THE ROLE OF KINESITHERAPY IN THE TREATMENT OF HOLOPROSENCEPHALY IN CHILDREN

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Abstract: Holoprosencephaly (HPE) is a congenital anomaly of the central nervous system in which the two hemispheres are more or less fused. Depending on the degree of the interhemispheric fissure's extension, there are 3 forms: the alobar form (with 3 subtypes: plane, cup and spherical), the semilobar form and the lobular form.
Alobar holoprosencephaly is the most severe form, in which the prosencephalon is not divided, persisting as a single vesicle. So the cerebral hemispheres do not appear. This malformation is associated with the absence of olfactory bulbs, olfactory tracts, corpus callosum, pellucid septum. The thalamus is undeveloped and cytoarchitectural anomalies occur. The brainstem and cerebellum are normally developed. Alobar holoprosencephaly is associated with facio-nasal malformations with varied morphology. The most serious malformation is the cyclopia, due to the fusion of orbits and eyeballs.The worst forms are unviable. Kinesitherapy plays an essential role in the complex treatment, improving the quality of life of the patients.
Keywords: *Holoprosencephaly, abnormal development, kinesitherapy.*

Introduction

As an embryogenetic process, the separation of the two cerebral hemispheres occurs between the fifth and sixth week of gestation. Holoprosencephaly appears as a result of the dysfunction of the induction and structuring of the cephalic mesoderm and of the disorders in the embryogenesis of the neuroectoderm with the adjacent neural crests and the endoderm.
The incidence of the disease is 1/16000 live births. However, developmental abnormalities of the brain are much more common. 1/250 cases are reported, but most of the resulting embryos are not viable [1].
Holoprosencephaly (HPE) is a congenital anomaly of the central nervous system in which the two hemispheres are more or less fused [2]. Depending on the degree of extension of the interhemispheric fissure, there are three forms: the alobar shape (with 3 subtypes: plane, cup and spherical) the semilobar shape and the lobar shape.

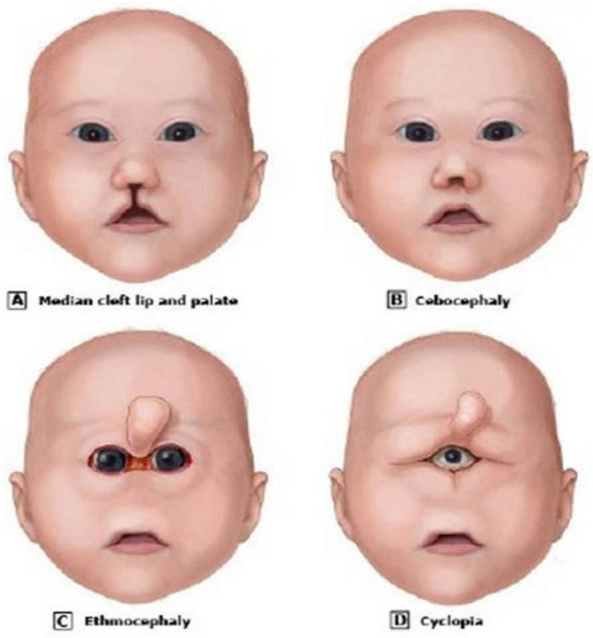

Fig. 1 Developmental disorders of the facial massif [3]

Alobar holoprosencephaly is the most severe form, in which the proencephalus is not divided, persisting as a single vesicle. Thus, the cerebral hemispheres do not appear nor the intermediate structures that connect them. This malformation is associated with the absence of olfactory bulbs,

olfactory tracts, calyx body, pellucid septum. The thalamus is undeveloped and cytoarchitectural anomalies occur. The brainstem and cerebellum are normally developed.

