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Bayley-III scales at 12 months of corrected age in preterm infants: Patterns of developmental performance and correlations to environmental and biological influences

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A R T I C L E   I N F O

A B S T R A C T

Background and aims: Premature infants are at high risk for neurodevelopmental impairment (NDI) even in the absence of known brain complications of prematurity. Evaluation of the effectiveness of therapeutic interventions in association to neurodevelopmental outcome is required to improve or prevent the neurodevelopmental consequences of prematurity. The Bayley-III is currently the most commonly applied measurement tool for assessing early development both in clinical practice and research settings.

Objective: To evaluate the relationship between known risk factors and early performance on the Bayley Scales of Infant Development-Third Edition at 12 months adjusted age in premature infants. Methods. Prospective study in a cohort of premature infants with gestational age ≤32 weeks, who underwent comprehensive developmental assessment using the five domains of Bayley Scales, cognitive, language, motor, social emotional and adaptive behavior at 12 months corrected age. Developmental scores were evaluated in relation to environmental influences, therapeutic interventions or practices and complications of prematurity.

Results: Composite and Subscale scores for the cognitive, language and motor scales were below the 50th percentile, with no significant differences among them. Scores for the social-emotional and adaptive behavior, which are derived from the parent-report questionnaires, were near the average and significantly higher than the scores derived by the examiners. Multiple regression analyses showed that blood transfusions, apart from severely abnormal head ultrasound, gender, being small for gestational age and duration of invasive mechanical ventilation and oxygen administration were consistently related to neurodevelopmental outcome.

Conclusions: Bayley-III assessments are important for getting early information about development following premature birth. Parents may overestimate children's

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performance. Neurodevelopmental outcome is related to several environmental, biological or medical conditions associated with prematurity. Adoption of therapeutic strategies targeting known neonatal risk factors could positively affect neurodevelopmental outcome.

1. Introduction

Extremely low birth weight infants are at high risk for neurodevelopmental impairment (NDI) (Stephens & Vohr, 2009) even in the absence of known cerebral complications of prematurity such as intraventricular hemorrhage (IVH) or periventricular leukomalacia (PVL) (Broitman et al., 2007; Laptook, O'Shea, Shankaran, & Bhaskar, 2005; Neubauer, Voss, & Kattner, 2008).

Standardized developmental assessments are important for the early detection of developmental delay in infants born prematurely (Aylward, 2002). The Bayley-III, a revision of the frequently used and well-known BSID-II (Bayley Scales of Infant and Toddler Development II) (Bayley, 1993), is currently the most commonly applied measurement tool for assessing early development (Fernald et al., 2009).

BSID-II includes only two developmental scores the Mental Developmental Index MDI (a composite of cognitive and language development) and the Psychomotor Developmental Index (PDI), a composite of fine and gross motor skills. This limitation contributed to the revision of BSID-II and the development of the Third Edition-Bayley III (Bayley III, 2006a). The most significant revision was the development of additional scales so that the areas of cognitive, communication, physical, social-emotional, and adaptive behavior development are examined (Albers & Grieve, 2006). Moreover, revision complies with IDEA and is more consistent with other measures such as the Mullen (1995).

The Bayley-III includes five distinct scales with separate composite scores for cognitive, language, and motor domains, and scaled scores for assessing receptive/expressive communication, and fine/gross motor development. Moreover, parent-report questionnaires have been incorporated into the Bayley-III to assess social-emotional and adaptive behavior. The Adaptive Behavior domain assesses the child's ability to adapt to various demands of normal daily living and the Social-Emotional domain identifies social-emotional milestones that are normally achieved by certain ages (Asrbouse-Moen, Weisglas-Kuperus, Van Goudeover, & Oosterlaan, 2009). The above domains help caregivers to understand their child's performance, give recommendations to promote development (Bayley III, 2006a), and discriminate specific problems in order to target early intervention programs (Bayley III, 2006b). However, published papers typically include only the cognitive, motor and language scores.

Since 2006, when the Bayley-III was adopted, there has been an increasing number of published papers, using this instrument, focusing on neurodevelopmental evaluation and correlates to biological influences and neonatal morbidities of premature infants mostly at the corrected age of 2–2.5 years of age (Duncan et al., 2012) and reveal that cognitive, language, and motor neurodevelopment is delayed at this age (Greene, Patra, Nelson, & Silvestri, 2012). Nevertheless, relevant data for the critical age of 12 months, at which more effective use of early intervention services have been shown to improve outcomes in preterm infants, is limited (Nordhov et al., 2010; Spittle, Doyle, & Boyd, 2008; Sun, Mohay, & O'Callaghan, 2009).

The objective of this study was to assess the relationship between known perinatal/neonatal risk factors and early performance on the Bayley Scales of Infant Development-Third Edition at 12 months adjusted age in premature infants using all the five domains.

2. Methods

2.1. Patients

This is a prospective study in a cohort of premature infants with GA ≤32 weeks, cared for in a Neonatal Intensive Care Unit (NICU) in a large academic medical center between January 2010 and June 2012. According to the protocol of our department, infants discharged home are followed up in the out-patient clinic. In the present study were included only subjects who underwent comprehensive neurologic and developmental assessments using the five domains of Bayley Scales of Infant and Toddler Development-III at 12 months corrected age (D'Agnostino, 2010).

Neonatal and maternal data were systematically reviewed from birth until hospital discharge, including demographic and neonatal variables, therapeutic interventions or practices and complications of prematurity that could potentially affect neurodevelopmental (ND) outcome.

2.2. Perinatal, demographic, and neonatal characteristics

Perinatal-demographic characteristics collected for all neonates included gestational age (GA), birth weight (BW), gender, premature rupture of membranes (PROM) >18 h, any antenatal steroid exposure (ANS) to accelerate fetal lung maturity, mode of delivery and being small for gestational age (SGA). GA was determined by best obstetric estimate using last menstrual period, standard obstetric parameters and/or ultrasonography. However, corrected age (CA) (in units of months) was used for all