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Commentary

MR Angiography: Reaching Adolescence

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Adolescence can be defined as the period between childhood and adulthood during which a person attains complete growth and maturity. The rapid change of the early years is gone, and the individual's features assume their adultlike state, and yet, continuous, often even monumental, transformation and development still occur. Moreover, the growth from child to adult is not equal in all aspects of the individual. Some parts will attain maturity before others. This time of transition is not effortless. The questions posed by the adolescent are most challenging. Indeed, the reality faced by the individual at this stage is probably more complex and ambiguous than at any other time.

Medical technology can be thought of as an entity that develops through a series of stages in a manner similar to that of humans. Progression occurs from early experimentation and development, to application and verification, and, finally, to acceptance and use. MR angiography is certainly entering the second stage, the adolescence, of technologic development. Since the advent of MR imaging, flow phenomena and imaging not only of the vasculature of the body but also of the flow within its vessels have been subjects of great interest [1–3]. The last several years have seen a multitude of papers describing various techniques for MR angiography. All have been based on either time-of-flight or phase-contrast flow effects, and a prodigious effort has been made to modify and improve the methods. In addition to the developments in sequence design and data acquisition, considerable thought and effort have been directed toward postprocessing methods and display alternatives.

The results of this activity have been translated into several commercially available "packages" for performing MR angiography. The wide availability of these methods on MR systems has piqued the interest of referring clinicians and stimulated demand for this technology, despite the limited clinical data available about the value and appropriate use of MR angiography. This technology, driven by enthusiastic radiologists and interested clinicians, is trying to skip adolescence.

At the same time, a flurry of reports detailing new twists in the technology continues unabated. Although this research is in the best long-term interest of technologic development, it poses an impediment to any sound effort to assess the value of the technology, its appropriate application, and its pitfalls and limitations. Still, this type of analysis and assessment is precisely the kind that is essential for MR angiography to develop and mature into a useful and clinically valuable technology.

The article by Lewin and Laub [4] in this issue of the *AJNR* is a clear example of the direction our ongoing investigation into MR angiography must take in the next several years. The authors have carefully analyzed the value of three different time-of-flight MRA techniques used to evaluate the intracranial vasculature in healthy volunteer subjects. The results, though somewhat predictable on the basis of the known characteristics of the technique used, are nonetheless important in directing future clinical applications of each of these techniques. The proximal arterial circulation is best seen with the single thick-volume and multiple thin-volume three-dimensional Fourier transformation (3DFT) methods; the distal arterial branches are best appreciated by using the multiple thin-volume 3DFT technique; and the venous circulation is best visualized using a sequential two-dimensional Fourier transformation method.

The most important conclusions to be drawn from this work are that examination of the intracranial vessels will need to

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be clinically "tailored" by the radiologist supervising the study and that more than one angiographic pulse sequence will have to be available as part of any package. The design of the clinical MR angiographic examination may depend not only on the clinical data available before the study but also on the results of any initial routine MR imaging sequences. It follows that the radiologist must know both the pathologic possibilities implied by the patient's clinical presentation and routine imaging studies and the potential value of the various MR angiographic sequences in order to make a rational selection of the appropriate MR angiographic technique.

Another important contribution Lewin and Laub have made is their analysis of the artifacts and related pitfalls inherent in each method. These factors too, will determine the appropriate imaging technique for a clinical situation.

The next stage in the growth of MRA toward maturity should be the application of specific techniques to appropriate clinical questions. Although some reports [5, 6] have described the use of MR angiography in patients with suspected intracranial vascular pathologic changes no *systematic* attempt has been made to apply and evaluate various techniques relative to different diseases. An approach of this sort in patients with aneurysms, arteriovenous malformations, and other vascular lesions will allow us to select the appropriate method for studying patients suspected of or known to have these entities. Equally important is the application of several different MR angiographic techniques in the same groups of patients, which may have the added benefit of uncovering information that is novel or unique and not currently available with contrast angiography. The goal of a new technology must be not only to replace an older method but also to add to our understanding of the disease process and how it affects the patient we are studying.

The verification of MR angiographic techniques as compared with the gold standard, conventional contrast angiography, should occur simultaneously with the application of different techniques to the various clinical problems. These comparative studies have already begun to appear with regard to MR angiography of the extracranial carotid arteries [7, 8] and, to a lesser degree, of the intracranial vasculature [6]. Before we can unequivocally recommend MR angiography of the intracranial vessels to our clinical colleagues, additional comparative studies must be performed. These studies must be focused on applying the best technique available to the individual clinical problem and on recognizing potential pitfalls as the pitfalls relate to specific diagnoses. The excitement of referring clinicians will rise from our own enthusiasm and from the first good images, but routine acceptance by clinicians will materialize only when we have truly demonstrated the value of our efforts. Moreover, the attention of the government and other third-party insurance carriers to the development and appropriate use of MR angiography and other medical technology is increasing. Thus, we also must be prepared to document the efficacy and usefulness of MR angiography in terms of patient care and procedure costs.

Studies of the type described before can be somewhat frustrating because they tend to use MR angiographic methods that may already have become outdated by the time a study ends. This is as it should be, for the effort to extend our technologic capabilities will always be ongoing. As the analogy of human development implies, even the mature adult continues to grow and develop throughout life. Likewise, any technology that has reached the stage of acceptance and use is not doomed to stagnation but should continue to advance. It is efforts like those of Lewin and Laub that will most likely translate directly into better diagnosis and care over time. We have only started to witness the great potential that MR angiography offers in the diagnosis of intracranial vascular abnormalities.

REFERENCES

1. Axel L. Blood flow effects in magnetic resonance. *AJR* **1984**;143:1157–1166
2. Dumoulin CL, Hart JR. Magnetic resonance angiography. *Radiology* **1986**;161:717–720
3. Bradley WG Jr. Flow phenomena in MR imaging. *AJR* **1988**;150:983–994
4. Lewin JS, Laub G. Intracranial MR angiography: a direct comparison of three time-of-flight techniques. *AJNR* **1991**;12:1133–1139
5. Masaryk TJ, Modic MT, Ross JS, et al. Intracranial circulation: preliminary clinical results with three-dimensional (volume) MR angiography. *Radiology* **1989**;171:793–799
6. Ross JS, Masaryk TJ, Modic MT, Ruggieri PM, Haacke EM, Selman WR. Intracranial aneurysms: evaluation of MR angiography. *AJNR* **1990**;11:449–456
7. Litt AW, Eidelman EM, Pinto RS, et al. Diagnosis of carotid artery stenosis: comparison of 2DFT time-of-flight MR angiography with contrast angiography in 50 patients. *AJNR* **1991**;12:149–154
8. Masaryk AM, Ross JS, DiCello MC, Modic MT, Paranadi L, Mawaryk TJ. 3DFT MR angiography of the carotid bifurcation: potential and limitations as a screening examination. *Radiology* **1991**;179:797–804