Alobar holoprosencephaly is accompanied by facio-nasal malformations with varied morphology. The most serious malformation is the cyclopia (cyclocephaly), due to the fusion of orbits and eyeballs (fig. 1). It is a nonviable malformation. Other associated facial malformations are: cheiloschisis and hypotelorism. In rare situations, the facial malformations from the neural crest are missing.

In alobar holoprosencephaly we also find cardiac, bone, genito-urinary, gastrointestinal malformations [4]. Severe malformations cause early death. Survivors present serious adaptation problems, epileptic seizures, apnea seizures, thermoregulatory disorders, disorders in the acquisition of neuro-psychic performance [5].

Semilobar holoprosencephaly: in this malformation the prosencephaly is divided only partially in the posterior part, which causes a great disturbance of the development of the brain. It is associated with facial anomalies such as cheiloschisis, hypotelorism and twisted nose. [6]

Lobar Holoprosencephaly - here the lobes and the interhemispheric groove are well formed. It resembles the atypical forms of callous body agenesis. Malformations are minor and are associated with mental retardation and cerebral palsy.

The diagnosis of holoprosencephaly should be suspected in all cases with middle-line facial malformations, especially cheilopalatoschisis, trigonocephaly, hypotelorism, microcephaly, spasms in flexion with hypsarrhythmia, polymorphic neurological pictures, mental retardation, endocrinological abnormalities.

Transabdominal ultrasound may indicate the diagnosis after the sixteenth week of gestation.

HPE is accompanied in 80% of cases of characteristic facial abnormalities. These vary in spectrum from the most severe form of cyclopia to premaxillary agenesis. Here is the full range of dysmorphias (except ethmocephaly, which is the rarest), as well as a case without facial manifestations. The minor and inconsistent dysmorphisms encountered in the cases presented were: trigonocephaly, absence of the internal suture with single nasal bone, cleft lip and palate.

In the etiology of these malformations the following have been incriminated: genetic factors with dominant or recessive transmission, chromosomal abnormalities in 24-45% cases, especially of chromosomes 13 and 18 with deletions 18p and 13q-, triploids. Mutation of the Tcc gene is responsible for familial malformations, genetic syndromes (Palister-Zal, Rubinchteina-Taybi, Kallmann, Smita-Lemli-Opit, Mekelipseudo-trisomy 13) in the proportion of 18-25%. Other possible causative factors could be toxic, uncontrolled maternal diabetes, infections during pregnancy, drug abuse etc.

In holoproencecephaly, the neurological syndrome is present with clinical signs such as microcephaly, hydrocephaly, spastic tetraplegia, epilepsy, mental retardation of different degrees, disorders in the acquisition of neuropsychic performance etc. Another aspect in this pathology is dysmorphic syndrome, which manifests with midline facial abnormalities, hypotelorism, single central jaw, coloboma, microphthalmia, cheilo~ and/or palatoschisis, proboscis (nose located in the forehead) or absence of facial features, cyclopia.

The prognosis is favorable for the milder forms, while in moderate forms 50% of the cases can survive past 12 months. The prognosis is unfavorable for the alobar forms, accompanied by serious malformations, in which there is a severe evolution, until death:

- 50% at the age of 4-5 months,
- 20% at 12 months.

The causes of death are: epilepsy, apnea, thermoregulatory disorders.

Unfortunately the treatment, although complex, has no curative variants. It can only improve the general condition and improve the quality of life in patients.

In this context, kinesitherapy plays an essential role, its objectives being:

• Tone the muscles from the upper and lower limbs (from different positions depending on the development stage);

• Educating the motor actions from rolling and the high and low doll postures;

• Stimulating the motor actions from sedestatism, quadruped, and transition;

• Stimulating the balance and stability in sedenstatism, quadrupedalism and transition;

• Stimulating the lift in orthostatism through the position of the servant knight;

• Education of walking with a support point at the wall bars or at a small table, on the treadmill, stabilization at the basin level, walking on the knees;

• Fighting and preventing contractures;

• Develop fine motor skills by pressing buttons on toys, puzzles, selecting toys by size and textures or using other objects used to develop fine motor skills.

