Magnetic Resonance Imaging in Ischemic Stroke

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BOOK REVIEW

Magnetic Resonance Imaging in Ischemic Stroke


Magnetic Resonance Imaging in Ischemic Stroke, edited by Drs. von Kummer and Back, with contributions by many distinguished stroke experts, is a well-organized timely textbook, with excellent teaching value. It certainly has great relevance to anyone involved in acute stroke triage, regardless of their background. Because the continued rapid advances in stroke imaging even now (just a few months since publication of the book) date some chapters, it is unlikely to be as enduring as Dr. Klaus Sartor had hoped in the “Foreword.” Indeed, this publication supersedes an earlier work by the Heidelberg group, Stroke MRI (Springer, 2003), edited by J.B. Fiebach and P.D. Schellinger. Some crucial references that have been in print for almost a year since the publication date of 2006 are lacking in certain chapters, most notably that referring to the Desmoteplase in Acute Ischemic Stroke trial (DIAS) (Hacke W, Albers et al. Stroke 2005;16:66-73), which is cited appropriately in chapter 2 but not in 3. Nevertheless, this book provides a valuable framework for placing in context the current important issues in stroke neuroimaging with regard to timeless underlying pathophysiologic and clinical features of stroke syndromes. The text covers a wide range of topics but is not encyclopedic. Arguably, the most important limitation in content is inherent in the title itself—that MR imaging, not CT, is the focus. Readers seeking a more comprehensive overview of state-of-the-art stroke evaluation, which includes CT angiography and CT perfusion imaging, must look elsewhere.

The book contains 175 figures with 327 separate illustrations (50 in color) and 20 tables, most of excellent quality. The labels and legends are accurate and, unlike some texts, convey largely relevant information that highlights key “pearls” from the text. The book is divided into 3 parts: 1) clinical presentation and impact of imaging; 2) MR imaging of stroke pathology, and 3) MR imaging correlates of stroke syndromes. As would be expected with any multiauthored textbook, there is considerable overlap of material between some chapters. In addition to the predictable coverage of such topics as diffusion- and perfusion-weighted MR imaging, there are detailed discussions of pathologies, including hemorrhage, transient ischemic attack, and white matter/microangiopathic, lacunar disease, as well as supplementary technologies including MR spectroscopy. Chapters on venous occlusive disorders (chapter 18) and, notably, spinal infarcts (chapter 17) are unique features that distinguish this book from other similar works. Chapter 18 is especially noteworthy in that CT venography (CTV) is, thankfully, acknowledged as a highly accurate technique (both CT angiography and CTV are likely to exceed MR angiography [MRA] and MR venography in the detection and delineation of intravascular thrombus).

Chapter 3, “Therapeutic Impact of MR imaging in Acute Stroke,” by Mark Parsons and Stephen Davis of Australia, is outstanding and of greatest consequence to clinical neuroradiologists. More so than the other chapters, this chapter succinctly reviews both past and ongoing clinical trials central to imaging triage. Specifically, the role of perfusion-diffusion mismatch in identifying ischemic penumbra—and hence, in selecting appropriate candidates for reperfusion therapy and providing a surrogate outcome measure—is addressed. An algorithm for potential future thrombolysis triage, based on both mismatch and MRA findings, is presented at the end of this chapter, with the implicit and explicit take-home message that “physiology is brain” should replace “time is brain” as the mantra for thrombolytic treatment beyond currently accepted time windows. The references are complete and scholarly—though some are already obsolete, following data presented at the recent American Heart Association International Stroke Conference (AHA ISC), held in February 2006 in Kissimmee, Fla. Table 5.1 surveys the most important of these large randomized trials, including the Echoplanar Imaging Thrombolysis Evaluation Trial (EPITHET), The Desmoteplase in Acute Stroke (DIAS), DWI Evolution for Understanding Stroke Etiology (DEFUSE), and MR and Recanalization of Stroke Clots by Using Embolectomy (MR RESCUE), to name a few. For example, the DEFUSE results, which were discussed at length at the AHA ISC meeting, provide convincing evidence that gradient-echo susceptibility MRI detected “microbleeds” alone are not a contraindication to IV thrombolysis in the acute stroke setting.

We learn from Table 3.2 and Fig 3.4 that perfusion-diffusion mismatch is present in 80% of patients at 6 hours after stroke onset, 65% at 12 hours, and 50% at 24 hours; and we are reminded that approximately 25% of those with mismatch do not have an observable lesion on MRA (considerable at-risk tissue can still be present in patients with mismatch without visible MRA lesions, likely because of distal emboli). We are also reminded that the mean-transit-time lesion probably overestimates the volume of truly hypoperfused tissue by including regions of benign oligemia and that the perfusion threshold for irreversible ischemia is more forgiving at 2 hours than at 6 hours postictus. Also, the EPITHET trial is poised to address the question of to what degree nonmismatch patients may benefit from thrombolysis (ie, to what degree are acute diffusion-weighted imaging [DWI] lesions reversible with early vascular recanalization?). Not surprisingly, the authors avoid mention of CT even when relevant and lack more up-to-date references. For example, in the section on clinical diffusion mismatch, 2 important articles (Kent DM, Hill MD, Ruthazer R, et al. Stroke 2005;36:1695-99 and Reineck LA, Agarwal S, Hillis AE. Neurology 2005;64:828-33), are notably absent, as is the reference to using MR imaging cerebral blood volume maps to predict hemorrhagic transformation after thrombolysis (Alsop DC, Makovetskaya E, Kumar S, et al. Stroke. 2005;36:746-50).
Chapters 4 and 8 provide a welcome and thorough discussion of underlying physiologic principles, including animal studies correlating histology with ischemic penumbra, which should remain pertinent despite future advances in human neuroprotective trials. Chapter 5, however, would have benefited from a more in-depth discussion of the potential future role of “vulnerable plaque” imaging in assessing stroke risk. Table 13.2 offers a good summary of DWI studies of lacunar stroke. Chapter 16 provides an off-the-beaten-path discussion of more diffuse global hypoxic-ischemic injury.

