Section: Pediatrics

Research

A STUDY TO ASSESS THE NEUROBEHAVIOURAL PATTERN IN TERM NEONATES

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Abstract

Background: The examination of newborn neurobehavior can be considered as a potential sentinel of future behavior and cognitive functioning, gives a unique opportunity to recognize prenatal influences on mental functioning before postnatal factors alter risk trajectories. The objective is to compare the neurobehavioral profiles between term AGA infants and term SGA. **Materials and Methods:** This is a study with prospective data collection carried out at tertiary centre, KIMS hospital Bengalore between December 2019 to June 2021. Term newborn babies divided into SGA and AGA babies based on birth weight(<10th centile on WHO scale were considered as SGA). Maternal data on socio-demography, medical conditions and non-medical factors were collected along with neonatal data like anthropometry and medical conditions. Neurobehaviour pattern assessment was done using NNNS scale and was compared between SGA and AGA babies. **Result:** In this study it was found that neurobehaviour pattern of SGA babies was abnormal compare to AGA babies. **Conclusion:** SGA newborn infants exhibited a greater number of abnormal neurobehavioural pattern compared to AGA newborns. It is possible that intrauterine growth restriction causes different cortical growth and organization changes during intrauterine life, which would explain the neurobehavioral differences observed in AGA and SGA newborns during their first days of life.

INTRODUCTION

Neonatal neurobehaviour assessment has become a standardized component of clinical care provided to newborninfants. Early editions of neonatal neurobehavioral assessment dates back to the 1900s and mainly emphasized the evolution of central nervous system organization and maturation. Studies have included items that focus on newborn neurobehavioral development, relating the developing nervous system to functional behavior in the postnatal environment.[1] The initial mechanism by which newborns, are identified as having disturbances in CNS and neurobehavioral development is through routine clinical assessment in neonatal care units. In addition to detailed physical and neurological exams, a number of standardized assessments are widely available to clinicians and researchers that provide a comprehensive evaluation of the newborn's neurobehavioral capabilities.

Systematic assessment of neonatal CNS maturity and organization involves the evaluation of primitive reflexes, spontaneous/elicited movements, and sensory behaviors. Reflexive and sensory behaviors undergo rapid sequential changes in the neonatal period, and as such, they are useful neurophysiological constructs to discriminate compromised CNS function in highrisk versus healthy neonates. In addition to CNS function, assessment of the newborn neurobehavioral profile involves the evaluation of three key capacities: 1. active/passive motor activity, 2. state-organization/regulation of arousal, and 3. attention/interactive abilities. The assessment of newborn neurobehavior has proven useful for the prediction of general neurodevelopmental outcomes by age 2 years, with some research suggesting potentially to a greater extent than CNS abnormalities identified by cranial ultrasound.[1]

Recently developed and commonly used neonatal neurobehavioral screening measures include The Assessment of Preterm Infants' Behavior (APIB), Neurobehavioral Assessment of the Preterm Infant (NAPI), Neonatal Behavioral Assessment Scale (NBAS), and the NICU Network Neurobehavioral Scale (NNNS). 1 Regarding test administration, the NBAS and NNNS are similar in terms of items being administered in clusters or packages, but differ in that they were created to evaluate behavior in healthy versus high-risk infants, respectively.

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MATERIALS AND METHODS

This Descriptive study was conducted at Kempegowda Institute of Medical Sciences and Hospital, Bangalore. Study subjects were all term newborns born at KIMS hospital during the study period (December 2019 to June 2021).Study was approved by research ethical committee of KIMS hospital. Informed consent from mother of term (>37weeks) newborns was taken.

Inclusion Criteria

All term (>37 weeks of gestational age) neonates in postnatal wards and NICU of KIMS hospital.

Exclusion Criteria

1. Preterm babies
2. Babies with major congenital anomalies which can affect neurobehaviour pattern

Sample Size Calculation: Sample size was 160

The sample size is calculated by using Precision formula with precision of 5% as follows;

n = Z2p(1-p)

d2

Gestational age was calculated from last menstrual date and confirmed by modified Ballard's scoring system.

