ASSESSING THE CEREBRAL PALSY AND NEURODEVELOPMENTAL DISABILITY AT TWO YEARS BY PRETERM GENERAL MOVEMENTS

Dr. Sandeep Rangaiah[1]*, Dr. Avinash bettasoge[2], Dr. Shambu S Angadi[3], Dr. Bapurao S Kanthi[4]*

Abstract

Background: Neurological examination before discharge is vital in subjects admitted to NICU (neonatal Intensive care unit), which would help in early assessment and targeted intervention to eliminate the severity and risk of the neurodevelopmental disability and cerebral palsy.

Aim: The present study aimed to evaluate the accuracy of general movements in the preterm subjects and period of fidgety movement in the prediction of cerebral palsy and neurodevelopmental disability in preterm infants of gestational age of ≤ 32 weeks at the corrected gestational age of 18-24 months.

Methods: In 85 very preterm infants with a mean birth weight of 1213±224 grams and gestational age of 29.6±1.34 weeks, fidgety movements were assessed at 8-18 weeks post-term, and general movements were assessed in a preterm period of 31-36 weeks following the post-conception age. Griffiths Mental Developmental Scales were used to assess the Neurodevelopmental outcomes in 64 child subjects.

Results: Neurodevelopmental disability was seen in 5 child subjects where. One subject had cerebral palsy, and four subjects had global developmental delays. With fidgety movements and preterm movements, the relative risk of neurodevelopmental disability was found to be 6.05 (0.95-38.07) and 1.44 (0.33-6.87) at 95% CI. The specificity and sensitivity values were 93% and 100% in the fidgety movement period and 63% and 50% in the preterm period, respectively.

Conclusion: The present study concludes that lower specificity and sensitivity were seen in the preterm movements compared to the fidgety movements in the prediction of neurodevelopmental disability and cerebral palsy in the later stages in preterm infants.

Keywords: Cerebral palsy, developmental delay, fidgety movement, neurodevelopmental disorder

[1]MD Paediatrics, NNF Fellow, Ovum Hospital, Bangalore, Karnataka
[2]MD pediatrics, Fellow in neonatology, Ovum Hospital, Bangalore, Karnataka
[3]MD Pediatrics, Senior resident, KIMS Hubli, Karnataka. Email: shambu.angadi07@gmail.com
[4]*MD Paediatrics FPICU(IGICH), Senior Resident, ESI MCH, Kalaburagi, Karnataka
Email : Kanthibapurao@gmail.com

***Corresponding Author:-** Dr. Bapurao S Kanthi
*MD Paediatrics FPICU(IGICH), Senior Resident, ESI MCH, Kalaburagi, Karnataka
Email : Kanthibapurao@gmail.com

DOI: 10.48047/ecb/2023.12.si10.0066

Introduction

In very low birth weight and preterm infants, improved rates of neurodevelopmental outcomes have been seen in recent times. However, these infants still are at high risk of developing cerebral palsy and pose difficulties in learning, attention, sensory, perceptual, visual, language, and cognitive aspects. Early detection and correct diagnosis of these complications can eliminate the risk of adverse developmental and motor outcomes, improve the well-being of the caregiver, and decrease secondary complications.[1]

Spontaneous movements in early fetal life can be easily detected and are known as general movements. These movements are seen until 4-5 months of age post-term. The GMA or general movements assessment poses a high ability to predict neurodevelopmental disability, in particular concerning cerebral palsy in term and preterm infants with the risk factors.[2] These general movements are classified into three types preterm movements, writhing movements, and fidgety movements seen in the age of 28 to 36-38 weeks post-conception, 36-38 to 46-52 weeks post-conception, and 46-52 to 54-58 weeks post-conception respectively.[3]

Adverse neurological outcomes in infants are usually associated with the absence of the main characteristics, including the fluency of normal general movements, adequate variability, and complexity. The general movement assessment has a high predictive ability which is superior to other assessment techniques, including neurological assessment and cranial ultrasound, and is comparable to the MRI (Magnetic resonance imaging).[4] For the prediction of cerebral palsy, the highest specificity and sensitivity is seen for fidgety movements followed by writhing movements. However, lower accuracy is seen for adverse outcomes not related to cerebral palsy. Assessing the general movements before the term has data scarce in the literature, with the studies done on preterm movements showing low values of specificity.[5]

