

Original Research Article

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Follow up of growth, development and clinical outcome in neonates discharged from the NICU of tertiary care hospital in central India

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ABSTRACT

Background: To assess the growth and neurodevelopmental outcome of all newborn discharged from the NICU of Netaji Subhash Chandra Bose Medical College, Jabalpur on follow up for 6 months.

Methods: Prospective observational cohort study of 200 high risk newborn discharged from NICU. Babies were called for follow up at 1 month, 2 months, 4 month and 6 months of corrected age and detailed information was taken regarding NICU stay and morbidity with the help of data available from discharge card. Anthropometric parameters like weight, length, and head circumference were noted. Suitable screening tests like denver's developmental screening test for Indian infants (DDSTII) for NDD (neurodevelopmental delay) and Amiel Tison scoring for tone assessment was done.

Results: Among the 200 NICU graduates chosen, 40 lost during follow up. The neurodevelopmental delay in this study was 31.3%. Authors also analysed NDD according to gestational age wise groups. NDD in pre-terms was 39.6%. The developmental delay was more in babies with neonatal sepsis, perinatal asphyxia, prematurity, RDS, NEC etc.

Conclusions: The morbidities like severe perinatal asphyxia, hypoglycaemia, seizures, shock, hypoxia, hypothermia, low gestational age have direct association with NDD.

Keywords: Amiel Tison score, Denvers developmental screening test for Indian infants, Neuro developmental delay, Neonatal intensive care unit, Respiratory distress syndrome, Necrotizing enterocolitis

INTRODUCTION

Improving perinatal and neonatal care has led to increased survival of infants who are at-risk for long-term morbidities such as developmental delay and visual/hearing problems. Moreover, many of these neonates (e.g. extremely low birth weight infants) tend to have higher incidence of growth failure and ongoing medical illnesses.^{1,2} Numerous studies have shown that despite substantial improvements in the neonatal mortality, the incidence of chronic morbidities and adverse outcomes among survivors has not declined much.³

A proper and appropriate follow-up program would help in early detection of these problems thus paving way for early intervention. This highlights the need for a follow-up care service that would ensure systematic and continuous monitoring of the general health and neurodevelopmental outcomes after discharge from the hospital.⁴ The monitoring would help the infants and their families (early identification of problems and hence early rehabilitation services) as well as the physicians involved in their care (to improve the quality of care provided and for research purposes). There is a common perception that high risk follow-up mainly concerns with detection and management of neurosensory disability.³

In fact growth failure and ongoing illnesses are equally, if not more important issues in high risk follow-up. Adequate emphasis must be placed on these.

The incidence of severe disabilities like Cerebral palsy has remained quite unrelenting at 4.5-10% over the past two decades.⁵ This is also associated with reports of increasingly high incidence of neuro-sensory impairment (blindness and deafness), cognitive, learning disabilities and behavioral problems like ADHD and depression.⁵

Many methods are available for the screening of neurodevelopment in infants. Authors want to apply DDSTII and Amiel Tison tone assessment to screen NICU graduates on follow up for early diagnosis of problems. Applying DDSTII and Amiel Tison score is easy and less time consuming.⁷

METHODS

This prospective cohort study was conducted in a tertiary care hospital, N.S.C.B.M.C.H Jabalpur from March 2017 to July 2018 after obtaining approval from institutional ethical committee. Neonates discharged from neonatal intensive care unit were enrolled after informed consent from attendants.

Exclusion criteria

- Neonates with major congenital anomaly.
- Incompatible with life.
- Parents not giving consent for participation in the study.

Data of all the studied 160 babies available from the discharge card were analysed and it was further categorized on the basis of gestational age, sex, age at admission, weight for gestation, clinical profile, course during treatment, complications encountered and immediate outcome.

