ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 08 | August - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

TO STUDY EARLY PREDICTION OF CEREBRAL PALSY IN HIGH RISK NEWBORN USING PRETCHL'S GENERAL MOVEMENT ASSESSMENT

Medical Science

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ABSTRACT

This study aimed at early predicting cerebral palsy in high-risk newborns using Pretchl's general movement assessment. This observational study was conducted in all inborn and outborn neonates (n=58) admitted to the NICU, Nehru Hospital, BRD Medical College, Gorakhpur, Uttar Pradesh, India. An expert Pediatrician and supportive medical team examined all the patients. Following that, routine clinical tests were performed to assess cerebral palsy and neuro-developmental abnormalities in patients undergoing cerebral palsy treatment. Details of their risk stratification were done, and then Pretchl's general movement assessment was applied to see its outcome. The data obtained were analyzed using SPSS software version 20.0 (SPSS, Chicago, IL). Most neonates were females and of appropriate age for gestational age. The birth weight of most studied neonates was ≤1.5 kg. 84.3% of neonates were premature, 2.4% had hypoglycemia, 36.1% suffered from sepsis, and HIE was in 20.5%. Writhing Movement was abnormal in 75.9% of neonates, of which Poor Repertoire was 51.8%, and Cramped Synchronized was 24.1%. Cramped synchronized, fidgety movement parameters of the general movement were associated significantly with the HIE of the studied neonates ($p<0.05$). Writhing movement and poor repertoire parameters of the general movement was markedly associated with the sepsis of the studied neonates ($p<0.05$). Writhing movement, fidgety movement, and cramped synchronized parameters of the general movement were associated significantly with the outcome of the studied neonates ($p<0.05$). Based on their outcome, it was found that 3.5% of the studied neonates get expired and 53.4% had High-Risk CP, and 43.1% were normal neonates. Birth hypoxic-ischemic encephalopathy (HIE) was associated significantly with the outcome of the studied patients ($p<0.05$). Prudence must be used when analyzing general movement in extremely preterm infants. Writhing movements may be influenced by perinatal morbidity and possibly by the severe brain immaturity of these infants; writhing movement correlates with HIE and nosocomial infections (sepsis). Analysis of movement in infants of 3 months corrected with age is a valuable means to detect neurological disorders using Pretchl's general movement assessment.

KEYWORDS

Cerebral Palsy; Neonates; Pretchl's General Movement Assessment; Observational study

INTRODUCTION

Lesions of the brain or spinal cord during fetal and neonatal development may dramatically alter the formation and function of sensorimotor pathways, depending on the lesions' extent, location, and timing [15]. Lack of movement and reduced neural drive in sensorimotor pathways can negatively impact neural circuit development and skill acquisition, whereas normal activity provides a substrate for circuit refinement and plasticity [16]. Evidence shows that the cortico-spinal system, a significant circuitry for skilled motor behaviors, is already active and shaping spinal circuits by the late prenatal period. However, these dynamics are derailed by prenatal to postnatal insults [17]. Therapeutic interventions that motivate movement are potential substrates for driving these circuits during their most dynamic phase of plasticity [18].

Prematurity and low birth weight are risk factors for CP [19]. Theoretically, meningitis, intracranial hemorrhage (IC), and hypoxic-ischemic encephalopathy (HIE) are also risk factors for CP due to brain injury [20]. Survival analysis on time to the occurrence of CP in high-risk babies has yet to be established, despite the importance of early prediction of CP in high-risk babies. In India, the higher survival rate of premature and other high-risk babies has also increased CP cases. High-risk babies are at risk of developing CP later due to risk factors in pre-, peri-and postnatal periods**.** This study aimed to detect neuro-developmental abnormality and assessment of quality and evolution of GM during 1st to 20th weeks of life in high-risk neonates using Pretchl's general movement assessment.

The ability to predict CP earlier than two years of age would have many advantages. Earlier recognition of infants at high risk for neurodevelopment delay would also benefit families through individualized case management and interventions. It may also lead to more focused follow-up and reassure the parents of those children who are unlikely to develop [21]. Early recognition of neurodevelopment delay needs a good tool for early diagnosis to predict the outcome and to enable early intervention as soon as possible and a sensitivity of 95–100% [22]. GMA conducted at three months of corrected age is helpful in a clinical setting for predicting CP at two years of corrected age for children born <32 weeks of gestation [23]. In its predictive power, the GM assessment is superior to cranial ultrasound (US) or neurological examination and equivalent to MRI (white matter assessment) [24].

We hypothesized the early markers of cerebral palsy from Pretchl's general movement assessment to the neuro-developmental abnormality, quality, and evolution of GM during 1st to 20th weeks of life in high-risk neonates. When indicated in assessing high-risk infants, studies provide an opportunity for early detection of any poor motor performance and possible early intervention.

