The Effectiveness of Early Therapeutic Intervention on Functional Independence of Children with Cerebral Palsy

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ABSTRACT

A total of 167 patients with cerebral palsy were studied. Patients of group I has been observed since being newborn (37), group II (130) - above age of 1 year. All patients received rehabilitation therapy by multidisciplinary team approach. At age of 5 year functional independence of all children were assessed by WeeFIM scale. For normal children control group III (N30) mean score of WeeFIM was 5.6 for patients of group I – 4.2 and for patients of group II – 3.6. It was evident, that early therapeutic intervention doesn't decrease the severity of cerebral palsy, but improves functional independence ($p<0.05$) of children with cerebral palsy. Every child, who has manifested early clinical or neuroimaging signs of cerebral palsy needs to start early therapeutic intervention, as this decrease the disability of the child. **(Int. J. Ch. Neuropsychiatry, 2004, 1(1): 21-28)**

INTRODUCTION

Cerebral palsy is the most common physical disability of children, that's why it has been of special concern of pediatric neurologists since 19th century.

The incidence of cerebral palsy varies from 1,2 to 4 per 1000 live births[1,2,3,4]. The incidence is much higher in newborns with birth weight less than 1500 gr - 5-15% [5,6].

"Cerebral palsy" refers to a group of disorders in the development of posture and motor control, occurring as a result of a non-progressive lesion of the developing brain[7]. This definition encompasses a wide variety of pathological and clinical entities that have in common a developmental disorder that can vary in etiology, manifestations, severity, prognosis, and comorbidities. Despite of the fact that neurologist's interest for cerebral palsy is a long story, there are several topics to be evaluated.

Early diagnosis of cerebral palsy is sometimes difficult; because of the clinical symptoms appear lately: spasticity - at 6-9 months, dyskinesia – until 18 months and ataxia even later[8]. That's why in most cases treatment begins after 1 year.

Although during the past decades several reviews of therapeutic interventions for children with or at risk for cerebral palsy have been published, the majority of results from most of the studies could not be interpreted from a scientific point of view and did not provide sufficient evidence for

the effectiveness of the interventions. 60% of investigations published in 1990-2001 correspond to short - 6 months period, 30% - 6-12 months period. A long-term study on effectiveness of therapeutic intervention has not yet performed[9].

Severe cerebral palsy is characterized by high degree of disability. The improvement of functional independence has important effects on the quality of his/her life and social activities. The long-term effects of early therapeutic intervention on functional independence of the patient with cerebral palsy are unknown.

The interest to study these questions is also increased by the fact that patients with cerebral palsy have disability of any type, which creates social and economic problems. By reducing the level of disability it is possible to improve quality of life and social activity of patients, to recreate the psycho-emotional climate of a child with disability itself and his/her family and to reduce economic wastes.

The aim of the study was to determine the effectiveness of early therapeutic intervention by assessing the effect of early (before 1 year of age) and late (after 1 year of age) therapeutic intervention on severity of cerebral palsy and on level of patient's functional independence.

METHODS

A total of 167 patients with cerebral palsy were studied during their treatment at The Children's Central Hospital and The Center of Child Neurology and Neurorehabilitation, Tbilisi, Georgia.

Cohort prospective study design was selected for the survey.

37 patients with cerebral palsy have been observed since being newborn (group I). Group II consisted of 130 patients with cerebral palsy that did addressed Centre of Child Neurology and Neurorehabilitation and were above age of 1 year.

Syndromic diagnosis of cerebral palsy was made after J. Miller`s classification (1992). All cases denied existence of progressive disease. The severity of cerebral palsy was evaluated after Russman and Gage`s classification[10].

Evaluation of motor development was performed by: Milani-Comparetti Motor Development Screening Test; Gross Motor Function Measurement (GMFM)[11] and Gross Motor Function Classification[12].

For the assessment of mental development we used: Bayley's scale of Infant Development, and Kauffman`s Battery of Childrens Assessment.

While estimating severity, patient's mental development was of special concern, although during the final evaluation the overall criteria was a priority: mild – independent, moderate - needs assistance, severe - needs total care.

For functional independence evaluation Functional Independence Measurement for children (WeeFIM) was used[13].

The functional independence (WeeFIM) of patients in both groups and 30 children with normal development were estimated at the age of 5 years and obtained data were distributed in groups.

During estimation of functional independence patients self-care, ability to control sphincters, locomotion, communicability and social activity were scored and average score was calculated: 7 – completely independent, 6 – modified independence (accomplishes all tasks, but

needs assistive device), 5, 4, 3 - modified dependence: 5 - needs supervision, 4 – minimal assist (child>75%), 3 - moderately assist (child > 50%); 2, 1 – complete dependence: 2 – maximal assist (child > 25%), 1 – total assist (child < 25%).

Neuroimaging study (neurosonography, CT of the brain or MRI) was performed in 67 cases. 34 in group I (91.9%), 33 in group II (25.4%). 76.5% of investigating methods in group I was MRI. Interpretations of study results were accomplished by two specialists simultaneously.

