

Early physiotherapy intervention in premature infants

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SUMMARY: Yiğit Ş, Kerem M, Livanelioğlu A, Oran O, Erdem G, Mutlu A, Turanlı G, Tekinalp G, Yurdakök M. Early physiotherapy intervention in premature infants. Turk J Pediatr 2002; 44: 224-229.

Preterm infants are more likely to have disabling cerebral palsy (CP) than term infants. It has been reported that early therapeutic approaches may be appropriate for infants at risk of neuromotor dysfunction, to minimize the degree of future handicaps. Two hundred and twenty-nine infants born at less than 34 weeks' gestation, with birth weight $\leq 2,000$ g, cared for in the neonatal intensive care unit of Hacettepe University Hospital between January 1997-June 1999 were included in this study. Of the 229 infants initially included, 39 (17%) were dropped from the study within the first 12 months' assessment, due to lack of participation from the families. Thirty of the remaining 190 infants were found to have perinatal hypoxia or abnormal neurosonography, and were taken as the group at risk of development of CP, thus receiving early intervention therapy; these are listed as "premature at risk". The study group consisted of 160 infants not considered at risk. These were randomly paired into two groups of 80 infants, one that was given early interventional therapy, and the control group that received no program. Eleven of the 30 infants at risk, 2 of the 80 infants from the intervention group, and 4 of the 80 from the control group were diagnosed as having CP within the first six months of life.

There was no difference in the age of loss or acquisition of reflexes and general abilities between the intervention and control groups. There was no difference in the prevalence of CP between the intervention and control groups. In conclusion this study showed no effect of early intervention in premature babies without risk of CP other than prematurity.

Key words: physiotherapy, early intervention, premature.

Preterm infants are more likely to have disabling cerebral palsy (CP) than term infants. Early exposure to the extra-uterine environment may impact on motor development in these infants, increasing length of exposure and impacting differentially on motor development according to gestational age at birth. Certain aspects of motor maturation may be delayed by early birth, while others may be accelerated by the extra-uterine experience¹. Motor development is an important area for monitoring of preterm infants since one-third of all cases of CP occur in children born prematurely². Physical therapy has been the treatment of choice for children suffering from neuromotor disorders such as CP³. It has been reported that early therapeutic

approaches may be appropriate for infants at risk of neuromotor dysfunction, to minimize the degree of future handicaps. However, affected children are often not identifiable at birth, thus making early treatment impossible. Twenty-seven studies of early intervention programs found that 93% of all studies reported successful interventions; however, these were often based on subjective reports and observations. Reviewers found statistical support for effectiveness in only 48% of the studies⁴. In another study³, designed to show prevention of CP by early intervention, no statistically significant difference in the neurologic status or motor and overall development was found after 12 months of

treatment. The current study is designed to assess the effects of early interventional therapy in preterm infants.

Material and Methods

Two hundred and twenty-nine infants born at less than 34 weeks' gestation, with birth weight $\leq 2,000$ g, cared for in the neonatal intensive care unit of Hacettepe University Hospital between January 1997-June 1999 were included in this study. Patients were registered for the study before discharge from hospital. Infants with severe congenital malformation, chromosomal abnormalities or metabolic diseases were excluded from the study. Gestational age was determined according to the last menstrual period and/or early ultrasound, and confirmed by New Ballard Score⁵. Full details of the pregnancy, birth history, Apgar scores and neonatal course (including details of nutrition, bilirubin levels, oxygen supplementation, and ventilatory support) were collected prospectively. Perinatal hypoxia diagnosis was made for the following infants: 1) with Apgar score of 5 or less at five minutes, 2) with cord blood pH lower than 7, and 3) when required bag and mask ventilation for more than three minutes immediately after birth. Cranial ultrasonography was performed on all infants, while cranial tomography or magnetic resonance imaging was performed in infants with abnormal neurosonography findings. For the first nine months, all study infants were seen monthly by the same physical therapist, then once every three months until 18-24 months old. Infants were also assessed by a neonatologist and a pediatric neurologist.

