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Neurodevelopmental Clinic at Tertiary Care Centre since 6 years: A Humble Beginning

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Abstract

Context: The improvement in perinatal care has led to increase in survival as well as morbidity in sick newborns. Babies discharged from NICU need to neurodevelopmental (ND) follow ups and rehabilitation. *Aims:* To assess the neurodevelopmental outcome of NICU discharged babies in follow up clinic. *Settings and Design:* A Retrospective Observational Study at High Risk Follow up clinic of a Tertiary Care Hospital. *Methods and Material:* Data was collected from follow up clinic of level III NICU of tertiary care hospital running since 6 years. Risk categorization at enrollment and neurodevelopmental assessment were done till 6 month age. The Amiel-Tison Method and Denver Development Screening Test were used. Assessments were done according to the follow up protocol. Various neonatal morbidities like Hypoglycemia, Acute Bacterial Meningitis, Asphyxia, RDS, ventilation more than 7 days, IVH Grade 2 etc were considered for analysis. *Statistical Analysis Used:* MS EXCEL & IBM SPSS (version 2015). *Results:* Out of 1704 infants enrolled, 345 (19.9%) were having a High risk of neurodevelopmental delay. Only 644 (37.7%) followed up at 3 months, numbers reduced to 366 (21.4%) at 6 months. Babies with risk factors of Prematurity, Hypoglycemia, ventilation more than 7 days & IVH Grade 2 were more likely to have the neurodevelopmental delay. *Conclusions:* Attrition in follow up percentage warrants active follow up interventions. Early developmental screening necessary for all NICU discharged babies irrespective of risk category.

Keywords: Follow up; NICU Discharged Babies; Neonatal Morbidities; Neurodevelopmental Outcome.

Introduction

Improvement in perinatal care has led to increase in survival as well as morbidity in sick neonates. It is necessary to measure the quality of intensive care services by the number of babies with intact survival [1], which will add to the future pool of productive population in the society. Babies discharged from NICU are at risk of neurodevelopmental delay and hence need periodic follow-up examination and developmental assessment. At risk follow up is a multidisciplinary project involving pediatrician, neonatologist, pediatric nurse, pediatric ophthalmologist, oto-rhino-laryngologist, occupational therapist, physiotherapist, medical social worker, child psychologist and Nutritionist [2].

Early follow up neurological assessment can predict long term developmental outcome [3]. It has been reported that early assessments and interventions are necessary for better outcome [4, 5, 6]. The risk of neurodevelopmental delay can be categorized into mild, moderate and high [7]. Those athigh risk may additionally require early intervention & rehabilitation.

Modern medicine not only detects neuro developmental delays but also detects mild deviations, which can be followed up and rehabilitated to normal. Being a tertiary care institute, though, with limited resources, we started the Neonatal Follow Up clinic for NICU discharged babies.

Follow up audit helps in establishing disease burden and feed back of data to service providers [8, 9]. Hence, this study was conceived for knowing the neurodevelopmental outcome of babies on follow up and various morbidities as risk factors for the delay.

Materials and Methods

A retrospective observational study was performed at a Tertiary care center. Data was collected from Follow up Clinic records. Subjects selected were babies discharged from level III NICU and enrolled in Follow up clinic from Jan 2010 till Dec 2016. Babies were categorized for Mild, Moderate and High risk of neurodevelopmental delay. At risk Follow ups were recorded at 1, 3, & 6 month age (corrected age in case of preterm). The neurodevelopmental assessment was done by using the Amiel-Tison Method and Denver Development Screening Test (DDST). Adverse outcome was defined as DDST "Fail" at 6 months. Tone abnormality was considered when there was hyper / hypotonia as per Amiel- Tison method. Hearing (informal clinical screening, OAE/BERA) and Ophthalmic assessments (including ROP) were done according to the follow-up protocol. All preterm babies were screened for ROP by a trained ophthalmologist. Hearing assessment was done by informal audiometry due to non-availability of audiologist for the first 5 years. Neuro imaging and EEG were done in relevant cases. Occupational therapy and physiotherapy were advised to babies having the impairment. Data were analyzed using MS Excel and IBM SPSS (version 2015). Maturity, Birth weight, and Risk categorization were assessed for statistical significance for neuro developmental delay using Pearson Chi square and Fischer Exact tests. Various neonatal morbidities like Hypoglycemia, Acute Bacterial Meningitis, Asphyxia, RDS, ventilation more than 7 days, IVH Grade 2 etc were considered for analysis.

