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General movements in healthy full term infants during the first week after birth

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ABSTRACT

Background: The quality of general movements (GMs) is a widely used criterion to assess neurological dysfunction in young infants. It is unknown, however, whether the birth process influences the motor repertoire of healthy full term infants during the first week after birth.
Aims: To assess the quality of GMs and to determine the motor optimality score (OS) in healthy full term infants during the first week after birth and to evaluate the influence of the mode of delivery on GM quality.
Study design: Thirty-three healthy full term infants born either vaginally or after caesarean section (CS) under spinal anaesthesia were video recorded in the first week after birth in order to assess GM quality and to determine OS with Prechtl's method.
Results: Abnormal GMs were observed mainly on the early recordings: 86% on the day of birth (day 0), 94% on day 1, and 68% on day 2. On days 5 to 7 (day 5–7) all GMs were normal ($P < .001$). The OSs increased significantly from median 12 on day 0 to 18 on day 5–7 ($P < .001$). Monotonously slow movements were frequently seen during the first days but not on day 5–7 ($P < .001$). GM quality and OS did not differ between infants born by vaginal delivery or after CS under spinal anaesthesia.
Conclusions: Healthy full term infants often showed abnormal GM quality and lower OSs during the first week after birth, irrespective of the mode of delivery. GM quality normalised during subsequent days and was normal on day 5–7.

1. Introduction

General movements (GMs) are endogenously generated, complex movement patterns present from early foetal life until about five months after birth. The assessment of GMs, based on Prechtl's method of observation, is now a widely used diagnostic tool for the neurological evaluation of the newborn and young infant [1,2]. This method is considered to be a powerful instrument for assessing the integrity of the central nervous system. If the nervous system is impaired GMs lose their complex and variable character and the repertoire becomes monotonous and poor [1,2]. This is the case for preterm and full term infants and continues up to the first 20 weeks postterm. Spontaneous normalisation of abnormal neurological findings does occur. If, however, abnormalities are found consistently over time, then the risk of developing major deficits is increased [2,3]. The predictive value of the quality of GMs is particularly high during the period of the fidgety movements from 2 to 4 months postterm [4]. Abnormal GMs at this age identify infants at risk of incurring neurodevelopmental disabilities later on [3–5]. In preterm infants this period corresponds to the same postmenstrual age as in the infant born at term, i.e. the age corrected for preterm birth [1].

In a previous study, de Vries and Bos found that GM quality of many extremely preterm infants was abnormal during the first days after birth [6]. Subsequently, in several infants both the overall quality of GMs and the more detailed aspects of their GMs, as reflected by their motor optimality score (OS), improved [6]. Some infants who displayed abnormal GMs normalised within the first week after birth. Clinical factors such as birth weight (BW), postmenstrual age, and the score obtained on the Nursery Neurobiologic Risk Score [7] appeared to be associated with this developmental trajectory. The question arose whether healthy full term infants might also have a similar developmental trajectory. While a continuity of GM quality from intrauterine life to extrauterine life is to be expected, Einspieler et al. advised not to attempt to assess GMs during the first three days after birth, because of the many fluctuating physiological variables [3]. To the best of our knowledge, however, GMs have not been studied in full term infants during the first few days after birth. Are they abnormal in healthy full

Abbreviations: BW, birth weight; GA, gestational age; GMs, general movements; PR, poor repertoire; SGA, small for gestational age; LGA, large for gestational age; OS, optimality score; ChFs, chaotic features; CS, caesarean section.

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terms during this period and if so, when do they become normal? A related question is whether factors regarding the birth process, such as the mode of delivery and the use of local anaesthetics, influence the quality of GMs. Local anaesthetics, widely used nowadays, are known to cross the placental barrier [8] although they are largely eliminated by the newborn within the first days after birth [9], the question is whether they influence the quality of GMs while still present.

Our primary aim was to analyse the quality of GMs and to determine the OS during the first week after birth in healthy full term infants. Secondarily, we aimed at determining the influence of clinical factors such as the mode of delivery on the quality of GMs.

2. Materials and methods

2.1. Patients

This was an observational cohort study. We included infants born at term (37 + 0 to 42 + 0 weeks) between April 2009 and September 2011 in the catchment area of Medical Centre Leeuwarden, the Netherlands. After an uncomplicated pregnancy, the infants were delivered either vaginally or by an elective caesarean section (CS) under spinal anaesthesia. These infants were chosen because they were assumed to be healthy (i.e. not having clinical problems after birth). To be able to study the effects of mode of delivery on the quality of GMs, we made sure to have a substantial number of infants born by CS in our study population. Large for gestational age (LGA) infants, i.e. a birth weight (BW) greater than the 90th percentile, could participate provided their mothers did not have diabetes and they did not have a serum glucose level below 2.0 mmol/l during the first 8 h after birth, checked by regular blood sampling.

