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Editorial

Neuroimaging and the preterm infant brain

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In this issue of Journal of Pediatric Neuroradiology, Leijser et al. [1] explore the correlation between morphology of the intracranial vasculature and cerebral blood flow velocity, non-invasively respectively assessed using magnetic resonance angiography (MRA) and Doppler ultrasound in term-born infants and preterm infants at term equivalent age.

Preterm birth is increasing and the rate of neurodevelopmental impairment, including motor and neurocognitive impairment, remains high in survivors [2]. Clinicians routinely need to provide parents and caregivers with prognostic information for these vulnerable newborns. Prediction of cognitive outcome early in life is of paramount importance to plan targeted cognitive intervention and neurorehabilitation.

Non-invasive imaging techniques, in particular ultrasound, have been widely used in clinical practice to provide prognostic information. Magnetic resonance imaging (MRI) is less widely available and more expensive; however, the use of 3 Tesla field strength scanners and parallel imaging technique has significantly decreased exam duration and the need for sedation in the newborn population. Knowledge of the prognostic value of cranial ultrasound and MRI relies on a relatively small number of studies [3]. While normal ultrasound or MRI studies predict a low risk of future motor impairment in preterm infants, the prognostic implications of many abnormal findings, as well as of morphological and functional differences between term and preterm infants detected by ultrasound and MRI are not well understood. Therefore, there is a strong need to better comprehend the prognostic correlates of neuroimaging findings in preterm newborns.

Previous neuroimaging studies have identified differences in cortical folding, gray matter volume, and white matter abnormalities between preterm and term born infants [4–7]. Dr. Leijser and her group focus their attention on the functional and morphological differences of the intracranial vasculature in these two groups of infants in the absence of overt brain pathology. After investigating the effects of preterm delivery on neonatal cerebral vasculature using MRA [8], the authors examine the correlation between vascular morphology assessed using MRA and functional metrics obtained using Doppler ultrasound [1]. This work is important for several reasons. First, a functional and morphological evaluation of the developing intracranial vasculature is only feasible using non-invasive imaging techniques, because post-mortem assessment of the brain cannot assess vascular geometry and functionality. Alterations in cerebral blood flow play a crucial role in the development of hypoxic-ischemic injury in preterm and term newborns and the cerebral flood flow velocity data provided in this paper may serve as a reference for many potential applications in research and clinical practice. Understanding patterns of cerebrovascular morphology and cerebral blood flow velocity in preterm neonates and their correlation with neurological outcome could be proven useful in the future to identify infants at risk of developmental and cognitive deficit.

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This study opens a window into the complex vascular changes occurring during gestational life, particularly during the third trimester, and into the preterm intracranial vasculature response to the premature switch from the in-utero to the ex-utero gaseous, metabolic, and nutritional environment. The long-term effects and significance of cerebrovascular resistance and vascular tortuosity differences between term and preterm infants remain less understood. How differences in cerebrovascular resistance and vascular tortuosity between term and preterm infants affect the growth and development of the infant brain, as well as future motor skills and cognition will be topics for future investigations.

In conclusion, neonatal neuroimaging has improved our understanding of the developing brain in presence and absence of pathology. There is a great need for noninvasive methods to predict prognosis in preterm infants. Novel quantitative MRI metrics, including diffusion imaging, specifically diffusional kurtosis imaging, and functional MRI connectivity, combined with image analysis tools, such as voxel-based morphometry and mathematical analysis of cortical folding may improve our understanding of alterations in brain development and their correlation with cognitive outcome and neurodevelopmental disability in this vulnerable population [9,10].

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