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Advanced Pediatric Imaging, An Issue of Neuroimaging Clinics

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together, these 2 chapters provide a very good overview of orbital anatomy and surgery as practiced by neurosurgeons.

The longest chapter in the book is "Endoscopic Third Ventriculostomy in the Treatment of Hydrocephalus in Pediatric Patients." The chapter is comprehensive, covering anatomy, technology, indications, and results. A good presentation of historic background is followed by detailed descriptions of endoscopic anatomy in the pertinent regions of the lateral and third ventricles. This section is well illustrated with color photographs of endoscopic views correlated with corresponding MR imaging. The various types of endoscopes are then explained in detail with illustrations. The techniques of use of the endoscopes and accessories, such as perforating devices, coagulation devices, balloon catheters, and other instruments, are reviewed. The indications for endoscopic third ventriculostomy are then provided. Hydrocephalus due to aqueductal stenosis is extensively described, followed by hydrocephalus related to posterior fossa tumors. The possible use of this procedure in hydrocephalus with a communicating component is suggested. The presentation of the use of third ventriculostomy in posthemorrhagic and postinfectious hydrocephalus is followed by other disorders such as Dandy Walker syndrome and hydrocephalus with myelomeningocele. Analysis of outcome of the procedure is extensively discussed, with criteria for defining a successful result. This involves neuroradiologic evaluations and may involve intracranial pressure monitoring. The section on early and late results includes reviewing the available information on intellectual outcome. Finally, an appropriate amount of space is devoted to complications. Although this chapter has somewhat stilted English, it is a useful comprehensive review of a relatively narrow topic that has been significantly influenced by advances in technology.

The next chapter is "Minimally Invasive Procedures for the Treatment of Failed Back Surgery Syndrome." The chapter begins with a good introduction to the problem, particularly of areas of prevalence and cost. Next is a discussion of the diagnostic process for chronic lower back pain, including specifics of history taking and physical examination and the limitations of these exercises. There is an extensive review of radiologic findings in failed back patients. The discussion of minimally invasive diagnostic procedures includes provocative diskography and nerve blocks performed with fluoroscopy; these should be of particular interest to the radiologist. The extensive coverage of minimally invasive treatments for lower back pain includes intradiskal electrotherapy, radio-frequency lesions, epidural injections, percutaneous epidural neuroplasty, epiduroscopy, spinal cord stimulation, and intrathecal medications. This chapter includes a good review of these techniques but is primarily procedure-oriented, including both diagnostic and therapeutic procedures. Although it has a thorough discussion of these procedures, the chapter should not be taken as a comprehensive approach to the evaluation and treatment of patients with failed backs. The most important missing component is the least invasive type of procedure, which is also most likely to produce benefits to most of these patients, namely aggressive physical therapy and rehabilitation.

The final chapter covers surgical anatomy of the calvarial

skin and bones, with reference to neurosurgical approaches. It reviews the layers, vasculature, and innervation of the scalp. The discussion of the skull begins with surface landmarks and includes particular detail concerning the base of the skull and the relations of venous sinuses to the surface landmarks of the skull. The chapter is relatively brief compared with the other chapters, but the illustrations, particularly of temporal bone anatomy, are very good.

This book is intended for neurosurgeons, but many neuro-radiologists will find it of interest. There are correlations between neurosurgical treatments and radiologic studies that are well illustrated. Reviewing this type of text can give the radiologist perspectives on how the neurosurgeon applies the knowledge gained from the radiographic studies.

BOOK REVIEW

Advanced Pediatric Imaging, An Issue of Neuroimaging Clinics

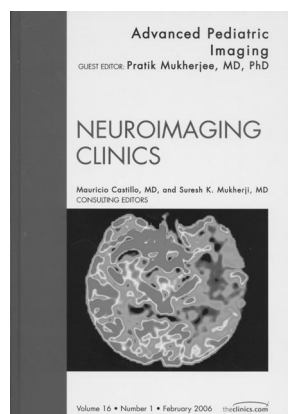
M. Castillo and S. K. Mukherji, consulting eds; P. Mukherjee, guest ed. Philadelphia: WB Saunders; 2006. 240 pages, \$94.00.

This edition of *Neuroimaging Clinics of North America* serves as a debut edition for the new consulting editors, Drs. Mauricio Castillo and Suresh Mukherji, as well as for the guest editor, Dr. Pratik Mukherjee. The intention to encourage young and promising neuroradiologists to serve as guest editors has resulted in a collection of reviews that certainly not only provide the state of the art for advanced pediatric imaging but also will likely serve as a benchmark for subsequent publications of this text. Dr. Mukherjee has certainly assembled a most distinguished group of contributors to cover almost every aspect of advanced pediatric neuroimaging.