Assessment was made, recording age at acquisition of general abilities (e.g. head control, rolling, crawling, sitting and walking) and reflexes (e.g. protective extension, corrective reaction, equilibrium), and age at loss of primitive reflexes [e.g. Moro, symmetrical tonic neck reflex (STNR), asymmetrical tonic neck reflex (ATNR), and positive support]⁶. Ages of acquisition of general abilities or of loss of primitive reflexes are given at chronologic and corrected ages.

Infants with perinatal hypoxia or abnormal neurosonography findings were included in the group at risk of development of CP and taken into early intervention therapy. Infants without any risk other than prematurity were assigned to intervention and non-intervention subgroups.

Infant in the intervention group, like the children in the at risk group, were treated in hospital according to techniques previously described⁷⁻¹⁰. In addition they were given a home exercise program.

The diagnosis of CP was based on persistently abnormal neurological examination (spasticity and/or variable tone and/or persistent primitive and pathologic reflexes) and functional impairment (including abnormal quality of movement). Data are presented as means (SD). Differences among groups were tested using Student's t test, one-way analysis of variance and chi-square analysis.

Results

Of the 229 infants initially included, 39 (17%) were dropped from the study within the first 12 months' assessment, due to lack of participation from the families. Thirty of the remaining 190 infants were found to have perinatal hypoxia or abnormal neurosonography, and were taken as the group at risk of development of CP thus receiving early intervention therapy; these are listed as "premature at risk". The study group consisted of 160 infants not considered at risk. These were randomly paired into two groups of 80 infants, one that was given early interventional therapy (listed as "study group"), and the control group that received no program (listed as "control group"). Eleven of the 30 infants at risk, 2 of the 80 infants from the intervention group, and 4 of the 80 from the control group were diagnosed as having CP within the first six months of life. As soon as diagnosis was made; all 17 infants were given specific therapy¹¹ appropriate to their condition and were considered as a fourth study group, namely CP. Table I shows mean birth weight, gestational age, gestational height, Apgar scores, gender, parental education levels and relevant hospital data for the four groups. Birth weights and birth heights of children in the at risk group were lower than for the other babies. Hospitalization and ventilation times of babies with CP were significantly longer than for babies in the other groups. Table II shows age of loss of primitive reflexes and age of acquisition of general abilities for intervention, non-intervention and risk groups. There was no difference in the ages of loss or acquisition of reflexes and general abilities between the study and control groups other than for Moro reflex.

Table I. Characteristics of the patients

Characteristics	Study group Exercise (+) N=78		Control group Exercise (-) N=76		Premature at risk N=19		Cerebral palsy N=17		
	Mean±SD		Mean±SD		Mean±SD		Mean±SD		
Gestational age (weeks)	31.27±2.18		31.98±1.60		31.31±1.85		30.68±3.18		
Birth weight (g)	1543±54±411.24		1578.79±410.85		1356.27±429.25*		1517.25±654.08		
Birth height (cm)	40.48±3.57		40.80±5.46		38.66±3.63*		40.46±4.32		
Apgar (5 min.)	7.56±1.60		7.67±1.62		6.26±2.68		6.66±1.41		
Hospitalization time (days)	17.70±10.70		16.05±9.29		24.78±14.26		34.11±32.72**		
Ventilation time (days)	4.05±2.74		3.50±2.28		4.23±2.74		7.57±1.52**		
Mother's age (years)	30.18±5.19		29.88±4.96		28.89±5.44		32.00±6.94		
		N	%	N	%	N	%	N	%
Gender	Girl	38	48.7	33	43.4	7	36.8	8	52.9
	Boy	40	51.3	43	56.6	12	63.2	9	47.1
Labor	Cesarean	67	85.9	58	76.5	17	89.5	15	88.2
	Normal	11	14.1	18	23.5	2	10.5	2	11.8
Pregnancy	Single	50	64.1	52	68.4	16	84.2	15	88.2
	Multiple	28	35.9	24	31.6	3	15	2	11.8
<i>Parental Education Level</i>									
Primary School	Mother	23	29.5	30	39.5	7	36.8	6	35.3
	Father	12	15.4	13	17.1	4	21.0	5	29.4
High School or University	Mother	55	70.5	46	60.5	12	63.2	11	64.7
	Father	66	84.6	63	82.9	15	79.0	12	70.6

* p<0.05

** p<0.01

Age of loss of Moro reflex was slightly lower in the control group than in the study group. Acquisition age of protective extension reflex was higher in babies at risk than in the other groups. Chronological ages of loss of primitive reflexes seen in both study and control groups were compatible with generally accepted ages for term babies, while corrected ages of acquisition of general abilities seen in both study and control groups were also compatible with generally accepted ages for term babies¹².