Concerning the Indian scenario, the follow-up rates for high-risk infants are poor. This can be attributed to various barriers in middle-income and low-income countries, including the financial constraints for perceived wellness and transportation issues in infants. GMA (General movement assessment) can be used as a useful tool for the assessment of neurological status in places with the limited resource where it is not feasible to get expensive modalities like neuroimaging.[6]

The present study was aimed at assessing the specificity and sensitivity of the preterm movement for the prediction of cerebral palsy and neurodevelopmental disability in very preterm infants. This was compared to the specificity and sensitivity of the fidgety movements for the prediction of cerebral palsy and neuro developmental disability in those very preterm infants. Standardized developmental assessment at 18-24 months corrected gestational age was used to assess the neurodevelopmental disability. Also, Prechtl standards were followed for video recordings of the fidgety movements and preterm movements.[7]

MATERIALS AND METHODS

The present prospective cohort clinical study was aimed to evaluate the accuracy of general movements in the preterm subjects and period of fidgety movement in the prediction of cerebral palsy and neurodevelopmental disability in preterm infants of gestational age of $\leq$ 32 weeks at corrected gestational age of 18-24 months. Informed consent in both written and verbal format was taken from all the subjects before the study participation.

The exclusion criteria for the study were subjects that were sedated or on a ventilator as that would not allow the video recording of the general movements, subjects whose parents were not willing to participate or to turn up at follow-up, subjects having anomalies incompatible with survival, and subjects with major congenital anomalies. After the final inclusion of the study subjects, the infant's details, perinatal history, and the antenatal history of the mother were recorded from the existing data of the institutional records.

In all the included infants, neurodevelopmental assessment, fidgety movement assessment, and preterm movement assessment were done between 18-24 months following the John HB et al. in 2022.[8] The general movements were classified to be abnormal or normal by the primary examiner expert in his field. All infants were set for early intervention before discharge from the NICU. In high-risk infants, the follow-up visit was planned every three months until the corrected gestational age of 18 months, where neurodevelopmental assessment was done.

At the corrected gestational age of 18 months and 24 months, neurodevelopmental assessment was done by an expert with the GMDS (Griffiths Mental developmental scale)-2nd edition.[9] The person performing neurodevelopmental assessment was blinded to the study protocol. GMDS contains five domains, namely performance, eye-hand coordination, hearing and language, personal and social skills, and locomotor. In each domain, a sub-quotient was assessed, and its average was taken as GQ (general quotient), which indicated the overall development of a child.

Neurodevelopmental disability was considered at a cut-off score of ≤ 76 and <-2 as the standard deviation; the mean normal GQ had a mean of 100 and 12 as the standard deviation. In infants of age 16-24 months, normative GQ had a mean and standard deviation of 109±9.4.[10] Cerebral palsy was considered in children with abnormal tone and posture and was classified following the GMFCS (Gross Motor Function Classification System) by an expert pediatrician not aware of the GMA results.

The data gathered were analyzed statistically using the SPSS software version 21.0 with a chi-square test, Fisher's exact test, and t-test. Medcalc software was used to assess the negative and positive predictive values, specificity, and sensitivity. The significance level was kept at a p-value of <0.05.

RESULTS

The present prospective cohort clinical study was aimed to evaluate the accuracy of general movements in the preterm subjects and period of fidgety movement in the prediction of cerebral palsy and neurodevelopmental disability in preterm infants of gestational age of ≤ 32 weeks at corrected gestational age of 18-24 months. The study results showed that no significant difference was seen in the study subjects concerning the abnormal general movements, neonatal morbidities, and demographic characteristics in 64 subjects that completed the study and the 21 subjects that did not turn in for the follow-up. The mean gestational age of the study subjects was 29.6±1.34 years, and the mean birth weight was 1213±224 grams. The mean post-conceptional age at the assessment of fidgety movements was 11.7±2.3 years, and at preterm movement, the assessment was 34.2±1.2 weeks post-term.

