FEATURES OF NON-IONIZING RADIATION DIAGNOSTICS OF HYDROCEPHALUS IN CHILDREN

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Abstract. *The urgency of the problem of diagnosis and treatment of hydrocephalus in children remains an important socio-medical problem due to the prevalence of pathological conditions in the population, severe manifestations of the disease and the low effectiveness of the treatment methods used. Currently, a wide range of instrumental research methods are used to diagnose hydrocephalus. The possibility of early non-invasive diagnosis of hydrocephalus appeared due to the active introduction into clinical practice of computed tomography (CT), magnetic resonance imaging (MRI), ultrasound methods of investigation, in particular, neurosonography (NSG) and transcranial dopplerography (TCD) of cerebral vessels.*

Keywords: *children, hydrocephalus, neurosonography, computed tomography, magnetic resonance imaging.*

Relevance. Modern diagnostics of hydrocephalus in children is one of the most important problems in pediatric neurology and neurosurgery. According to the World Health Organization, the incidence of hydrocephalus in newborns is 1:4000. The high proportion in the structure of morbidity and mortality of children with congenital hydrocephalus imposes special requirements for the clinical and instrumental diagnosis of this form of cerebral pathology. To date, neurosonography (NSG) remains an actual method of diagnosing hydrocephalus in children of the first year of life. Advantages of the method: the possibility of multiple, daily examination; absence of X-ray radiation load; examination without transporting the child to the device and depending on the participation of an anesthesiologist in the examination (E.S.Pastukhova, Z.S. Karieva, 2015).

The simplicity and accessibility of performing NSG are an actual advantage over other methods used in elective neurosurgery of children of the first year of life (E.S.Pastukhova, Z.S.Karieva, 2015).

Clinical aspects of studies of children with hydrocephalus (active and passive) require functional verification of the features of vascularization of brain structures during life, which determines the relevance of this study. The first signs of impaired cerebrospinal fluid dynamics can manifest themselves at various stages of a child's development, leading to the formation of neuropsychiatric and motor disorders, and largely determining the prognosis of psycho-neurological development.

Despite the prevalence of perinatal lesions of the central nervous system among children, only 15%-20% of them are detected in the first days and weeks of life. The majority of authors associate the unfavorable outcome of perinatal lesions of the nervous system with the imperfection of prevention, diagnosis, as well as with untimely and inadequate therapy of this pathology, often passive monitoring of such children. The reserve of possible compensation is not only in the search for new means of therapy, but also in the choice of the moment of its application.

The purpose of the study. Improvement of the method of neuro sonography in hydrocephalus in children.

Material and methods of research. Ultrasound examination was performed in 49 children aged from 1 to 12 months with various cerebrospinal fluid disorders at the TashPMI clinic. The studies were carried out on Sonoscape 5000 and Aplio 500 ultrasound diagnostic devices using micro convex transducer with a frequency of 7.0 – 12.0 MHz. The results of neuro sonography were confirmed by magnetic resonance imaging (MRI) and multispiral computed tomography (MSCT).

Special medical preparation and anesthesia were not required for ultrasound examination of the brain in newborns and young children. The severity of the condition was not a contraindication for neuro sonography. The transducer was placed on a large fontanel of the skull and scanned in the coronary plane. By changing the tilt of the sensor, sections were sequentially obtained through: A - frontal lobes; B - anterior horns of the lateral ventricles; C -interventricular foramen (Monroe's hole) and III ventricle; D - bodies of the lateral ventricles; D - triangle of the lateral ventricles; E - occipital lobes.

The sensor was turned 90 degrees to enable scanning in the sagittal plane. The right and left hemispheres of the brain were captured by adjusting the sensor's inclination: W - median sagittal section through the III and IV ventricles of the brain, corpus callosum, cerebellar worm, brain stem; 3 -parasagittal section through the caudothalamic notch (angle of inclination of the sensor 10° from the median section); And - parasagittal section through the lateral ventricle (the angle of inclination of the sensor is 15°-20° from the median section); K is the parasagittal section through the "island" (the angle of inclination of the sensor is 40°-50° from the median section).

The analysis of the echogram included an assessment of the state of the parenchyma of the brain, ventricular system and cisterns, the severity of convolutions and pulsation of cerebral vessels. When identifying additional pathological foci or structures in the parenchyma, their qualitative characteristics and localization were given. According to the degree of echogenicity, echo-free (anechoic), increased (hyperechoic) and reduced (hypoechoic) echogenicity, homogeneous (homogeneous) and heterogeneous (heterogeneous) formations were distinguished.