Newborns were divided into two groups depending on the birth weight with respect to their gestational age.

Appropriate for gestational age is defined as birth weight between $10^{th}$to 90^{th}centile for gestational age

Small for gestational age is defined as birth weight <10^{th}centile.

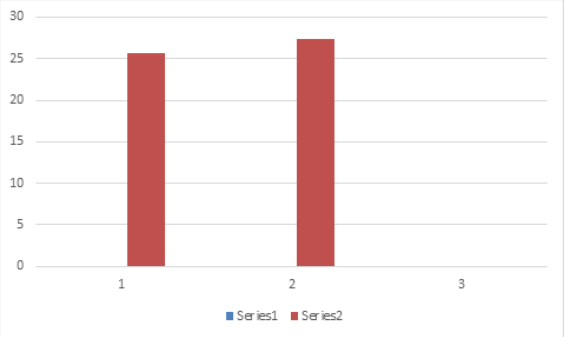
- The neurobehavioral patterns were assessed using NNNS scale at 48 to 72hours of birth or at the time of discharge (mean 5 days) by the investigator in between the feeds.
- The examination was performed on infants who are medically stable, preferably in an open crib and in calm, dimly lit and warm room.
- NNNS scale was administered in a fixed sequence, that starts with a pre-examination observation, followed by the neurologic and behavioural components.
- The stress/abstinence scale is based on signs of stress observed throughout the examination and the order of administration is relatively invariant.
- NNNS scale is a scale that assesses neurological integrity, behavioural function and presence of signals of stress and abstinence in newborn. Reliability of NNNS was verified periodically in order to detect and correct possible discrepancies.
- After assessment NNNS scale was divided into 13 summary scores: Habituation, Attention, Arousal, Regulation, Number of Handling Procedures, Quality of Movement, Excitability, Lethargy, Number of Nonoptimal Reflexes, Number of Asymmetric Reflexes, Hypertonicity, Hypotonicity, and Stress/Abstinence signs.
- Each component was assessed using appropriate materials to obtain the scores.

Stress/Abstinence Scale

- Physiological labored breathing and nasal flaring were observed along with autonomic sweating, spit-up, hiccoughing, sneezing, nasal stuffiness, yawning.
- Central nervous system items from stress/abstinence scale thatwere included were: abnormal sucking, choreiform movements, athetoid postures and movements, tremors, cogwheel movements, startles hypertonia, back arching. Fisting, cortical thumb, myoclonic jerks, generalized seizures abnormal posture

RESULTS

Antenatal Imaging



Series 1 is (AGA) and Series 2 I s(SGA)

Figure 1: Maternal stress scores obtained from DERS stress scale showing mean score of25.68 among AGA and mean score of 27.37 among SGA .

It is found that anxiety in 32 mothers, depression in 2, working stress in 22, sleep deprivation in 32, excessive worry about pregnancy and delivery, less supportive family was observed in 15mothers and was found to be higher in mothers of SGA babies.In SGA babies (mean of 27.68 of maternal stress scale) it was observed that there was decreased habituation in 6 babies, arousal in 4, quality of movements in 6 and increased lethargy in 8, hypotonia in 5 and stress/ abstinence in 7 babies. In AGA babies (mean of 25.38 of maternal stress scale) components like worry about pregnancy in 14 mothers, economic worry in 10 and work-related stress in 14, sleep deprivation in 12 and irritation in 12 was observed and neurobehaviour pattern of these babies was abnormal, like it was decreased habituation in 6 babies, excitability 8babies, regulation 6 babies and Quality of movements in 8 babies increased hypotonia in 9, non-optimal reflexes in 6 and stress/ abstinence in 5 have observed.

AGA female showed decreased habituation in 2babies, arousal in 4, attention in 4, regulation in 3 and quality of movements in 2. And increased

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lethargy in 2 babies, hypotonia 3 babies, andstress/abstinence 3babies. AGA male babies showed abnormal (decreased) habituation in 5 babies, arousal in 3, attention in 2, regulation in 6 and quality of movements in 2 and non-optimal reflexes in 2. And increased lethargy in 3babies, hypotonia 3 babies, and in stress/abstinence 6 babies.

