ICMH Journal 2020; 11(1): 22–26

Original Article

Neurodevelopmental Impairments in High-Risk Neonates of a Tertiary Care Hospital

Laila Areju Man Banu[1], Shaheen Akhter[2], Kanij Fatema[3], F.M. Anamul Haque[4], Ifthakhar Ahmed[5], Mahbub Ahmed[6]

Abstract

Background: *High-risk neonates are most vulnerable to developing neurodevelopmental disorders. Early identification and intervention can modify brain development and improve the outcome in neonates at risk for neurodevelopmental disorders. So, it is important to identify neurodevelopmental disorders as early as possible in this risky group of children.*

Objective: *To observe neurodevelopmental disorders(NDD) among high-risk neonates during discharge from NICU.*

Methods: *This observational study was conducted in a tertiary care center in Bangladesh.A total of 85high-risk term neonates were included in this study. After detailed history and clinical examination, the neurodevelopmental assessment was performed using Rapid Neurodevelopmental Assessment Tool (RNDA).*

Result: *Among the enrolled 85 neonates, neurodevelopmental impairments (NDI)were found in 64.7% of neonates. Seizure was present in 49.4% of cases. Most frequently affected domains were cognition (48.2%), behavior (47.1%), hearing (45.9%), gross motor (41.2%), vision (42.3%) and speech (42.3%).The most severely affected domains were fine motor (22.4%) and seizure (25.9%).*

Conclusion: *NDDs are common sequelae of high-riskneonates. The frequency of NDIs was 64.7% of which cognition and seizures were most frequently involved.*

Keywords: *Neurodevelopmental impairments (NDIs), Rapid neurodevelopmental assessment (RNDA), High-risk neonates.*

Authors:

1. Consultant, Paediatrics, Bangabandhu Sheikh Mujib Medical University (BSMMU).
2. Professor, Department of Pediatric Neurology, Director, Institute of Paediatric Neuro disorder and Autism (IPNA), BSMMU
3. Associate Professor, Department of Pediatric Neurology, BSMMU
4. Associate Professor, Department of Obstetrics and Gynaecology, Institute of Child and Mother Health (ICMH), Dhaka.
5. Assistant Professor, Department of Pediatrics, ICMH, Dhaka
6. Registrar, Department of Pediatrics, ICMH.

Correspondence: Laila Areju Man Banu. Consultant Paediatrics, BSMMU.
E-mail: drlailak54dmc@gmail.com.

Introduction

Neurodevelopmental disorders are conditions characterized by impairments of brain functions in cognition, communication, behavior, and/or motor skills resulting from abnormal brain growth and development.[1] Neurodevelopmental impairment (NDI) may express in various forms, including mental retardation, cerebral palsy, autism, attention deficit disorders, visual and hearing problems, speech and language disorders, learning disabilities, and many more.[2]

According to a report by Lancet, globally 52·9 million children younger than 5 years had developmental disabilities in 2016 and about 95% of these children lived in low-income and middle-income countries.[3] Data from a meta-analysis have shown that the median pooled prevalence per 1,000 for neurodevelopmental disorders was 7.6 in low and middle-income countries.[4] Prevalence is highest in South Asia.[3] Data regarding neurodevelopmental impairment among infants is scarce in Bangladesh.

With improved neonatal intensive care, neonatal mortality rate continues to decline but developmental challenge is now an emerging problem across the globe. Many critically ill neonate survive with brain damage and leads to ultimate developmental disability.[2] Babies who had asphyxia , hypoxic ischemic encephalopathy, severe infections in early period of life, born preterm, severe jaundice and required prolonged intensive care during neonatal period are at high risk of developing different neurodevelopmental disabilities.[5] It is estimated that worldwide, 18.5% of neonates who survive complications experience NDI.[6] An estimated 20% of infants are born prematurely in Bangladesh, and 30% have low birth weight and thus have high risk for developing NDI.[7]

Thus, neurodevelopmental assessment of high-risk neonates is essential for early detection of developmental disorder and to prevent or restrict disability through early intervention.[8] The Rapid Neurodevelopmental Assessment (RNDA) is a comprehensive assessment procedure for ascertaining neurodevelopmental status of children aged 0 to 16 years in a developing country. RNDA is able to determine functional status in the following domains: primitive reflexes, gross-motor, fine-motor, vision, hearing, speech, cognition, behavior, and seizures.[9]

In Bangladesh there is high prevalence of risk factors which puts large number of children at risk for NDIs and disabilities. Therefore, the aim of this study was to assess the neurodevelopmental status of high-risk neonate discharged from NICU.

