



Acid–base status at birth, spontaneous motor behaviour at term and 3 months and neurodevelopmental outcome at age 4 years in full-term infants

Janny Wildschut^a, Frans J.M. Feron^b, Jos G.M. Hendriksen^c,
Mariette van Hall^a, Danilo W.D. Gavilanes-Jiminez^d,
Mijna Hadders-Algra^e, Johan S.H. Vles^{a,*}

^aDepartment of Child Neurology, University Hospital Maastricht, P.O. Box 5800,
6202 AZ Maastricht, The Netherlands

^bYouth Health Care Division of the Regional Public Health Institute Maastricht, The Netherlands

^cDepartment of Neuropsychology, University Hospital Maastricht, The Netherlands

^dDepartment of Neonatology, University Hospital Maastricht, The Netherlands

^eDepartment of Neurology, University of Groningen, Groningen, The Netherlands

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Abstract

Objective: The aim of the study was to assess the relationship between acid–base status and quality and quantity of General Movements (GMs) at birth and quality of GMs at age 3 months and motor, cognitive and behavioural functioning at the age of 4 years.

Methods: From a cohort of 84 term children with different umbilical artery pH without severe neonatal neurological abnormalities, GMs were assessed at term and at 3 months. At the age of 4 years, 44 children were assessed by means of the Movement Assessment Battery for Children (Movement-ABC), Neurological Examination for Toddlers of Hempel, Kaufman Assessment Battery for Children information processing (Kaufman ABC), Visuomotor Integration (VMI), the Child Behaviour Checklist (CBCL) and Precursors ADHD Questionnaire (PAQ).

Results: We found no relationship between pH or GM-quality and quantity at term or GM-quality at 3 months and scores on most of the items of the Movement-ABC,

* Corresponding author. Tel.: +31 43 3876543; fax : +31 43 3877055.
E-mail address: jvle@sneu.azm.nl (J.S.H. Vles).

cognitive and behavioural outcome. However, neonatal pH value and GM-quality at 3 months were related to some extent to the presence of subtle signs of neuromotor dysfunction as measured by the Hempel test.

Conclusions: In a sample of infants with a large variation in umbilical artery pH and without severe neonatal neurological abnormalities, acid–base status at birth and quality of GMs at 3 months of age is not predictive for motor milestone achievement, cognitive and behavioural functioning at 4 years, but these parameters are related to a less optimal condition of the nervous system. The latter finding has, however, limited clinical significance.

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1. Introduction

There is an ongoing discussion in the literature on the issue which examination in early infancy is the most sensitive indicator of brain damage and which infant examination predicts later outcome most precisely. It has been suggested that the qualitative assessment of General Movements (GMs) at the age of 3 months of age is a sensitive indicator of brain damage/brain dysfunction with a high predictive value [1–3]. It has been stated that a qualitative assessment of GMs in early infancy has a better predictive value than the neurological examination at this age [4,5]. The predictive value of the quantity of GMs lacks reliability of diagnostic and prognostic value [6–9]. It is assumed that evaluation of spontaneous motor behaviour is a method to evaluate the functional integrity of the brain. The advantage of this method is that it can be performed without interference or manipulation of the newborn. Other studies indicate that cranial ultrasound and MRI are methods of choice to diagnose structural injury and to predict functional outcome [10,11]. Ultrasound has the advantage that it can be performed at the bedside, is non-invasive and can be repeated whenever indicated. MRI allows a precise structural localization of the lesions. Other means of assessing brain injury related to outcome include evoked response techniques and continuous cerebral function monitoring and their potential value is probably great. Which of the abovementioned methods is actually in use, seems to be primarily based on local interest and local facilities. It is accepted that umbilical arterial pH is a short-term indicator of the acid–base status of the foetus [12,13]. The literature is inconclusive on the value of the acid–base status for predicting outcome. Astrup and co-workers were unable to determine a definite level of tissue acidosis associated with electrical failure in primate brain [14]. Points of discussion are the cutoff between at high-risk and

low-risk values and the number and type of sequelae [15–18].

In neurology, observation of the patient is one of the basic tools in order to come to a diagnosis and in obstetric practice determination of umbilical artery pH is a routine action.

The aim of this longitudinal study of term infants, in which umbilical artery pH, quality and quantity of GMs and motor and cognitive function at 4 years of age are related to each other, is to determine the predictive value of these two clinical tools: umbilical artery pH and observation of GMs.

More specifically, we addressed the following questions:

- Is there a relation between umbilical artery pH of term infants with normal birth weight on the one hand and neurological, cognitive and behavioural functioning at the age of 4 years on the other hand?
- Is there a relation between the quality of GMs at term and at the age of 3 months and neurological, cognitive and behavioural functioning at the age of 4 years?
- Is there a relation between the quantity of GMs at term and neurological, cognitive and behavioural functioning at the age of 4 years?

2. Participants and methods

The infants were enrolled in the study after obtaining informed consent from the parents. The Medical Ethics Committee of our Hospital approved the study. If the infants fulfilled the inclusion or exclusion criteria, parents were approached to participate. Two hospitals [academical hospital Maastricht (azM), and the general hospital St. Jozef Kerkrade] cooperated in this study. The inclusion criteria consisted of: known umbilical artery pH, born at postmenstrual age of 37–42 weeks, with a birth weight between the 2.3rd and

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