

Effect of early intervention in the developmental outcome of hypoxic ischemic encephalopathy infants

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Abstract:

Background: Neonatal brain injury due to intrapartum asphyxia is a significant cause of cerebral palsy, mental retardation, and epilepsy. Despite advances in perinatal care over the past three decades, the incidence of cerebral palsy attributed to birth asphyxia has not changed. In developing countries, the incidence of post asphyxiate neurological damage is particularly high.

Objectives: To study the developmental outcomes of hypoxic ischemic encephalopathy infants by early physiotherapy intervention till one year

Methodology: This study had conducted on 48 asphyxiated full term newborn infants who developed Hypoxic-Ischemic Encephalopathy (HIE) admitted in Neonatal Intensive Care Unit (NICU) of Rajah Muthiah Medical College & hospital. The studied infants have classified on the basis of Sarnat and Sarnat staging of HIE into 3 stages, and they were given early intervention. Denver developmental screening test have administered to infants every four months till one year. The level of achievement of various developmental domains in among various stages of HIE early intervention infants were compared.

Results: We found improvement in the level of achievement of developmental domains in various stages of birth asphyxia infants with a better outcome in stage I HIE infants.

Conclusion: The early interventional program on HIE infants in the neurodevelopmental outcome after one year of age investigated in this study was efficacious in infants who participated in the study.

Keywords: Birth asphyxia, Hypoxic ischemic encephalopathy, Early physiotherapy intervention, Developmental outcome

I. Introduction

According to the World Health Organization (WHO), four to nine million cases of newborn asphyxia occur each year.¹ The incidence of birth asphyxia ranges from 0.3/1000 in a Swedish study² to 36.6/1000 live birth infants in an Indian study.³ In spite of significant advances in monitoring technology, obstetric care and knowledge of foetal and neonatal pathologies, asphyxia remains a serious condition causing significant mortality and long-term morbidity.⁴ More than a million newborns who survive asphyxia at birth develop long-term problems such as cerebral palsy, mental retardation, speaking, hearing, visual and learning disabilities.¹ An early intervention (EI) could improve neuro-developmental outcomes in survivors of birth asphyxia. Early detection of infants at high risk is of paramount importance, to assess their developmental status and for planning intervention so that secondary problems can be avoided.

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 functioning⁵. EI promotes child health, minimize developmental delays, cures existing disabilities, prevents functional deterioration, and promotes parent-child interaction⁵.

Little work had done on neurodevelopmental outcomes of babies surviving birth asphyxia in developing countries.⁶ Very few studies had done on the outcome of asphyxiated infants. Various studies on the outcome of neonatal asphyxia have documented, but high-risk follow up programs specifically for physiotherapists have not been widely reported or studied.⁷ No physiotherapy generated studies on the neurodevelopmental outcome and/or follow up of asphyxiated infants could be found except the study by Robertson and Finer.⁸ Involvement of physiotherapist in the immediate and long-term assessment, and follow up of the asphyxiated infant remains largely unexplored. By reviewing various studies, there is no uniformity exists regarding inclusion criteria, methods, assessors or the period of follow up.⁹⁻¹² This resultantly makes it extremely difficult to compare the outcomes of these studies with each other. Thus, we employed to study the effects of EI in the neurodevelopment of Birth asphyxia infants followed till their one year of age.

The goal of this study is to measure the effect of EI program in various stages of HIE infants. The hypothesis is that HIE infants under EI will not achieve the developmental domains equal to normal infants. The clinical staging of Sarnat and Sarnat has been widely used as a staging examination to estimate the severity of the hypoxic ischaemic insult in infants. DDST comprising of gross motor, fine motor, personal social and language domains have used prospectively to evaluate the effects of EI on their neurodevelopment during follow-up in the first year of life.

II. Methods

Samples: Asphyxiated full term newborn infants who developed HIE admitted in NICU of RMMC & H has recruited for the study (Experimental group). Fifty full term normal newborn infants served as the control group. Sarnat and Sarnat criteria for clinical encephalopathy have used to infants of 36 or more weeks of gestation to determine the degree of neuronal injury based on the infant's symptoms.

The studied infants have classified on the basis of Sarnat and Sarnat staging of HIE into the following 3 groups ; Group I (stage I HIE) included 8 infants , Group II (stage II HIE) included 32 infants and Group III (stage III HIE) included 9 infants . Fifty healthy full term newborn infants' age and weight matched served as control.

Inclusion criteria: For study group, term newborn infants completed 37 week of gestation with Apgar score <7 at 5 min, and clinical signs of asphyxia have included. For the control group, term newborn infants with no maternal illness, Apgar score >7 at 5 min, and uneventful clinical course during the first 3 days of life have included.

Exclusion criteria: Infants with Gestational age < 37, perinatal infection, congenital anomalies or metabolic disorders and those who did not complete the course of the follow up had excluded.

Early Intervention

Early Intervention has initiated for high risk infants right from the neonatal period after the babies became stable. Early intervention applied remarkably to HIE infants in order to arouse their actions and feelings ultimately giving them a normal experience of development through interaction with the mother and environment.⁵ Individually adjusted program had described to the parents (especially to the mother) who have trained and received written programs elaborated for their infants. This program contains intensive schedules to develop elementary sensorimotor patterns. Also individualized care plans, centered on the infant behavioral organization; mother child interaction and extending to vision hearing feeding and vocalization. Stimulation had given for at least one hour a day according to the infant feeding and sleep time schedule. Infants had reviewed every month. It have emphasized that aside from the training programs the infant requires the affection and care of the family members. Infants assigned to study group received regular early interventional therapy.