Material and method

The research was carried out between May 15, 2016 - May 15, 2018, within the recovery ward of the Social Services Center "Ghiocelul", Bucharest. In the kinesitherapy program, a variety of methods and techniques were applied: passive mobilization, active mobilization, massage, the BOBATH method etc. Said methods were applied according to the stages of the child's neuromotor development; the recovery program was modified during the recovery depending on the progress made and the neuromotor development stages.

Passive mobilizations were performed slowly in three series, and were performed on all muscle groups and in all directions of movement.

Fig. 2. Passive mobilisation

Fig. 3. Preparation for the doll posture

Fig. 4. Crawl exercises

Fig.5. Sedestatic preparation (a)

Fig.6. Sedestatic preparation (b)

Fig. 7. Quadrupedalism acquisition

Fig. 8. Equilibrium education

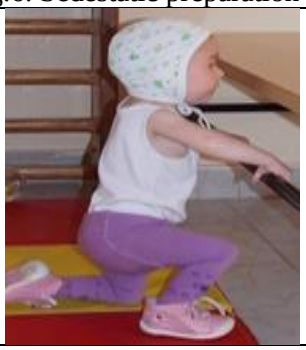

Fig. 9. Transition to orthostatism through the knight servant position

Fig. 10. Walking with point of support

The active mobilizations consisted in facilitating the debut of recovery reactions on the gym ball from the dorsal, ventral and lateral decubitus. The purpose of these mobilizations were to tone the hypotonic muscles, improve muscle strength, stability, balance, coordination. To tone the muscles and to go through the stages of neuromotor development of the child, we applied imbalances from the low doll's posture, the high doll's posture, quadrupedalism, moving the center of gravity from one hand to another, lifting from the knees, from sitting position, crawlism, quadruple walking, stabilization on the gym ball, on the balance board, walking between parallel bars and mattress exercises.

For the sensory stimulation and to diminish the agitation we have made several games in the sensory room such as: stimulation in the ball pit, throwing the balls by colors in the basket, watching the projected images on the wall etc.

The number of recovery sessions was three per week, for a period of 2 years and the duration of the recovery sessions lasted one hour.
The mother was taught to apply the exercise program at home, these costing in passive mobilization and active mobilization with resistance. The sessions lasted at least 30 minutes, twice a day.
Remarks:
Applying the individualized recovery program, we observed an evolution of the baby from a neuromotor point of view, as well as a prevention of the sequelae that may appear as a result of these conditions, as well as the equivocation of the biological age with the chronological age.

Results and discussions

The evolution of the researched subject was highlighted by the POABODY scale, which includes several parameters:

- reflexes
- manipulation of objects (pre-tensioning execution),
- visual-motor integration.

The evolution of the subject was permanently monitored. In table 1 we present the scores obtained by the patient, in comparison with the scores of the normal child.
By evaluating the reflexes it was observed a time evolution of the pacing reflex, the positioning reflex, the Landau reaction, the protective reaction, the recovery reaction, the rotation of the head, the alignment of the trunk, the alignment of the head, the extension of the head, the stabilization of the trunk, the passage into the seated position, the maintenance sedenstatism, kneeling etc.

Table 1. POABODY evaluation in four treatment periods

No.	Date	Reflexes		Prehensions		Visual-motric Integration	
		Score	Evaluation	Score	Evaluations	Score	Evaluations
1.	24.02.2017	112	3	42	8	62	12
2.	30.07.2017		35		19		25
3.	30.01.2018		55		21		35
4.	19.04.2018		93		33		54