Results

Baseline Characteristics

Study flow diagram is depicted in Figure 1. Total 1704 babies were enrolled in follow up clinic, over a span of 6 years. Out of which 1089 (63.9%) were males and 615 (36%) were females. Out of 1704 only 644 (37.7 %) followed up at 3 months and 366 (21.4%) followed up at 6 months. Baseline characteristics of these babies are depicted in Table 1. Categorization for risk of neurodevelopmental delay is shown in Table 2.

Outcome

The neurodevelopmental outcome with respect to risk categories (Table 3), maturity (Table 4), and birth weight (Table 5) was assessed at 6 months' follow up. Table 6 shows different neonatal morbidities in NICU discharged babies and Neurodevelopmental outcome at 6 months.

Table 1: Baseline Characteristics (Birth weight & Gestational Age)

Birth weight (g)	N (%)	Gestational Age (wk)	N (%)
< 1000	9 (0.5%)	< 30	16 (0.9%)
1000- 1500	195(11.4%)	30 – 34	391(22.9%)
1501– 2500	889(52.1%)	34 – 36	299(17.5%)
>2500	611(35.8%)	>37	998(58.5%)

Table 2: Risk categorization for Neurodevelopmental Delay

Risk Categories	N (%)
Mild	345 (20.2%)
Moderate	1019(59.8%)
High	340(19.9%)

Table 3: Neurodevelopmental Outcome at 6 months as per risk category

Risk Category	No. of babies in follow up at 6 months	DDST Fail* N (%)	Tone Abnormality N (%)	Epilepsy N (%)
Mild	67	8	4	-
Moderate	241	100	24	19
High	58	25	8	3
	366 (21.4%)	133 (36.6%)	36 (9.8%)	22(6%)

(*p <0.005, statistically significant, DDST- Denver Developmental Screening Test)

Table 4: Neurodevelopmental outcome at 6 months and Maturity

Maturity	DDST* Fail	Tone Abnormality	Epilepsy
Preterm (n=150)	36	11	10
Term (n= 216)	97	25	12

(*p<0.05, p= 0.000043 statistically significant)

Table 5: Neurodevelopmental outcome at 6 months and Birth weight

Weight (gm)	DDST Fail*	Tone Abnormality*	Epilepsy*
<2500 (n= 237)	92	20	13
>2500 (n= 129)	41	16	9

(*p> 0.05 statistically NOT significant)

