

The Development of Young Children: The Review of Assessment Methods

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Развитие детей раннего возраста: обзор методов оценки

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Abstract. The problem of the state of health of early children, especially infants of the perinatal risk group, remains relevant. Modern trials show that the first two to three years of a child's life are an important age period and the infant's nervous system has significant compensatory capabilities during this period. Delayed psychomotor development may be the first sign of distress, and may be a leading syndrome in various somatic or neurological diseases in etiology and pathogenesis. Accordingly, it is important to be able to objectively monitor the main parameters of development throughout the entire period of early childhood. Today the Prechtl's Method is a unified and reliable methodology. In recent years, the most prognostically significant features of general movements have definitely been identified and their clinical role has been considered in detail, especially with regard to the prediction of cerebral palsy. Hammersmith Neonatal Neurological Examination is a highly reliable method of neurological examination of premature and full-term newborns. Habilitation programs should be implemented within the framework of the concept of early intervention. It is necessary

to have a unified methodology for monitoring, correcting or minimizing consequences of disease based on the knowledge of ontogenetic features of the child organism, objective data on structural and functional disorders thereof and the degree of restriction of activity and participation for successful habilitation of at risk kids.

Keywords: *perinatal pathology; psychomotor development; methods of assessment; general movements; habilitation*

Аннотация. Проблема состояния здоровья детей раннего возраста, особенно младенцев группы перинатального риска, остается актуальной. Современные исследования показывают, что первые два-три года жизни ребенка являются важным возрастным периодом, и в этот период нервная система ребенка обладает значительными компенсаторными возможностями. Задержка психомоторного развития может быть первым признаком дистресса, а может быть ведущим синдромом при различных соматических или неврологических заболеваниях в этиологии и патогенезе. Соответственно, важно уметь объективно отслеживать основные параметры развития на протяжении всего периода раннего детства. Сегодня метод Прехтля — это единая и надежная методология. В последние годы выявлены наиболее прогностически значимые особенности общих движений новорожденных и подробно рассмотрена их клиническая роль, особенно в отношении прогнозирования церебрального паралича. Неонатальное неврологическое обследование по шкале Хаммерсмит является высоконадежным методом неврологического обследования недоношенных и доношенных новорожденных. Программы абилитации должны осуществляться в рамках концепции раннего вмешательства. Для успешной абилитации детей группы риска необходима единая методика мониторинга, коррекции или минимизации последствий заболевания, основанная на знании онтогенетических особенностей детского организма, объективных данных о его структурных и функциональных нарушениях, степени ограничения активности и участия.

Ключевые слова: *перинатальная патология; психомоторное развитие; методы оценки; общие движения; абилитация*

Introduction

Despite favorable trends in the development of obstetric and pediatric services in the health-care system of the Sverdlovsk region and the Russian Federation in general, perinatal pathology has a significant impact on the level of disability of the child population.

Low-weight gestation and premature infants are the main risk group for early childhood disability. They are more likely to detect violations of motor, sensory, cognitive and communicative functions, leading to further restriction of life's activity and social maladaptation. Knowledge of risk factors, complications, and adverse outcomes and their early prediction determine the possibility to take preventive measures to harmonize the development of the child and limit the negative impact of the environment (Palchik,

Fedorova, & Ponyatishin, 2011). In this regard, the issues of optimizing the quality of medical care for patients in the early stages of ontogenesis remain relevant (Voroshilina & Rovda, 2015).

There is a rapid development of the brain in early childhood. The formation of visual and auditory analyzers is completed. All the structures necessary for the normal development of intellectual, cognitive and communicative abilities of the child mature (Kustova, Taranushenko, & Demyanova, 2018).

Modern trials show that the first two to three years of a child's life are an important age period and the infant's nervous system has significant compensatory capabilities during this period. The basis for the restoration of impaired functions is neuroplasticity — the ability of the nervous tissue to structural-functional restructuring that occurs after its damage (Kryzhanovsky, 2001). Currently, it has been revealed that the “plasticity” of the brain of children with developmental disorders and children at risk of developing them can be activated by early therapeutic intervention.