Five of 78 babies from the study group showed mild spasticity and hyperreflexia within the first two months of life. These symptoms were virtually resolved by the time the babies reached four months of corrected age. Table III gives medical diagnosis of the study and control groups during hospitalization, showing no difference between the study and control groups. Table IV shows age of loss of primitive reflexes and age of acquisition of general abilities for babies diagnosed as CP versus the control group. Age of loss of Moro reflex and

motor developmental levels were very different from the control group.

Discussion

Preterm birth is associated with a clear increase in risk of CP^{13,14}. Several hypotheses have been proposed to explain the origins of CP in preterm babies. It may be result of ischemic insult in utero, leading to both preterm birth and damage to white matter¹³ or, it may be that immature babies, who are vulnerable to cerebral hemorrhage and ischemia, sustain injury as a result of intrapartum and neonatal complications¹⁵. The stress and medical complications associated with preterm birth are presumed to have a negative influence on development, resulting in the differences seen between preterm and fullterm infants².

Early intervention strategies for premature babies for the prevention of CP were first developed in 1980. One of these studies, conducted by Piper et al³, failed to show any

Table II. Age of loss primitive reflexes and age of acquisition of general abilities for intervention. Non-intervention and risk groups

	Study group		Control group		Premature at risk	
	Corrected age	Chronologic age	Corrected age	Chronologic age	Corrected age	Chronologic age
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Moro	3.40±1.00	5.32±0.94	3.04±1.49*	4.90±1.46*	3.66±1.35	5.66±1.23
STNR	2.79±1.17	4.63±1.80	2.77±1.15	4.66±1.12	3.15±0.87	4.73±1.09
ATNR	2.95±1.12	4.78±1.06	2.67±1.18	4.42±1.09	2.92±1.23	4.57±1.34
(+) Support	2.29±1.29	4.23±1.23	2.03±1.54	3.84±1.77	2.91±1.02	4.78±0.89
Protective extension	5.98±1.24	7.94±1.25	5.95±1.04	7.55±1.10	6.27±1.09*	8.00±1.56*
Corrective reaction	4.87±1.27	6.72±1.23	5.31±0.95	5.35±1.00	7.40±0.84	
Equilibrium	6.03±1.09	8.00±0.98	5.71±1.22	7.52±1.03	6.38±0.76	8.44±0.72
<i>Motor Developmental Levels</i>						
Head control	2.20±1.09	4.07±1.02	2.29±1.32	4.17±1.38	2.67±0.85	4.66±0.90
Rolling	4.91±1.21	6.85±1.21	4.91±1.17	6.76±1.21	4.79±0.94	6.77±0.93
Sitting	7.10±1.58	9.02±1.56	6.54±1.53	8.33±1.59	6.10±1.69	8.10±1.59
Crawling	8.70±1.59	10.48±1.63	8.52±1.74	10.19±1.69	9.35±1.21	11.14±1.21
Walking	12.47±2.25	14.41±2.18	12.18±3.10	13.91±3.18	13.72±3.61	15.63±3.55

* p<0.05

STNR symmetrical tonic neck reflex

ATNR asymmetrical tonic neck reflex

improvement in the early intervention group when compared to the control group. In another study, researchers found no differences between neurodevelopment treatment and control groups at one year of age¹⁶. A six-year follow up by this group reported no long-term effects of early intervention in the prevention of CP¹⁷. In 1990, the Pediatric Section of the American Physical Therapy Association concluded that there was no evidence that physical therapy reduces muscle tone or primitive reflexes, although some current evidence claimed positive effects of physical therapy on postural control¹⁸. Quantitative analysis of the treatment effects of 49 studies of early intervention showed poor statistical validity¹⁹. Another quantitative analysis, looking at 91 effects from 31 early intervention studies, determined that

the data showed moderate positive effects of treatment²⁰.