Simple anthropometric measurements were taken on admission and on follow up visits (which are scheduled at 1st, 2nd, 4th, 6th months of corrected age.) such as weight, length and head circumference of babies and developmental assessment by DDSTII, Amiel Tison tone assessment by goniometer and complete neurological examination was done.

A detailed Proforma was filled including details of the neonate on admission and standard treatment was given and appropriately intervened in the follow up whenever required. Weight was measured using electronic weighing machine with precision of 10 gm. Length was measured using Infant-meter and head circumference by non-stretchable tape. Corrected age is calculated from the expected date of delivery of the neonate.

Developmental screening was done using DDST II during follow up at 1,2,4 and 6 months corrected

gestational age. There were 125 performance-based and parent reported items on the test in the following four areas of functioning: fine motor-adaptive, gross motor, personal-social, and language skills.

Scoring per item is rated as

- P: pass-child successfully performs item or caregivers reports the child can do the item.
- F: fail-child does not successfully perform the item or the caregiver reports the child cannot do the item.
- No: No opportunity-the child has not had the opportunity to perform the task due to restrictions
- R: Refusal-the child refuses to attempt and the parent cannot report.

The number of scores a child received below the normal expected range classifies the child as within normal, suspect, or delayed. Scores were recorded per item through direct observation of the child and in some cases what the parent reports. The test was interpreted to place the child into two categories: normal or suspect. If the child is suspect it is recommended that rescreening occur in 1-2 weeks.

Amiel Tison tone assessment was done in follow up study at 1st, 2nd, 4th and 6th month of age and the various angle measured during the visits were tabulated.⁷

RESULTS

In the present study total 200 babies were initially chosen for follow up study. Out of which 40 were lost during follow up. 160 babies were followed up for 1 month, 2-month, 4 month and 6 months. Out of which 122 were term and 38 were preterm babies.

Table 1: Gender distribution of the study group.

Study groups	Male	Female
Preterm (n=38)	21 (55.3%)	17 (44.7%)
Term (n=122)	82 (67.2%)	40 (32.8%)
Total (n=160)	103 (64.3%)	57(35.6%)

Table 2: Gestational age wise and birth weight wise distribution of the study group.

Gestational age in weeks	No. of subjects studied	Percent
		Percent
28-<32 (group 1)	15	9.4
32-<37 (group 2)	23	14.4
≥37 (group 3)	122	76.3
Birth weight (grams)	No. of subjects studied	Percent
1000-1499 (VLBW)	9(5.6%)	5.6
1500-2499 (LBW)	68(42.4%)	42.4
>2500 (normal weight)	83(51.8%)	51.8

The gender distribution data of the study group. Among the term babies 67.2% were males and 32.8% were females. Among the preterm 55.3% were male and 44.7% were female babies (Table 1).

The above table shows the gestational age wise and birth weight distribution of study group (Table 2). The above table shows the Neonatal morbidity distribution among subjects (Table 3).

Table 3: The neonatal morbidity distribution among subjects.

Complications	Preterm (n=38)	Term (n=122)	Total	p value	Odds ratio
Perinatal asphyxia	5(13.1%)	49(40.16%)	54	0.0038	0.225
Hyperbilirubinemia	15(39.4%)	36(29.5%)	51	0.25	1.55
RDS	13(34.2%)	0	13	<0.0001	129.7
Hypoglycaemia	18	17	35	<0.0001	5.55
Neonatal sepsis	22(58%)	52(42.6%)	74	0.0009	4.27
NEC	15(39%)	8(6.5%)	23	<0.0001	39.6
Hypocalcaemia	4	13	17	0.98	0.98
Pulmonary haemorrhage	0	2	2	0.76	0.62
Seizures	5(13%)	45(36.8)	50	0.008	0.26

Table 4: The immunization coverage among the subjects.

Immunization status	No. of subjects studied	Percent
Complete	158	98.8
Incomplete	2	1.3
Total	160	100

The above table shows the Immunization coverage among the subjects (Table 4).

