Therapy in Parkinson's disease: surgery, pharmacy, and surgery again. But now with a spark?

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the concept that, in the clinical setting, DWI signal usually reflects acutely infarcted tissue, not tissue at risk of infarction. This conclusion is suggested by the normal DWI findings in a transient ischemic attack, presumably reflecting reversibly ischemic tissue, and the lack of "disappearing" DWI lesions during ischemic tissue recovery. In addition, the authors describe a patient with a slowly evolving posterior cerebral artery infarct who must have had an area-at-risk of infarction missed on initial DWI. Although these results are at odds with prior animal studies showing reversible DWI ischemic changes, they are compatible with most prior clinical studies. Clinical results show DWI to be a very sensitive technique for detecting early infarction, but an insensitive approach for detecting areas-at-risk of infarction.

Questions concerning DWI of cerebral infarction that still need more attention are: 1) What is the most practical DWI sequence? 2) Can simple, single axis DWI imaging suffice or are more complex diffusion parameters necessary? 3) What is the reproducibility of the observations, particularly in relation to the subtle changes of CT? and 4) How sensitive is DWI and combined techniques in revealing hemorrhage? Answers to these more detailed questions will help guide the routine implementation of this most important MR technique for the evaluation of acute stroke. We, however, still need a method for defining the elusive ischemic penumbra, at the area-at-risk of infarction. Perhaps a complementary MR technique such as perfusion imaging will meet this persistent challenge.

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References

1. Bryan RN. **MR Spectroscopy of Temporal Lobe Epilepsy: Good News and Bad News (Editorial).** *AJNR Am J Neuroradiol* 1998;19: 189

Therapy in Parkinson's Disease: Surgery, Pharmacy, and Surgery Again. But Now with a Spark?

In this issue of the *American Journal of Neuroradiology* Cohn et al describe the preoperative and postoperative MR evaluation of stereotactic pallidotomy (see page 1075). The authors prefer a turbo spin echo inversion recovery sequence for guidance, but perform no formal evaluation to prove that this is better than any other high resolution sequence that provides good gray/white matter delineation. For follow-up purposes, straightforward T1- and T2-weighted acquisitions are all that are necessary in most cases. This information, however, is not what is fun about this work. A brief history will show that the therapy of Parkinson's disease has come nearly full circle.

Before Hans Spatz established the existence of an "extrapyramidal" motor system in 1927, neurosurgical therapy of Parkinson's disease centered on the spinal cord and brain stem. Tremors could be relieved, but the patient often paid the price with severe weakness and spasticity. After Spatz, the focus shifted to the basal ganglia and thalami. Neuroanatomic direction was still quite dependent upon contrast ventriculography or superficial landmarks, and even included ligation of the anterior choroidal artery to devascularize the ablation target. Some of these procedures had mortality rates of up to 41%. Stereotactic guidance changed this. Some groups, notably Lars Leskell's in Lund and Stockholm, performed carefully controlled interventions demonstrating that the optimal pallidotomy site was the posterior medial aspect of the medial globus palladus (1). As anatomic guidance became more precise, postoperative lesion size diminished and bilateral pallidotomies became safe. Despite such well controlled studies, ventral lateral thalamotomy became the preferred ablation target. Thalamotomies peaked in the 1960s, stopped only by the development of levodopa with its striking clinical benefits. By the mid 1960s and early 1970s, Parkinson's disease was rarely treated by functional neurosurgery. As clinical experience with dopaminergic agonist treatment of parkinsonism grew, however, 50% of treated patients were found to have significant motor complications. Medications developed to ameliorate motor complications increased the incidence of non-motor difficulties, especially psychiatric problems. These limitations of pharmacologic therapy in concert with the advent of much more sophisticated neuroanatomic guidance, especially MR imaging, have allowed the rebirth of functional neurosurgery. What is especially exciting about this neurosurgery now, however, is that ablation is not the only option. In fact, it may not even be the best. Spectacular results have been found with electrical stimulation devices, driven by work done by the Medtronic Corporation (Minneapolis, MN) of cardiac pacemaker fame. A strong proponent of electrical stimulation, Alim Benabid from Grenoble, France, reported favorable results in nearly 75% of tremor patients treated with this device. The excitement over neurostimulation has been noticed by a "journal" that is increasingly becoming "required reading" for the medical community, *The Wall Street Journal*(2). As would be expected, there is controversy over the ideal implantation site for this electrical stimulation device, with the globus palladus and subthalamic nucleus the two most favored. In fact, there is a blinded investigation in progress at the University of Oregon aimed at solving this controversy. Other investigators are considering the benfits of ablating one

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.

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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