Tracking childhood development with MR: the next steps.

W S Ball, Jr

AJNR Am J Neuroradiol 1998, 19 (6) 1005-1006
http://www.ajnr.org/content/19/6/1005.citation

side of the globus pallidus while stimulating the other, reducing the morbidity associated with bilateral ablations. Related controversy involves the use of microelectrodes for guidance, a technique favored by Cohn et al, versus neuroanatomic guidance and macroelectrode stimulation. Though not discussed in Cohn et al's manuscript, microelectrode techniques prolong operating room times by three to four times those associated with macroelectrode methods.

Although serendipity and surgical mishap make this story colorful, what becomes apparent is that application without basic science can go far astray. Only those applications rooted in effective vertical integration reliably succeed. The one basic science that must always be present is neuroanatomy. We, as neuroradiologists, must shine in this science if we are to provide a contribution in the care of Parkinson's disease. Neuroradiology, of course, has entered the basic sciences with X-ray, MR, sonography, and radionuclide investigations. The bass drum beating in the background of these investigations, however, is neuroanatomy. If we cannot get this right, nothing else is going to turn out right for us.

STEPHEN S. GEBARSKI, MD
University of Michigan
Ann Arbor, MI

References

1. Svennilson E, Torvik A, Lowe R, Leksell L: **Treatment of parkinsonism by sterotactic thermolesions in the pallidal region.** *Acta Psychiatr Neurol Scand* 1960;35:358–377
2. Burton TM: **Pacemaker-style devices mend the nervous system.** *The Wall Street Journal* January 6, 1998:B1,B4

Tracking Childhood Development with MR: The Next Steps

Assessment of normal brain maturation has become an established application of MR. Since its clinical inception, investigators have recognized MR's ability to assess myelination at a specific age based on T1 and T2 signal characteristics.

In this issue of the *American Journal of Neuroradiology*, Nakagawa et al (page 1129) demonstrate yet again MR's ability to assess the normal sequence of myelination accurately and reproducibly. In a systematic fashion, these authors evaluated the appearance and progression of myelination within fiber bundles. Myelination was primarily evident in the brain stem and corticospinal tracts in subjects ranging in gestational age from 35 to 145 weeks. Their study is similar in scope to previous publications on myelination by Barkovich (1), Bird (2), Hittmair (3), and Deitrich (4). Their results are also similar, with only a few exceptions that varied from four weeks' to several months' difference. Their approach was unique in that they evaluated not only when myelination of a fiber bundle appears, but also when the same fiber might disappear because of progressive myelination of the surrounding nerve bundles. The authors attribute much of their work to improved resolution in MR, which has allowed further characterization of myelin as it progresses in the developing brain. These investigators remind us that conspicuity in MR can also be regarded as a dynamic process related to any changes over time.

Yet this report, along with previous studies, brings into focus several important issues regarding the use of MR to assess normal development. As noted, there are excellent publications equating myelin appearance with gestational age, though neuroradiologists are generally unfamiliar with the phases of myelination shown on T1- and T2-weighted images. This important aspect of any MR interpretation of an infant is frequently overlooked or purposely avoided. There is little doubt that this information obtained by MR may prove invaluable in the diagnosis and treatment of progressive neurologic childhood disease. No neuroradiologist should be interpreting MR in infants of young children unless s/he first becomes generally familiar with the appearance of these developmental stages. Nakagawa et al's investigation and the excellent works that have preceded it assert that the practicing neuroradiologist should have a basic knowledge of these developmental stages before s/he reaches for the dictaphone.

Alternatively, a large void in the evaluation of brain development exists, and the application of MR to this end is also wanting. If we were to look at other monumental works in child development such as Greulich and Pyle's atlas of normal female and male bone maturation (5), we would recognize just how much work lies ahead if we are to provide similar firm statistics about the developing brain. Unfortunately, despite several attempts, such a statistically based atlas of normal brain myelination correlated to specific stages in a child's development does not exist.

Another problem we face is the absence of a systematic correlation between patterns of myelination and standards of normal clinical neurologic development. For example, is there a correlation between the timing of complete myelination of the corpus callosum at six months with a six-month-old's ability to pass an object from one hand to the other? What do we know about the relationship between patterns of myelination shown on MR and the clinical stages or milestones of normal development familiar to the neurologist and pediatrician? The answer: very little. Can we expect to use a pattern of myelination on MR to actually predict the clinical developmental examination? An affirmative answer to this question will require a collaborative effort between clinicians and

neuroradiologists. Nakagawa et al's study, with its focus on specific fiber bundle myelination at high resolution, takes us one step further toward this reality. Although this area of neuroscience is far from complete, this study and the excellent works preceding it, offer essential information for any neuroradiologist interpreting MR in infants and young children.

WILLIAM S. BALL JR, MD
Senior Editor

References

1. Barkovich AJ, Kijos BO, Jackson DE, Norman D. **Normal maturation of the neonatal and infant brain: MR imaging at 1.5T.** *Radiology* 1988;166:173
2. Bird CR, Hedberg M, Drayer BP, et al. **MR assessment of myelination in infants and children: usefulness of marker sites.** *AJNR Am J Neuroradiol* 1989;10:731–740
3. Hittmair K, Wimberger D, Rand T, et al. **MR assessment of brain maturation: comparison of sequences.** *AJNR Am J Neuroradiol* 1994;15:425–433
4. Deitrich RB, Bradley WG, Zaragoza EJ, et al. **MR evaluation of early myelination patterns in normal and developmentally delayed infants.** *AJNR Am J Neuroradiol* 1988;9:69–76
5. Greulich WW, Pyle SI. *Radiographic Atlas of Skeletal Development of the Hand and Wrist.* (2nd ed) Stanford, CA: Stanford University Press; 1993