Concerning the complications and the neuro developmental outcomes, it was seen that normal neurodevelopmental outcome was seen in 59 subjects and abnormal outcome in 5 subjects. One subject from normal neurodevelopmental outcomes had necrotizing enterocolitis, 8.47% (n=5) had septicemia, 16.94% (n=10) needed invasive ventilation, 15.25% (n=9) had broncho-pulmonary dysplasia, 5.08% (n=3) had pneumonia, 3.38% (n=2) had perinatal asphyxia, 6.77% (n=4) had head circumference score <-2SD, 11.86% (n=7) had length score <-2SD, and 1.69% (n=1) had birth weight score of <-2SD, whereas, these complications were not seen in any subject with abnormal neurodevelopmental outcomes (Table 1).

Hyaline membrane disease was seen in 80% (n=4) subjects with abnormal neurodevelopmental outcomes and 50.84% (n=20) subjects with normal neurodevelopmental outcomes. No antepartum steroids were given in 20% (n=1) and 13.55% (n=8) subjects with abnormal and normal neurodevelopmental outcomes. PIPH was seen in 40% (n=2) and 27.11% (n=16) subjects with abnormal and normal neurodevelopmental outcomes, respectively. Multifetal pregnancy was seen in 60% (n=3) and 30.50% (n=18) subjects with abnormal and normal neurodevelopmental outcomes, respectively. Normal delivery was done in 40% (n=2) and 33.89% (n=20) subjects with abnormal and normal neurodevelopmental outcomes, respectively. Birth weight was 1155±177 and 1217±±227 grams, and gestational age was 29.36±1.65 and 29.7±1.27 weeks in subjects with abnormal and normal neurodevelopmental outcomes, respectively. There were 40% (n=2) and 40.67% (n=24) females in groups with abnormal and normal neurodevelopmental outcomes, respectively (Table 1).

With fidgety movements and preterm movements, the relative risk of neurodevelopmental disability was found to be 6.05 (0.95-38.07) and 1.44 (0.33-6.87) at 95% CI. The specificity and sensitivity values were 93% and 100% in the fidgety movement period and 63% and 50% in the preterm period, respectively. The sensitivity specificity, negative predictive value, and positive predictive values of the fidgety movements and general movements are listed in Table 2.

S. No	Complications	Neurodevelopmental outcomes	
		Abnormal n=5 (%)	**Normal n=59 (%)**
1.	**Necrotizing enterocolitis**	0	1 (1.69)
2.	**Septicemia**	0	5 (8.47)
3.	**Invasive ventilation**	0	10 (16.94)
4.	**Hyaline membrane disease**	4 (80)	20 (50.84)
5.	**Bronchopulmonary dysplasia**	0	9 (15.25)
6.	**Pneumonia**	0	3 (5.08)
7.	**Perinatal asphyxia**	0	2 (3.38)
8.	**No antepartum steroids**	1 (20)	8 (13.55)
9.	**PIPH**	2 (40)	16 (27.11)
10.	**Multifetal pregnancy**	3 (60)	18 (30.50)
11.	**Normal delivery**	2 (40)	20 (33.89)
12.	**Head circumference score <-2SD**	0	4 (6.77)
13.	**Length score <-2SD**	0	7 (11.86)
14.	**Birth weight score <-2SD**	0	1 (1.69)
15.	**Birth weight (grams)**	1155±177	1217±±227
16.	**Gestational age (weeks)**	29.36±1.65	29.7±1.27
17.	**Female**	2 (40)	24 (40.67)

Table 1: Association of neurodevelopmental outcomes with neonatal and antenatal complications