Rehabilitation is a set of measures (medical, pedagogical, psychological, social, legal, etc.) aimed at restoring impaired functions and social adaptation of a person (Kadykov, Chernikova, & Shakhparonova, 2008).

It should be noted that the generally accepted methods of dispensary observation and the “schematic” approach to the management of children with developmental disorders or risk of such disorders do not fully provide the necessary rehabilitation measures in this group of patients. The reasons are the lack of a general methodology for assessing the child's psychomotor development. In addition, timeliness and inconsistency of diagnostics and knowledge of age-related norms of formations of sensorimotor and cognitive functions are necessary. Delayed psychomotor development may be the first sign of distress, and may be a leading syndrome in various somatic or neurological diseases in etiology and pathogenesis. That is why a significant proportion of young children with certain developmental problems have a common diagnosis of delay or lag in psychomotor development. Accordingly, it is important to be able to objectively monitor the main parameters of development throughout the entire period of early childhood (Kustova et al., 2018).

Specialists efforts should be directed to early risk prediction using reliable assessment scales use of data-based evidence-based medicine intervention technologies (Novak et al., 2017).

Methods of Assessment

Prechtl's Method on the Qualitative Assessment of General Movements (GMA)

Heinz Prechtel (1990) formulated the basic requirements for an ideal method of neurological evaluation of newborns. It should be non-invasive, time-consuming and highly sensitive to changes in the age-related functional repertoire (Cioni, Belmonti, & Einspieler,

2014). Observation of children's spontaneous movements in the early months of life allowed H. Prechtl and his colleagues to classify several normal and abnormal motor patterns. Among other things, so-called "general movements" (GMs) — movements covering all parts of the infant's body proved particularly suitable for evaluation (Prechtl, 1990, 2001). This became the basis of Prechtl's Method on the qualitative assessment of generalized movements in preterm, term and young Infants (Einspieler, Prechtl, & Bos, 2005).

Although the evaluation of general movements is based on a holistic and qualitative judgment, the method has proven itself to be very practical. Its validity and reliability have been demonstrated in a number of studies focusing on prediction of cerebral palsy development, evaluation of minor neurological disorders, analysis of cognitive development, diagnosis of Rett syndrome, as well as autism spectrum disorders (Cioni et al., 2014).

"Normal" general movements involve the entire body in a complex sequence of movements of the arms, legs, neck and torso. GMs appear as early as 9–12 weeks of gestation and continue after birth without significant change in their form until 46 to 49 weeks of postconceptual age. There is a significant change in the form of movements between the age of 46 to 49 weeks. At about 3 months of age so-called fidgety movements appear (Prechtl, 1990). After 5–6 months of life, the GMs disappear, transforming into more coordinated motor patterns. Despite the complexity of their determination, GMs can be classified into a limited number of recognizable patterns, such as in relation to postconceptual age, or characterized as "normal" or "abnormal."

Their representation and age compliance correlates with the optimality state-coordinating formation and cognitive functions (Hadders-Algra, 2004). Global visual perception of movements quality has proven to be a powerful and reliable tool for recognition of "normal" and "abnormal" GMs. At the same time, specialists should be properly trained, and the analysis technique is carefully observed.

Today the Prechtl's Method is a unified and reliable methodology. In recent years, the most prognostically significant features of GMs have definitely been identified and their clinical role has been considered in detail, especially with regard to the prediction of cerebral palsy. Various scientific groups evaluated the value of FMs for early prediction of cerebral palsy. Burger and Low analyzed 15 studies on the prognostic value of FMs and found the sensitivity of this method > 91 % and specificity > 81 %. An interesting fact is that normal FMs are also absent in infants with some genetic diseases. Thus, fidgety movements are significant in the forecast of cerebral palsy, as well as other motor features combined with the absence of FMs (Cioni et al., 2014).