The above table shows the anthropometric parameters of the study group like means values of weight (in kg), Height (in cms) and head circumference among the three study groups (Table 5).

Table 5: The anthropometric parameters of the study group.

Age	Weight (in kg)			Length (in cms)			Head circumference (in cms)		
	Group 1 (n=15)	Group 2 (n=23)	Group 3 (n=122)	Group 1 (n=15)	Group 2 (n=23)	Group 3 (n=122)	Group 1 (n=12)	Group 2 (n=23)	Group 3 (n=122)
1 month	2.21±0.53	2.51±0.57	2.62±0.42	47.2±3.5	47.68±2.34	53.07±2.49	33.14±1.46	33.95±1.29	35.53±1.31
2 months	3.03±0.73	3.26±0.75	3.47±0.54	50.17±4.04	50.75±3.34	57.16±2.61	35±1.41	36.1 ±1.54	37.59±1.42
4 months	4.16±0.68	4.63±0.82	4.49±0.62	55.07±3.41	56.17±3.41	61.81±2.47	37.64±1.22	38.43±1.62	39.95±1.37
6 months	5.45±0.85	5.95±0.85	5.78±0.72	61±2.71	62.27±3.31	65.8± 2.38	39.85±1.52	40.77±1.74	42.24±1.57

The above comparison chart shows that the weight gain velocity was more in group 3 (term infants) than the other two groups but there was catch up growth in the other 2 groups after 2nd month of life (Figure 1).

The above comparison chart shows that the length gain velocity was more in group 3 but the other two groups showed catch up growth after 2 months (Figure 2).

The above comparison chart shows that the head circumference gain velocity was more in group 3 but the other two groups showed catch up growth after 2 months (Figure 3).

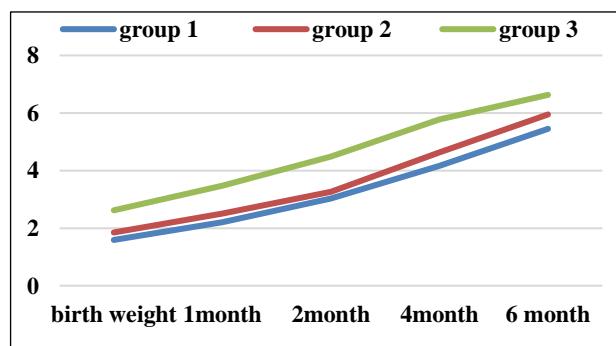
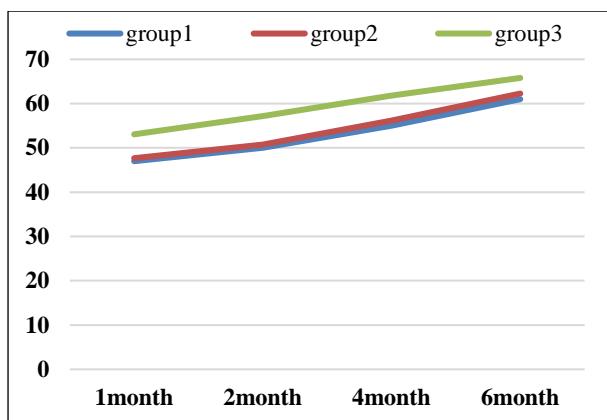
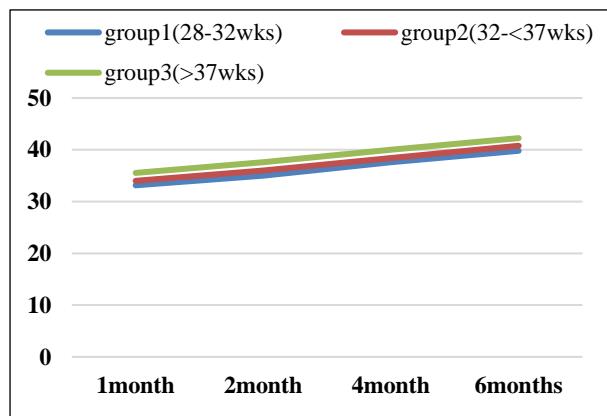


Figure 1: Comparison of weight gain velocity.