In our study we found that delivery by LSCS was more in SGA group (62%). Male SGA babies delivered by LSCS have shown abnormal neurobehaviour pattern decrease in habituation in 6,attention in 6, arousal in 4 and quality of movement in 8. Increase in lethargy observed in 6, hypotonia in 8 and stress/abstinence in 6 babies.

Female babies delivered by LSCS showed abnormal neurobehaviour pattern that decrease in habituation in 4 babies, attention in 5, arousal in 4 and quality of movement in 6. Increase in lethargy 7 and stress/abstinence 6 babies.

Table 1: Significant antenatal USG findings in study groups

Significant USG findings	SGA	AGA	Total
Normal	58	73	131
Oligohydramnios	4	9	13
Polyhydramnios	4	12	16
Total	66	94	160

Table 2: Anthropometry of study group

	SGA		AGA		t-value	P-value
	Mean	SD	Mean	SD		
Weight	2.20	0.14	2.83	0.25	-18.507	< 0.001
Length	48.29	0.88	49.07	0.96	-5.228	< 0.001
Head circumference	34.17	0.49	34.62	0.46	-5.921	< 0.001

In SGA group with lesser head circumference showed that decrease in habituation in 5 babies, arousal in 6, attention in 6, Regulation in 4 and quality of movement in 8.and increase in lethargy found in in 9 babies, hypotonia in 8 and stress/abstinence 6 babies.

It was observed neonatal medical conditions among them AGA group of babies had PPHN found in 9 babies, TTNB in 18, EPJ in 22, PDA in 3, Sepsis in 2. And in SGA babies following medical conditions are observed, TTNB observed in 15 babies, NEC in 15, PDA in 2, Sepsis in 19 and birth asphyxia in 1 babies.

Among PPHN, neurobehaviour of AGA babies had shown decrease inhabituation in 1 baby, arousal in1 baby, attention in 2, regulation in 1 and quality of movements in 1 baby and increase in lethargy in 1, hypotonia in 1 and stress/ abstinence in 1.

TTNB is more in SGA group in 18 babies causing neurobehavioural abnormalities in SGA, like decrease in habituation in 2 babies, arousal in 2, attention in 4, quality of movements in 2 and increase in lethargy in 1, hypotonia in 2 and stress/abstinence in 5.

Changes in neonatal medical conditions in AGA in 15 babies were like decreased habituation in 2 babies, arousal in2, attention in 2 and quality of movements in 4 and increase in hypotonia in 2, lethargy in 1 and stress/abstinence in 2 babies.

NEC in SGA was seen in 15 babies, and showed decrease in habituation in 3 babies, arousal in 3, attention in 2 and quality of movements in 1 and increase in hypotonia in 2, lethargy in 3 and stress/abstinence in 4.

Neurobehavioural Changes in AGA because of PDA were like decrease habituation in 4 babies, arousal in 4 babies, attention in 3 baby and quality of movements in 4 babies and increase in hypotonia in 6 babies, lethargy in 6babies and stress/abstinence in 4 babies.

Sepsis incidence is higher in SGA group and found in 19 babies. And neurobehavioural abnormalities found they were like decrease in habituation in 5 babies, arousal in 6 babies, attention in 4, quality of movements in 6 and increase in lethargy in 4, hypotonia in 5 and stress/abstinence in 6.

While sepsis observed in 2 AGA babies had shown decrease in habituation in 2 babies, arousal in 2, attention in 1 baby and quality of movements in 2 babies and increase in hypotonia in 1 baby, lethargy in 3 and stress/abstinence in 2 babies.