Assessment of the Neurological Status of Full-Term and Premature Infants

Currently, Hammersmith Neonatal Neurological Examination (HNNE) is a highly reliable method of neurological examination of premature and full-term newborns. The evaluation parameters are organized into six sections: posture and tone, reflexes, movements, abnormal signs and behavior (Cioni et al., 2014). Typical normal and abnormal signs detailed in the manual have proved to be easily applicable in clinical practice. The "optimality" index was also calculated for full-term and premature newborns for research purposes

(Mercuri et al., 2003; Romeo et al., 2012). Thus, in the study of Spittle A. J. the co-authors a reliable association of low HINNE scores in premature infants (gestational age at birth 32–36 weeks) with cognitive development problems at the age of two years was established (Spittle et al., 2016).

Based on the above-mentioned survey, Dubowitz with colleagues developed a Protocol for use after the neonatal period in infants between 2 and 24 months of life (Hammersmith Infant Neurological Examination, HINE) (Cioni et al., 2014). The Protocol consists of 26 points in 5 domains, which are devoted to the evaluation of neurological signs (including cranial nerves, position control, motor skills, muscle tone, reflexes), regardless of age, the formation of motor skills and characteristics of three behavioral models. Summing points in each domain allows you to determine the “total” score (Dubowitz, Mercuri, & Dubowitz, 1998).

HINE is easy to perform and accessible to most doctors, has good reliability of application even for low-experienced employees. One of the advantages of the method, compared to other similar tools, is that HINE not only identifies children at risk of developing cerebral palsy, but also often provides additional information about the type and severity of motor disorders (Romeo, Ricci, Brogna, & Mercuri, 2016).

Research data indicate the high diagnostic significance of Hammersmith Infant Neurological Examination in relation to cerebral palsy. The HINE score < 57 at the age of three months is a prognostically valuable factor in the formation of cerebral palsy. According to the international clinical guidelines on cerebral palsy, it is recommended to use the HINE method, especially in situations where the most accurate predictive tools cannot be applied (the Prechtl method for qualitative assessment of general movements and MRI of the brain).

HINE allows clinicians to monitor the development of high-risk infants in longi-tude over two years of life, reproducing specific threshold scores at different age periods. The obtained results can help plan for appropriate intervention.

The Bayley Scales of Infant and Toddler Development (BSID-III)

BSID-III is a standardized series of evaluation scales originally developed by psychologist Nancy Bayley (1969). The evaluation protocol consists of a series of developmental game tasks that may take about 60 minutes to complete. It is used to analyze the development of children between the ages of 1 to 42 months of life.

BSID-III consists of the following scales. The cognitive scale that includes elements such as attention to familiar and unfamiliar objects, object search, and game interaction. The language development scale that evaluates the receptive and expressive forms of speech function. The motor sphere rating scale allows you to analyze large- and small-motor skills.

The Bayley Scales of Infant and Toddler Development helps professionals identify the need for further monitoring and inclusion in early intervention programs. The Bailey-III Scale is actively used as an objectification tool in clinical research (Weiss, Oakland, & Aylward, 2010).

Assessment of Sensory Functions in Young Children. The Test of Sensory Functions in Infants (TSFI)

Some time ago, experts faced the problem of identifying children who are at risk for violations of cognitive or emotional development (lack of objective criteria and information on the formation of sensory functions). The Sensory Function Test for children was created as a research and diagnostic tool that can be used to identify children with disorders of regulatory function, with developmental delay, who are at risk learning and having sensory disorders. The test provides a General assessment of sensory processes and reactions in infants. TSFI includes 24 modules used to evaluate sensory and reaction processes in children aged 4 to 18 months of life.

The Protocol consists of five subtests: response to tactile deep stimuli, adaptive motor functions, visual-tactile integration, oculomotor control, and response to vestibular stimulation. TSFI is intended for clinical application by pediatricians, psychologists, physiotherapists and ergotherapists with instructions for interpretation of the obtained results in the field of sensory functions.

TSFI can be used in parallel with other tests to provide a holistic and accurate assessment of development, for example, in conjunction with the Bayley Scales of Infant and Toddler Development or other standardized assessment scales. The development of such tools plays an important role in providing preventive measures and implementing preventive approaches among (Barton, Reichow, Schnitz, Smith, & Sherlock, 2015).

Each scale, under certain conditions, may have its own limitations. The methods described above were chosen precisely in view of their high applied significance. In the context of our practice, the main problem limiting the use of the part of the described methods (GMA, BSID-III) is the lack of certified specialists. Specialists who are proficient in these technologies implement their knowledge within the framework of research projects, outside practical health care.

