Research Article

Neurodevelopmental outcome of high-risk newborns discharged from NICU in a tertiary-care hospital of western India

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Abstract

Background: High-risk newborns are most susceptible to acquire neurodevelopmental delay (NDD). Prior finding of delay in this group and identification of related perinatal factors and their inhibition can avoid incapacity in future life.

Objective: To assess the level of NDD using standard scale and establish an association between the risk factors and level of developmental delay.

Materials and Methods: This prospective, observational study was conducted at neonatal intensive care unit (NICU) of a tertiary-care hospital in Ahmedabad city, Gujarat, India. Hospital-based tracking and neurodevelopmental screening of high-risk newborns discharged between January 2010 and June 2012 from a NICU of teaching hospital was carried out. It was conducted by a team of developmental specialists, using standardized tools such as Denver Developmental Screening Tool II and Trivandrum Developmental Screening Chart. Associated perinatal factors were identified. Early intervention was initiated on those detected with NDD.

Result: Developmental delay was detected in 50% of study population. Of the 25 with developmental delay, 16 were preterm, 12 low birth weight (LBW), with history of sepsis in 24, birth asphyxia in 8, and jaundice in 24 neonates. Prevalence of NDD was significantly higher in babies of LBW, preterm babies, and in babies with history of asphyxia at birth.

Conclusion: Incidence of NDD among high-risk newborns is significantly high, with LBW, prematurity, and birth asphyxia being major contributors. Most NDDs go undetected in the early years of life. Improved perinatal care, early detection, and early intervention at the grass-root level will bring down incidence of developmental challenges in this vulnerable group.

KEY WORDS: High-risk newborn, developmental delay, early detection of delay

Introduction

Progresses in neonatal medicine have eventuated in heightened survival of infants at very low birth weight (LBW). While these medical success stories bring to light the strength of medical technology to rescue numerous tiniest infants at birth, serious questions prevail about how these infants will grow and whether they will lead normal, productive lives. LBW children can be born at term or before term and show varying degree of other medical and social risk factors. LBW children exhibit varied outcome, generally show higher rates of subnormal growth, illnesses, and developmental problems. These problems increase as birth weight decreases. Impaired neurodevelopmental outcome is a major long-term complication of surviving premature infants, especially extremely premature infants who are born at or below 32 weeks gestation.[1,2] Premature infants are at risk of major and minor deficits, such as cerebral palsy, cognitive and speech delays, motor and visual deficits, psychosocial and behavioral disorders,

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and dysfunction at school.[3–7] With the exception of a small minority of LBW children with mental retardation and/or cerebral palsy, the developmental sequel for most LBW infants includes mild problem in cognition, attention, and neuromotor functioning such as depression and ADHD. Long-term follow-up studies conducted on children born in the year 1960 indicated that the adverse consequences of being born with LBW were still apparent in adolescence.

Very often, their problems are identified quite late, may be at school age, when only some rehabilitation measures can be taken and which do not bring out the best in the child. Such issues are of paramount importance to the average Indian parent. Timely and appropriate intervention can prevent or modify many of these disabilities. The neonates at increased risk of neurodevelopment disability can be identified by assessing certain perinatal risk factors and the course of their illness postnatally: a structured plan of follow-up can then be designed for them in order to assess their developmental status and identify delay at the earliest, using simplified developmental assessment tools such as the Trivandrum Developmental Screening Chart (TDSC) or the Denver Developmental Screening Test (DDST) even by general pediatrician. Now, in modern days, focus of care is shifting from merely survival to intact survival of the infants. Early identification of developmental delay and early stimulation and intervention to give better neurological outcome and, hence, a better quality of life has become the need of the hour.

In India, unfortunately, there is not enough awareness about the abovementioned facts and that neurodevelopment assessment has long been considered the domain of pediatric neurologist, and general pediatricians often fail to recognize the delay that had begun to set in the neonatal intensive care unit (NICU) graduate that had come to him for various medical problems. This opportunity is big one to miss because, it was at this point, if early intervention done to modify social and psychosocial environment of the infant would have made a large difference to his eventual neurodevelopment outcome.

