

Study of the Sensory and Motor Functions of Premature Infants

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Abstract

Currently, the number of infants with mental retardation and developmental speech delay has significantly increased, so the issue of the mental evolution during infancy is of great importance for the child's quality of life.

The object is to study the characteristics of higher mental functions of very preterm and term infants. We performed evaluation and description of common features of the mental development of preterm infants (15 infants) and infants with standard development of the same age (15 infants) using Bayley Scales of Infant Development. The asthenic and autistic variants of psychological dysontogenesis were identified in preterm infants. The results of this study allow us to highlight the common factors typical for the mental development of very preterm infants. We observed the transit from severe mental disorders to moderate and mild mental disorders during a year.

Keywords: Premature Infants; Neuropsychic Development; Sensory and Motor Functions; Psychological Dysontogenesis

Introduction

Current requirements to behavioral health of infants are determined by the nature of the leading medical and demographic trends [12].

Against the increased infant survivability, there is an increase in premature birth. In this respect, 12 - 15% of premature infants (usually born on 8 - 10 weeks ahead of time with very low and extremely low body weight) have severe cerebral damages, leading to ICP and mental maldevelopment, and among those suffering from perinatal encephalopathies this indicator reaches 50%. In other cases, there is a high risk of delays and other disorders of mental development.

Preterm infants need comprehensive medical and psychological assistance from the first days of life [2,16]. However, due to the severity of the somatic neurological status of preterm infants, their development during the first years of life remains mainly in the focus of

clinicians' attention. Thus, diagnostics of mental dysontogenesis events is performed on the psychoneurological examinations without a specialist in perinatal psychology.

The psychology development problem during infancy is of great relevance for the child quality of life. More recently, there is a considerable increase in the number of children with mental retardation and developmental speech delay, who cannot fully cope with the program of general educational schools and pre-schools. Only 35% of elementary school children have a satisfactory level of readiness for learning. The pathology of the nervous system takes a leading place among the causes of children retardment in psychomotor development, and its perinatal damages reaches 60 - 80% of all neurological diseases in children [6]. A meaningful progress in the field of perinatology, the introduction of new technologies for assisted human reproduction, achievements in the intensive care and nursing of newborns with combined perinatal pathology have significantly reduced infant mortality rates [4]. However, this led to an increase in the general population of children with neurological pathology associated with violations of the ante- and intrapartum gestation period [11,13].

Study Objective

To study the characteristics of higher mental functions of extremely preterm infants and a group of term infants.

Subject

Mental development of extremely preterm infants and the main symptom complexes.

Object of study

The development of sensory and motor functions in preterm and term infants.

Study problems:

1. State evaluation of sensory, motor and other higher mental functions in extremely preterm infants of the experimental group.
2. State evaluation of sensory, motor and other higher mental functions in infants of the control group.
3. Description of the common features of the mental development of extremely preterm infants.
4. Determination and analysis of typical variants of psychological dysontogenesis in infants of the experimental group.

Patients and Methods

In order to obtain the objective evaluation of the neuropsychic development of the studied infants we used "Bayley Scales of Infant Development" [11,14,15]. It allowed us to evaluate the level of neuropsychic development both qualitatively and quantitatively.

All infants (30 children) were examined according to this method. The study was carried out under standard conditions, in the presence of one or both parents. The program involved examinations of infants and questioning parents. The duration of one study ranged from 1.5 to 2 hours.

The following reasons became the key for choosing this method:

- Firstly, the Bailey scale is well standardized and allows us to compare the value of standard points received by an infant with his own previous points obtained at an earlier age, as well as with values obtained by a group of healthy peers;
- Secondly, the Bailey scale allows us to make correct comparison of term and preterm infants, since the study is performed considering their gestational age;
- Thirdly, the Bailey scale allows us to make a sufficiently complete evaluation of the higher mental function status;
- Fourthly, the Bailey scale can be used as a kind of manual for parents, allowing them to see the strengths and weaknesses in the development of their child and use the tasks offered by the test as a guide for early development.

