Breastmilk Feeds Improve Brain Microstructural Development in Very Premature Infants

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Background: Infants born at very low birth weight (VLBW <1500g) experience a high incidence of neurocognitive dysfunction, even in the absence of structural brain injury. Early breastmilk feeding has been linked to increased volumetric brain growth and improved cognitive and behavioral outcomes. Very few studies have investigated the impact of breastmilk feeding on white matter microstructural development in preterm infants using advanced, quantitative MRI (qMRI) techniques such as diffusion tensor imaging (DTI).

Objective: Our objective was to compare white matter microstructural development in VLBW preterm infants receiving primarily preterm formula versus breastmilk feeds.

Methods: We prospectively enrolled infants born at very low birthweight (<1500g) and < 32 weeks gestational age (GA) admitted to our NICU within the first 48 hours of life and performed MRI at term equivalent age. Infants with parenchymal brain injury were excluded. Daily nutritional intake (parenteral and enteral) was collected for all infants until term equivalent MRI. Diffusion tensor MRI data were acquired on a 3T scanner using a 3mm 30 direction DTI protocol. For our DTI analyses, parametric maps were generated for fractional anisotropy (FA) and mean diffusivity (MD) in regions of the cerebellum, pons, posterior limb of internal capsule, and corpus callosum (Figure 1). Controlling for gestational age, we performed ANCOVA to evaluate group comparisons of enteral nutrition type on term equivalent white matter microarchitecture.

Results: Nutritional and qMRI data were obtained for 37 infants admitted within 48 hours of life; 22 versus 15 infants received primarily preterm formula versus breastmilk feeds, respectively. Infants were born at a mean GA of 28 (+/- 2.7) weeks and birthweight of 1015 (+/- 340) g. MRI studies were performed at a mean GA of 40 (+/- 2.4) weeks. Preterm infants receiving breastmilk demonstrated significantly greater white matter microstructural organization with greater FA in the left PLIC and MCP (Table 1).

Conclusions: VLBW infants receiving primarily breastmilk feeds demonstrated significantly greater white matter microstructure in the cerebrum and cerebellum at term-equivalent age compared to those receiving preterm formula. Our data suggest that breastmilk promotes greater microarchitectural development of the preterm brain compared to preterm formula. The extent to which breastmilk may have protective effects on long-term neurodevelopment in ex-preterm infants is currently under investigation.
Figure 1. DTI Images

DTI parametric maps of A) genu of corpus callosum and posterior limb of internal capsule and B) pons, middle cerebellar peduncle, and superior cerebellar peduncle.