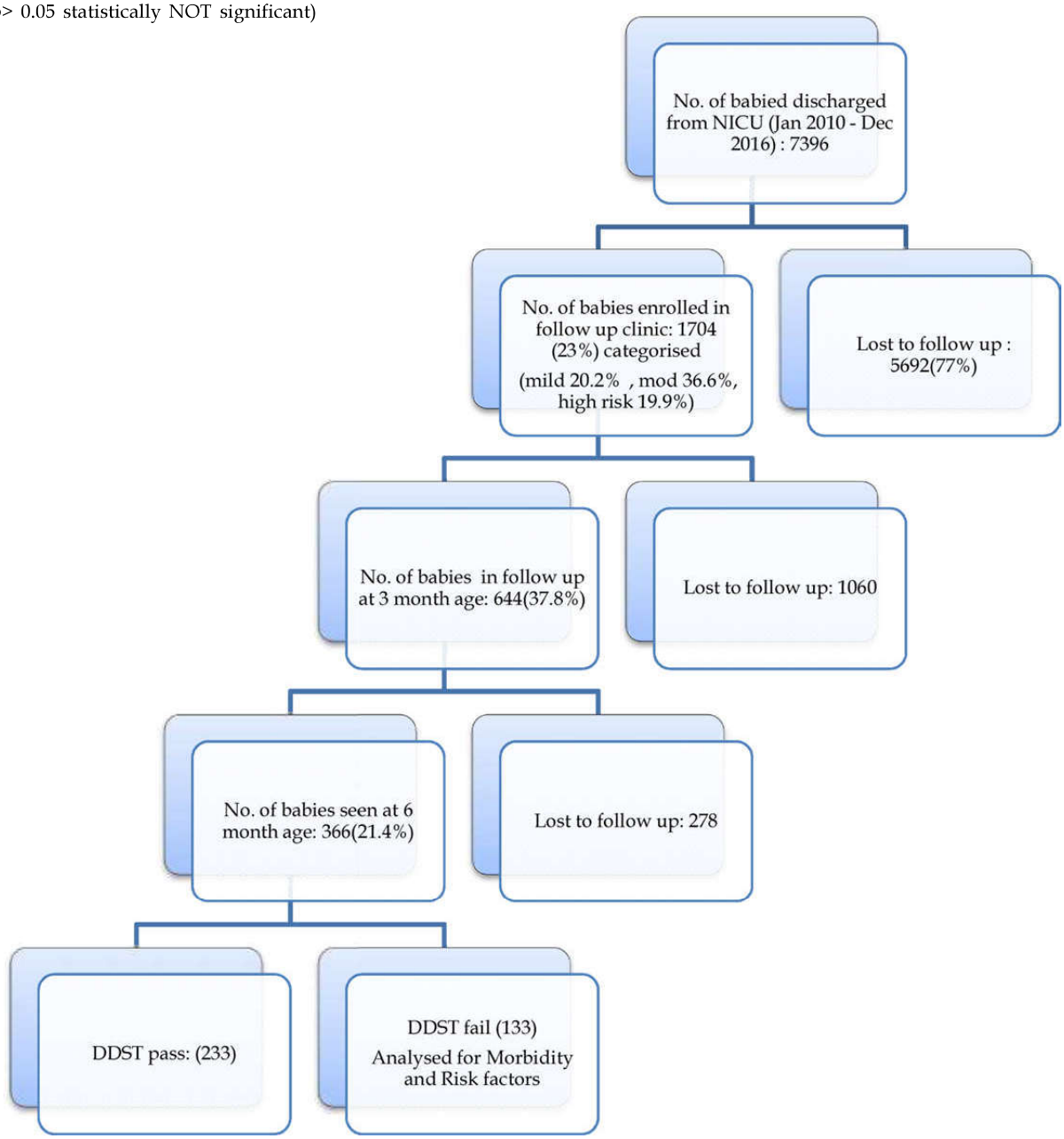

Fig. 1: Study Flow Diagram

Table 6: Morbidity and risk of Neurodevelopmental delay

Morbidity	Total Followed up At 6 month age	DDST Fail	DDST Pass	RR
Hypoglycemia*	21	17	4	2.40
Ventilation >7 Days*	42	29	13	2.15
IVH*	46	38	8	2.78
Acute Bacterial Meningitis	162	67	95	1.27
Asphyxia	125	50	75	1.16
RDS	67	25	42	1.03

(*p<0.005, statistically significant, IVH- Intra Ventricular Hemorrhage, RDS – Respiratory Distress Syndrome)

Table 7: Outcome of ROP screen

Gestational Age (wk)	No. of babies eligible	No. of babies followed up for ROP screen	Stage 1	Stage 2	APROP
<30	16	7	4	2	2
30-34	391	86	38	5	1
34 -37	299	56	25	0	0
Total	706	149	67 (9.4%)	7 (1%)	3 (0.4%)

(ROP - Retinopathy of Prematurity, APROP - Aggressive Posterior ROP)

Hearing screening was possible in 55 (3.2%) babies only. Hearing Deficit was present in 2 babies. All preterm babies were screened for ROP. Table 7 shows the outcome of ROP screening.

Discussion

Total babies enrolled in follow up clinic during the study duration were 1704 (23%) out of total discharged 7396. Attrition of the number of babies following up in the clinic over subsequent visits is a lingering challenge [10]. Follow up rate reported by De Souza et al [11] was 53.9% & Mas C et al [10] was 58.4%, and that in the USA varied from 21–40% [12]. Patra K et al [13] in a retrospective study demonstrated a rise from 27-29 % to 55-64% with some interventions. Rates were better (75%) Halloran et al [14] & (94.6%) in AIIMS ICMR report [15], probably because those were prospective studies. Considering this problem of low rates of follow-up, NEON group (Neonatal Evaluation and Outcomes Network) Texas have come up with guidelines for Follow-up [2].

A lesser proportion of female babies seen in our study was also found in AIIMS ICMR study [15] & Chattopadhyay N [16], probably due to poor health seeking behaviour for feminine gender.

