An MR System for Imaging Neonates in the NICU

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Purpose: The current practice of transferring neonates to radiology departments and imaging in full-sized MR scanners is associated with significant safety and image quality issues. To overcome these issues, we are converting a low-cost, small-bore (28cm) single channel 1.5 Tesla MRI scanner intended for adult orthopedic use (GE Healthcare, Waukesha, WI) into a dedicated neonatal MRI system designed for pre-clinical and clinical use. This small system can be easily sited and installed in a Neonatal Intensive Care Unit (NICU), mitigating many of the logistical limitations. We present the capabilities of our system, and review the steps necessary in the development of such a project.

Materials and Methods: We have installed a prototype scanner for technological development and preclinical research in a Biosafety Level 2 (BSL-2) research laboratory. A second scanner will be installed in our NICU for clinical use in approximately 9 months. The MR imaging performance of the gradient system (70 mT/M max amplitude; 200 T/m/s slew rate) exceeds that found on full-sized MR systems, permitting us to optimize the most advanced MRI techniques (e.g. ASL, DCE, diffusion tensor imaging (DTI)) for neonate size and anatomy. Modifications to the original system include the addition of multiple receiver channels and the development of dedicated phase array surface and volume coils.

Results: The modified system enables state-of-the-art imaging of the neonatal brain, chest and abdomen with a high degree of safety and diagnostic imaging quality. S/N enhancements and parallel imaging enabled by these changes result in improved image quality and/or reductions in scan time, beyond what is currently possible on conventional MRI scanners. The advanced techniques and resulting image data from our research laboratory unit will be presented.

Conclusion: The development of new RF coils, parallel imaging techniques and advanced MR acquisition strategies optimized for the neonate enables high-performance neonatal MRI on a small-size 1.5 Tesla MRI scanner within the NICU and creates new research tools to advance the study of early human development. The adult orthopedic MR system is a product of GE Healthcare, Waukesha, WI.