This text comprises 10 chapters, beginning with prenatal imaging, progressing temporally to neonatal imaging and postnatal development. It includes chapters on fetal MR imaging, diffusion tensor imaging (DTI), and fiber tractography of human brain development; diffusion-weighted imaging (DWI); MR spectroscopy of human brain development; MR spectroscopy of metabolic disorders; MR imaging of the neo-

natal brain; dynamic susceptibility perfusion MR imaging; arterial spin labeling; advanced neuroimaging of pediatric brain tumors; and pediatric magnetoencephalography/magnetic source imaging.

The first chapter describes fetal central nervous system (CNS) MR imaging. It provides a nice overview of the sequences available for rapid MR imaging to overcome fetal motion and the indica-



tions, utility, and safety issues when scanning the prenatal brain. Normal fetal development and possible clinical applications, including a number of fetal abnormalities and malformations of cortical development, are described with exquisite figures of the fetal CNS, which include DWI and a single-voxel MR spectrum from 29- and 36-gestational-week fetuses, respectively. This is certainly a comprehensive review of the current capabilities of MR imaging of the prenatal brain and spine. The 2nd chapter presents the work and interests of the guest editor, providing high-quality figures from the National Institutes of Health MR Imaging of Normal Brain Development study. It summarizes the diffusion and DTI findings in human brain maturation, including the changes in diffusion anisotropy in the white matter and cerebral cortex. There are numerous color figures of fractional anisotropy maps and fiber tractography to illustrate the changes that occur during development. Some of the limitations of 3D DTI are discussed, including the problem of fiber tracking in regions of complex white matter architecture, where crossing fibers cannot be adequately resolved. The use of high-angular-resolution diffusion imaging to overcome some of these limitations is discussed, and this technique provides further promise in a very exciting field. The clinical application of DTI in congenital brain malformations, metabolic diseases, and neurodevelopmental disorders is presented at the end. The 3rd chapter deals with DWI of the pediatric brain. This is likely one of the most comprehensive reviews of DWI in the pediatric (or adult) brain that I have read, with many clinically applicable figures (26 in total), from metabolic diseases to DWI in cerebral empyema. It not only serves to demonstrate how DWI can be applied in the pediatric brain but also could serve as a review of the utility of DWI in the brain in general. The number of pathologies covered and the quality of figures on the whole are excellent; much can be gained from just reviewing the figures alone in this chapter.

Chapter 4 provides a good summary of the metabolite changes that occur during early brain maturation. It also describes the spectroscopic changes that occur in premature infants, including those with an abnormal outcome. The figures presented certainly give a nice overview of the temporal changes that occur in the developing brain as well as the spatial differences that are seen in the neonatal brain. The 5th chapter is "MR Spectroscopy of Metabolic Disorders." It gives a summary of the techniques and future directions and then describes the metabolite changes in lysosomal, peroxisomal, mitochondrial, and other white matter disorders. Again, it is likely one of the most comprehensive reviews of MR spectroscopy in metabolic disorders that I have ever seen. The 6-page table, summarizing each disorder in terms of the gene locus, mode of inheritance, primary classification and defect, metabolite consequence, and MR spectroscopy findings, is an excellent reference for neuroradiologists, neurologists, geneticists, and spectroscopists. It also, to a certain extent, demonstrates the relative lack of specificity of MR spectroscopy in many of these diseases because the predominant finding is a decrease in *N*-acetylaspartate, with an increase in choline and myo-inositol. Nevertheless, the table also shows that there are some

white matter diseases with specific metabolite changes that would be useful for clinical diagnostic confirmation.

Chapter 6 is an overview of MR imaging of the neonatal brain, including sequelae of hypoxic-ischemic injury in the premature infant as well as some metabolite disorders presenting in neonates. There is some overlap and repetition with the previous 2 chapters. I was surprised that the author did not present some of his extensive experience on imaging congenital and cortical malformations in the pediatric brain. In particular, as stated in the introduction to this chapter, the development of dedicated surface array coils and MR compatible incubators has allowed high-resolution imaging of cortical and subcortical structures of the neonatal brain. The 7th chapter discusses the application of dynamic susceptibility contrast perfusion-weighted MR imaging (DSC-PWI) in pediatric patients but really only describes the application of this technique to pediatric brain tumors. Naturally, there are other applications of DSC-PWI, such as in stroke, infection, trauma, and metabolic disease, which were excluded. It does, however, describe the dosage and rate of injection as well as some of the technical pitfalls in imaging a pediatric patient. The remainder of the chapter deals with perfusion imaging in different tumor types, with some overlap with Chapter 9. Chapter 8 provides a complete review of the current state of arterial spin labeling perfusion MR imaging from the methodologic to technical issues such as the effect of differences in T1 relaxation of blood in children being longer than that in adults because of the blood-water content being higher in adults. It also presents issues regarding the effect of sedation on perfusion of the pediatric brain, which is critical when quantifying brain perfusion for various pathologies. In general, it provides a good overview of arterial spin labelling techniques, which currently are not as widely used clinically as exogenous contrast-based perfusion techniques.