MATERIAL AND METHODS

This prospective observational study was conducted on all inborn and outborn neonates admitted to the Neonatal intensive care unit (NICU), at Nehru Hospital, BRD Medical College, Gorakhpur, Uttar Pradesh, India, from November 2019 to October 2020. A total of 83 neonates were screened, and 25 neonates' parents were rejected to participate in the study. Finally, 58 neonates fit according to the inclusion criteria (all high-risk neonates of 40 wks PMA and not on Anti-epileptic drugs or other CNS depressant drugs). Parents not giving consent for video analysis and neonates with major congenital malformation were excluded.

An expert Pediatrician and supportive medical team examined all the patients. After those, routine clinical examinations were done to analyze cerebral palsy and neuro-developmental abnormality assessment in patients undergoing treatment of cerebral palsy. Details of their risk stratification were done, and then the preschool's general movement assessment was applied to see its outcome.

The various high-risk neonate sought out in this study are:

High-Risk Neonate

- **Preterm birth**, around 50% suffer from a broad range of neurodevelopmental impairments, and 10 to 20% have characteristics of cerebral palsy.
- **Small for gestational age** CP is associated with infants born at or near term.

- **Asphyxia perinatal** –HIE Grade III are at risk of neurodevelopmental disorder.
- **Maternal infection-** Infections such as toxoplasmosis rubella CMV and HSV are associated with increased risk for CP.
- **Birth defects** - Several different brain developmental defects can produce cerebral palsy, predominantly neuronal migration disorders such as schizencephaly and polymicrogyria.
- **Perinatal risk factor-** Perinatal strokes, which occur between the late gestation period and 28 days after birth, account for as much as half of the hemiplegic CP in infants born at term.
- **Placental factors-** Such as chorioamnionitis, premature rupture of membrane, and thrombosis.
- **Maternal factors**- Like preeclampsia
- **Kernicterus Hypoglycemia -** Persistent Hypoglycemia is defined as hypoglycemia requiring GIR >12mg/kg/min or hypoglycemia persisting > 7 days is at risk of insult for developing brain.

There are various tools to detect CP in these high-risk neonates; some of them are

- General movement
- MRI
- Hammersmith Infant Neurological Examination

General Movement Assessment: This tool was developed by Dr. Hans Prechtl et al. [10] for the early assessment of cerebral palsy and other motor disorders by evaluating the minute difference in movement of a newborn baby, which in turn shows the various aspects of developing brain.

Type of GMs:

Writhing GMs: in utero and up to 46 weeks PMA. These are characterized by small to moderate amplitude and slow to moderate speed movements, which are elliptical. Abnormal GMs in the writhing period are poor repertoire (PR), cramped synchronized (CS), and chaotic.

- Poor Repertoire (PR)– The sequence of successive movement components is monotonous, and the movement of different body parts does not occur in the complex way seen in normal GMs.
- CRAMPED SYNCHRONISED (CS) movements appear rigid and lack normal smooth, fluent character. All limbs and trunk muscle contract and relax almost simultaneously.
- CHAOTIC GM- (Ch)- movements of all limbs of large amplitude and occur in a chaotic order without any fluency or smoothness

Fidgety Movements (FM):

- FMs are small movements of moderate speed and variable acceleration of neck trunk and limbs in all directions, except during fussing and crying in an awake infant.
- FMS can be seen as early as 6 wks but usually occurs around 9 wks and is present till 20 wks post-term, followed by intentional and antigravity movement.

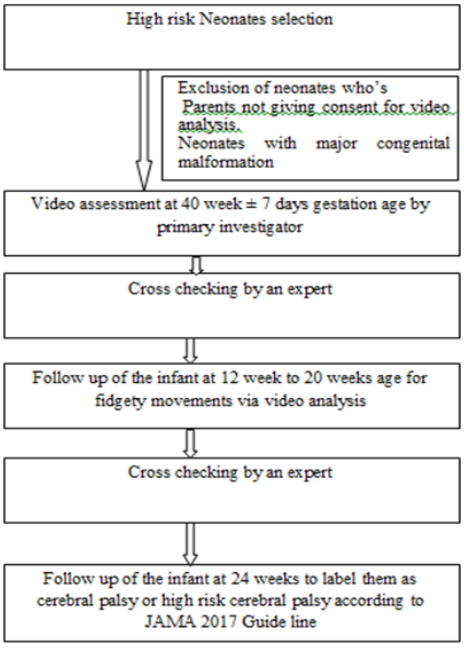

Figure 1: Flow chart of pretchl's general movement assessment.