Exclusion criteria were infants born with congenital abnormalities, infants who were small for gestational age (SGA), i.e. a BW less than the 10th percentile, infants with hypoglycaemia, and infants with any kind of medical problems who needed hospitalisation on the paediatric ward. Furthermore, we excluded infants whose mothers had used medication that could have had any effect on the foetus or newborn. In case of vaginal delivery medication for pain relief like pethidine or epidural anaesthesia was another reason for exclusion.

The procedure to include infants in our study was as follows: in case of elective CS, parents were approached antenatally by the gynaecologist at the outpatient clinic. Parents of vaginally delivered infants were approached postnatally in the delivery room by the researchers or by the midwives. All parents gave written informed consent. The study was approved by the Ethics Committee of the Medical Centre Leeuwarden. We recorded obstetrical and neonatal clinical data such as the mode of delivery, BW, gestational age (GA), maternal smoking during pregnancy, and gender.

2.2. Methods

2.2.1. Recording of spontaneous movements

Digital video recordings of approximately 15 min were made of 33 infants during the first week after birth. Recordings were made within the first 24 h (referred to as day 0) followed by one, two or three recordings on days 1, 2, 3, or 4, and in at least fifteen infants a recoding was made on days 5, 6, or 7 (referred to as day 5–7). We tried to record as systematically as possible, but for a few infants the timing and frequency of the recordings differed for logistic and patient-related reasons (e.g. feeding schedule, rest hours, neurobehavioural state of the infant, and discharge from the hospital). All the recordings were made with the infants lying supine or on their sides in a cradle or bed, wearing only a nappy. The video camera was positioned approximately 1 m above the infant, at an angle of 45°. Recordings were preferably performed during active wakefulness (state 4, according to Prechtl's classification of states) [10].

2.2.2. Analysis of GMs

Prior to analysis, the recordings were randomly selected and coded by author WP. Subsequently, the recordings were randomly copied onto a disc and scored after all recordings were made. The GMs were analysed according to Prechtl's method by authors WP and NV. NV is certified by the GM Trust as an advanced scorer. WP was trained by NV. NV was completely blind to the clinical situation. In case of disagreement on the presence of normal or abnormal GMs or about the assessment of the motor OS by more than one point, the infant's recordings were re-evaluated by all three authors. Then, consensus was achieved after discussion on the arguments why each reached the particular score. Author AB is a licensed tutor and co-founder of the General Movements Trust, and was also completely blind to the clinical situation. After the assessment of all the recordings, WP unlocked the codes.

2.2.3. Quality of GMs

Prechtl's method for the assessment of the normal or abnormal quality of GMs is based on visual Gestalt perception [1,2]. GMs are scored as normal if the movements are complex, they involve the entire body with variable sequences of the arms, legs, neck and trunk, and last for a few seconds to several minutes. Normal GMs are characterised by complexity, variability and fluency.

Three main types of abnormal GMs are distinguished that apply to the writhing period, i.e. from term until the first two months postterm. They are classified as followed [1,5]:

1. Poor repertoire GMs (PR): the sequence of the successive movement components is monotonous and the movements of the different body parts do not occur in the normal rich and complex sequence.
2. Cramped synchronised GMs: movements appear rigid and stiff. They lack the normal smooth and fluent character; all limb and trunk muscles contract and relax almost simultaneously.
3. Chaotic GMs: movements of all limbs are of large amplitude and occur in a chaotic order without any fluency or smoothness; they consistently appear to be abrupt.

Additionally, after the assessment of GM quality, we assessed chaotic features (ChFs). ChFs can be seen during periods of GMs but not the whole time [6].

2.2.4. Optimality score

In addition to and following the assessment of GM quality, we determined the motor OS according to Prechtl's optimality concept [2,9]. This is a detailed analysis of GM quality, whereby eight different aspects of the GMs are assessed. The highest OS is 18, the lowest OS is 8. All eight aspects must be assessed. The first aspect is the quality of the GM that can be scored as normal (4 points), PR (2 points), chaotic (1 point), or cramped synchronised (1 point). The other aspects of GMs are sequence, amplitude, speed, space, rotations, onset and offset, and tremulous movements. They can be scored as normal, variable, and complex (2 points) or as abnormal (1 point). Speed can be scored as variable (2 points), monotonously slow (1 point), monotonously fast (1 point), or mainly one speed (1 point). Tremulous movements may be absent (2 points) or present (1 point).

2.3. Statistical analysis

Statistical analysis was performed using SPSS for Windows, version 19.0 (SPSS Inc., Chicago, IL). We used the chi-square test for trend to test the trends on the quality of the GMs on the different days of recording. For the association between the OS and postnatal day we used the Spearman rank correlation coefficient. For each day we also tested whether clinical data were related to the quality of GMs. In case of categorical variables we used the Fisher exact test and for non-parametric continuous variables we used the Mann–Whitney test. Throughout the analyses we considered $P < .05$ (2-tailed) to be statistically significant.