This study was carried out with objective to assess the level of neurodevelopment delay (NDD) using standard scale and establish an association between the risk factors and level of developmental delay.

Materials and Methods

This prospective, observational study was conducted in a tertiary-care hospital at Ahmedabad city, Gujarat, India. Neonates admitted in NICU in this institute during the year 2011 were followed up for the next 1 year. Neonates with life threatening, gross congenital anomalies were excluded from the study. Prenatal and postnatal risk factors were assessed among study participants. Each neonate was inquired for antenatal risk factors, and postnatal risk factors were assessed during their NICU admission. For each neonate, total number of risk factors was enlisted, and total risk score for each neonate was calculated. Those with total risk score of ≤5 were considered to be at low risk, scores 6–9 were considered moderate risk, and those with >9 were considered to be at high risk of NDD. The enrolled babies were called for follow-up at 3, 6, 9, and 12 months. At each visit, infant's weight, length, and head circumference were measured. Developmental screening was performed using TDSC: this is a simple screening tool with 17 items covering the motor, cognitive, and language domains of development, based on Bayley developmental screening tool, developed and validated in India.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using Epi info 7.1. Frequency was used to show the distribution of participants and risk factors distribution among them. Appropriate tests were used to analyze qualitative and quantitative data accordingly.

Result

A total of 150 babies were enrolled in the study initially, of which 50 babies were followed up completely for a duration of 1 year. There were 52% boys and 48% girls in the study. Of these participants, 70% were delivered vaginally. Eight neonates revealed birth weight more than 2.5 kg, and three (6%) neonates showed very LBW. Among study participants, 30% neonates were term neonates, and six (12%) neonates were born before 30 weeks of gestation [Table 1].

About 10% babies showed none of the antenatal risk factors that were included in this study. Consanguinity among parents was seen in about half of the study participants. Pregnancy-induced hypertension (50%) and severe preeclampsia/eclampsia formed the major chunk among antenatal risk factors. Thirty percentage of mothers experienced a previous abortion, and most of them were in the first trimester of pregnancy. In this study, when total score was calculated for each baby depending upon the antenatal and postnatal risk factors, 12% babies fell in mild risk category for NDD. About 48% neonates fell in moderate risk category, while 40% fell in to severe-risk category [Table 2].

The mean time required for assessment of babies using TDSC was 2.79 ± 1.3 min. When babies were assessed for neurodevelopment by TDSC, 50% babies showed delay in development. In Table 3, we can see that, of those classified as being at mild risk of NDD, none showed NDD when assessed by TDSC method. Of twenty-five babies who showed developmental delay, most of them fell in severe risk category. This higher-risk category assigned by antenatal and postnatal risk factors show significant association with chances of development of NDD.

Fourteen of seventeen babies (82.3%) with birth weight of < 1.5 kg. showed some degree of NDD, while only 33.3% of babies whose weight was more than 1.5 kg revealed NDD. This difference is statistically significant. Eighty percentage of the babies who were born at gestational age <32 weeks of

Table 1: Baseline variables of the study population

Variable	Number	Percentage
Sex		
Male	26	52
Female	24	48
Birth weight (kg)		
≥ 2.5	8	16
1.5–2.499	28	56
1–1.499	11	22
≤1	3	6
Gestation period (weeks)		
≥37	15	70
<37	35	30
Type of delivery		
Vaginal	35	70
Cesarean section	15	30
Neurodevelopment assessment by TDSC		
NDD present at 1 year	25	50
NDD absent at 1 year	25	50

Table 2: Distribution of risk factors among study participants

	Frequency	Percentage
Antenatal risk factor		
Deaf parent	1	2
Consanguinity	13	26
Mental retardation in parent	1	2
Previous abortion/miscarriage	15	30
Neonatal death in family	4	8
Infertility treatment taken	8	16
Developmental delay in sibling	1	2
Hypertensive mother on drugs	25	50
Severe preeclamptic toxemia to mother	16	32
Diabetic mother on insulin	0	0
Postnatal risk factor		
Sepsis	42	84
Jaundice	45	90
Respiratory distress	25	50
H/o mechanical ventilation	18	36
Hypoglycemia	15	30
Hypocalcemia	4	8
Hypoxic ischemic encephalopathy	9	18
Early circulatory failure	3	6
Abnormal neurological examination at discharge	8	16
Nonlife-threatening GCA/CHD	11	22
Risk category (risk score)		
Mild (≤5)	6	12
Moderate (6–9)	24	48
Severe (>9)	20	40