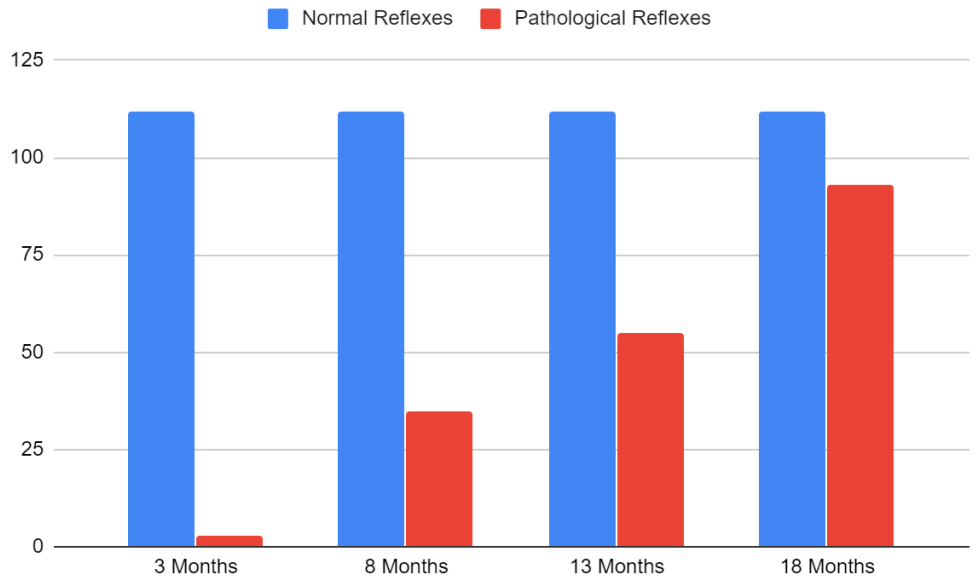

Fig. 11 Reflex Evolution

Following the application of these periodic tests, we gave a score from 0 to 2 depending on the achievement of each parameter. The score accumulated by a child with normal neuro-motor development following these tests is 112 points, compared to the one achieved by the studied subject, who recorded values of 3, 35, 55, 93. Comparing these values with the standard ones, we obtain the evolution of the child following the treatment:

- the first evaluation represents 2.67% of the maximum score of 112;
- the second evaluation represents 31.25% of the maximum score of 112;

• the third evaluation represents 49.11% of the maximum score;
• the fourth period represents 83.04% of the maximum score and as a result a progress of the child's evolution is observed (fig. 11).