In our study, enrolment of Term babies was more probably due to better survival rates in the Institute. The incidence of babies with Perinatal Asphyxia was (33.3%) whereas that reported by Halloran et al was 25% [14].

In a systematic review about Morbidity and developmental delay in low and middle income countries, Gladstone M et al [17] reported that lack of uniformity of approach is because there is no standardized set of criteria to define neonatal or infant morbidity. Risk categorisation was done as per NNF evidence based Clinical Practice Guidelines [7] in our study, and was a statistically significant variable for DDST "fail". Studies by Das S et al [18], Baburaj S et al [19], AIIMS ICMR [15] used their own risk categorization. Overall percentage of neurodevelopmental delay in our study was 36.6%, whereas that reported by Nair MKC [20] was 24.3%.

Tone abnormality was seen in 32% (n= 25) babies in the High risk category, which is lesser than 35.2% (n= 190) observed by Chaudhari S et al [21] and 37.42% by Das S et al [18]. Chaudhari S et al [3] in a prospective study noted abnormal outcome in 40.5% (n=111) at 3 months, with 96.9% Negative predictive value. Various researchers have reported a varying incidence of abnormal outcome viz. Singh V et al [22] 6%, Meena N et al [23] 35% (Early intervention) & 70% (Non early intervention group) and Halloran et al [14] 31%. In our study, the percentage of DDST "fail" at 6 months was 36.6% (n=133). This variation may be due to different risk categorization and morbidity patterns in the enrolled babies.

Prematurity (Table 4) was a significant independent risk factor for DDST fail. LBW (Table 5) as an independent variable was not associated with statistically significant risk for adverse neurodevelopmental outcome. A similar finding was

also reported by Das S et al [18] & Baburaj S et al [19]. We observed DDST "fail" in 36.6%, whereas Das S et al [18] reported a neurodevelopmental delay in 22%, they had used DASII test though. Incidence varying from 10% to 46% has been reported by other studies [24, 25].

Hypoglycemia, Acute Bacterial Meningitis, Asphyxia, RDS, Ventilation more than 7 days & IVH Grade 2 were common morbidities in enrolled babies. Some babies had more than one co morbidity. Out of 366 babies followed up at 6 months age, 21 (5.7%) babies had hypoglycaemia. DDST "fail" was seen in 17 (80.9%; RR2.4; 95% CI 1.86 – 3.10, NNH 2.11). Das S et al [18] reported neurodevelopmental delay in 46.67% and Luo et al [26] reported that 85.7% had mental retardation in follow up of babies suffered hypoglycaemia during neonatal period.

In our study, we found that, babies requiring invasive ventilation more than 7 days had increased risk of neurodevelopmental delay (RR 2.15, 95% CI 1.66 TO 2.78, NNH 2.7). Similar finding (OR 2.3, 95% CI 1-5.1) was reported by Neubauer AP et al [27] for ventilation more than 14 days. Delmas O et al [28] reported that there was no disability associated with short ventilation (OR=0.96 [0.93-0.99]; P=0.03). This increased risk of neurodevelopmental delay in babies requiring prolonged ventilation may be due to stormy neonatal course. Intra Ventricular Hemorrhage was also a significant risk factor for neurodevelopmental delay (RR 2.78, 95% CI 2.24 to 3.44, and NNH 1.890). Similar finding (OR13.3, 95% CI 4 -44.9) was reported by Neubauer AP et al [27].

ROP screening in our study showed severe ROP associated with extreme prematurity. Hearing screening (OAE/BERA) was possible only for last one year of the study duration.

Limitation of the Study

Our study was a retrospective study had more drop outs. Hence, follow up examinations up to 6 months only were included. Babies "failed/ Caution" in DDST were not subjected to DASII. Some of these babies would have Transient Tone Abnormality, for which longer follow up is needed. Growth monitoring was not included in this study. Hearing screening for all eligible babies by OAE/ BERA was not possible. Other risk factors for ROP were not considered.

Conclusion

The commonest morbidity in babies following up was perinatal asphyxia with hypoxic ischemic encephalopathy. Attrition in follow-up percentage warrants implementation of active follow up interventions.

Developmental screening is necessary for all NICU graduates irrespective of risk category. District Early Intervention Centre team presence is required at every level II/ III NICU. Babies with abnormal early findings need a more structured follow-up program to assess their physical & mental health, learning & cognition and family variables [8].

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Conflict of Interest

None

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