

Impact of Early Physiotherapy Intervention on Neurodevelopment in Preterm Low Birth Weight Infants

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Abstract: A prospective, controlled trial was conducted to assess the outcome of early physical therapy intervention on preterm low birth weight infants during the first six months of life. A cohort of 100 preterm low birth weight infants who got admitted in neonatal intensive care unit (NICU) and referral newborn unit (RNB) of Raja Muthiah Medical College and hospital (RMMC&H) were included prospectively. Infants who received regular early physiotherapy intervention were assigned as interventional group (EI) & infants who were advised but did not turn up for early intervention as comparison group (NEI). The Amiel-Tison neurologic examination and Denver developmental screening test (DDST) were used and results were compared. Results: Better performance of infants in EI group in neurologic and developmental outcome. Conclusion: The data suggest significant benefit of the use of EI program over NEI in the neurodevelopmental outcome of preterm LBW infants at 6 months of corrected age.

Keywords: Preterm low birth weight infants, Early Intervention, Developmental outcome

I. Introduction

Improving perinatal and neonatal care has led to increased survival of infants who are at-risk for long-term disabilities^{1,2}. Survival of preterm LBW infants have resulted in an increased incidence of physical and mental disabilities³. Medical complications due to LBW infants may impact later development^{4,5}. Preterm birth is associated with neuromotor delays, intellectual and behavioral problems^{3,6}. Early detection of infants at high-risk is of paramount important to assess their developmental status and for planning intervention to avoid secondary problems^{7,8}.

Early intervention (EI) consists of providing continuous multidisciplinary services to infants from birth throughout the first year of life. It means interventional therapy specified for babies at-risk for developmental delay and periodic developmental assessment of motor, cognitive function, language/adaptive functioning⁹. EI promotes child health, minimize developmental delays, cures existing disabilities, prevents functional deterioration, and promotes parent-child interaction⁹.

There are various longitudinal studies related to the developmental outcome of infants born prematurely^{10,11,12}. The early intervention institute at Utah University reviewed 316 articles suggested that early intervention has immediate positive effect¹³. EI showed greater developmental progress in acquisition of skills, cognition, intellectual, social functioning and increased weight gain^{14,15,16,17,18}. However, results from several studies are not conclusive. Many recommend the study of specific developmental training techniques to find positive effects of EI on neurodevelopment of infants during their first year of life^{19,20}. EI facilitated the mother-infant relationship²¹. Thus, we employed these techniques to study the effects of EI in the neurodevelopment of preterm low birth weight infants followed during their first six months of life.

The goal of this study is to measure the effects of EI program in a group of high-risk preterm LBW infants. The hypothesis is that high-risk infants under EI perform better than a group of high-risk infants without EI. DDST comprising of gross motor, fine motor, personal social and language domains were used prospectively to evaluate the effects of EI on their neurodevelopment during follow-up in the first six months of life.

II. Method

2.1. Subjects

Preterm LBW newborns in NICU and RNB of our hospital over a period of two years were recruited for the study. Inclusion criteria – infants with gestational age between 28-36 weeks²²; inadequate weight for gestational age²³; Singleton delivery. Exclusion criteria - Maternal history of high blood pressure; Diabetes or any chronic maternal disease during pregnancy; congenital infections; congenital malformations.

Impact Of Early Physiotherapy Intervention On Neurodevelopment In Preterm Low Birth Weight

Infants who received regular early physiotherapy intervention were assigned as interventional group (EI) & infants who were advised but did not turn up for early intervention as comparison group (NEI). Sixty infants constituted the EI group (31 male and 29 female) and forty infants (21 males and 19 females) comprised the NEI group.

2.2. Early Intervention

EI was initiated for High risk infants right from the neonatal period after the babies became stable. Early intervention applied remarkably to preterm low birth weight infants, in order to arouse their actions and feelings, ultimately giving them a normal experience of development through interaction with the mother and environment⁹. The individually adjusted program was described to the parents (especially to the mother), who were trained and received written programs elaborated for their infants. These programs contain intensive schedules to develop elementary sensorimotor patterns^{24,25}, individualized care plans centered on the infant behavioral organization, mother-child interaction, and extending to vision, hearing, feeding, and vocalization. Stimulation was given for at least one hour a day, according to the infant feeding and sleep- time schedules. Infants were reviewed every month. It was emphasized that, aside from the training programs, the infant requires the affection and care of the family members.

2.3. Neurologic Examination.

The Amiel-Tison²⁶ test was performed by a pediatric therapist, with the infant undressed and awake but quiet. Hypertonia or hypotonia were looked for by measuring the adductor angle, popliteal angle, ankle dorsiflexion, and scarf sign. Any asymmetries between the extremities were recorded.

