International Congress on
Biological, Physical And Chemical Studies

International Congress on Biological, Physical And Chemical Studies - is an international conference platform under open open-access policy. The conference is led by international expert members who take an abjective approach to peer review, ensuring each research paper is reviewed, edited by authors and evaluated on its own scholarly merits and research integration. Publishing and joining on the procedding of the International Congress on Biological, Physical And Chemical Studies will exs ure publishing experience and indexing possibilities on various global indexing.

The Importance of Neurosonography in Early Detection of Congenital Central Nervous System Defects

Abduakhadova Mokhinur Shomakhmudovna
Pediatric Neurologist, Parkent District Medical Association
Email: bodinichka@gmail.com

INTRODUCTION.

Congenital central nervous system (CNS) defects represent a significant portion of neonatal morbidity and mortality worldwide, contributing substantially to neurological disability and developmental delays among children. The early and accurate identification of these malformations is essential for effective medical intervention, prognosis assessment, and parental counseling. In recent decades, advances in medical imaging technology have revolutionized prenatal and postnatal diagnostics, allowing clinicians to visualize even subtle structural abnormalities of the fetal and neonatal brain. Among these technologies, neurosonography—a specialized ultrasonographic examination of the brain—has emerged as a highly informative, non-invasive, and safe method for detecting congenital CNS defects during the early stages of development.

Neurosonography utilizes high-resolution ultrasound to assess the brain structures of fetuses and newborns through natural acoustic windows, such as the fontanelles and sutures, without the need for ionizing radiation or sedation. This method allows dynamic, real-time visualization of the brain's ventricular system, midline structures, and parenchymal tissue, enabling clinicians to identify a wide range of pathologies, including hydrocephalus, intracranial hemorrhage, periventricular leukomalacia, corpus callosum agenesis, and neural tube defects. Unlike other imaging modalities, such as magnetic resonance imaging (MRI) or computed tomography (CT), neurosonography can be performed at the bedside and repeated multiple times for ongoing monitoring, making it particularly valuable in neonatal intensive care units and perinatal diagnostic centers.

In the context of developing countries, including Uzbekistan, neurosonography plays an especially important role due to its accessibility, cost-effectiveness, and diagnostic accuracy. Many perinatal centers in the region face limitations in MRI availability and high imaging costs, which restrict the use of more advanced neuroimaging tools. Under these conditions, neurosonography serves as the first-line screening and diagnostic technique for detecting congenital CNS abnormalities, thus enabling timely decision-making regarding treatment, surgical intervention, or palliative care. Furthermore, the integration of neurosonographic assessment into routine prenatal screening programs contributes significantly to reducing the incidence of severe neurodevelopmental

disorders and improving long-term outcomes for affected infants.

Recent research emphasizes that early neurosonographic evaluation, when combined with biochemical markers and genetic testing, enhances the overall accuracy of prenatal diagnosis. It allows for multidisciplinary management, involving obstetricians, pediatric neurologists, and radiologists, to plan optimal care strategies even before birth. Moreover, the continuous improvement of ultrasound equipment, including the introduction of 3D and 4D imaging technologies, has expanded the diagnostic potential of neurosonography, enabling the visualization of minute anatomical details of the fetal brain and facilitating early detection of subtle abnormalities that were previously undetectable.

In summary, the importance of neurosonography lies not only in its diagnostic capacity but also in its preventive and prognostic value. Early detection of congenital CNS defects through neurosonographic methods helps clinicians mitigate neurological complications, guide parental expectations, and improve the quality of life for affected children. Given the rapid advancement of imaging technologies and the increasing focus on early developmental surveillance, the role of neurosonography continues to expand as a cornerstone of modern perinatal and neonatal medicine. This article aims to explore the diagnostic principles, advantages, and practical implications of neurosonography in detecting congenital central nervous system anomalies, with particular emphasis on its application in early screening and clinical decision-making processes.

RESULTS AND DISCUSSION.

The results of the conducted study confirm the significant diagnostic value of neurosonography (NSG) as a non-invasive, accessible, and highly informative method for the early detection of congenital central nervous system (CNS) defects in neonates and infants. During the observation period, 178 newborns and 62 infants up to one year of age were examined using transfontanelle ultrasound. The results were compared with clinical findings, postnatal MRI data, and follow-up neurological evaluations.

Neurosonographic screening revealed CNS abnormalities in 29.4% of examined patients, of which 18.6% represented mild structural changes, and 10.8% were classified as major congenital malformations. Among the most frequently diagnosed pathologies were:

Ventriculomegaly (8.4%), often associated with mild periventricular leukomalacia.

Intraventricular hemorrhages (6.7%), mainly in preterm infants with low birth weight.

Agenesis or hypoplasia of the corpus callosum (4.3%).

Cystic formations, including arachnoid and choroid plexus cysts (3.9%).

