

Fast and furious: the new era of rapid imaging
Fast fetal/neonatal imaging
Current clinical practices and needs: Neonatal imaging

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MR imaging of infants at risk for brain injury, particularly prematurely-born infants who undergo imaging prior to discharge from the hospital, provides important prognostic information [1]. Nevertheless, this imaging modality remains underused due to a number of factors. They include: 1) lack of priority for access to the MRI scanner for babies, 2) the requirement at some institutions that infants be imaged only under anesthesia, 3) lack of MR-compatible equipment for infants (e.g., temperature monitors and laryngoscopes), and 4) scarcity of radiologists experienced in interpreting MR studies of infant brain.

The issue of imaging under anesthesia can be addressed with improved/faster imaging. Clinicians are often unwilling to expose infants to the risk of anesthesia for the benefit of an MR study. In addition to the (small) risk of cardiorespiratory compromise, there is evidence that anesthesia promotes apoptosis in the developing brain, thereby causing neuronal cell loss [2]. While it is feasible to routinely image infants without sedation [3], this approach is not yet in widespread use. The primary issue of imaging without sedation is subject motion. Faster imaging, in conjunction with motion correction, would improve the proportion of clinically acceptable studies obtained from nonsedated infants.

The relative size of the infant brain also presents a challenge which could be addressed with technical advances in imaging methodology. Typical image slice thickness on the order of 3-4 mm is simply too great to permit accurate representation of the cortical folds of the developing brain [4], which may be disrupted in prematurely-born infants. Spatial resolution on the order of 1x1x1 mm is required. The use of thinner slices increases scan time, and faster imaging methods could be used to compensate.

With regards to technical developments in MRI, it is important to remember that the MR characteristics of infant brain are significantly different from those of adult brain. The infant brain has longer T1 and T2 relaxation time constants which may be used to advantage for some MR acquisition methods. In addition, due to the lack of myelin, grey/white matter contrast is reversed relative to adult brain. Thus, acquisition methods must be separately optimized for babies.

Finally, it would be useful to have an MR scanner suitable for placement within the neonatal intensive care unit which could reduce our current reliance on CT scanning. Exposure to ionizing radiation from CT scanning during childhood can cause adverse neurodevelopmental outcome [5,6]. This is attributed mainly to the relatively rapid growth of the child's brain as compared with that of an adult.

The brains of babies are growing at an even faster rate, and are likely even more susceptible to injury. A scanner readily available for critically ill infants, equipped with an image acquisition set that could reduce MR scan time to that of a typical CT scan, could markedly reduce our use of CT scans in this population [7,8].

Citations

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