All patients underwent rehabilitation therapy by multidisciplinary team (child neurologist, psychologist, physical therapist, speech therapist, epileptologist, orthopedist, orthosist).

Statistical analysis of the data was accomplished by SPSS for Windows.

RESULTS

During study of syndromal distribution of patients in both investigational groups, spastic syndrome appeared to be the most frequent with: spastic diplegia to be 66.5%, hemiplegia – 4.8%, quadriplegia – 13.8% and 85.1% of all cases made spasticity syndrome, from other syndromes Dyskinetic was – 10.2%, then ataxic – 3% and the atonic syndrome – 1.7%, thus the latter three syndromes made up 14.9%.

Although the major part of study cases consisted of spastic diplegia, most of severe cases were spastic quadriplegia and it composed 37.2% of severe cerebral palsy cases. No cases with quadriplegia were mild and most of cases were severe – 69.6%, on contrary there were no severe cases of spastic hemiplegia and almost every case was of mild – 87.5%. Distribution according severity of spastic diplegia cases was different, mild cases (25.2%) predominated under severe (13.5%) ones (table 1).

While distributing syndromes according term/preterm and neuroimaging correlates it turned out that most cases of spastic diplegia were in preterm newborns: from 111 cases of spastic diplegia 84 (75.7%) were preterm newborns and 27 (24.3%) term newborns. In 75% of cases of spastic diplegia, there was a periventricular leukomalacia (only periventricular leukomalacia – 38.9%, plus atrophy – 19.4%, periventricular leukomalacia and malformation – 2.8%, ventricular dilatation – in 11.1%, periventricular "flare" – in 2.8%) on neuroimaging scans.

In our study 50% of spastic hemiplegia cases were accompanied by asymmetric periventricular leukomalacia by neuroimaging, asymmetric ventricular dilatation – in 25% and porencephalic cyst in 25%. 75% of cases were term newborns.

Cases of spastic quadriplegia were merely predominant in term newborns (52.2%), and by neuroimaging atrophy - 60% - (porencephalic cyst or generalized atrophy) was predominant, periventricular leukomalacia and periventricular leukomalacia plus atrophy appeared with similar frequency (13.3%). Malformation plus leukomalacia and malformation plus atrophy were more infrequent (6.7%).

It was evident from our investigation that dyskinetic syndromes occurred mostly in term newborns – 58.8% and on neuroimaging: atrophy, atrophy plus periventricular leukomalacia and hyperintensity of basal ganglia occurred by similar rates (25%).

Ataxic and atonic syndromes mostly occurred in term newborns (60% and 66.7% respectively) and malformation and atrophy

occurred in similar rates (50-50%) in both syndromes. From our study occurrence of atrophy or atrophy conjugated with other type of brain damage by neuroimaging was associated with severe cerebral palsy ($p<0.01$).

To determine effectiveness of early (before age of 1 year) therapeutic intervention patients and children with normal development were assessed at the age of 5 years. In control group (30 normal children) WeeFIM was 5.6 (±0.5), in I group – 4.2 (±1.5), in II group – 3,6 (±1.6) (histogram 1).

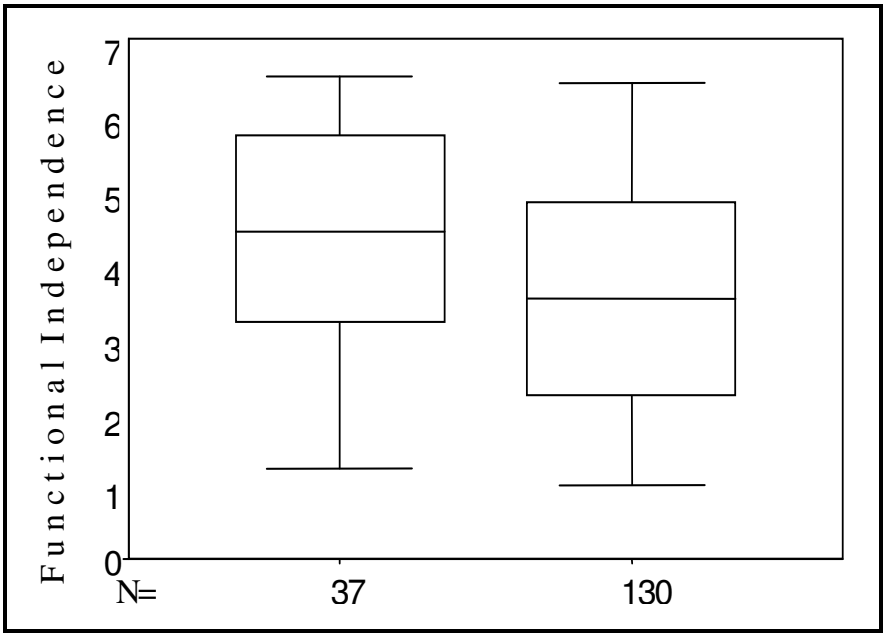
While estimating distribution of severity of cerebral palsy in groups, severe cases were more frequent in group II – 72.1%, but in this group mild cases predominated – 25.4%, then severe – 23% (table 2). No significant differences of severity of cerebral palsy were found between groups. Severe cerebral palsy cases were not more frequent in group II.