The study was performed in conditions of Lyubertsy Children's City Hospital, the regional department of psychiatry and neurology No. 2.

The characteristics of the studied groups of infants (Table 1):

- Control group: Apparently healthy infants, delivered at term - 15 infants.
- Experimental group: Extremely premature infants with very low and extremely low birth weight without organic pathologies, unrelated to premature birth - 15 infants.
- The experimental group consists of extremely premature infants with extremely low (< 1,000g) and very low birth weight (< 1,500g). The first category included 4 children, the second one included 11 children. 12 preterm infants were born with the body weight appropriate for the gestational age: three of them weighted less than the standard indicator by more than 2 sigma's.
- The selection of subjects for the experimental group was performed considering the data of the conversation with mothers and attending physicians and infants' chart analysis. The control group was formed after primary conversations with the mothers and infants' chart review. The control and experimental groups were balanced by parameters related to the nonspecific determinants of the mental development of preterm infants.
- Biological parameters: Sex composition of groups, somatic neurological hereditary burden.
- Sex composition of groups: 8 girls and 7 boys in each group.
- The groups were adjusted by the hereditary chronic somatic diseases. More than a quarter of the grandparents had hypertension and atherosclerosis, approximately third part of parents suffered from various allergies and moderate myopia. In individual cases, there were chronic tonsillitis, varicose veins and some other somatic diseases.

Characteristics of the studied groups of infants	Control group			Experimental group		
	Borders	Average	Stand. dev.	Borders	Average	Stand. dev.
Gestational age, weeks	38 - 40	39.4	0.8	25 - 32	28.4.	2
Weight at birth, g	2710 - 3790	3287	389	540 - 1390	1137	221
Maternal age	21 - 33	23.5.	2.9.	18 - 35	25.8.	5.2.

Table 1: Characteristic of test subjects.

We should pay attention on some features of neurological disorder frequency in the experimental group (Table 2).

Neurological status of subjects of the experimental group	Number of subjects with this syndrome in the acute PEP period (0 - 1 months)	Number of subjects with this syndrome in the early recovery PEP period (1 - 6 months)	Number of subjects with this syndrome in the late recovery PEP period (6 - 12 months)
CNS depression syndrome	15	In the first half of the period - 6, then - 0	0
Hypertension-Hydrocephalic Syndrome	15	10 (5 girls, 5 boys)	0
Syndrome of heightened nervous-reflexory irritability	0	In the first half of the period - 9, then - 15	10 (6 girls, 4 boys)

Table 2: Frequency of neurological syndromes in the experimental group.

Thus, hypertension-hydrocephalic syndrome more often led to an increase in neuro-reflex excitability, and only with this combination convulsive disorder and cerebral palsy (ICP) developed. Predominantly, infants with developed IPC were girls. In contrast, vegeto-visceral disorders (sleep and digestion disorders) were found mainly in boys with persistent hydrocephalic symptoms.