**Figure 2: Comparison of length gain velocity.****Figure 3: Comparison of head circumference gain velocity.**

From Figure 1, 2 and 3 authors can say that the overall growth rate was high in group 3 > group 2 > group 1. But there is catch up growth in group 1 and 2 after 2 months of life.

Abnormal DDSTII score was more in group 1 than the other 2 groups (Table 6). Abnormal Amil tison score was more in group 1 than the other 2 groups (Table 7). When the correlation of neurodevelopmental delay with risk factors was done significant developmental delay was seen in neonates who had hypoglycaemia, perinatal asphyxia, necrotizing enterocolitis and seizures. These are the risk factors which are more predisposed in a preterm baby (Table 8).

Table 6: Neurodevelopmental outcome by DDSTII at 6 months of life.

Gestational age (in weeks) group	Normal	Abnormal
Group1 (28-32) n=15	6 (46.2%)	7 (53.8%)
Group2 (32-<37) n=23	14 (63.6%)	8 (36.4%)
Group 3 (>37) n=122	87(71.3%)	35(28.7%)

Table 7: Comparison of Amiel Tison score at the end of 6 month.

Gestational age (in weeks) group	Normal	Abnormal
Group 1 (28-32) n=15	7 (53.8%)	6 (46.2%)
Group 2 (32-<37) n=23	15 (65.2%)	8 (34.8%)
Group 3 (>37) n=122	89 (73%)	33 (27%)

Table 8: Neurodevelopmental delay and correlation with risk factor.

Disease	Abnormal	Normal	Chi square test	p value
HMD (n=13)	3 (23.1%)	10 (76.9%)	0.03	0.772
Hypoglycaemia (n=35)	19 (54.3%)	16 (45.7%)	29.22	<0.001
Perinatal asphyxia (n=53)	25 (46.3%)	28 (53.7%)	30.55	<0.001
NEC (n=22)	9 (40.9%)	13 (59.1%)	5.81	<0.001
Sepsis (n=87)	22 (25.3%)	65 (74.7%)	1.86	0.068
Jaundice (n=51)	5 (9.8%)	46 (90.3%)	5.86	0.027
Seizures (n=50)	24 (48%)	26 (52%)	31.1	<0.0001

DISCUSSION

A prospective cohort study was done on 200 babies, who were discharged from NICU. They were initially assessed in terms of neonatal morbidities and were further followed up at 1st, 2nd, 4th and 6 months of corrected age. Out of 200 patients 160 were followed up for 6 months. The 40 patients who did not report after first follow up were excluded from the study. Out of 160 patients, 122 (76.3%) were term and 38 (23.7%) were preterm babies. The incidence of preterm babies is less compared to

Nandita et al, a study in west Bengal where the incidence of preterm was 39.3%.⁸ Survival of preterm in set up was less at the time of the study. So, the percentage of preterm distribution was less compared to other studies.

In terms of gender, out of 160 babies 103 (64.3%) were male and 57 were female (35.6%). In this study authors have noticed sex predilection with a male predominance. This correlates with Nandita et al a study from west Bengal also showed same results with male 62.9% and female 37.1%.⁸ The difference in care seeking for male and female newborn

and infants probably shows the gender bias prevalent among the families, who are more concerned about the survival and wellbeing of male off springs than the females. This result also correlates with Rohit et al, study in Gujarat, were males 52% and female 48%.⁹

In terms of weight, 48.2% (<2500 gm) are low birth weight and 51.8% had normal birth weight (>2500 gm). In Nandita et al, 53.2% belonged to low birth weight group and 46.8% were of normal birth weight.⁸ The result from this study group matches closely with Nandita et al, but this result also concludes that prevalence of low birth weight is more all throughout the country, hence alarms the need for improvement in good antenatal care and follow ups.