Methods

This observational study was conducted at the Department of Neonatology, Bangabandhu Sheikh Mujib Medical University (BSMMU) and the Department of Pediatric Neurology, BSMMU from July 2019 to June 2020. Permission from the ethical committee of the institutional Internal Review Board (IRB) was obtained. High risk, term neonates who were admitted in department of neonatology were included in this study by purposive sampling. The risk factors taken as inclusion criteria were history of delayed cry (>1 minute) after birth, low birth weight, small for gestational age, neonatal seizure, jaundice, septicemia, prolong NICU admission (>14 days) and pneumonia. Though preterm babies are at high risk for developing NDIs, in this study preterm babies were excluded as they need additional follow up and chance of drop out is more.

An informed written consent was taken from a parent of each child. A detailed history of prenatal, perinatal and postnatal period was taken from each of the participants. Prenatal and postnatal risk factors were assessed among study participants. General physical examination and anthropometry was carried out for each neonate.

Neurodevelopmental assessment was done using the RNDA tool. For neonatal assessment age specific form 0 to < 1month was used. Items were arranged under the following developmental domains: primitive reflexes (for 0 to < 1 month), gross motor, fine motor, vision, hearing, speech, cognition, behavior, and seizures. Neonates were assessed on all age-appropriate items in each domain. For every item, severity of functional limitations was also determined. At the end of assessment, a summery sheet was completed, and impairment was graded as mild, moderate and severe. Data were collected using a pre-designed data collection sheet. Statistical analysis was performed using Statistical Package for Social Science (SPSS) version 22 (SPSS Inc., Chicago, Illinois, USA).

Results

Total 85 high risk term neonates were taken as study subject. Most of the neonates 60(70.6%) were assessed between 8-14 days of age. More than half of the participants44 (51.7%) had low birth weight (<2500gm). Males were predominant 50(58.8%) in the neonates.

Among 85 study neonates, neurodevelopmental impairments were identified in 55(64.7%) neonates by RNDA. Among the neonates with NDIs, maternal illness was observed in 28 (50.9%) mothers and prolonged labour in 36 (65.45%) mothers. Neonatal insult like perinatal asphyxia was observed in 37 (67.27%) cases, low birth weight was in 32 (58.18%)cases, seizure in 38 (69.09%) cases, neonatal sepsis in 20 (36.36%) and neonatal jaundice in14 (25.45%) cases (Table I). Frequency of neonates identified with NDIs and their severity grading is shown in Table II. Regarding the NDI, most frequently affected domains were cognition (48.2%), hearing (45.9%), behavior (47.1%), gross motor (41.2%), vision (42.3%) and speech (42.3%) (Table II). About half of the study subject had seizure (49.4%). In respect of severity, most severe impairments were observed in fine motor development, primitive reflex and seizure(Table II).

Table I:Risk factors for development of neurodevelopmental impairments (NDI) among study neonates

Risk Factors	Total n (%)	Neurodevelopmental Impairments(n=55)
Consanguinity	9 (10.6)	3 (5.4)
Maternal problem		
Maternal illness	39 (45.9)	28 (50.9)
Drug in 1st trimester	16 (18.8)	10 (18.18)
Trauma	14 (16.5)	8 (14.54)
Prolonged labour	50 (58.8)	36 (65.45)
Neonatal problem		
Low birth weight	44 (51.7)	32 (58.18)
Perinatal asphyxia	49 (57.6)	37 (67.27)
Neonatal sepsis	24 (28.2)	20 (36.36)
Neonatal seizure	51 (60.0)	38 (69.09)
Neonatal jaundice	48 (56.5)	14 (25.45)
*Others	6 (7.1)	4 (7.3)

*Others: Hypoglycemia, hypocalcemia, electrolyte imbalance etc.