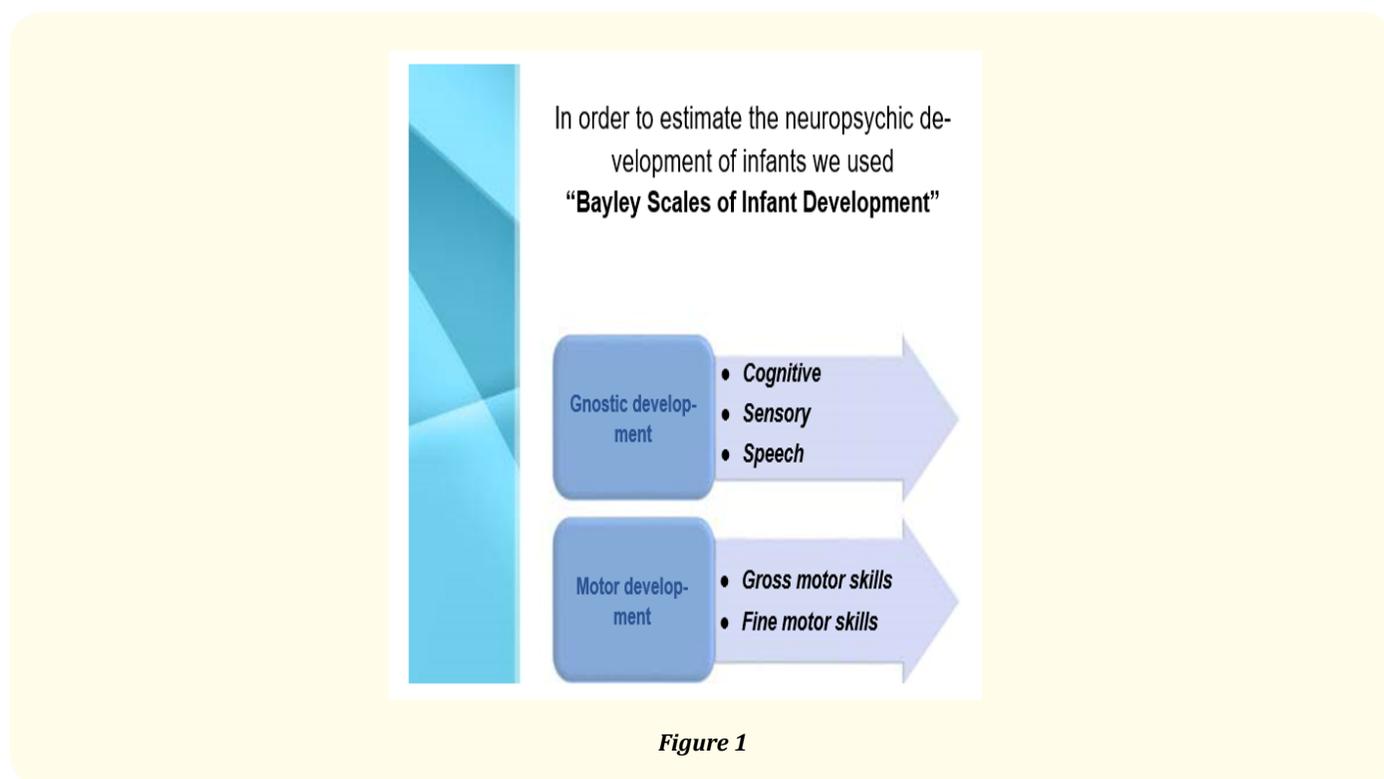
Besides the drug therapy, all infants of the experimental group underwent therapeutic massage and gymnastics. The general complex of gymnastics and massage was mastered and applied by mothers independently after discharge from the hospital.

The results obtained during the study were subjected to a qualitative analysis in order to identify the key features of mental development in LBW preterm neonates and describe specific development options.

Results and Discussion

The basis of the Mental Scale is the assessment of cognitive, sensory, and speech development. The key task of study was to determine the developmental status of higher mental functions, and, at first instance, speech (impressive and expressive), attention, communication.

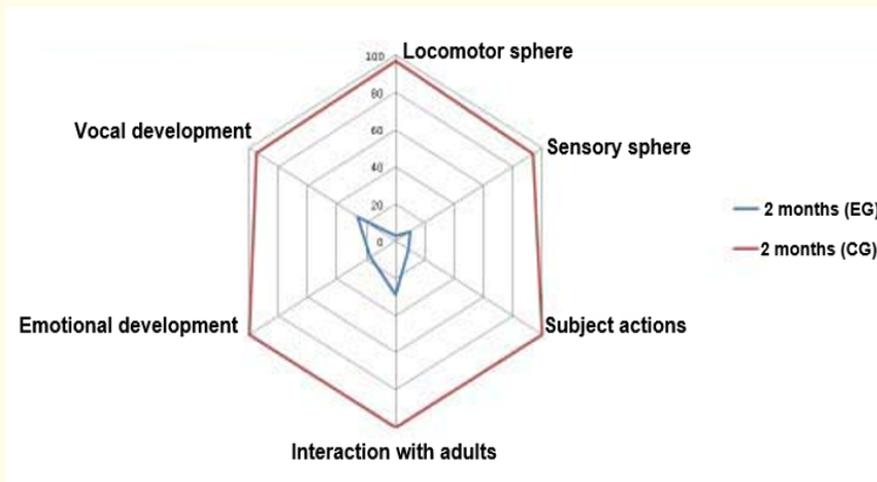
The Motor Scale allowed us to estimate the gross motor and fine motor skills. The test result became the preliminary evaluation corresponding to the number of completed tasks, on the basis of which, using centile tables, the index of neuropsychic (PDI) and motor development (MDI) were calculated. This allowed us to draw a conclusion on the degree of conformity of the neuropsychic and motor development level to the age of the examined child.