S. No	Parameter	Fidgety movements (n=59)	Preterm general movements (n=68)
1.	**Cerebral palsy**		
a)	Negative predictive value	100	99.06 (96.42-99.75)
b)	Positive predictive value	16.04 (9.22-26.44)	1.62 (0.42-6.22)
c)	Specificity	93.77 (88.56-97.14)	63.67 (55.95-70.94)
d)	Sensitivity	100 (15.83-100)	50 (1.28-98.76)
2.	**Neurodevelopmental disability**		
a)	Negative predictive value	99.95 (92.57-96.57)	93.62 (90.05-95.92)
b)	Positive predictive value	18.53 (5.42-47.27)	5.85 (2.35-13.88)
c)	Specificity	92.75 (86.19-96.83)	64.43(55.05-73.02)
d)	Sensitivity	25.02 (3.17-65.07)	33.35 (7.47-70.09)

Table 2: Accuracy of Fidgety movement age and general movement age in the prediction of cerebral palsy and neurodevelopmental disability in the study subjects

DISCUSSION

In the present study, no significant difference was seen in the study subjects concerning the abnormal general movements, neonatal morbidities, and demographic characteristics in 64 subjects that completed the study and the 21 subjects that did not turn in for the follow-up. The mean gestational age of the study subjects was 29.6±1.34 years, and the mean birth weight was 1213±224 grams. The mean post-conceptional age at the assessment of fidgety movements was 11.7±2.3 years, and at preterm movement, the assessment was 34.2±1.2 weeks post-term. These results were similar to the studies of Spittle AJ et al. [11] in 2008 and Noble Y et al. [12] in 2012, where authors assessed subjects with demographic data comparable to the present study.

The study results showed that for the complications and the neurodevelopmental outcomes, it was seen that normal neurodevelopmental outcome was seen in 59 subjects and abnormal outcome in 5 subjects. One subject from normal neurodevelopmental outcomes had necrotizing enterocolitis, 8.47% (n=5) had septicemia, 16.94% (n=10) needed invasive ventilation, 15.25% (n=9) had bronchopulmonary dysplasia, 5.08% (n=3) had pneumonia, 3.38% (n=2) had perinatal asphyxia, 6.77% (n=4) had head circumference score <-2SD, 11.86% (n=7) had length score <-2SD, and 1.69% (n=1) had birth weight score of <-2SD, whereas, these complications were not seen in any subject with abnormal neurodevelopmental outcomes. These results were consistent with the previous studies of Kwong AKL et al. [13] in 2018 and Groen SE et al. [14] in 2005, where authors

showed similar complications and neurodevelopmental outcomes in their study subjects, as seen in the present study.

It was also seen that Hyaline membrane disease was seen in 80% (n=4) subjects with abnormal neurodevelopmental outcomes and 50.84% (n=20) subjects with normal neurodevelopmental outcomes. No antepartum steroids were given in 20% (n=1) and 13.55% (n=8) subjects with abnormal and normal neurodevelopmental outcomes. PIPH was seen in 40% (n=2) and 27.11% (n=16) subjects with abnormal and normal neurodevelopmental outcomes, respectively. Multifetal pregnancy was seen in 60% (n=3) and 30.50% (n=18) subjects with abnormal and normal neurodevelopmental outcomes, respectively. Normal delivery was done in 40% (n=2) and 33.89% (n=20) subjects with abnormal and normal neurodevelopmental outcomes, respectively. Birth weight was 1155±177 and 1217±±227 grams, and gestational age was 29.36±1.65 and 29.7±1.27 weeks in subjects with abnormal and normal neurodevelopmental outcomes, respectively. There were 40% (n=2) and 40.67% (n=24) females in groups with abnormal and normal neurodevelopmental outcomes, respectively. These results were in agreement with the findings of Bruggink JL et al. [15] in 2008 and Zahed- Chiekh M et al. [16] in 2011, where authors reported a similar prevalence of neurovascular complications in their study subjects, as seen in the present study.

The study results also showed that with fidgety movements and preterm movements, the relative risk of neurodevelopmental disability was found to be 6.05 (0.95-38.07) and 1.44 (0.33-6.87) at 95% CI. The specificity and sensitivity values were 93% and 100% in the fidgety movement period and 63% and 50% in the preterm period, respectively. The sensitivity specificity, negative predictive value, and positive predictive values of the fidgety movements and general movements. These results were in line with the studies of Kodric J et al. [17] in 2010 and John HB et al. [18] in 2022, where similar fidgety movements and preterm movements as of the present study were shown by the authors.

