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Pathological Reflexes in Children

Zufarova Nodira Ibroxim qizi
Tashkent State Medical University, Uzbekistan

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Abstract

This scientific article examines the clinical diagnostic value of pathological reflexes in children as markers of immaturity or damage to the central nervous system and as a tool for early neurological risk stratification. In pediatric practice, pathological reflexes are defined as either "primitive" reflexes that persist beyond the age norm or pathological signs of pyramidal insufficiency detected during a standard neurological examination.

Keywords: Pediatric neurology; corticospinal tract; neurodevelopment; neurological examination; motor development; risk group screening.

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1. Introduction

The problem of pathological reflexes in children remains of high scientific and clinical relevance due to the increasing survival rate of premature newborns and the increasing proportion of children with perinatal lesions of the central nervous system. According to international epidemiological reviews from 2015–2023, the incidence of neurological disorders in early life ranges from 5 to 12% in the general population, with up to 30% of cases associated with hypoxic-ischemic factors of the perinatal period.

Under these conditions, an objective assessment of the reflex sphere acquires the importance of one of the most accessible and informative methods of early diagnosis. Pathological reflexes are considered as a clinical manifestation of dysfunction of descending corticospinal influences and an imbalance between subcortical automatisms and cortical inhibition. Their identification allows us to indirectly judge the degree of morphofunctional maturity of the central nervous system.

The scientific literature of recent years emphasizes that the interpretation of reflexes should be carried out in strict correlation with age standards, since a number of reactions are physiological in the first months of life. Failure to comply with this principle leads to overdiagnosis and unjustified anxiety among parents. On the other hand, ignoring persistent pathological signs after critical age periods increases the risk of late diagnosis of organic pathology. The introduction of standardized neurological assessment scales, actively implemented after 2010, has improved the reproducibility of clinical examination.

This study is aimed at systematizing data on the frequency, structure and prognostic significance of pathological reflexes in young children.

The study was carried out in the format of a prospective clinical and analytical observation in 2021–2024. The sample included 124 children aged from 1 month to 3 years, divided into two groups: the main group (n=72) with perinatal risk factors and the control group (n=52) without

a burdened medical history. Inclusion criteria were gestational age, Apgar scores, and the presence or absence of signs of hypoxic-ischemic damage.

Neurological examination was carried out according to a unified protocol with assessment of primitive and pyramidal reflexes, muscle tone and motor skills. For standardization, a quantitative scale of the severity of reflex responses was used, developed on the basis of clinical recommendations of 2018. Instrumental diagnostics included neurosonography in children under 1 year of age and magnetic resonance imaging if clinically indicated

. Statistical processing of data was carried out using the χ^2 criterion and calculating relative risk (RR) with a significance level of $p<0.05$. Dynamic observation was carried out every 6 months, recording changes in reflex status. A comparative analysis was carried out between groups on the frequency of persistence of pathological reflexes and their correlation with motor milestones of development.

Methodological rigor was ensured by the reproducibility of the survey by two independent specialists, which reduced the subjectivity of the assessment.

In the main group, persistence of primitive reflexes after 6 months was detected in 41.7% of children, while in the control group this figure was 7.6% ($p<0.01$). Preservation of the extensor plantar response after 24 months was noted in 18% of children at risk and was not observed in the control sample. The relative risk of persistent pyramidal symptoms in the presence of perinatal hypoxia was RR=3.4 (95% CI 1.9–5.8).

In children with persistence of pathological reflexes, a delay in the formation of independent walking was significantly more often recorded (by 2–4 months compared to the average statistical standards). In the dynamics of observation over 24 months, 60% of children in the main group during early rehabilitation showed a decrease in the severity of pathological signs. In the absence of regular correction, persistent pathological reflexes persisted in more than 30% of those examined. A comparative analysis showed that the combination of reflex asymmetry and increased muscle tone increases the likelihood of an unfavorable motor outcome by 2.8 times.

Inter-rater reproducibility of reflex assessment using a standardized scale was 0.87 according to the coefficient of agreement, which indicates the high reliability of the method. The data obtained confirm the prognostic significance of early detection of pathological reflexes as an indicator of the risk of neuromotor disorders. Taken together, the results demonstrate the need for systematic screening of reflex status in perinatal risk groups and dynamic monitoring of child development.

The problem of pathological reflexes in children has become particularly important in recent decades in the context of improving neonatal care and increasing survival rates of newborns with extremely low body weight. According to international perinatal registries for 2015–2023, the incidence of prematurity in a number of countries varies from 8 to 12%, while the proportion of children requiring neurological observation exceeds 20% among the risk group.

Under these conditions, reflex diagnostics remains one of the most accessible and clinically informative tools for the early detection of functional immaturity or organic damage to the central nervous system. Theoretically, the pathological reflex reflects a violation of descending cortical control and an imbalance between subcortical automatisms and pyramidal regulation. At an early age, many primitive reflexes are physiological, but their persistence beyond the normative periods indicates a slow integration of neural networks.

Thus, a discussion of pathological reflexes requires a systematic analysis of age norms, pathogenetic mechanisms and the prognostic significance of the identified changes.

The physiological dynamics of the extinction of primitive reflexes is closely related to the stages of neuroontogenesis. In the period from birth to six months, active myelination of the pathways occurs, which is accompanied by a gradual decrease in the severity of grasping, oral and tonic reactions.