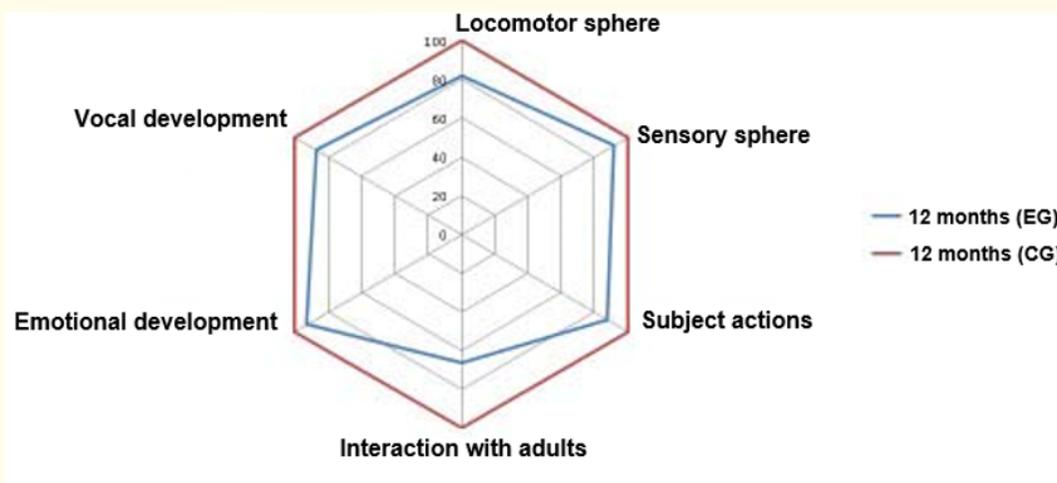
For a quantitative assessment of cognitive activity of the examined group, we used the average group developmental indexes of the following spheres: motor sphere, sensory sphere, objective actions, interaction with adults, emotional development, voice development (vocalization) [1].

During the study, the "specific" symptom complexes characterizing the level of emotional and psychological activity of infants in the control and experimental groups were identified.

The analysis of the results obtained is presented in graph 1 and 2.



Graph 1: Evaluation of neuropsychic development in infants aged 2 months.
EG: Experimental Group; CG: Control Group.



Graph 2: Evaluation of neuropsychic development of infants aged 12 months.
EG: Experimental Group; CG: Control Group.

The analysis of the results obtained showed that infants from the experimental group (preterm) significantly lag behind their peers in the control group in all spheres analyzed, especially infants below six months, gradually catching them up by one year of age but not in full.

The biggest lag is observed in the motor and sensory spheres and objective actions. As for vocalization (voting), emotional response and interaction with adults, the gap in group values is less evident.

Some infants from the experimental group began to demonstrate persistent behavioral features from a certain age. That was revealed during examinations and identified according to structured interviews with their mothers. The development of the remaining subjects was assigned to the “standard” category. In accordance with the typical strongly marked features, two specific subgroups were identified within the experimental group with a description of their typical psychological constitution, which were summarized in “Specific Symptom Complexes” at each age stage of infancy.

