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Neonatal brain microstructure correlates of neurodevelopment and gait in preterm children 18-22 mo of age: an MRI and DTI study.

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Abstract

BACKGROUND: Near-term brain structure was examined in preterm infants in relation to neurodevelopment. We hypothesized that near-term macrostructural brain abnormalities identified using conventional magnetic resonance imaging (MRI), and white matter (WM) microstructure detected using diffusion tensor imaging (DTI), would correlate with lower cognitive and motor development and slower, less-stable gait at 18-22 mo of age.

METHODS: One hundred and two very-low-birth-weight preterm infants (≤1,500 g birth weight; ≤32 wk gestational age) were recruited prior to routine near-term brain MRI at 36.6 ± 1.8 wk postmenstrual age. Cerebellar and WM macrostructure was assessed on conventional structural MRI. DTI was obtained in 66 out of 102 and WM microstructure was assessed using fractional anisotropy and mean diffusivity (MD) in six subcortical brain regions defined by DiffeoMap neonatal atlas. Neurodevelopment was assessed with Bayley-Scales-of-Infant-Toddler-Development, 3rd-Edition (BSID-III); gait was assessed using an instrumented mat.

RESULTS: Neonates with cerebellar abnormalities identified using MRI demonstrated lower mean BSID-III cognitive composite scores (89.0 ± 10.1 vs. 97.8 ± 12.4; P = 0.002) at 18-22 mo. Neonates with higher DTI-derived left posterior limb of internal capsule (PLIC) MD demonstrated lower cognitive and motor composite scores (r = -0.368; P = 0.004; r = -0.354; P = 0.006) at 18-22 mo; neonates with higher genu MD demonstrated slower gait velocity (r = -0.374; P = 0.007). Multivariate linear regression significantly predicted cognitive (adjusted r(2) = 0.247; P = 0.002) and motor score (adjusted r(2) = 0.131; P = 0.017).

CONCLUSION: Near-term cerebellar macrostructure and PLIC and genu microstructure were predictive of early neurodevelopment and gait.