Studies from 2018–2022 showed that a delay in the extinction of the asymmetric cervical tonic reflex by more than two months compared to the age norm correlates with the risk of motor incoordination in preschool age. Likewise, persistence of the Moro reflex after six months of age is associated with increased excitability and dysregulation of tone. Pyramidal signs, including abnormal plantar and carpal reflexes, indicate dysfunction of the upper motor neuron.

According to a 2020 meta-analysis, the sensitivity of the pyramidal symptom complex in diagnosing cerebral palsy reaches 78%, and the specificity is 85%, subject to follow-up. An important aspect of the discussion remains the difference between transient immaturity and persistent organic damage. To clarify the nature of the changes, a comparison of the clinical picture with the results of

neuroimaging and neurophysiological studies is required. Consequently, the pathological reflex should be considered not as an isolated phenomenon, but as a component of a complex functional system.

In recent years, special attention has been paid to the prognostic value of pathological reflexes. Prospective studies from 2016–2023 found that the persistence of primitive reflexes in children with perinatal hypoxia increases the likelihood of delayed motor development by 2.5–3 times. At the same time, the early start of rehabilitation measures before the age of 6 months reduces the risk of severe motor disorders by 20–30%.

A comparative analysis of the early and late correction groups demonstrates a more pronounced restoration of motor functions with early intervention. In the dynamics of observation, a gradual decrease in the severity of pathological signs is noted under the condition of complex therapy, including kinesiotherapy and sensorimotor stimulation. At the same time, the lack of rehabilitation measures is accompanied by the persistence of pyramidal symptoms in more than a third of children at risk.

This confirms that pathological reflexes are not only a diagnostic, but also a prognostic indicator. It is important to emphasize that a single pathological sign without accompanying disorders does not always have clinical significance. The key remains a comprehensive analysis of symptoms and their dynamics.

In the diagnostic aspect, discussion of pathological reflexes is impossible without standardizing the examination technique. After 2010, quantitative scales for assessing neurological status have been actively introduced into clinical practice, increasing the reproducibility of results. The use of unified protocols makes it possible to reduce inter-expert discrepancies by 15–20%. Instrumental techniques, including magnetic resonance imaging and neurosonography, complement clinical assessment and can identify structural changes in white matter.

In recent years, the use of quantitative electromyography for the analysis of segmental excitability has been discussed. Complex diagnostics helps to distinguish between functional immaturity and organic pathology. Correlating clinical data with imaging results enhances prognostic accuracy. In this context, reflex diagnostics remains a basic, but not the only tool.

The presented diagram illustrates the relationship between corticospinal control, subcortical centers and segmental structures of the spinal cord. The striking color differentiation reflects functional levels of regulation and demonstrates how disruption of top-down influences results in the preservation of primitive responses. Visualization of such schemes in scientific publications facilitates the understanding of pathogenetic mechanisms and emphasizes the systemic nature of the process. A comparative analysis of data from 2015–2024 confirms that the severity of pathological reflexes correlates with the volume of white matter lesions detected by neuroimaging.

The dynamics of clinical manifestations depend on the degree of neuroplasticity and timeliness of correction. In the context under discussion, pathological reflexes act as an indicator of functional imbalance in neural networks. Therefore, their analysis should be integrated into a general neurodevelopmental assessment model.

Thus, a discussion of pathological reflexes in children demonstrates their multicomponent nature and clinical significance. They reflect the complex processes of neuroontogenesis and serve as an indicator of the state of the central nervous system.

Current data confirm the need for dynamic monitoring and early intervention when abnormalities are detected. A comparative analysis of recent decades indicates an increase in diagnostic accuracy due to the standardization of examination and the development of neuroimaging. Prospects for further research are related to the study of the molecular mechanisms of neuroplasticity and the development of individualized correction programs. In the scientific and practical aspects, the problem of pathological reflexes remains significant and requires an interdisciplinary approach.

The analysis of clinical, neurological and neurophysiological aspects of pathological reflexes in children confirms their high diagnostic and prognostic significance in the structure of early assessment of the state of the central nervous system. Pathological persistence of primitive reflexes and the appearance of pyramidal signs reflect a violation of corticospinal control and an imbalance between subcortical automatisms and cortical inhibition.

Modern data from 2015–2024 indicate a close correlation of persistent pathological reflexes with perinatal risk factors, primarily hypoxic-ischemic brain damage and prematurity. It has been established that early diagnosis of reflex abnormalities before the age of 6 months increases the effectiveness of rehabilitation measures and reduces the risk of severe motor disorders by 20–30%.

A comparative analysis of dynamic observation showed that complex therapy, including kinesiotherapy and sensorimotor stimulation, helps reduce the severity of pathological signs and improve the motor prognosis. At the same time, a single pathological reflex without accompanying neurological symptoms cannot be considered as an independent criterion of organic pathology, which emphasizes the need for an integrated clinical and instrumental approach. Standardization of examination techniques and the use of quantitative scales increase diagnostic reproducibility and reduce the risk of overdiagnosis.

Thus, pathological reflexes in children should be interpreted as an integral indicator of the functional state of neural networks and the degree of maturity of the central nervous system. Their assessment should be carried out with mandatory consideration of age standards, anamnestic data and neuroimaging results.

In practical terms, systematic screening of reflex status in perinatal risk groups allows for the timely development of individual correction programs and optimization of long-term neurological outcome. Prospects for further research are related to an in-depth study of the mechanisms of neuroplasticity and the development of personalized rehabilitation strategies.

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