Table 3: NNNS summary score

	SGA		AGA		t-value	P-value
	Mean	SD	Mean	SD		
Habituation	0.11	1.14	0.26	0.44	-1.156	0.249
Attention	-0.21	1.13	0.44	0.52	-4.879	< 0.001
Arousal	0.71	0.91	0.26	0.46	4.173	< 0.001
Regulation	0.02	0.98	0.49	0.50	-3.991	< 0.001
Handling	0.03	0.98	0.51	0.56	-3.932	< 0.001
Quality of movements	0.11	1.14	0.26	0.44	-1.156	0.249
Excitability	0.02	0.98	0.49	0.50	-3.991	< 0.001
Lethargy	0.71	0.91	0.26	0.46	4.173	< 0.001

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Non optimal reflexes	-0.21	1.13	0.44	0.52	-4.879	< 0.001
Asymmetry reflexes	0.03	0.98	0.51	0.56	-3.932	< 0.001
Hypotonia	0.85	0.44	0.81	0.51	0.514	0.608
Stress / abstinence	0.71	0.91	0.26	0.46	4.173	< 0.001

It is observed that neuro behaviour pattern assessed by NNNS scale, obtained summary scores were suggestive of neuro behaviour pattern is better in AGA babies compared with SGA babies.

Table 4: NNNS scale summary score of Regulation showing mean and SD

	SGA		AGA		t-value	P-value
	Mean	SD	Mean	SD		
Regulation	0.02	0.98	0.49	0.50	-3.991	< 0.001

Table 5: NNNS scale summary score of handling showing mean and SD

	SGA		AGA		t-value	P-value
	Mean	SD	Mean	SD		
Handling	0.03	0.98	0.51	0.56	-3.932	< 0.001

Table 6: NNNS scale summary score of Quality of movements showing mean and SD

	SGA		AGA		t-value	P-value
	Mean	SD	Mean	SD		
Quality of movements	0.11	1.14	0.26	0.44	-1.156	0.249

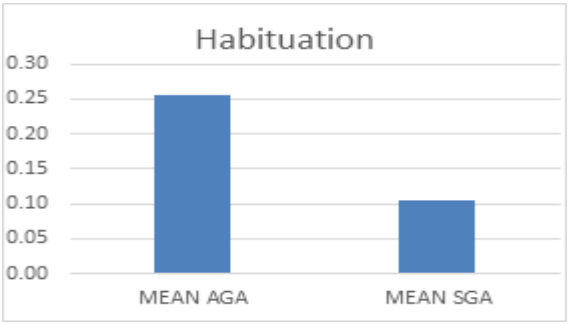

Figure 2: NNNS scale summary score Habituation showing mean of0.11 in SGA and Mean of 0.26 in AGA.

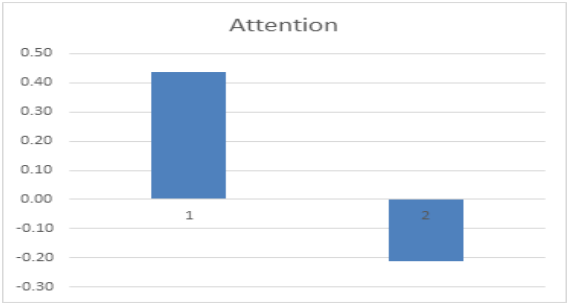

Figure 3: NNNS scale summary score of Attention showing mean of -0.21 in SGA and Mean of0.44 in AGA

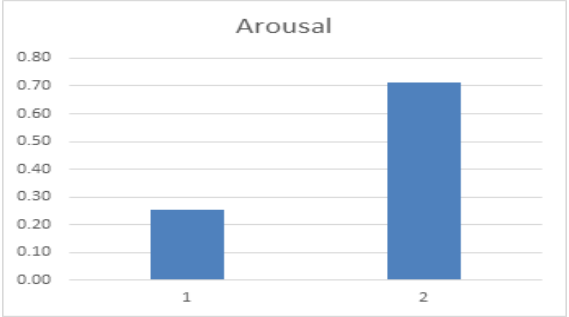

Figure 4: NNNS scale summary score of Arousal showing mean of SGA 0.71 and Mean of AGA 0.26.