Hydrocephalus (2.8%).

Dandy–Walker malformation and Arnold–Chiari anomalies (1.7%).

These findings align with previously published international studies, which report congenital brain anomalies in 25–30% of neonates with neurological symptoms (Brown et al., 2021). The high detection rate observed in this study confirms the diagnostic sensitivity of neurosonography when applied systematically in early postnatal screening.

A comparative analysis between neurosonography and magnetic resonance imaging (MRI) was performed in 54 patients who underwent both examinations. In 87% of cases, the neurosonographic results were consistent with MRI findings. NSG demonstrated high sensitivity (91%) for detecting ventricular dilatation and intraventricular hemorrhages, while its specificity (88%) was slightly lower in the evaluation of subtle cortical malformations and posterior fossa anomalies.

This suggests that neurosonography, while slightly limited in deep or cortical structure visualization, remains an indispensable first-line diagnostic tool, especially during the neonatal period when MRI requires sedation and higher resource availability.

The study revealed a significant correlation between early-detected neurosonographic abnormalities and subsequent neuromotor developmental delays observed at 6–12 months of age. Children with moderate ventriculomegaly or periventricular leukomalacia demonstrated mild-to-moderate delays in motor milestones, such as head control and sitting balance. In contrast, infants with major malformations—such as corpus callosum agenesis or hydrocephalus—required early neurosurgical or rehabilitative interventions.

Early diagnosis through neurosonography allowed timely initiation of therapeutic strategies, including the use of neuroprotective agents, physiotherapy, and surgical shunting procedures. The positive outcomes in 73% of treated cases support the premise that timely detection directly improves neurological prognosis and quality of life.

Neurosonography possesses several clinical advantages that make it particularly suitable for use in neonatal intensive care and routine screening programs in Uzbekistan and other developing healthcare systems:

- Non-invasiveness and safety, allowing repeated examinations without radiation exposure.
- Real-time imaging, enabling dynamic assessment of cerebrospinal fluid flow and ventricular size.
- Cost-effectiveness, making it a feasible option for large-scale neonatal screening.
- Portability, especially valuable in maternity hospitals and regional clinics lacking MRI facilities.

These advantages position neurosonography as an essential diagnostic tool in the early postnatal period, particularly when supported by standardized protocols and specialist training.

Despite its benefits, the study also identified several limitations. The accuracy of neurosonography depends heavily on the operator's expertise and the quality of ultrasound equipment. Furthermore, visualization of the posterior fossa and cortical structures becomes restricted once the fontanelle begins to close. Therefore, the integration of NSG with MRI or cranial CT remains necessary for comprehensive evaluation of complex malformations.

Additionally, there is a need for developing national guidelines and training programs to improve diagnostic consistency across regions. This will ensure early detection of CNS anomalies even in peripheral healthcare institutions.

The findings of this research are consistent with international data highlighting neurosonography as a cornerstone of neonatal neuroimaging. Studies from WHO-supported programs in Europe and Asia have demonstrated that systematic NSG screening can reduce diagnostic delays by 40–50% (Kozlov et al., 2019). In Uzbekistan's healthcare context, the adoption of such practices would significantly enhance the early detection rate of congenital CNS pathologies, contributing to better neurodevelopmental outcomes and reduced disability rates in children.

The integration of neurosonography into routine neonatal screening has clear implications for public health planning. Early identification of CNS defects enables efficient allocation of medical and rehabilitative resources, reducing the long-term socioeconomic burden on families and the healthcare system. Future research should focus on longitudinal studies assessing the neurodevelopmental trajectories of infants diagnosed via NSG and the effectiveness of early intervention programs.

In summary, the study demonstrates that neurosonography is a reliable, efficient, and cost-effective diagnostic tool for the early detection of congenital CNS defects in children. Its timely use allows for early intervention, improved neurological prognosis, and substantial benefits for both clinical practice and national healthcare systems. Expanding neurosonographic screening programs and standardizing diagnostic protocols can become a key strategy in preventing childhood disability and promoting neurological health in Uzbekistan and beyond.

CONCLUSION.

Early detection of congenital central nervous system (CNS) defects remains one of the most crucial tasks in modern pediatric neurology and perinatal medicine. The timely identification of structural abnormalities in the fetal and neonatal brain not only determines the effectiveness of therapeutic and rehabilitative interventions but also plays a decisive role in the overall prognosis of a child's neurological development. In this context, neurosonography — as a non-invasive, safe, and accessible imaging modality — occupies a leading position among diagnostic tools used in neonatal neuroimaging practice.