Statistical analysis

Data was recorded on a predesigned Performa and managed in a Microsoft Excel spreadsheet. The data obtained were analyzed using SPSS software version 20.0 for Windows (SPSS, Chicago, IL). Data were presented as proportions, median (range), or mean (± standard deviation), as appropriate. Baseline demographic characteristics, medical history, and preschool general movement assessment score were compared between the two groups according to neuro-developmental abnormality. Analyses were conducted using the Student t-test or ANOVA test for continuous variables and Pearson chi-square ($\chi 2$) test for categorical variables, whenever applicable. The nonparametric Mann-Whitney test was used for skewed variables. A 2-tailed $p < 0.05$ was considered significant.

RESULTS

In the present study, 83 cases were enrolled; 25 (30.1%) patients were not reported in the follow-up; only 58 (69.9%) were reported at all follow-up times. Most neonates were females (51.8%) and of appropriate age for gestational age (55.4%). Also, the birth weight of the majority of the studied neonates was ≤1.5 kg (51.8%). 84.3% of neonates were premature, 2.4% had hypoglycemia, 36.1% suffered from sepsis, and HIE was in 20.5%.

Writhing Movement was abnormal in 75.9% of neonates, of which Poor Repertoire was 51.8% and Cramped Synchronized was 24.1%. Normal Fidgety movement was 56.8% and abnormal in 44.2% of neonates. In the present study, none of the parameters of the general movement were associated significantly with the gender, birth weight, gestational age and prematurity of the studied neonates ($p>0.05$).

In the present study, it was found that cramped synchronized, fidgety movement parameters of general movement were associated significantly with the hypoxic-ischemic encephalopathy (HIE) of the studied neonates ($p<0.05$) (Table 1).

Table 1: Association of HIE with General Movement Assessment.

		HIE (n=58)			P value
		Yes	No		
Writhing Movement	Normal	1 (1.7%)	13 (22.4%)	3.343	0.251
	Abnormal	9 (15.5%)	35 (60.3%)		
Poor Repertoire		4 (6.8%)	26 (44.8%)	0.363	0.164
Cramped Synchronized		5 (8.6%)	9 (15.5%)	4.333	**0.036**
Fidgety Movement	Abnormal	9 (15.5%)	24 (41.4%)	9.000	**0.020**
	Normal	1 (1.7%)	24 (41.4%)		

In the current study, it was found that writhing movement and poor repertoire parameters of the general movement were associated significantly with the sepsis of the studied neonates ($p<0.05$) (Table 2).

Table 2: Association of sepsis with General Movement Assessment.

		Sepsis (n=58)			P value
		Yes	No		
Writhing Movement	Normal	1 (1.7%)	13 (22.4%)	11.870	**0.006**
	Abnormal	21 (36.2%)	23 (39.7%)		
Poor Repertoire		16 (27.6%)	14 (24.1%)	4.718	**0.007**
Cramped Synchronized		5 (8.6%)	9 (15.5%)	0.882	0.844
Fidgety movement	Abnormal	16 (27.6%)	17 (29.3%)	2.980	0.057
	Normal	6 (10.3%)	19 (32.8%)		

Writhing movement, fidgety movement, and cramped synchronized parameters of the general movement were associated significantly with the outcome of the studied neonates ($p<0.05$) (Table 3).

Table 3: Association of outcome with General Movement Assessment.

		Outcome (n=58)		P value
		CP/Expired	Normal	
Writhing Movement	Normal	1 (1.7%)	13 (22.4%)	**<0.001**
	Abnormal	32 (55.2%)	12 (20.7%)	
Poor Repertoire		18 (31.0%)	12 (20.7%)	0.791
Cramped Synchronized		14 (24.1%)	0 (0.0%)	**<0.001**
Fidgety Movement	Abnormal	33 (56.9%)	0 (0.0%)	**<0.001**
	Normal	0 (0.0%)	25 (43.1%)	

Based on their outcome, it was found that 3.5% of the studied neonates get expired and 53.4% had High-Risk CP, and 43.1% were normal neonates. Birth hypoxic-ischemic encephalopathy (HIE) was

associated significantly with the outcome of the studied patients (p<0.05); the rest of the other risk factors were not associated significantly with the outcome of the studied neonates (p>0.0) (Table 4).

Table 4: Association of outcome with risk factors.

		Outcome		P value
		CP/Expired	Normal	
Sex	**Male**	20 (34.5%)	10 (17.2%)	0.120
	Female	13 (22.4%)	15 (25.9%)	
Birth Weight	**≤1.5kg**	18 (31.0%)	11 (19.0%)	0.426
	>1.5 kg	15 (25.9%)	14 (24.1%)	
Gestational periods	**SGA**	13 (22.4%)	10 (17.2%)	0.963
	AGA	20 (34.5%)	15 (25.9%)	
Prematurity	**Yes**	27 (46.6%)	24 (41.4%)	0.101
	No	6 (10.3%)	1 (1.7%)	
HIE	**Yes**	9 (15.5%)	1 (1.7%)	**0.020**
	No	24 (41.4%)	24 (41.4%)	
Sepsis	**Yes**	16 (27.6%)	6 (10.3%)	0.057
	No	17 (29.3%)	19 (32.8%)	

DISCUSSION

The current study aims to investigate the early prediction of cerebral Palsy in high-risk neonates using Pretchl's general movement evaluation of quality and evolution of GM in high-risk neonates over the first 20 weeks of life. In this study, 83 cases were enrolled; 25 (30.1%) patients were not reported in the follow-up; only 58 (69.9%) were reported at all follow-up times. So we have analyzed all the associations on these 58 neonates only.