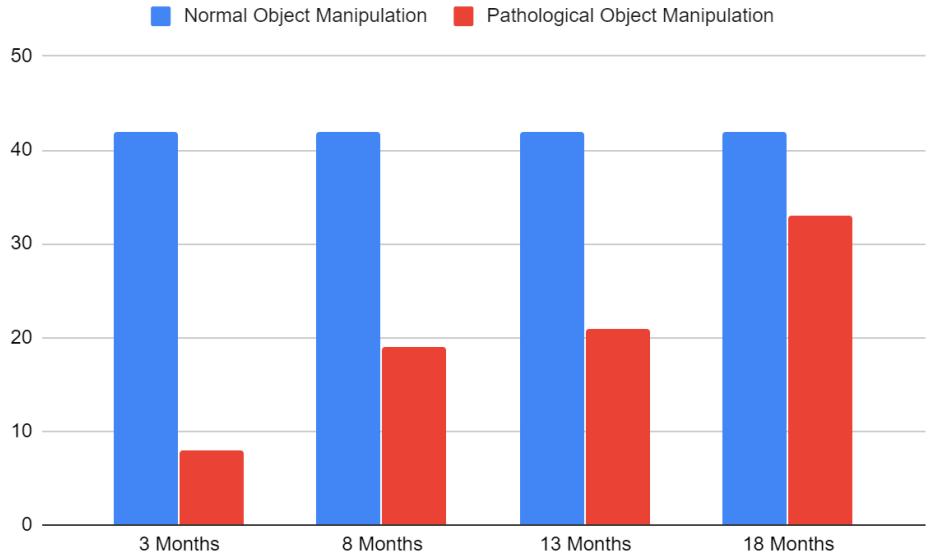

Fig. 12 Prehension & Object Manipulation Evolution

Figure 12 presents the evaluation of the prehension and manipulation of the objects, being offered a score from 0-2 following the application of the following tests: grabbing a towel, grabbing a toy, manipulating the toy, grabbing a rope, grabbing a paper, grabbing a cube from different positions, grabbing the candy, catching a ball, rolling the ball, powerfully throwing the ball and kicking the ball. The maximum normal score is 42 points; the patient performed at the periodic evaluations scores of: 8, 19, 21, 33, representing 19.05% (first evaluation), 45.24% (second evaluation), 50% (third evaluation) and 78.57% respectively at the fourth assessment.

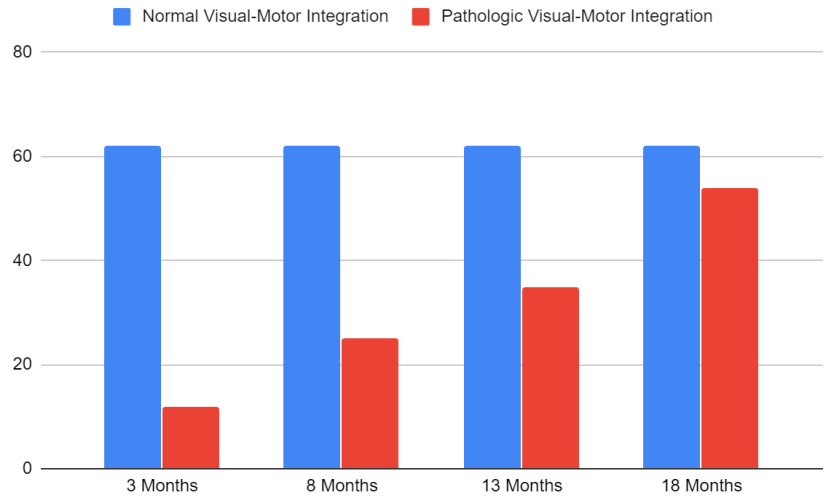

Fig. 13 Evolution Of The Visual-Motor Integration

Figure 13 shows the evolution of visual-motor integration according to the stages of development. The tests applied were: tracking a toy, placing a hand, perceiving the toy (of the noise produced by it), looking at the hands, tracking a ball, stretching the arms, touching the fingers, approaching the hands, transferring the cube, taking the pawns, combining the cubes, throwing the cube, removing socks, turning pages, spinning a teaspoon, inserting small pieces etc.

Following the experiment, a favorable evolution of visual-motor skills was observed. The maximum possible score is 62 points. The evolution of the score obtained by the patient was: 12 at the first evaluation, 25 at the second, 35 at the third and 54 at the last evaluation, representing 19.35% (first

evaluation), 40.43% (second evaluation), 56.45% (third assessment) and 87.10% (fourth assessment, respectively).

Conclusions

Due to the application of a correct and individualized kinetic recovery program, very good results have been obtained in the recovery of the child.

By applying the objective evaluation methods, satisfactory results have been obtained, demonstrated by approaching the biological age with the chronological age, in all the parameters that were followed in the paper: neuro-motor acquisitions, reflexes, prehension, visual-motor integration.

The most effective exercises were those of the Bobath method, but especially those that were based on play, in the form of sensory-motor stimulation and symbolic games.

Focusing on the functional needs of the child, but also on the elements that created comfort and pleasure, led to his active participation in the therapeutic process, which was the basis of the success of the present experiment.

The family played an important role in the recovery of the baby. The mother of the child collaborated and was receptive to the indications regarding the kinesitherapy program recommended for home. He learned the recovery program and applied it in the most correct way.

Kinetic treatment should be followed throughout life to prevent disruption of the body scheme.

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