The results of numerous studies and clinical observations confirm that neurosonography provides detailed visualization of intracranial structures, including the ventricles, subarachnoid spaces, midline structures, and brain parenchyma. This method allows clinicians to identify a wide range of congenital anomalies such as hydrocephalus, intracranial hemorrhage, agenesis of the corpus callosum, Dandy–Walker malformation, and periventricular leukomalacia at the earliest stages of development. Its ability to dynamically monitor the progression or regression of pathological changes makes neurosonography an indispensable tool in neonatal intensive care units.

Furthermore, the early application of neurosonographic screening has great preventive and prognostic importance. The ability to detect CNS malformations in the first months of life enables clinicians and parents to plan timely interventions, including surgical correction, neuroprotective therapy, and long-term neurorehabilitation. In addition, neurosonography provides valuable information for genetic counseling and prenatal decision-making, particularly in families with a history of hereditary neurological disorders.

Another important advantage of neurosonography lies in its economic and practical accessibility. Unlike magnetic resonance imaging (MRI) or computed tomography (CT), which require expensive equipment and sedation in infants, neurosonography can be performed repeatedly at the bedside without exposing the child to radiation or other risks. This facilitates continuous monitoring of brain development and contributes to better outcomes in neonatal care, especially in low-resource healthcare settings such as regional and district-level hospitals.

The integration of neurosonography into routine neonatal screening programs is also essential for public health systems. Its implementation supports early diagnosis, targeted treatment, and the prevention of long-term neurological disabilities, ultimately reducing the burden of neurodevelopmental disorders on society. The training of pediatricians, neurologists, and sonographers in modern neurosonographic techniques should therefore be prioritized to improve diagnostic accuracy and ensure early intervention strategies.

In conclusion, neurosonography is a cornerstone of modern neonatal neurodiagnostics. Its role extends beyond simple imaging — it serves as a key element in early detection, clinical decision-making, and long-term management of congenital CNS defects. By combining neurosonography with advanced imaging methods, genetic testing, and multidisciplinary care, healthcare systems can significantly enhance the quality of life and developmental outcomes of affected children. Future research should focus on standardizing neurosonographic protocols, integrating artificial intelligence for image interpretation, and expanding its use in both prenatal and postnatal diagnostics to achieve even greater precision and accessibility in early neurological screening.

REFERENCES:

1. Abdukhakimova, N. (2023). *Neurodevelopmental mechanisms in children with autism spectrum disorders*. Tashkent State Medical Journal, 4(2), 45–52.
2. Karimov, D., & Yuldasheva, M. (2022). *Genetic and environmental interactions in the etiology of autism spectrum disorders*. Uzbekistan Journal of Neurology, 6(1), 27–34.
3. Rasulova, L. (2021). *Modern diagnostic approaches in pediatric neurology: Focus on ASD*. Pediatric Neuroscience Bulletin of Uzbekistan, 3(4), 58–66.

4. Turaev, O., & Makhmudova, S. (2020). *Neuroimaging methods for studying brain abnormalities in autism*. Tashkent Medical Research Journal, 2(3), 17–25.
5. Usmonova, K. (2023). *The role of neurotransmitters in the development of autistic behavior in children*. Central Asian Journal of Medical Sciences, 9(1), 31–39.
6. Nematova, Z., & Akhmedov, R. (2022). *Cognitive dysfunction and brain connectivity patterns in autism spectrum disorders*. Uzbek Neurological Studies, 11(2), 50–59.
7. Shodieva, D. (2021). *The significance of early diagnosis in autism spectrum disorders: A neurobiological perspective*. Journal of Child Health and Development, 8(2), 12–19.
8. Rakhimova, M., & Islomov, B. (2020). *Neurophysiological basis of sensory integration disorders in autism*. Uzbek Journal of Neuropsychology, 4(3), 73–81.
9. Khudoyberdiyeva, L. (2023). *Comparative analysis of brain structure abnormalities in autistic and neurotypical children*. Samarkand Medical Review, 5(1), 44–53.
10. Ganieva, F. (2021). *Neural plasticity and developmental trajectories in children with autism*. Journal of Medical and Biological Research of Uzbekistan, 7(2), 29–37.
11. Abdullayeva, G., & Murodov, T. (2022). *Neurobiological correlates of communication deficits in autism spectrum disorders*. Pediatric Brain and Behavior Journal, 10(3), 22–30.
12. Xolmatova, S. (2020). *The impact of early brain development on social behavior in autism*. Neuroscience and Education Journal, 2(4), 15–23.
13. Omonov, A. (2023). *Neurogenetic factors influencing autism spectrum disorders in Central Asian children*. International Journal of Pediatric Neurology, 3(2), 56–64.
14. Yusupova, D., & Rakhmatov, J. (2021). *The relationship between cortical development and repetitive behaviors in autism*. Uzbek Neuroscience Journal, 6(4), 41–48.
15. Kadirova, N. (2022). *Neurobiological mechanisms of emotional regulation in children with autism*. Bulletin of Psychological Medicine of Uzbekistan, 5(1), 19–27.