The majority of newborns in our research were females (51.8%) and of suitable gestational age (55.4%), which is consistent with findings from previous studies such as Handryastuti et al. (2018) [1] and Ferrari et al. (2019) [2]. In contrast, Hemachithra et al. (2020) [3] and Goel S & Ojha (2015) [4] found offspring with male sex in 53.0% and 68.7% of their studies, respectively.

The birth weight of most studied neonates was ≤1.5 kg (51.8%). 84.3% were premature, 2.4% had hypoglycemia, 36.1% suffered from sepsis, and HIE was in 20.5%. **Stanley (1992) [5]** reported the incidence of CP is much higher when the newborn baby is very preterm (<32 weeks) and has a meager birth weight (<1.5 kg). **Chattopadhyay & Mitra (2015) [6]** reported the sex distribution among the children with developmental delay was 67.9% male and 32.1% female. A maximum incidence of developmental delay was noted in babies with BW ≤1.5 kg (67.8%), with a sharp decline in incidence in babies weighing >2.5 kg (32.2%) at birth. The incidence of developmental delay is also significantly higher in preterm babies (37.3%) than in term babies (23.0%), which is supported by a review of 100 related articles by **Xiong et al. (2012) [7].** According to WHO, between four and nine million newborns develop birth asphyxia each year; of these, an estimated 1.2 million die, and at least the same number develop severe consequences such as epilepsy, cerebral Palsy, and developmental delay [8]. But much other research has given an antenatal cause as a primary etiology for developing cerebral Palsy, and perinatal asphyxia accounts for between 6% and 8% of cerebral Palsy [9]. Overly inclusive definitions were associated with high rates of attribution of CP to birth asphyxia.

In our study, the Writhing Movement was abnormal in 75.9% of neonates of this Poor Repertoire in 51.8%, and Cramped Synchronized was 24.1%. During the fidgety age (6-9 weeks), normal fidgety in 43.2%, and fidgety was abnormal or absent in 56.8%. Our study is very similar to **Prechtl et al. (1992) [10]**, and **Burger & Louw's (2009) [11]** studies on highly preterm infants revealed abnormal motor activity during the WM period in 60% of cases, of which 40% are poor repertoire movements. In a similar study focused on the first 15 days of life, **Bos et al. (1997) [12]** observed a higher number of abnormal trajectories (16/19 cases), mostly with poor repertoire, in 19 highly preterm infants (<28 WA).

In the present study, when we compare the parameters of general movement with associated risk factors, none of the parameters of the general movement were associated significantly with the gender, birth weight, gestational age, and prematurity of the studied neonates (p>0.05). The cramped synchronized, fidgety, fidgety absent parameters of the general movement were associated significantly with HIE in the studied neonates (p<0.05). The writhing movement and poor repertoire parameters of the general movement were associated considerably with sepsis in the studied neonates (p<0.05). And the writhing movement, fidgety, and cramped synchronized parameters of the general movement were associated significantly with the outcome of the studied neonates (p<0.05).

In the present study, the birth HIE was associated significantly with the outcome of the studied patients (p<0.05), and other risk factors were not associated significantly with the outcome of the studied neonates (p>0.0). 3.5% of the studied neonates expired, 53.4% had High-Risk CP, and 43.1 % were normal neonates. HIE is one of the most severe birth complications affecting full-term infants. By the age of 2 years, up to 60% of infants with HIE will die or have severe disabilities, including mental retardation, epilepsy, and cerebral Palsy [13,14].

Limitation

There were a few inadvertent limitations in this study:

- This was a one-year, single-center research with a small sample size.
- This includes data collected after the Early Neurodevelopment Clinic was established.
- We could not compare the diagnosis rate or determine if the clinic reduced the average age of CP diagnosis.

CONCLUSION

Prudence must be used when performing the analysis of general movement in extremely preterm infants. Writhing movements may be influenced by perinatal morbidity and possibly by the severe brain immaturity of these infants; writhing movement correlates with hypoxic-ischemic encephalopathy and nosocomial infections (sepsis). Analysis of movement in infants of 3 months corrected with age is a valuable means to detect neurological disorders using Pretchl's general movement assessment. Birth HIE and sepsis were associated significantly with the outcome of the studied patients.

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