CONCLUSION

Considering its limitations, the present study concludes that lower specificity and sensitivity were seen in the preterm movements compared to the fidgety movements in the prediction of neurodevelopmental disability and cerebral palsy in the later stages in preterm infants. The study had a few limitations being done at a single institute, and recordings were made by a single examiner.

REFERENCES

1. Einspieler C, others. Prechtl's method on the qualitative assessment of general movements in preterm, term, and young infants. Mac Keith Press London, UK; 2004.
2. Prechtl HF. General movement assessment as a method of developmental neurology: New paradigms and their consequences. Dev Med Child Neurol. 2001;43:836-42.
3. Novak I, Morgan C, Adde L, et al. Early, accurate diagnosis and early intervention in cerebral palsy: Advances in diagnosis and treatment. JAMA Pediatr. 2017;171:897-907.
4. Pascal A, Govaert P, Oostra A, Naulaers G, Ortibus E, Van den Broeck C. Neurodevelopmental outcome in very preterm and very-low-birthweight infants born over the past decade: A meta-analytic review. Dev Med Child Neurol. 2018;60:342- 55.
5. Mukhopadhyay K, Malhi P, Mahajan R, Narang A. Neurodevelopmental and behavioral outcome of very low birth weight babies at corrected age of 2 years. Indian J Pediatr 2010;77:963-7.
6. Manacero SA, Marschik PB, Nunes ML, Einspieler C. Is it possible to predict the infant's neurodevelopmental outcome at 14 months of age using a single preterm assessment of general movements? Early Hum Dev. 2011;88:39-43.
7. Einspieler C, Prechtl HF. Prechtl's assessment of general movements: A diagnostic tool for the functional assessment of the young nervous system. Ment Retard Dev Disabil Res Rev. 2005;11:61-7
8. John HB, Oommen SP, Kumar M. Trajectories of general movements in very preterm infants: An experience from South India, a prospective cohort study. Current Medical Issues. 2022;20:16-21.
9. Griffiths R. Griffiths, mental development scales, extended, revised manual. Firenze: Giunti Organizzazioni Speciali. 2006.
10. Oommen SP, Santhanam S, John H, et al. Neuro-developmental outcomes of very low birth weight infants at 18-24 months, corrected gestational age in a tertiary health center: a prospective cohort study. J Trop Pediatr. 2019;65:552-60.
11. Spittle AJ, Doyle LW, Boyd RN. A systematic review of the clinometric properties of

neuromotor assessments for preterm infants during the first year of life. Dev Med Child Neurol. 2008;50:254-66.
12. Noble Y, Boyd R. Neonatal assessments for the preterm infant up to 4 months corrected age: A systematic review. Dev Med Child Neurol. 2012;54:129–39.
13. Kwong AKL, Fitzgerald TL, Doyle LW, Cheong JLY, Spittle AJ. Predictive validity of spontaneous early infant movement for later cerebral palsy: A systematic review. Dev Med Child Neurol. 2018;60:480-9.
14. Groen SE, De Blécourt AC, Postema K, Hadders-Algra M. General movements in early infancy predict neuromotor development at 9 to 12 years of age. Dev Med Child Neurol. 2005;47:731-8.
15. Bruggink JL, Einspieler C, Butcher PR, Van Braeckel KN, Prechtl HF, Bos AF. The quality of the early motor repertoire in preterm infants predicts minor neurologic dysfunction at school age. J Pediatr. 2008;153:32-9.
16. Zahed-Cheikh M, Brévaut-Malaty V, Busuttil M, et al. Comparative analysis of perinatal and postnatal factors and general movement in extremely preterm infants. Brain Dev. 2011; 33:656-65.
17. Kodric J, Sustersic B, Paro-Panjan D. Assessment of general movements and 2.5-year developmental outcomes: Pilot results in a diverse preterm group. Eur J Paediatr Neurol. 2010;14:131-7.
18. John HB, Oommen SP, Kumar M. Trajectories of general movements in very preterm infants: An experience from South India, a prospective cohort study. Current Medical Issues. 2022; 20:16-21.