A comprehensive approach using development assessment techniques has been successfully implemented in various international medical centers. We are currently using the HINE and TSFI scales. In terms of the development of our clinic, several specialists are planned to be trained in techniques such as Prechtl's method on the qualitative assessment of general movements and The Bayley Scales of Infant and Toddler Development to carry out consistent surveillance of at-risk patients and organize timely habilitation.

Rehabilitation

It is necessary to state that today the absence of a single scientifically sound rehabilitation strategy causes difficulties in setting tasks of rehabilitation, determining the starting point and its duration, and evaluating the effectiveness of the measures taken. Overdiagnosis and overactive therapy result in excessive stimulation, and wait-and-see tactics lead to a late start of the rehabilitation process, when the optimal time for the development or formation of functions has already been missed (Kazanskaya, 2008).

The term “rehabilitation” for children at risk for violations of ontogenetic development is quite controversial. In infants, the issue of formation, rather than restoration of lost functions, is relevant, so it would be more accurate to use the term *habilitation* for this group of patients. Habilitation is understood as a process aimed at developing the child’s functions that are initially absent, preventing the appearance of restrictions on activity and participation, or reducing their degree of expression.

Infancy is a unique time interval during which, with adequate treatment and timely habilitation, the outcome is the most promising. From birth to three years of age, a child has great potential in terms of physical, cognitive, emotional, and social development. Maturation and complication of the motor and mental functions, the formation of the child’s personality occurs under the influence of hereditary factors and in the process of mastering social experience (Kustova, 2018).

Habilitation programs should be implemented within the framework of the concept of early intervention. It is a system of measures and a set of services aimed at the development of young children with developmental disorders or the risk of such violations, as well as measures aimed on supporting the family and improving the competence of parents on the harmonious development of their children.

The distinctive features of the program of early intervention from the traditional model are: the earliest detection of developmental deviations, inclusion in the program of children not only with developmental disorders, but also with the risk of their occurrence. Early intervention is based on an interdisciplinary and family-oriented approach, takes into account the individual assessment in building an assistance program based on functional classification of disorders, analysis of human activity and participation in the life of society against the usual statement and categorization of the identified pathology.

The practice of early intervention is based on the integration of modern research data, scientifically based habilitation approaches, requests and needs of the family directly involved in the adaptation and upbringing of a child at risk.

The systematization of data indicates that programs to form the correct motor skills and general harmonious development can be the most promising way to adapt children at risk to modern living conditions.

As an example, we can refer to the Portugal’s experience, where the early intervention system was introduced 15 years ago. The impact of this model of assistance was significant not only for the infant’s neurodevelopment, but also for specialists (improving their competencies) involved in the program. The analysis of our foreign colleagues has shown that the early intervention program can serve as a positive example of the implementation of state projects. Its implementation is recommended as part of comprehensive measures to assist the population throughout the country (Franco, Melo, Santos, Apolónio, & Amaral, 2017).

A group of Dutch researchers revealed that early intervention had a positive effect on long-term outcomes in children with a birth weight of less than 1500 grams, especially in deeply premature infants with bronchopulmonary dysplasia (Van Hus et al., 2016).

According to a review from Australia, early intervention contributes to the motor and cognitive development of children born prematurely in the first two years of life (Doyle et al., 2014).

Conclusion

The scales presented above are a highly reliable tool for assessing the development of young children. Consequently, the deficit identified with the help of these methods serves as a foundation for making a decision based on the need for habilitation measures. For example, BSID-III is the “gold standard” of evaluation and provides analysis of all major areas of child’s development. This, in turn, helps to select a range of specialists in various fields who will take part in the therapy. It should be emphasized that these scales are not intended to predict the child’s limitations or success in the future, but their use allows monitoring the child’s development at the stages of the habilitation process.

It is necessary to have a unified methodology for monitoring, correcting or minimizing consequences of disease based on knowledge of ontogenetic features of the child organism, objective data on structural and functional disorders and the degree of activity restriction and participation in successful habilitation of risk group kids.

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