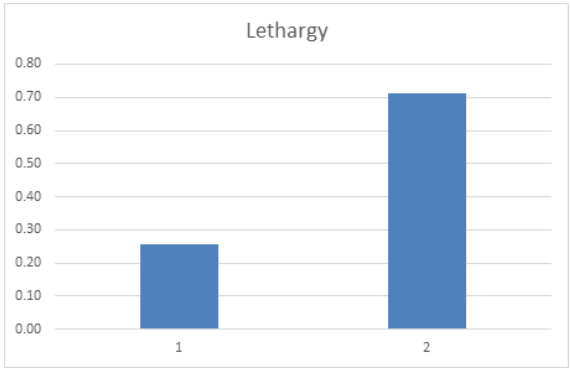

Figure 5: NNNS scale summary score of lethargy showing mean of SGA 0.71 and mean of AGA 0.26

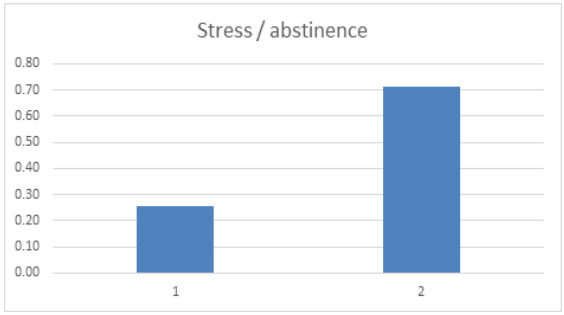

Figure 6: Finally, NNNS scale summary score of stress/ abstinence showing mean of SGA 0.71 and mean of AGA 0.26.

DISCUSSION

In this study maternal stress was assessed using DERS stress scale (which had maximum score of 36) and scores obtained from DERS stress scale showed mean score of25.68 among AGA and mean score of 27.37 among SGA. Findings from a study suggest that prenatal stress, anxiety and depression measured at 20 weeks' gestation increase the risk of SGA. The effects of maternal anxiety and depression on SGA were strongest in male infants. 2

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Stress seems to increase the risk of preterm birth. In our study we have found anxiety in 32 mothers, depression in 2, working stress in 22, sleep deprivation in 32, excessive worry about pregnancy and delivery, less supportive family was observed in 15 mothers and was found to be higher in mothers of SGA babies.In SGA babies (mean of 27.68 of maternal stress scale)it was observed that there wasdecreased habituation in 6 babies, arousal in 4, quality of movements in6 and increased lethargy in 8, hypotonia in 5 and stress/ abstinence in 7 babies. In our study it was also found that maternal mindfulness, good family support and social support, upper socio-economic status, good maternal education attainment and less stress during antenatal period have greater chance of AGA babies delivery and normal neuro behaviour pattern. In a study done by Janet A DiPietro on Maternal stress and affect influence on fetal neurobehavioral development showed that fetuses of women who were more affectively intense, appraised their lives as more stressful, and reported more frequent pregnancy-specific hassles were more active across gestation. Fetuses of women who perceived their pregnancy to be more intensely and frequently uplifting and had positive emotional valence toward pregnancy were less active and associations with fetal heart-rate variations were detected at 36 weeks gestation. These data provide evidence for earlier effects of maternal psychological functioning on fetal neurobehavior.[3]

In our study we have found that neurobehaviour pattern in female babies are better compared to male babies. Female babies in SGA showed decreased habituation in 3 babies, arousal in 5, attention in 4, regulation in 4 and quality of movements in 2. And increased lethargy in2 babies, hypotonia 2 babies, andstress/abstinence 4 babies. SG Amale babies showed abnormal (decreased) habituation in 6 babies arousal in 5, attention in 8, regulation in 6 and quality of movements in 4 and non-optimal reflexes in 6. And increased lethargy in 4 babies, hypotonia 5 babies, and stress/abstinence 5 babies.