The results of the study. In 49 examined children, ultrasound revealed various degrees of severity of cerebrospinal fluid disorders. Moderate hydrocephalus was detected in 11, moderate severity - 23 and pronounced degree - 15 patients. They were characterized by dilation of the ventricular system in 5 children, abnormalities of brain development - in 14, subarachnoid cysts - in 2, neoplasms of the cerebellar worm, cavities of the III and IV ventricles - in 13, polycystic brain - in 4, atrophy of the cortex and white matter - in 2, previously suffered inflammatory (6) and hemorrhagic (3) diseases. Periventricular hemorrhage (PVH) revealed the presence of blood clots in the lumen of the lateral ventricles with their expansion, grade IV PVH were characterized by hyperechoic formations with clear contours located above the body of the lateral ventricle (parenchymal hemorrhage), as well as in its lumen. During dynamic observation, an inhomogeneous echo structure of this formation was noted with the formation of a porencephalic cyst in the future. Brain development abnormalities were represented by: Arnold-Chiari type II malformation - 9 cases, a variant of the Dandy-Walker anomaly – 3 cases and Crouzon syndrome in 1 child. All patients underwent repeated dynamic ultrasound examination of the brain, positive dynamics was noted in 43 cases, and in 6 cases there was no improvement in their condition after a course of drug therapy or surgery. After bypass surgery of the cerebrospinal fluid system, patients

underwent neuro sonography and assessed the correct position of the ventricular end of the catheter, the presence of various hematomas and subdural fluid accumulations (pseudo hygromas), ventricular collapse, the development of porencephaly and other complications.

Conclusions. Neuro sonography is an informative method in the diagnosis and assessment of the severity of brain damage in young children with various forms of cerebrospinal fluid disorders. Neuro sonography allows us to assess the dynamics of changes after cerebrospinal bypass surgery and their complications.

CT and MRI are of primary importance in objectifying the nature and localization of intracranial hypertension (ICH). However, in children, the use of these methods is associated with many additional difficulties. Therefore, the main method of visualization of CHG is ultrasound examination of the brain – neuro sonography (NSG).

The most recognized was the method of research through a large fontanel, proposed by E. G. Grant in 1986. According to the literature, the overdiagnosis of hydrocephalus is due to the fact that until now, not only among doctors of different specialties, but also among neurosurgeons, there is no common understanding of what pathological process is meant when the diagnosis of hydrocephalus is formed.

Thus, the cause of the development of hydrocephalus is an imbalance between the production and resorption of cerebrospinal fluid, and it does not matter what caused it - as a result of hyperproduction, malabsorption or occlusion of the cerebrospinal fluid pathways. The main thing is that more cerebrospinal fluid is produced than absorbed, and the lingering cerebrospinal fluid, like any additional intracranial volume, leads to an increase in intracranial pressure and a decrease in the volume of brain matter. In addition to the sequence of events, the following main symptoms of hydrocephalus follow from the definition: excessive accumulation of cerebrospinal fluid in the cranial cavity (76%), progressive increase in cerebrospinal spaces (83%), high intracranial pressure (91%), a decrease in the volume of brain matter (61%).

It follows from this definition that hydrocephalus always proceeds with an increase in intracranial pressure, and if so, then there are no such forms as normotensive and, moreover, hypotensive hydrocephalus in children with posthemorrhagic hydrocephalus. Reduction of CSF production occurs only with an increase in intracranial pressure by more than 300 mm of water, but this happens in terminal situations and does not have a significant effect on intracranial pressure, because mechanisms have already been launched that have become self-sufficient and support intracranial hypertension due to the vicious circles that have formed. In other words, if the listed measures to normalize intracranial pressure are insufficient, then decompensation occurs and the process becomes uncontrollable - hydrocephalus develops.

Considering the above, when there is an imbalance between production and resorption (we are talking only about the communicating form of hydrocephalus), the fluid entering the ventricles increases the pressure in them, which, with some delay, is transmitted to all liquor spaces. Which leads to an increase in pressure in them and, as a result, the expansion of all liquor-containing spaces due to compression of the parenchyma of the brain, but for a very short period of time, because the brain is a poorly compressible substance, because it itself consists of almost 80% water.

Neuro sonography is a sensitive method for detecting periventricular hemorrhage, intraventricular hemorrhage, periventricular leukomalacia, meningoencephalitis. Detection of subarachnoid hemorrhage depends on the size and localization of the lesion. Increasing

ventriculomegaly and posthemorrhagic hydrocephalus were observed more often with periventricular hemorrhage III and IV. Occlusion was noted more often at the level of the plumbing and the Monroe hole. With pronounced dilation of the ventricles, the ventricular index increases.

The detection of intracranial hypertension based on clinical, Doppler graphic data and direct measurements of intracranial pressure, the increase in the volume of the ventricular system and compression of subarachnoid spaces made it possible to differentiate hydrocephalus from other conditions similar in clinical and Introscope picture, avoiding overdiagnosis, the appointment of unreasonable treatment.

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