Early motor trajectories in very low birth weight premature infants: use of diffusion tensor imaging, general movement assessment, and the test of infant motor performance

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Background

The quality of infant general movements, specifically fidgety movements (FMs), may be a marker of the integrity of corticospinal or reticulospinal pathways. Diffusion tensor imaging (DTI) has shown disrupted thalamocortical connectivity and abnormalities of descending corticospinal tracts in young children with cerebral palsy. DTI has not yet been used to compare structural white matter tract integrity with FMs and the neuromotor status of high-risk, premature infants.

Aims

Our objective was to describe the relationship of the presence (FM+) or absence (FM-) of FMs among high risk premature infants at 10–15 weeks post term, their performance on the Test of Infant Motor Performance (TIMP), and MRI measures at term age equivalent (TAE) of white matter tract structure as measured by DTI.

Lessons Learned

• Abnormal MRI DTI ratings do not strongly predict children’s early developmental trajectories with respect to fidgety movements and motor skill acquisition. This may reflect developmental plasticity or that FMs and TIMP scores may be related to both sensory and motor pathways underlying emerging motor skills and their adaptive correlates.

The Intervention

• Thirty infants who were born at less than or equal to 31 weeks gestational age, with a birthweight of less than 1500 grams and who required oxygen at birth were recruited at a university hospital.

• Subjects received cerebral MRI, DTI scan on a 3T Phillips Achieveas MRI with a SENSE MRI coil array, at term equivalent age.

• Tracts of internal capsule, posterior thalamic radiations and corona radiate were graded by an experienced pediatric neuroradiologist masked to neurodevelopmental status. (Figure 1)

• Infants were assessed at 10-15 weeks post-term age with the General Movement Assessment (GMA) and the Test of Motor Performance (Version 5.1). Video analysis of the GMA was performed by two expert GMA certified testers using the Prechtl method.

Results

Thirty infants, <32 weeks gestational age Infants ranged in birth weight from 575–1365 g. Six infants had FM-, six infants had abnormal TIMP scores and six infants had abnormal DTI scores. (Table 1) Only one infant was scored as having severely abnormal white matter tracts; in this case both TIMP and FM scores were abnormal. In three of the five cases of mildly abnormal DTI both TIMP and FM scores were normal. In two cases of mildly abnormal DTI scores, one TIMP was abnormal and one scored FM-

Figure 1. Tracts of internal capsule, posterior thalamic radiations and corona radiate were graded on a 0-2 scale. Subject A received a normal score of “0” for retrolental and posterior limb tracts of the internal capsule. Subject B received severely abnormal grade of “2” for these tracts. (Colored FA axial maps)

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Next Steps

• Further longitudinal investigations examining biological risk, CNS structural and functional connectivity, fidgety movements, neuromotor performance, and long term gross, fine, and oral motor control, and adaptive competencies are required.