Table 3: Assessment of neurodevelopmental delay by different risk category

Risk category	No neurodevelopmental delay by TDSC, *n* (%)	Neurodevelopmental delay by TDSC, *n* (%)	*P*
Mild	6 (24)	0 (0)	<0.001
Moderate	16 (64)	8 (32)	
Severe	3 (12)	17 (68)	

Table 4: Effect of variable on neurodevelopmental delay

	No neurodevelopment delay, *n* (%)	Neurodevelopmental delay, *n* (%)	*P*
Perinatal hypoxia			
Present	1 (11.1)	8 (88.9)	<0.05
Absent	24 (58.5)	17 (41.5)	
Gestational age (weeks)			
<32	4 (20)	16 (80)	<0.05
≥32	20 (66.7)	10 (33.3)	
Birth weight (kg)			
<1.5	3 (87.7)	14 (82.3)	<0.05
≥1.5	22 (66.7)	11 (33.3)	

gestation age revealed NDD. Gestational age showed statistically significant association with neurological development. In this study, eight of nine babies (88.9%) who showed perinatal asphyxia and subsequent hypoxic ischemic encephalopathy (HIE) as judged clinically using Leven's criteria were found to show NDD, while in others, 17 of 41 babies (41.5%) developed NDD. Thus, the association between the HIE and NDD were found to be statistically significant [Table 4].

Discussion

In our study population, we have noticed a sex predilection with a male preponderance, which is also reflected in the children identified with developmental delay. The difference in care seeking for male and female newborns and children probably shows the gender bias prevalent among the families who are more concerned about the survival and well-being of male offsprings than the females, rather than an actual difference in neurodevelopmental outcome among male and female babies.

In our study, most of the neonates fell into moderate and severe risk categories, while in the study by Chaudhari,[8] it was found that 70% of their babies were in the low-risk category. In our study, consanguinity was high among parents of participants than general population. This high level of consanguinity is explained by major patients in our hospital being from Muslim community. This is probably because the sample population was collected from a tertiary-level NICU, where more number of high-risk babies is likely to be admitted.

The prevalence of developmental delay among NICU graduates is found to be quite high (50%), which is higher to the 29% incidence reported by Calame et al.[9] A systematic review of 153 studies across the globe, documenting 22,161 survivors of intrauterine or neonatal insults showed an overall median risk of at least one sequela in any domain as 39.4%.[10]

In this study, LBW and prematurity were found to be the major contributory factors for NDD. Maximum incidence of developmental delay was noted in babies with birth weight between 1.5 and 2.0 kg, with a sharp decline in incidence in babies weighing >2.5 kg at birth. Incidence of developmental delay is also significantly higher in preterm babies, than in term babies, which is supported by similar results noted in other studies.[11–14] This is because developing brain of premature infant is extremely vulnerable to injury, and if they are exposed to any adverse condition, they are more prone to developmental delay. In our study, the association between the HIE and NDD was found to be statistically significant. These results were comparable with the observation made by Carli et. al.,[12] where 72% babies presenting HIE showed severe NDD. Improvement of gestational age at birth and birth weight will help in curbing the incidence of developmental delay.

This study had involved a faculty from pediatric department for assessment of neurological development; so, there is proper assessment and less chance of error. The study was done on limited number of participants; so, study will be replicated with more number of participants so that it will strengthen the results of study.

Conclusion

Incidence of NDD among high-risk newborns is significantly high, with LBW, prematurity, and birth asphyxia being major contributors. Most NDDs go undetected in the early years of life. Improved perinatal care, early detection, and early intervention at the grass-root level will bring down incidence of developmental challenges in this vulnerable group.

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