Table II: Rapid Neuro Development Assessment (RNDA) findings of high-risk neonates

Domain	Normal n (%)	NDIs n (%)			
		Total	Mild	Moderate	Severe
Primitive reflexes	54 (63.5)	31 (36.5)	6 (7.1)	11 (12.9)	14 (16.5)
Gross motor	50 (58.8)	35 (41.2)	4 (4.7)	26 (30.6)	5 (5.9)
Fine motor	57 (67.1)	28 (32.9)	7 (8.2)	2 (2.4)	19 (22.4)
Vision	49 (57.6)	36 (42.3)	5 (5.9)	30 (35.3)	1 (1.2)
Hearing	46 (54.1)	39(45.9)	4 (4.7)	23 (27.1)	12 (14.1)
Speech	49 (57.6)	36 (42.3)	6 (7.1)	27 (31.8)	3 (3.5)
Cognition	44 (51.8)	41(48.2)	4 (4.7)	29 (34.1)	8 (9.4)
Behavior	45 (52.9)	40 (47.1)	6 (7.1)	22 (25.9)	12 (14.1)
Seizure	43 (50.6)	42 (49.4)	2 (2.4)	18 (21.2)	22 (25.9)

Discussion

High-risk neonates are more susceptible to develop NDI due to early insult in developing brain.[10] Early identification of developmental disorders can prevent disability in later life.[11] Despite rising interest in child disability, little is known about the frequency and situation of children with disabilities in low- and middle-income countries.[12] This study was undertaken to find out the neurodevelopmental status of high-risk neonate.

In this study, 64.7% of the high-risk term neonates had NDI. It was relatively higher than the finding of a related study by Modi et al. where NDI was observed in 48% of the neonates.[13] This difference may be due to adoption of different methodologies. In the study by Banu et al.[14], 88.8% patient had NDIs on initial assessment, which was even higher than this study. Inclusion of only cases of moderate to severe degree HIE could be the cause of high NDI found in their study. Chattopadhy et al.[2] observed 31.6% of NICU patients had NDIs, which is lower than this study. It may be due to the difference in study participantsage groups.

Regarding the involvement of the different domains, in this study, gross motor was affected in 41.2% and speech in 42.3% cases. Primitive reflexes were affected in 36.5% (Table II). Banu et al.[14] in her study found impairments in gross motor in 60.5%, speech in 46.9% and primitive reflexes 60.5%, which was much higher compared to current study. All the cases in their study had perinatal asphyxia with HIE where tone and primitive reflexes were usually found impaired. In a study by Islam et al.[7] on preterm babies, abnormal findings of primitive reflexes was found in 39.7% cases, gross motor in 40.7% and speech in 38.7% cases. The status of other domains were as follows: fine motor 31% and visual impairment in 38.7% respectively which is almost similar to the present study where fine motor and vision impairments was observed in 32.9% and 42.3% neonates. (Table II). On the other hand, seizure at the time of 1st assessment in their study was only 2.8% compared to 49.4% in this study. This variation may be due to selection of only preterm infants in their study.

In the current study, among NDI cases maternal illness was observed in 50.9% and prolonged labour in 65.45% mothers. Regarding neonatal problems, perinatal asphyxia was present in 67.27% cases, low birth weight in 58.18% cases, neonatal seizure in 69.09% cases, neonatal sepsis in 36.36% cases and neonatal jaundice in 25.45% cases.(Table I). Modi et al.[13] also found increased incidence of neurodevelopmental delay in low birth weight baby and neonate with perinatal asphyxia. In the study by Uddin et al.[15] maternal illness was observed in 41.2% cases, prolonged labor in 17.6% cases, perinatal asphyxia in 11.7% cases, LBW in 17% cases and neonatal jaundice in 5.9% cases. In a study on high risk newborns, it was found that prevalence of NDI was higher in neonate with LBW 67.8%, sepsis 38.8%, seizure 46.6%, perinatal asphyxia 29.1% and jaundice 10.4%.[2] Anand et al.[16] also found that adverse neurodevelopmental outcome was observed more in neonates with neonatal seizure.

Conclusion

This study had shown that through using RNDA, a very high prevalence of NDI was found among high-risk neonates. Most frequently affected domains were cognition, behavior, vision and speech. Most severe form of NDI was observed in seizure, fine motor and primitive reflexes sector.