AGA female showed decreased habituation in 2babies, arousal in 4, attention in 4, regulation in 3 and quality of movements in 2. And increased lethargy in2 babies, hypotonia 3 babies, andstress/abstinence 3babies. AGA male babies showed abnormal (decreased) habituation in 5 babies, arousal in 3, attention in 2, regulation in 6 and quality of movements in 2 and non-optimal reflexes in 2. And increased lethargy in 3babies, hypotonia 3 babies, and in stress/abstinence 6 babies. In a study by De Moraes et.al done to assess neurobehaviour of full term SGA it was found that male SGA newborn infants exhibited a greater number of stress/abstinence signals compared to females. In a study by de Moraes Barros MC et. Al neurobehavioral changes in extreme preterm infants using the NNNS, reported that female babies exhibited better performance than males for “quality of movement” .It is known that higher levels of stress hormones are found in male newborn infants when they are subjected to stressful procedures. It is possible that intrauterine growth restriction causes different cortical growth and organization changes during intrauterine life for male and female fetuses, depending on the predominant hormonal influence, which would explain the neurobehavioral differences observed in male and female SGA newborn infants during their first days of life.[4]

Male SGA babies delivered by LSCS have shown abnormal neuro behaviour pattern decrease in habituation in 6, attention in 6, arousal in 4 and quality of movement in 8. Increase in lethargy observed in 6, hypotonia in 8 and stress/abstinence in 6 babies.

Female babies delivered by LSCS showed abnormal neuro behaviour pattern that decrease in habituation in 4 babies, attention in 5, arousal in 4 and quality of movement in 6. Increase in lethargy 7 and stress/abstinence 6. Regarding uncomplicated pregnancies and deliveries most studies found no difference in neurodevelopment according to mode of delivery, apart from emergency cesarean, which usually correlates with worse outcomes .[5]

In our study we have observed neonatal medical conditions among them AGA group of babies had PPHN found in 9 babies, TTNB in 18, EPJ in 22, PDA in 3, Sepsis in 2. And in SGA babies following medical conditions are observed, TTNB observed in 15 babies, NEC in 15, PDA in 2, Sepsis in 19 and birth asphyxia in 1 babies. A study by Janet C Constantinou PhD found that respiratory dysfunction, retinopathy of prematurity, brain injury, feeding problems, sleepiness and/or excessive crying and later, neurological and learning deficiencies.[6]

Neurobehavioural Changes in AGA because of PDA were like decrease habituation in 4 babies, arousal in 4 babies, attention in 3 baby and quality of movements in 4 babies and increase in hypotonia in 6 babies, lethargy in 6babies and stress/abstinence in 4 babies.

Sepsis incidence is higher in SGA group and found in 19 babies. And neurobehavioural abnormalities found they were like decrease in habituation in 5 babies, arousal in 6 babies, attention in 4, quality of movements in 6 and increase in lethargy in 4, hypotonia in 5 and stress/abstinence in 6.

CONCLUSION

SGA new born infants exhibited a greater number of abnormal neurobehavioural pattern compared to AGA new borns. It is possible that intrauterine growth restriction causes different cortical growth and organization changes during intrauterine life, which would explain the neurobehavioral differences observed in AGA and SGA new borns during their first days of life.

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REFERENCES

1. Lean RE, Smyser CD, Rogers CE. Assessment: The Newborn. Child and Adolescent Psychiatric Clinics of North America 2017;26:427–40.
2. Monk C, Hane AA. Fetal and Infant Neurobehavioral Development. vol. 1. Oxford University Press; 2014. https://doi.org/10.1093/oxfordhb/9780199778072.013.20.
3. Maternal stress and affect influence fetal neurobehavioral development n.d.
4. de Moraes Barros MC, Guinsburg R, Mitsuhiro SS, Chalem E, Laranjeira RR. Neurobehavior of full-term small for gestational age newborn infants of adolescent mothers. Jornal de Pediatria 2008;84:217–23. https://doi.org/10.2223/JPED.1796.
5. The Increasing Trend in Caesarean Section Rates: Global, Regional and National Estimates: n.d.
6. Neurobehavioral Assessment Predicts Differential Outcome Between VLBW and ELBW Preterm Infants n.d..

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