In this study 42.5% of the term babies (group3) and 44.7% preterm required resuscitation procedures either in the form of basic steps or bag and mask ventilation.

Authors studied anthropometric parameters like weight, length and head circumference on 1st, 2nd, 4th and 6th month of life.

Below standards in anthropometric parameters were seen both in term as well as preterm.

The growth velocity was high among term in initial 2 months of corrected age. In the later month growth velocity was higher in preterm than term due to catch up growth (Figure 1, 2 and 3).

In this study very preterm had significant lag in growth of all physical parameters at 6 months of corrected age.

When comparing the growth pattern of subjects in this study with that of Gp Capt D Singh et al, pattern of weight gain, gain in length and head circumference was not similar, the growth velocity of subjects in all parameters in this study group was less as compared to Gp Capt D Singh et al.¹⁰ When compared the anthropometric data of this study with other studies like Ghaghoriya et al, the weight gain velocity in this study group was significantly low.¹¹ This may be attributed to poor feeding counselling of the mother and other family members. Dietary counselling of the infants during follow up is very essential components and strict growth monitoring is also necessary. Authors chose only NICU graduates in this study where as Ghaghoriya et al, and Capt D Singh et al, had both NICU graduates as well as normally born babies in labour room.¹¹ So the average growth rate of their study was higher than ours.

The prevalence of developmental delay among NICU graduates was found to be 50 (31.3%), comparable to the 29% incidence reported by Calame et al, when NDD result was correlated with studies like Nandita et al, and Rohit et al, it is obvious that the NDD detection rate was comparable with Nandita et al but lower than the Rohit et al. In Rohit et al, the number of cases followed up was

small group and also the cases chosen where high-risk group with severe morbidity.

NDD correlation with risk factors

Preterm

In this study, low birth weight and prematurity were found to be the major contributory factors for neurodevelopmental delay. Maximum incidence of developmental delay was noted in very preterm babies (group1) with gestational age 28 to <32 weeks with developmental delay of 53.8% (Table 6), and 36.4% NDD in gestational age of >32 to <37 weeks of gestation (group 2), with a sharp decline in incidence in term babies (group3) with developmental delay 28.7% (Table 6), which is supported by a review of related articles by Tao Xiong.¹² Improvement of gestational age at birth and birth weight will help in curbing the incidence of developmental delay. Even though authors found higher incidence of NDD in preterm compared with term. Authors could not establish the significance.

Table 9: Comparison of NDD of preterm infants with other studies.

Study groups	preterm study group (n=38)	Sudhir et al, ¹³ (n=82)	Kanya mukhyopadhyay et al ¹⁴ (n=101)
Method of screening used	Screened till 6 months by DDSTII	Screened till 12 months by DASII	Screened till 12 months by DASII
NDD in %	39.4%	28%	25%

In Sudhir et al, NDD was seen in 28% by DASI scoring at the end of 1 year follow up in preterm babies in institute.¹³ It is lesser when compared to this study where NDD was seen in 39.4% (Table 9). This can be explained because DDSTII is a screening test where many of the babies can be screened and DASI scale is more of confirmatory test which can be applied in those who screened positive. Lower sample size of pre-terms in this study may also be the reason for higher incidence of developmental delay.

The detection rate may be less in DASI scale. Kanya mukhyopadhyay et al, follow up of preterm till 18 months of age by DASII scoring, showed NDD in 25% of cases.¹⁴

This shows as the gestational age decreases the severity, and the chance of co morbidity increases like RDS, NEC, chance of sepsis, hypoglycaemia which contributes to NDD. The lower the gestational age, the higher the chance of NDD in preterm. The correlation of birth weight with NDD. NDD is seen in 55.5% of VLBW infants. NDD is seen in 26.4% of LBW infants and

24.09% in normal birth weight infants (Table 10). As the birth weight decreases there is greater chance of neurodevelopmental delay.