The current study was also unable to show any clear effect of early physiotherapy on motor functions in preterm infants with birth weight $\leq 2,000$ g. This study confirms the lack of response to hospital and home intervention in either the at-risk or normal premature groups compared with controls, showing no clear effect. It is possible that our early intervention therapy may have brought benefits not measured in this study. Early intervention might have been effective for the five infants from the intervention group showing hypertonicity and hyperreflexia in the early weeks of life. The highest rate of CP was found in the group accepted as at risk (36%). This shows that criteria used for determining infants at risk of developing CP were efficient. Although there was no statistical difference between study and control groups for incidence of CP, higher CP prevalence was found in control group (2 versus 4). The rate of CP for preterm infants below 34 weeks gestational age varied from 2.4-9%^{21,22}. The CP rate found in this study (8.9%) is in accordance with these values. Although no term control group was included in this study, it is interesting to see that in both study and control groups age of loss of primitive reflexes was in accordance with term babies for chronological age while age of acquisition of general abilities was compatible with generally accepted ages for term babies for corrected age.

Table III. Medical diagnosis of the study and control groups

	Study group		Control group	
	N	%	N	%
Medical problems				
Sepsis	6	7.7	3	3.9
Pneumonia	2	2.6	1	1.3
SGA	6	7.7	7	9.2
RDS	7	9.0	7	9.2
Hypoglycemia	1	1.3	5	6.6
Hypocalcemia	3	3.8	3	3.9
NEC	5	6.4	4	5.2

Table IV. Ages of loss of primitive reflexes and of acquisition of general abilities for babies diagnosed as CP versus the control group

Reflex	Cerebral palsy (CP)		Control	
	Corrected age Mean±SD	Chronological age Mean±SD	Corrected age Mean±SD	Chronological age Mean±SD
Moro	3.87±1.72*	6.08±1.83*	3.04±1.49*	4.90±1.46*
STNR	3.45±1.42	5.81±1.77	2.77±1.15	4.66±1.12
ATNR	4.04±1.23	6.16±1.46	2.67±1.18	4.42±1.09
(+) Support	2.57±1.33	4.92±1.38	2.03±1.54	3.84±1.77
Protective extension	7.92±1.17	10.14±1.34	5.95±1.04	7.55±1.10
Corrective reaction	5.27±1.78	7.66±0.58	5.31±0.95	7.14±0.99
Equilibrium	7.07±1.01	9.28±1.11	5.71±1.22	7.52±1.03
Motor developmental levels				
Head control (n=17)	2.55±1.31	4.90±1.41	2.29±1.32	4.17±1.38
Rolling (n=17)	7.25±4.26*	9.58±4.14*	4.91±1.17*	6.76±1.21*
Sitting (n=14)	10.23±4.37**	12.69±4.40**	6.54±1.53**	8.33±1.59**
Crawling (n=12)	13.33±6.29*	15.88±6.58*	8.52±1.74*	10.19±1.69*
Walking (n=10)	22.25±8.42**	24.62±8.76**	12.18±3.10**	13.91±3.18**
Clinical type	N	%		
Spastic Diplegia	12	70.6		
Spastic Tetraplegia	3	17.7		
Spastic Hemiplegia	2	11.7		

* p<0.05

** p<0.01

STNR symmetrical tonic neck reflex

ATNR asymmetrical tonic neck reflex

The patients diagnosed as CP were given neurodevelopmental therapy, as it is one of the most common approaches for infants presenting mild-to-moderate neurological dysfunction. In this study most of the infants with CP were diagnosed around the age of six months. One of the benefits of the study was the establishment of the importance of a routine follow-up program for all infants diagnosed as at risk of developing CP. In conclusion, this study showed no effect of early intervention in premature babies without risk of CP other than prematurity.

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