Denver developmental screening test (DDST)

The Denver developmental screening test is an easy clinically useful tool for the early detection of infants with developmental delay¹³. The test comprised of four domains namely gross motor fine motor/adaptive language and personal social. The level of achievement has scored as advanced, ok/pass, caution and fails depending on the age line.

Data Analyses

It was proposed to examine whether the average level of various developmental domains achievement differ significantly between the 3 stages of BA infants. To examine the null hypothesis H_0 : The average scores of various developmental domains achievements do not differ significantly between the infants belonging to the 3 stages, due to the given early intervention. For this purpose the non-parametric test namely Kruskal-wallis one way ranked analysis of variance procedure^{14,15} was adopted.

III. Results

Birth Asphyxia infants were categorized in to 3 stages namely stage I, Stage II and Stage III. Early intervention was given to these infants from birth. The level of achievement in various developmental domains of these EI Infants was assessed after 4th 8th and 12th month.

According to Sarnat and Sarnat staging of HIE, The study included 8 newborn infants with stage I HIE (group I), 32 newborn infants with stage II HIE(group II) and 9 newborn infants with stage III HIE(group III);

and 50 healthy full term newborn infants as control . All study infants were age and weight matched with no statistical difference regarding their gestational age and the birth weight.

The level of achievement in various domains of these EI Infants was assessed after 4th 8th and 12th months. It was proposed to examine whether the average level of various domains achievement differ significantly between the 3 stages of BA infants. To examine the null hypothesis Ho: The average scores of various domains achievements do not differ significantly between the infants belonging to the 3 stages, due to the given early intervention. For this purpose the non-parametric test namely Kruskal–wallis one way ranked analysis of variance procedure was adopted. The mean value of the level of achievement in gross motor, fine motor, personal social, language developmental domain at 4th 8th and 12th month of various stages of HIE infants are given in table 1.

Table-1: Mean values of all domains achievement at 4th 8th and 12th month

Gross motor domain

Stages of BA	Mean values		
	4 th month	8 th month	12 th month
I	3.000	3.512	3.875
II	2.069	2.806	3.548
III	1.000	1.11	1.33

Fine motor domain

Stages of BA	Mean values		
	4 th month	8 th month	12 th month
I	3.000	3.509	3.75
II	2.054	2.774	3.451
III	1.000	1.000	1.222

Personal social domain

Stages of BA	Mean values		
	4 th month	8 th month	12 th month
I	3.000	3.500	3.62
II	2.064	2.709	3.322
III	1.000	1.000	1.141

Language domain

Stages of BA	Mean values		
	4 th month	8 th month	12 th month
I	3.000	3.500	3.821
II	2.044	2.700	3.129
III	1.000	1.000	1.060

From the table, there is a significant difference in the average level of achievement of developmental domains in various stages of HIE after 4th 8th and 12th months of intervention. It is also seen that for the BA infants under stage I, the average level of improvement is more when compared to other stages of BA infants. Therefore, for the infants with BA the EI is able to give greater achievement in language domain in stage I BA and to some extent in stage II BA when compared to stage III BA infants.

IV. Discussion

We studied the effects of intensive EI in selected sample of HIE infants from neonatal period to 12 months of age. We found a better performance in the EI infant group and narrowing in the developmental outcome by one year in comparison with that of normal infants. The study suggests a positive effect of EI in the developmental outcome of BA infants.

Perinatal asphyxia and resulting hypoxic ischemic encephalopathy (HIE) occur in 1 to 3 per 1000 births in the United States. Higher rates occur in developing countries with limited diagnostic and interventional resources. ¹⁶The survivors will have long- term neurodevelopmental sequelae. ¹⁷ Hypoxic ischemic encephalopathy is the primary cause of 15% to 28% of cerebral palsy among children. Perinatal asphyxia progresses to HIE based on the degree of brain injury and resulting clinical presentation. ¹⁸It has estimated that an equal or larger proportion of survivors suffer brain damage resulting in mental retardation and cerebral palsy.

At neonatal follow-up clinics, a large proportion of infants with developmental delays or cerebral palsy retrospectively have a history of birth asphyxia. ¹⁹The effects of asphyxia on long-term developmental outcome are greater in term infants which concurs the study. ²⁰

Early intervention programs (EIP) improve the neurodevelopmental outcomes in survivors of birth asphyxia. By early intervention the level of achievement of all developmental domains has improved. In addition, the present study revealed gestational age particularly post-term gestation significantly associated with HIE. The small for gestational age (SGA) infants showed a slightly increased risk, but this difference was not statistically significant. In the present study Apgar scores observed at 5-minute Apgar scores were significantly lower in HIE infants than normal infants. One can anticipate that a 5-minute Apgar score of 3 or less is highly indicative of severe perinatal asphyxia and a strongly predictive risk for HIE.

It had emphasized that, the importance of neurodevelopmental assessment and follow up of asphyxiated infants should include neurological as well as developmental testing. The role of the neurodevelopmental assessment is to assess the integrity of the musculoskeletal system, searching for any abnormality in movement. For the purpose of this study, both neurological and developmental assessment have included in the data form.

The frequently observed major and minor neurodevelopmental impairments in asphyxiated infants is motor impairments, visual impairments, hearing impairments, cognitive and learning impairments.²¹ Any infant who suffered a significant asphyxia episode should be monitored closely for developmental difficulties after hospital discharge. The aim of regular monitoring is to identify, as early as possible, presence of developmental delays and the signs of future disability ensuring the provision of appropriate services and support to the infant and their families. Follow up of all moderately to severely asphyxiated infants have suggested, neurodevelopmental screening on its own had viewed sensitive in identifying infants in need of intervention and early intervene them at the earliest.

V. Conclusion

The early intervention on HIE infants after one year of age in the neurodevelopmental outcome investigated in this study was efficacious in infants who participated in the study.

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