2.4. Denver developmental screening test (DDST)

The Denver Developmental Screening Test is a simple, clinically useful tool for early detection of infants with developmental delay²⁷. The test comprised of 125 items, divided in to four domains: gross motor, fine motor/adaptive, language and personal social. The levels of achievement were scored as Advanced, ok/pass, caution and fail depending on the age line²⁸. The milestones assessment was done according to the corrected age, often calculated prior to developmental assessment for a more accurate comparison of the developmental status⁴. The date of assessment and the infant corrected age were mentioned against each milestone

III. Data Analyses

In order to examine the effectiveness of early interventional therapy, it is proposed to apply the Chi-square test of independence to examine whether the level of achievement depends up on the early interventional therapy. Also to compare the effectiveness of the therapy over the level of achievement in the EI group and NEI, the “Z” test for the equality of proportions is applied²⁹.

IV. Results

The age of each infant in both groups was corrected for comparison, and the last examination for the objectives of this study was performed at 6 months of corrected age. No differences in age, socioeconomic features, and examination results were observed at the first examination. Significant differences between groups were observed with better performance in EI than NEI group after 6 months.

4.1. Neurologic Examination

In the initial assessment, infants of 86% were suspected of neurologic abnormalities, while 14% exhibited a normal result. Six months later at the second examination, in NEI infants 12.5% present a normal result, while 87.5% had suspicion of neurologic abnormalities. In EI Group, all infants had a near normal result at sixth month. Significant differences between groups were observed with better performance in EI than NEI group

4.2. DDST

With a view to examine the impact of the EI therapy for improving the level of achievement in gross motor, fine motor/adaptive, personal social and language domains of preterm LBW infants, the Chi-square test of independence is carried out. The results obtained are given in **Table 1**. The null hypothesis to be tested is H₀: The level of achievement in all domains is independent of the EI and NEI preterm LBW infants.

TABLE 1 -Level of achievement in all domains in Early Interventional (EI) and Non-Interventional (NEI) infants

Domains	Interventional (EI)/ Non-Interventional (NEI)	Level of achievement (%)			
		Advanced	Ok	Caution	Fail
Gross motor	EI	33.3	35	23.3	8.4
	NEI	12.5	15	37.5	35
Fine motor	EI	25	41.7	20	13.3
	NEI	15	10	37.5	37.5
Personal social	EI	18.3	41.7	28.3	11.7
	NEI	12.5	10	25	52.5
Language	EI	16.7	45	23.3	15
	NEI	12.5	10	27.5	50

From the results obtained the following conclusions could be drawn,

The chi-square statistic value for the gross motor domain data is =18.37 with a corresponding P=0.004. Since ‘P’ value is <0.05, the Chi-square statistic is significant and hence the null hypothesis is rejected. It implies that the level of achievement in gross motor domain is influenced by early interventional therapy. In the case of fine motor, personal social & language domains also the chi-square value is significant, and the level of achievement in these domains is also influenced by the early interventional therapy. Therefore the interventional therapy is useful in getting higher level of achievement.

It is further proposed to examine whether there is any significant difference between the proportions of preterm LBW infants with regard to each level of achievement in all domains, the ‘Z’ test for the equality of proportions is used. The null hypothesis to be tested is the proportion with the level of achievement in all domains differs significantly between the EI and NEI. So the null hypothesis is given as H0:P1=P2, where P1&P2 refer to the population proportions of the two groups. The following **Table 2** gives the ‘Z’ statistic values with their level of significance as well as the proportion of two groups of infants achieving the desired level of improvement in all four domains.

From this table, following conclusions can be drawn. There is a significant difference in the proportion of infants achieving advanced level of improvement in gross motor domain, similarly in the case of ok and delay. But there is no significant difference in the proportion of caution group.