Table 1. Severity of Cerebral Palsy Syndromes.

	Mild		**Moderate**		**Severe**	
	No	**%**	**No**	**%**	**No**	**%**
Diplegia	28	25.2	68	61.3	15	13.5
Hemiplegia	7	87.5	1	12.5	-	-
Quadriplegia	-	-	7	30.4	16	69.6
Diskinetic	2	11.8	6	35.3	9	52.9
Ataxic	2	40.0	3	60.0	-	-
Atonic	-	-	-	-	3	100
Total	39	23.4	85	50.9	43	25.7

Table 2. Severity of Cerebral Palsy in Groups.

	Mild	**Moderate**	**Severe**	**Total**
	No / %	**No / %**	**No / %**	**No / %**
Group I	6 / 16.2	19 / 51.4	12 / 32.4	37 /100
Group II	33 / 25.4	66 / 50.8	31 / 23.8	130 / 100
Total	39 / 23.4	85 / 50.9	43 / 25.7	167/ 100



Histogram 1. FIM in Groups

DISCUSSION

Epidemiologic data obtained completely corresponds to literature data: from Surveillance of Cerebral Palsy in Europe (SCPE), data from 14 centers of European countries were studied. More than 6000 children with cerebral palsy born between 1976 and 1990 were entered onto the database. From the results of these centers spastic syndromes composed 65.2-92.1%, from these unilateral damage consisted 0-40.4% of cases, bilateral – 41.7-100%, dyskinetic – 1.4-12.8%, ataxic – 1.1-7.3% and unclassified – 0.5-18.6%[4].

If we consider that only 10–20% of cerebral palsy cases are caused by intranatal asphyxia[14,15] and hypoxic-ischemic damage of basal ganglia is only part of it, and as perfection of management of kernicterus is no more a serious problem, and cerebellar pathology are infrequent, it will be clear that most of cases are spastic syndromes. Thus, epidemiologic results of our research are understandable.

Even in the literature the most severe of the syndromes was considered quadriplegia, and implies a severely multiply handicapped infant, while hemilpegia and ataxic syndrome are causing mild to moderate motor disability[6,16,17].

In our study most cases of spastic diplegia were preterm newborns and among them predominated neuroimaging scan pattern was periventricular leukomalacia, that corresponds with data given in literature[18,19,20,21,22]. Actually periventricular

leukomalacia in preterm newborn is typical hypoxic-ischemic brain damage and spastic diplegia is a logical clinical presentation.

Cases of spastic hemiplegia were accompanied by asymmetric periventricular leukomalacia, ventricular dilatation or porencephalic cyst. The most of cases were term newborns, which corresponds with data given in literature about distribution of syndromes according term/preterm and neuroimaging correlates[6,23,24,25].

Obtained data about spastic quadriplegia corresponds with those given in literature as with neuroimaging correlates (periventricular leukomalacia, intraventricular haemorrhage or postasphyxian atrophy) also, with epidemiology changes (the incidence of spastic quadriplegia has increased in infants with low birth weight)[26,27,28]. In cases of quadriplegia, severe disability is especially frequent, this is associated with intensive damage of brain white matter and it is a reason for high rates of atrophy in cases of this syndrome.

According to our study dyskinetic syndromes more frequently occurred in term newborns, then in preterms and on neuroimaging there was atrophy, atrophy plus periventricular leukomalacia or hyperintensity of basal ganglia. This data well corresponds with literature data, that dyskinetic syndrome is associated with hyperintensity of basal ganglia or malformation and is characteristic for term newborns[29,30,31].

Ataxic and atonic syndromes were very few (total of 8 and only 4 was investigated by neuroimaging) and it is difficult to make any conclusion. Based on literature data ataxic syndrome is considered to be a heterogeneous group and neuroimaging correlates may vary from norm to malformation[8,32], neuroimaging correlates for atonic syndrome is unestimated.

Major criteria in diagnosis of cerebral palsy are motor disability. It is frequently associated to loss of brain white matter by neuroimaging, and more intensive the process is, so is the motor disability. We could consider that during perinatal period hypoxic–ischemic damage causes necrosis of all cellular elements and areas of necrosis become in areas of cavitation - brain substance disappears. It is confirmed by the results of our study, that atrophy or an atrophy conjugated with other type of brain damage is associated with severe cerebral palsy.

While estimating the effectiveness of early therapeutic intervention (from age of 4 months), it was evident that early therapeutic intervention doesn't changes the severity of cerebral palsy, but improves patients functional independence ($p<0.05$).

Today the main priority of management of cerebral palsy is achievement of maximal independence in activities of daily living. The improvement of patient's functional independence positively impedes quality of life and social activity of patients. It is crucially important in the case of child with disability. That's why every child, who has manifested early clinical or neuroimaging signs characteristic for cerebral palsy, needs starting of early therapeutic intervention, because this improves patient's independence at home and in the community.

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