The cognitive activity of infants begins with orientation responses to various stimuli (a stimulus is understood as an object or a person in the field of vision of an infant, the sound of a human voice or a rattle). The development level of the functions of the motor, sensory, emotional and vocal spheres in very preterm infants corresponded to a severe degree of impairment. To a greater or lesser extent, these infants develop orientation responses (to visual and auditory stimulation, sometimes with the ability to follow a moving object and the ability to sound localization, and among emotional reactions - smiles to a touch and a speaking face). Only two neonates made attempts to raise their heads when they were shown a bright rattle. In the sphere of interaction with adults and objective actions, the development indexes of five and one child, respectively, fell into the category of moderate disorders; another infant showed mild lag behind the norm in the first group of indicators. In the subject area, the “Focusing on the toy” indicator became the most effective. In the communication sphere - “Eye contact” (skills of visual examination of an object without attempts to capture).

At the age of 2.5 - 5 months, infants normally show the period of active presentation and realization of the communication need. They start to pay special attention to a human: infants become curious of the adult appearance, take a comfortable position; being picked up, they listen to the voice, start to crow and made rare response sounds. In or around half of the cases, parents note the capacity for a positive emotional response to the appearance of a familiar adult (more often a mother) or a favorite toy, as well as a sleep grin [7-9].

Depending on the nature of the task execution, the following specific symptom complexes were identified.

Autistic variant: Some infants of the experimental group nearly always turned away from the adult walked up to the bed, even if he did not look at them, or closed his eyes.

A similar behavior was observed in a situation of formal communication: no visual contact was seen in all experimental episodes; the initiation of communication was replaced by silent ignoring or hysterical crying. Even being taken in hands for feeding, infants from this subgroup did not take an adherent position, and sometimes they started to cry and could not calm down for a long time. No other manifestations of fear and continuous motor stereotypies were observed.

Moreover, infants performed tests for visual perception much better than for audio perception. The static skills happened to be the most developed: looking at toys and pictures, holding toys. A few manifestations of hands motor activity were also observed: “Activation of hands”, “Game with hung-up toys”. Not one subjects could perform other tests for manual motility and preservation of visual control.

In neurological status at this stage, the boys had a syndrome of increased neuro-reflex excitability against hydrocephalus, vegeto-visceral and convulsive disorders, and girls had CNS depression.

Asthenic variant: The behavior of six premature infants (three boys and two girls) was characterized by increased exhaustion, emotional sensitivity and lability, tearfulness. The neonates from this subgroup easily came into skin-to-skin and visual contact listening to the adult’s speech and vocalized in response. However, in active game interaction and vocalization, infants became fatigue fast and began to whimper, roll over and yawn. When they got into their beds, these infants could hardly fall asleep. They needed long lulling, stroking and talks.

According to the neurologist, one girl and one boy had a syndrome of increased neuro-reflex irritability with vegeto-visceral disorders, two girls developed increased convulsive readiness against the same syndrome; one of them underwent a course of therapeutic massage. Another two boys suffered from CNS depression, and one of them also underwent a course of massage.

Concluding Observations

1. The primary defect in infants born very prematurely is manifested in disorders of higher mental functions due to morphological immaturity of certain parts of the cerebral cortex, implementing these processes, and arises out of the premature birth.
2. Dysfunctions that are directly related to the predominant primary defect have the secondary nature: sensorimotor immaturity and deterioration of affective regulation and psychic activation.
3. The tertiary defect also has its own specifics: HMF disorders associated with energy and motor insufficiency and generally manifested in the dynamic and operational side of the activity.
4. The asthenic and autistic variants of psychological dysontogenesis were identified in premature infants. The asthenic symptom complex is formed in infants with the most stable manifestations of CNS depression and further development of severe motor abnormalities (including ICP). The autistic variant of development is represented mostly by events of increased neuro-reflex excitability of the hydrocephalic nature in association with vegeto-visceral symptoms.
5. Maldevelopment of most higher mental functions in very preterm infants reaches the borders of mild intensity by one year of age. Lagging the norm is noted in the communicative sphere.

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