmetrical "crescent-shaped" formations represented by hippocampal gyrus were detected, between which the trunk and indistinct contours of an anechogenic formation - the fourth brain ventricle - were vertically visualised. Hyperechogenic structures of the heads of the caudate nuclei, basal nuclei, were seen under the bodies of the lateral ventricles near the optic tubercles in the form of a "tail of a kameta". Moderately hyperechogenic Y-shaped sylvian furrows were observed in the middle cranial fossa. In the posterior cranial fossa the cerebellar nucleus and cerebellar vermis were detected in the form of structures of increased echogenicity, less echogenic were cerebellar hemispheres and anechogenic great cisterna of the brain.

At cross-section through the triangle of the lateral ventricles in all children it was possible to determine symmetrically located cavities of the lateral ventricles, partially filled with hyperechogenic "oval-shaped" formations caused by vascular plexuses. A small anechoic band of liquor is visible around the vascular plexuses. Lateral to the vascular plexuses there were hyperechogenic Y-shaped structures of the brain - sylvian sulci. In the posterior cranial fossa, hyperechogenic formations created by the cerebellar vermis and the cerebellar outline were detected.

At coronal section through the occipital lobes, the interhemispheric slit was clearly differentiated in the anterior cranial fossa in all children. Bony structures in the form of hyperechogenic masses were observed in the posterior cranial fossa. The convexital surface of the occipital lobes of the brain was represented by a moderate hyperechogenic pattern of tortuosities and furrows.

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At examination in the medial sagital section of the brain in all children, a hypo-echogenic arc-shaped formation represented by the corpus callosum, which consisted of a knee, trunk, and shaft, was observed. A cingulate sulcus was visualised above the corpus callosum, and under the corpus callosum there was an anechogenic mass due to the cavity of the transparent septum, smoothly passing into the Verge cavity. Under the cavity of the transparent septum in the form of an anechogenic structure of triangular shape.

The third cerebral ventricle was identified under the transparent septal cavity as an anechogenic triangular-shaped structure with its apex facing the pituitary fossa. The main cisterns of the brain were visualised below: inter- pedicular, cerebromedullary.

At parasagittal examination through the lateral ventricles we visualised an anechogenic formation represented by the anterior, temporal, occipital horns, body and triangle of the lateral ventricle, which surrounded the optic tubercle and basal nuclei. In the cavity of the lateral ventricle, a vascular plexus was located in the form of a hyperechogenic formation, which thickened in the occipital horn to form a glomus.

At parasagittal examination through the caudo-thalamic notch in all children, a hyperechogenic formation formed by the caudo-thalamic notch separating the head of the caudate nucleus from the thalamus was clearly differentiated.

At parasagittal examination through the "islet", hyperechogenic structure of the sylvian sulcus was detected in all children. In this projection, the condition of the brain parenchyma was assessed, and hyperechogenic formations represented by the cranial bones were observed.

Due to the absence of small, anterolateral and posterolateral fontanels in children of the study group, additional scanning methods were not performed. It is generally recognised to distinguish between norm and pathology through the determined dimensions of brain structures expressed in mm.

Special indices (resistance index, pulsation index, systolodiastolic ratio) were used to determine the angle of the probe inclination. Accordingly, all obtained indices were monomorphic and stable, which corresponded to all literature descriptions of normal indices in Dopplerography. In neonatology, the most used index in neonatology is the resistance index (RI). The resistance index reflects the degree of resistance to blood flow of the part of the vascular tree distal to the study site. According to the data of the study, the value of the resistance index, reflecting the elastic-elastic properties of vessels, resistance to blood flow.

properties of vessels, resistance to blood flow, and resistance of the vascular wall did not depend on the age of the observed children. Asymmetry of blood flow indices in the main arteries of the right and left cerebral hemispheres in early infants was not revealed in norm. The cerebral arteries (anterior, middle, posterior, basilar), connecting with each other, form the Viscian circle. The presence of a closed system of blood supply to the brain makes it possible to obtain similar parameters and make a conclusion with a high degree of informativeness even on the basis of data obtained from one artery. The similarity of parameters obtained from the anterior, middle and basilar arteries allowed us, as well as other authors, to base our judgements on the study of the anterior cerebral artery. Echoencephalography was used to assess the size of the ventricular system of the brain and the state of the liquor-conducting pathways. Since the literature available to us reflected quantitative echoencephalographic norms obtained in newborns, older infants and adults, we considered it incorrect to use these norms in early infants. Own data in children at the age of 2, 3, 4 months of life, obtained by ECHO-12. The indices of the distance to the cavity of the transparent septum, to the third ventricle, to the ventricular echo, to the intertemporal diameter of the skull in different age groups moderately increased in dynamics, which was due to the growth of the brain parenchyma. In turn, the indices obtained remained relatively constant, indicating the stability of the liquor-conducting pathways and the absence of pathological process in the ventricular system of the brain.

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The most informative method of studying normal anatomical structures of the brain is neurosonography. This method of research is easy to perform, does not require special preparation of the child. The obtained neurosonography parameters in children of the control group, at the age of 2, 3, 4 months of life, correspond to the data published earlier in different countries and regions.

Dopplerography of cerebral vessels makes it possible to assess the state of blood flow in the basins of the anterior cerebral, middle cerebral and basilar arteries. The obtained data confirm the opinion of I. V. Dvoryakovsky and O. A. Sudaro-va that the parameters obtained from the anterior cerebral artery are quite informative. When assessing quantitative parameters of the Doppler curve of cerebral blood flow, it is necessary to use special indices that do not depend on the angle of sensor insonation and are constant. The resistance index is one of the most informative indices of cerebral blood flow. The obtained indices of cerebral blood flow in children from the control group at the age of 2, 3, and 4 months of life correspond to the normal indices published by I. V. Dvoryakovsky, E. A. Zubareva, and A. B. Sugak, which confirms the correctness of the methodological approach in selecting the group of children under study.

Echoencephalography is a less informative ultrasound method for the study of brain structures, as it allows us to judge only the symmetry of the brain, the state of the ventricular system of the brain without visualising the morphological substrate of the brain in norm.

CONCLUSIONS.

1. The indicators of brain structures (obtained during neurosonography) of children of the control group correspond to the generally accepted Russian normative indicators.
2. Doppler indices of cerebral haemodynamics in children from the control group at the age of 2, 3, 4 months of life are similar to the generally accepted ones. 3.
3. echoencephalography is a low-informative ultrasound method of studying brain structures, which does not allow visualising the morphological substrate of the brain in norm.
4. In the algorithm of visual diagnostics of brain structures in infants, the main method of investigation is neurosonography and Dopplerography of cerebral vessels.

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