References

1. Mullin A, Gokhale A, Moreno-De-Luca A, Sanyal S, Waddington J, Faundez V. Neurodevelopmental disorders: mechanisms and boundary definitions from genomes, interactomes and proteomes. Translational psychiatry. 2013;3(12):e329.
2. Chattopadhyay N, Mitra K. Neurodevelopmental outcome of high risk newborns discharged from special care baby units in a rural district in India. Journal of public health research. 2015;4(1):e 318.
3. Olusanya BO, Davis AC, Wertlieb D, Boo N-Y, Nair M, Halpern R, et al. Developmental disabilities among children younger than 5 years in 195 countries and territories, 1990–2016: a systematic analysis for the global burden of disease study 2016. The Lancet Global Health. 2018;6(10):e1100-e21.
4. Bitta M, Kariuki SM, Abubakar A, Newton CR. Burden of neurodevelopmental disorders in low and middle-income countries: a systematic review and meta-analysis. Wellcome open research. 2017;2: e 121
5. Shrestha M, Bajracharya L, Shrestha L. Neurodevelopmental Outcome of High Risk Babies at One Year of Age Born in a Tertiary Centre. Journal of Nepal Paediatric Society. 2017;37(1):45-50.
6. Milner KM, Duke T, Steer AC, Kado JH, Koyamaibole L, Kaarira R, et al. Neurodevelopmental outcomes for high-risk

neonates in a low-resource setting. Archives of disease in childhood. 2017;102(11):1063-9.

7. Islam MMZ, Hossain MM, Haque SA, Khan NZ. Neurodevelopmental Assessment in Preterm Neonates at Early Ages: Screening of at-risk Infants for Long Term Sequlae. Bangladesh Journal of Child Health. 2016;40(1):5-11.
8. Xiong T, Gonzalez F, Mu D-Z. An overview of risk factors for poor neurodevelopmental outcome associated with prematurity. World Journal of Pediatrics. 2012;8(4):293-300.
9. Khan NZ, Muslima H, Begum D, Shilpi AB, Akhter S, Bilkis K, et al. Validation of rapid neurodevelopmental assessment instrument for under-two-year-old children in Bangladesh. Pediatrics. 2010;125(4):e755-e62.
10. Ara UN, Rahman ME, Khan NZ, Ullah MSS, Yusuf MA. Screening for Neurodevelopmental Impairments among less than 2 Years Old Children in a Tertiary Care Hospital in Dhaka city. Journal of National Institute of Neurosciences Bangladesh. 2015;1(2):57-61.
11. Committee BFS. Medical Home Initiatives for Children With Special Needs Project Advisory Committee Identifying infants and young children with developmental disorders in the medical home: an algorithm for developmental surveillance and screening. Pediatrics. 2006;118(1):405-20.
12. Gottlieb CA, Maenner MJ, Cappa C, Durkin MS. Child disability screening, nutrition, and early learning in 18 countries with low and middle incomes: data from the third round of UNICEF's Multiple Indicator Cluster Survey (2005–06). The Lancet. 2009;374(9704):1831-9.
13. Modi R, Patel J, Mishra A. Neurodevelopmental outcome of high-risk newborns discharged from NICU in a tertiary-care hospital of western India. International Journal of Medical Science and Public Health. 2016;5(07):1350-1354.
14. Banu SH, Salim A, Ara R, Akhter R, Khan NZ. Neurodevelopmental evaluation in full-term newborns with neonatal hypoxic ischemic encephalopathy (HIE): a case control study. Bangladesh Journal of Child Health. 2015;39(1):6-13.
15. Uddin MZ, Rahman MM, Fatema K, Khan ASH, Hossain MM, Saad T. Status of neurodevelopmental impairments among children using rapid neurodevelopmental assessment attending a tertiary care hospital. International Journal of Contemporary Pediatrics. 2019;6(6):2254-2259.
16. Anand V, Alpana K, Santosh K, Harshita S. Determinants of physical and Neurodevelopment outcome of high risk newborn with maternal and neonatal risk factors Original Research. 2017;6(3):140-148.