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Quality of general movements in term infants with asphyxia

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Abstract

Background: Perinatal asphyxia may result in a developmental disorder. A recently developed non-invasive tool to investigate brain function at an early age is the assessment of general movements (GMs).
Aim: To evaluate relationships between perinatal risk factors and the quality of GMs in the neonatal period and at 3 months in term newborns with asphyxia in a secondary paediatric setting.
Methods: 64 term (>36 weeks postmenstrual age (PMA)) infants with perinatal asphyxia were studied. GMs were assessed at 'writhing' GM age (38–47 weeks PMA) and at 'fidgety' GM age (48–56 weeks PMA). Pre- and perinatal factors were collected in a standardized way.
Results: Multivariate analysis revealed that DA GMs at 'writhing' age mainly correlated with asphyxia related illness. DA GMs at 'fidgety' age correlated in particular with abnormalities on the neonatal ultrasound scan of the brain.
Conclusion: In secondary paediatric settings GM-assessment especially around 3 months is a valuable tool for the assessment of the integrity of the nervous system in term infants with asphyxia.

1. Introduction

Perinatal asphyxia is a well known cause of developmental disorders [1,2]. It may result in the development of cerebral palsy (CP), but most cases of CP are not the result of an interruption of oxygen supply around birth [3–6]. In addition, many children born with perinatal asphyxia develop in a typical way [7,8].

To date it is still unclear which child born with asphyxia will develop neurological impairment and which will not. Recently developed imaging techniques of the newborn brain, such as diffusion weighted MRI and magnetic resonance spectroscopy are promising in this respect [9,10], but

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these techniques are not readily available in a secondary paediatric setting. In the more general paediatric setting it remains difficult to predict outcome of perinatal asphyxia. The lack of clinical clarity on prognosis can be explained partially by the variable way in which the term asphyxia is applied. Traditionally the term asphyxia ('being pulseless') was used for infants with a low Apgar score and/or failure to breath [3,11]. Of course a low Apgar score may be the result of perinatal hypoxia or ischaemia, but it may also have been caused by other problems, for example a congenital disorder of the brain [12]. The term asphyxia is also used for conditions in which indirect parameters such as an abnormal fetal heart rate tracing or acidosis suggest the presence of hypoxia and ischemia [13]. Others suggest to use the term asphyxia only for infants born with indicators of hypoxia-ischaemia who present with neonatal encephalopathy [2,14,15]. Here it should be realized however, that – in analogy to CP – a major part of neonatal encephalopathy is not caused by hypoxic-ischaemic insults [16,17].

The aim of the present study is to analyze the contribution of pre- and perinatal risk factors to the neurological condition at birth and at the age of 3 months in infants with perinatal asphyxia referred to a secondary paediatric department. We included infants with and without neonatal encephalopathy, as this reflects admission practice in the secondary paediatric setting. Neurological condition was assessed by means of the quality of general movements (GMs). The assessment of GMs is a non-invasive sensitive method to evaluate the integrity of the young nervous system [18,19] and as such complementary to the clinical neurological examination of the paediatrician. A previous study indicated that the assessment of GMs was a good indicator of neurological sequelae in term infants with asphyxia referred to a tertiary care centre [20]. In the latter study all subjects had signs of neonatal encephalopathy as indicated by a Sarnat score ≥ 2 [21]. Other studies evaluated GM-quality in mixed groups of at risk infants, including term infants with perinatal asphyxia. The studies concluded that the assessment of GMs is a valuable and reliable tool to predict later neurological dysfunction and behavioural problems [22–24].

2. Subjects and methods

2.1. Subjects

The study group consisted of term infants presenting with perinatal asphyxia admitted to the regional general hospital, Gelre Hospital in Apeldoorn the Netherlands between January 1999 and July 2005. Term birth was defined as birth after 36 completed weeks of gestation. Children were included into the study group, if they fulfilled at least two of the following criteria for asphyxia: 1) abnormal cardiotocogram (CTG), e.g. late decelerations, persistent bradycardia (<100 beats per minute, or persistent tachycardia (>160 beats per minute)), 2) Apgar score at 5 min<7, 3) umbilical pH<7.20 and 4) umbilical base excess<−10 mmol/l. Ninety term infants fulfilled the criteria for asphyxia. The parents of 17 infants declined the offer to participate in the study; another 9 infants were not reported to the research team. Therefore, 64 infants were enrolled in the study group. Thirty infants presented with neurological symptoms during the first days after birth (neonatal encephalopathy (NE); Table 1).

Table 1 Clinical characteristics of the study group

Variables	Study group
	n = 64
Prenatal and social characteristics	
Male gender (%)	37(58%)
Maternal education: higher education (%) [a]	17 (27%)
Presence of complications during pregnancy:	21 (33%)
— HELLP/preeclampsia/hypertension	12 (19%)
— Loss of blood/placenta praevia	3 (4%)
— Placental abruption	3 (4%)
— Rhesus antagonism	1 (2%)
— Imminent preterm labour	1 (2%)
— Hyperglycaemia	1 (2%)
Perinatal characteristics	
Gestational age at birth in weeks: median (range)	40 (36–43)
Breech presentation	3 (5%)
Duration first stage in hours: median (range)	8.75 (0–24)
Duration second stage in minutes: median (range)	21.5 (0–240)
Decelerating CTG (%)	41 (64%)
Instrumental delivery	39 (61%)
Neonatal characteristics	
Apgar score after 1 min: median (range)	3 (0–8)
Apgar score after 5 min: median (range)	6 (2–9)
Birthweight, mean ± SD	3387 ± 630
Small for gestational age, birthweight < P10	7 (11%)
Cord pH, mean ± SD	7.1 ± 0.2
Cord BE, mean ± SD	−15.7 ± 6.5
EEG:	
— No EEG performed	30 (47%)
— Normal EEG	18 (28%)
— Abnormal EEG [b]	16 (25%)
Sarnat score [c]:	
— No signs of neonatal encephalopathy	34 (53%)
— Grade I	16 (25%)
— Grade II	13 (20%)
— Grade III	1 (2%)
Clinical seizures	14 (22%)
Neonatal ultrasound (US) scan of the brain:	
— No US performed	40 (62%)
— US normal	10 (16%)
— US abnormal [d]	14 (22%)
Parenteral feeding > 1 week	8 (13%)
Breastfeeding	49 (77%)
Organ failure:	
— Kidney failure	8 (13%)
— Liver failure	5 (8%)
— Hypoglycaemia [e]	8 (13%)
— Respiratory problems, no artificial ventilation	36 (56%)
>1 organ with failure	16 (25%)
Perinatal infection	12 (19%)

[a] University education or vocational college.
[b] Abnormal EEG findings according to [37].
[c] Score according to [21].
[d] Abnormal US findings according to [25].
[e] 1 h postnatally < 1.6, 3 h postnatally < 2.7, 24 h postnatally < 3.0 mmol/l [38].