Stroke imaging is, without doubt, a very hot topic, and there are numerous current and in-press publications vying for the readers’ attention (as well as their professional fund budget!). Recent related texts—each with strengths and weaknesses of their own—include the 2-volume Neuroimaging Clinics of North America: Stroke, edited by M.H. Lev (Elsevier, 2005), and Acute Ischemic Stroke: Imaging and Intervention, edited by R.G. Gonzalez, J.A. Hirsch, W.J. Koroshetz, et al (Springer, 2006). Inherent in any textbook on stroke imaging is the risk that the material will become quickly dated. Despite this peril, Magnetic Resonance Imaging in Ischemic Stroke has largely enduring value to both clinical neuroradiologists and researchers interested in advancing acute stroke therapy through imaging triage. It addresses timeless pathophysiologic mechanisms and explores their clinical context and hence should continue to complement other textbooks as stroke neuroimaging progresses—by using not only MR imaging but also CT and other techniques.

BOOK REVIEW

Clinical Magnetic Resonance Imaging e-edition

As the applications for MR imaging expand, the number of publications and books on MR imaging increases logarithmically. The newest entry is the 3rd edition of Clinical Magnetic Resonance Imaging edited by Drs. Edelman, Hesselink, Zlatkin, and Crues. This 3649-page 3-volume text contains contributions from 251 authors, many of whom are leaders in the world of diagnostic radiology and MR imaging physics. These books cover the entire spectrum of MR imaging from the basics to all of its current clinical applications (heart, vascular system, brain, spine, head/neck, chest, breast, body, and musculoskeletal); in fact, it is so complete in the descriptions of each area that reviewing the text in detail would consume half an issue of the AJNR. So for the purposes of the Journal and the neuroradiology audience, this review will cover that portion of volume 1 that includes the physics, instrumentation, and advanced techniques and of volume 2 that deals with brain, head/neck, and spine imaging. Volume 3 (not reviewed) deals with body and musculoskeletal MR imaging. Note is made that with the purchase of this publication, on-line access is possible with a PIN code given at the time of purchase.

Volume 1 begins with a 22-page summary of the history of MR imaging. Names and pictures of major figures in its development, along with a synopsis of each person’s contribution, constitute the first part of this chapter. You will now know what Jean Baptiste Joseph Fourier looked like and exactly why the Fourier transfer is so fundamental to current imaging. How about the appearance of Bloch, Purcell, Lauterbur, Henning, Mansfield, Rabi, Pauli, Gorter, and Damadian among others and what their specific contributions were or who first used the term “nuclear MR” in a publication? In addition, later you will view some of the very first images from the original MR imaging units and pictures of the scanners themselves, which became available in the late 1970s. Included are figures of the basic pulse sequences, and the names that the major MR imaging companies gave to their sequences. The stages of MR imaging development from the 1920s to its present status makes for fascinating reading, and 3 boxes outline the historic development of MR imaging and the Nobel Prizes (13 in total) awarded to those in physics, chemistry, and medicine who contributed to the development of MR imaging. This chapter was an excellent way of beginning a walk through all aspects of MR imaging.

Following the introductory/historic chapter, 7 of the next 8 chapters (226 pages) are devoted to the physical underpinnings of routine clinical MR imaging. The chapters, in order, are “Basic Principles,” “Practical Considerations and Image Optimization,” “Instrumentation” (magnet/gradients/receiver coils), “Pulse Sequence Design,” “Advanced Imaging Techniques,” and “Parallel Imaging Methods.” Why a chapter on the “Biochemical Basis of MR of the Cerebral Hemorrhage” got tossed in the middle of these chapters is not clear; it would have been better to integrate that information into the chapter in book 2 on “Intracranial Hemorrhage.” The points in the basic principles and practical considerations are familiar to almost all those involved with MR imaging on a daily basis; nonetheless, a periodic review of this material, as in this book, is always of value. The graphics are crisp, and the legends for each figure are complete and understandable. Because the jargon for pulse sequences and the many techniques varies from manufacturer to manufacturer, a 2-page table of acronyms reminds us of who calls the same imaging option by different names—for example, true FISP versus balanced FFE versus FIESTA. Although this chapter is an overview, it provides solid information (eg, sampling bandwidth, trade-off of imaging parameters, higher field imaging, and so forth) in a readable fashion. Safety issues are dealt with more completely by Dr. Shellock in a chapter later in this book.

Although a clinical neuroradiologist might quickly flip past the chapters on instrumentation and pulse sequence design, there are sections that are helpful when a physicist or a technical representative of a company tosses out unfamiliar concepts and hardware considerations. In these 2 chapters, a review of siting a magnet, magnet technology, and the layering of the various coils (shield, main, gradient, and radio-frequency) is presented. Here