Table 10: Birth weight correlation with NDD.

Birth weight	NDD
VLBW (N=9)	5 (55.5%)
LBW (N=68)	18 (26.4%)
Normal weight (N=83)	20 (24.09%)

Neonatal sepsis

The cases of neonatal sepsis included any of the 3 manifestations like septicaemia, pneumonia, and meningitis. Sepsis included both early and late onset sepsis. The total sepsis cases comprised of either the investigation proven sepsis or based on the clinical suspicion. In this study authors found NDD in 25.3% of cases (Table 8) of sepsis. This correlates well with the study by stoll et al, were NDD was 30% of sepsis cases.¹⁵

Out of 74 sepsis positive cases, 22 were preterm (58% of all preterms) and 52 were term (42.6% of all term babies). (From table no.8) Hence we can conclude that the incidence of sepsis is more common in preterm and the NDD due to sepsis is more common in preterm.

Perinatal asphyxia

Authors found NDD in 46.3% of cases with perinatal asphyxia, this association was statistically significant.

These results were comparable with the observation made by Carli et al, were 72% babies presented with HIE showed severe NDD.¹⁵

Senthil kumar k et al, found 14% NDD in HIE cases where the babies were followed up for 6 months.¹⁶ Similarly, Baburaj et al, showed 16.7% NDD.¹⁷ Padayachee et al, showed 11.5% of NDD.¹⁸ The reason behind the higher incidence in this study group compared to other studies is that along with the birth asphyxia these patients also had other co morbidities like sepsis, hypoglycaemia, hypocalcaemia, seizures which adds up to the NDD.

Hypoglycaemia

In this study authors found 54.3% NDD in cases (Table 8) of hypoglycaemia. The association is statistically significant. In Manu goyal et al, the NDD by DDSTII at 6 months was 66.6%. this is slightly higher than this study result.¹⁹

NEC

In this study authors found 40.9% NDD in NEC cases (Table 8). The association is statistically significant.

This correlates well with Schulke et al, which describes the risk long term neurological impairment which is statistically significant in at least stage II NEC.²⁰

Neonatal jaundice

In this study authors found NDD in 9.8% of hyperbilirubinemia cases. This is not statistically significant. Jaundice was more often a co morbidity in this study. Arun Babu et al, excluded the cases of physiological jaundice and they followed up only cases of pathological jaundice.²¹ They found significant NDD in cases with pathological jaundice.

CONCLUSION

In the present study authors studied the morbidity distribution of the group, the changes in anthropometric parameters and the occurrence of developmental delay on follow up. Incidence of neurodevelopmental delay was significantly high in lower gestational ages, lower birth weight and associated risk factors. NDD was high in birth asphyxia, seizures, NEC, Hypoglycaemia. The severity of morbid conditions including hypoxia and shock can lead to significant NDD.

The detection of NDD by both the method were comparable with each other. Authors detected NDD in 21.8%, 23.8%, 27.5% and 31.3% during follow up on 1st, 2nd, 4th and 6th month respectively. It was difficult to diagnose NDD in infants under 6 months of life, because very less domains are available for screening of infants. Here authors conclude that early screening by frequent follow up can lead to early detection of NDD and result in early stimulation therapy.

Authors also compared the efficacy of DDSTII and Amiel Tison scoring by tone assessment. Authors found that in the first 2 months of life in the group 1, Amiel Tison tone assessment was more sensitive than DDSTII and was easier to apply. But after 2 months of life DDSTII was more sensitive because more domains were available for screening the infants.

Most NDD, go undetected in the early months of life. Improved perinatal care, early detection by appropriate tools, emphasizing the parent's involvement and early intervention will bring down the incidence of developmental challenges in this vulnerable group.

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