Table 2 – ‘Z’ statistic values with their level of significance as well as the proportion of two groups of infants achieving the desired level of improvement in all four domains

Domains	Interventional (EI) n=60	Non-Interventional (NEI) n=40	z	P1	P2
Gross motor					
Advanced	20	5	2.32*	0.33	0.125
O k	21	6	2.25*	0.35	0.15
Caution	14	15	1.64	0.23	0.38
Fail	5	14	3.41*	0.08	0.35
Fine motor					
Advanced	15	6	1.20	0.25	0.15
O k	25	4	3.41*	0.08	0.35
Caution	12	15	1.97*	0.2	0.37
Fail	8	15	2.85*	0.13	0.37

Personal social					
Advanced	11	5	0.74	0.18	0.125
O k	25	4	3.4*	0.08	0.35
Caution	17	10	0.33	0.28	0.25
Fail	7	21	4.46*	0.116	0.52
Language					
Advanced	10	5	0.56	0.166	0.125
O k	27	4	3.72*	0.45	0.1
Caution	14	11	0.51	0.23	0.27
Fail	9	20	3.77*	0.15	0.5

* Significant

1. The % or proportion of babies with advanced level of achievement is higher in the EI group when compared to the same for the NEI group. Therefore the interventional strategy contributes to the level of achievement in gross motor domain.
2. In the case of fine motor domain the difference is not significant between the proportion of the two groups with the advanced level of achievement.
3. A similar conclusion can be drawn in the case of personal social as well as language domains. So having advanced level of achievement is found to be a difficult task for even the EI group with regard to fine motor ,personal social & language domains .It may be concluded that the proportions of infants under the caution group both in EI and NEI groups do not show a significant improvement in all the domains except in fine motor.

V. Discussion

We studied the effects of intensive EI in selected sample of high risk infants from neonatal period to 6months of age. We found differences in neurologic and developmental outcome between EI and NEI infants, with a better performance in the EI infant group. The study suggests a positive effect of EI on neurodevelopment when compared with results from the NEI group.

“Early” can be understood in several ways, for example: 1) early after birth; 2) early in the first year of life; and 3) early after onset of the condition. Each intervention type is associated with advantages and disadvantages .Very early treatment are intervention provided for infants who are at risk for neuromotor disorders, and treated as soon as possible to minimize future handicaps³⁰.CDC model of ‘early stimulation therapy’ was effective at one year. The beneficial effect also persisted at 2 years, without any additional interventions. A reduction of 40% in poor performance could be achieved by EI in LBW babies in Trivandrum³¹.

EI have been carried out in the NICU, after hospital discharge, or may initiate during the second semester of life^{19,32,33,34} .But in our study we began EI during newborn period itself before hospital discharge .Various studies suggested that children who were born prematurely are discharged from the NICU were still at risk for future developmental disabilities^{35,36} ,this necessitates systematic monitoring, follow-up, and early intervention services . In our study, we initiated early intervention right from the neonatal period itself and continued during the first 6 months of life by reviewing infants every month in EI group. NEI group were also advised to take EI for their infants, but they did not turn up for early interventional therapy.

In our study in the initial assessment of neurological examination, infants of 86%were suspected of neurologic abnormalities, while 14%exhibited a normal result. Six months later at the second examination, in NEI infants 12.5%present a normal result, while 87.5%had suspicion of neurologic abnormalities. In EI Group, all infants had a near normal result at sixth month. So significant differences between groups were observed with better performance in EI than NEI group

A difference in developmental items was observed when comparing infants under EI group with those of NEI group. The level of achievement in gross motor, fine motor, personal social and language domains of preterm LBW infants is influenced by the early interventional therapy in EI group. It is therefore suggested that the use of early interventional therapy will help in the process of achieving higher level of achievement in different domains of preterm LBW infants.

In our study, EI therapy helps in the process of achieving higher level of achievement in gross motor domain, similar studies ^{37, 38, 39} is in agreement with our result.

The difference between the proportions of preterm LBW infants with regard to each level of achievement in all domains was examined. In the gross motor domain there is a difference in infants achieving advanced, ok and delay level of achievement. But there is no significant difference in caution level of achievement. The advanced level of achievement is higher in gross motor domain of EI group when compared

to the same for the NEI group. Therefore the interventional strategy contributes to the level of achievement in gross motor domain.

In the case of fine motor domain the difference is not significant between the two groups with the advanced level of achievement. A similar conclusion was drawn in the case of personal social and language domains. So having advanced level of achievement is found to be a difficult task for even the EI group with regard to fine motor ,personal social & language domains .

We conclude the infants under the caution group both in EI & NEI groups do not show a significant improvement in all the domains except in fine motor. Our data attributed to the most intensive EI program .Moreover; the training facilitated the mother-infant relationship. It was emphasized that, aside from the training programs, the infant requires the affection and care of the family members.

Although our follow-up time was short, our results hold the promise of good outcome in the neurodevelopment of high-risk infants. In **summary**, comparison between the EI and NEI premature LBW infants, the early interventional therapy helps in the process of achieving higher level of functions in different domains.

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Impact Of Early Physiotherapy Intervention On Neurodevelopment In Preterm Low Birth Weight

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