Fetal and infant movements and the young nervous system

Editorial

Historically, observation of infant behaviour has been fundamental to the understanding of developmental neurology and ontogenetic adaptation. Darwin's account of his infant son's development is an evocative example.[1] More recently, assessment of the quality of spontaneous general movements (GM) in the fetus and young infant has advanced insight into the development and integrity of the nervous system. How can these observations contribute to the diagnosis of neurodisability? Does this model have useful clinical applications?

A remarkable repertoire of fetal movements is revealed by ultrasound from as early as 7½ weeks' postmenstrual age (PMA). The first movement is lateral bending of the head followed at 9 to 10 weeks by complex, coordinated, generalized movements of the head, trunk, and limbs. Curiously, spontaneous movements of one arm and leg both occur together at 10 to 11 weeks' PMA. Not only are these sophisticated for such an early stage of development but the simultaneous evolution in the arm and leg are unexpected in view of the traditional principle of cephalo-caudal development.

The fluent and complex movements seen from early fetal life continue in a similar pattern in the preterm infant and are termed fetal or preterm GMs.[2] Around 36 to 38 weeks' PMA writhing GMs emerge which are slower, smaller in amplitude, and more powerful than preterm GMs, and show less involvement of the trunk. Typically they are ellipsoid in form, which creates the impression of a writhing quality. These continue until the end of the second month postterm when another transition takes place. The movements become fidgety; a continuous stream of tiny, elegant movements occurring irregularly all over the body. Fidgety movements normally continue until the age of 4 to 5 months when they are replaced by purposeful movements. It is interesting that in blind infants fidgety movements persist longer, are greater in amplitude, and are more jerky, leading to speculation that this may reflect problems with integration of proprioception and vision.

Changes in the quality of GMs have been observed in the presence of nervous system impairment. Consistent poor repertoire, cramped-synchronized GMs at preterm and early postterm age, and absence of fidgety movements or exaggerated amplitude, speed, and jerkiness at age 2 to 4 months have been shown to be associated with an increased risk of cerebral palsy (CP).[3] The absence of fidgety movements is strongly associated with CP and has been shown in some studies to have a higher sensitivity than ultrasound or neurological examination. Of equal importance is the observation by Prechtl's group that CP has never been diagnosed following consistently normal GMs.[2] The detection of CP when other clinical signs are absent is clearly of great value for prognosis and for early intervention. Congenital hemiplegia, for example, can be difficult to diagnose in infancy but studies of GMs have revealed asymmetry of segmental movements (distinct movements of hands and fingers) as early as the second month in infants who were later found to have hemiplegia.

Abnormal GMs in both the fetus and young infant have been observed in a variety of other conditions such as maternal type-1 diabetes, intrauterine growth retardation, and cerebral malformations. Study of the quality of GMs in utero is a promising avenue for future research.

Interestingly, another condition in which the pattern of GMs has been noted to be atypical is Rett disorder. Einspieler et al.[4] reviewed family videos of females diagnosed with Rett disorder and found that, in contrast to the hypothesis that early development is normal, observation in the first 5 months of life revealed that none of the infants had normal GMs, although a specific abnormal GM pattern was not found. Additionally, detailed analysis revealed other unusual behaviours such as eye blinking, tongue protrusion, abnormal facial expression, and hand stereotypies. These observations suggest that this disorder is manifest soon after birth.

GM assessment has received cautious recognition by some, largely because of its apparently subjective nature. Essential to GM assessment is the Gestalt evaluation of movement complexity and variation. Training and practice in the technique are of key importance; 5-day courses have been shown to achieve high levels of reliability. The use of video is a key feature of training and assessment. For those in training, one hopes that the systematic approach will encourage the gradual assimilation of the subtle skills involved so that recognition of important signs such as fidgety movements becomes second nature.

As a non-invasive instrument GM assessment is eminently suitable for use in the intensive care setting and one would like to see it being widely used in neonatal nurseries and at follow-up clinics during the fidgety stage. Its limitations are numerous. For example, it can never replace magnetic resonance imaging and it is unable to detect abnormalities of the various neural subsystems (e.g. the oculo-motor system and peripheral nervous system). But alongside neurological examination, electrophysiology, and imaging GM has an important role to play in the integrated neurodevelopmental assessment of the fetus and young infant.

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