Chapter 9 is an overview of MR diffusion, MR perfusion, and MR spectroscopy in pediatric brain tumors. It reviews each of these techniques and how each can be applied clinically to determine preoperative tumor grading, evaluation of tumor margins, radiation versus recurrent tumor, response to therapy, fiber tractography, and future applications. With 132 references, it is certainly a comprehensive review, combining all of these techniques individually and also in a multiparametric approach to imaging pediatric brain tumors. The 10th and final chapter describes pediatric magnetoencephalography and magnetic source imaging. For a reader with little experience, as well as for the expert in these techniques, this is certainly a good review of the basic principles and the clinical application, particularly in epilepsy surgery.

This edition of *Neuroimaging Clinics* will likely appeal to a wide audience. It has important information for the academic neurosurgeon, neurologist, and neuroradiologist, with access to these state-of-the-art imaging techniques. It also serves as a nice review for researchers, physicists, and spectroscopists, who are using or investigating these advanced imaging techniques both in the pediatric and adult CNS. Last, this text would also be interesting reading for the general practitioner who would like to learn more about newer imaging techniques and how they can be applied to pediatric imaging. In compar-

ison with other publications of this type, this is certainly one of the most comprehensive reviews I have ever seen, with a large number of excellent figures, fitting for a neuroimaging publication. It should prove to be a useful reference on any shelf for many years to come.

BOOK REVIEW

Diagnostic and Surgical Imaging Anatomy: Brain, Head & Neck, Spine

H.R. Harnsberger, A.G. Osborn, A. MacDonald, J. Ross, K.R. Moore, K.L. Salzman, R.H. Wiggins, H.C. Davidson, B.E. Hamilton, and C.R. Carrasco, eds. Salt Lake City: Amirsys; 2006. 1000 pages, 2870 illustrations, \$249.

In a single, beautifully illustrated book, the neuroradiology group from the University of Utah has presented the neuro-radiology and neuroscience community with detailed structural anatomy of the brain, head and neck, spine, and peripheral nerves by using anatomic drawings, CT, MR imaging, and angiography. Nine authors have contributed to this 1000-page book, which is structured as follows: The brain section is divided into a) scalp, skull, meninges, b) supratentorial brain, c) infratentorial brain, d) CSF spaces, e) cranial nerves, f) extracranial arteries, g) intracranial arteries, and h) veins and dural sinuses. The head and neck section is divided into a) temporal bone and skull base, b) orbit, nose, sinuses, c) supra and infrahyoid neck, and d) oral cavity. The spine section is divided into a) vertebral column/disks/paraspinal muscles, b) spinal cord/meninges/spinal spaces, c) spinal vasculature, d) plexuses, and e) peripheral nerves. Many of the illustrations are drawn from the authors' previous 3-volume set of books on diagnostic imaging.

The labeling of structures is precise, and the anatomy is not obscured by overly abundant labels. There are so many positive aspects of this large and information-packed book that they all cannot be mentioned in this review; however, like the authors' bulletlike presentation, just a few highlights (in this reviewer's opinion) will be similarly described.

- There are outstanding color-plate drawings (called "graphics") of key anatomic features, which drive home those imaging correlations often needed when reviewing a topic or reviewing high-resolution images. Outstanding examples are (just to name a few): the limbic system; internal structure of the brain stem (medulla/pons/mesencephalon); detailed courses, origins, interconnections, and terminations of the cranial nerves (each dealt with individually); the temporal bone with exquisite details of the inner ear including the cochlea, membranous laby-

rinth, and facial nerve; the spaces of the neck (if only the clinical MR and CT images came out colorized to show the fascial layers and the various compartments!) laryngeal/hypopharyngeal area; lymph node anatomy; oral cavity/sublingual space; the brachial, lumbar, and sacral plexuses; and peripheral nerves.

- High-quality MR images and CT scans demonstrate the key findings in all areas. This is particularly useful in the skull base and head/neck areas.
- Descriptive material for every major area includes the following subheadings—"Terminology," "Imaging Anatomy," "Embryology" (where appropriate), "Anatomy-Based Imaging Issues," and "Clinical Implications." The latter 2 categories (subheadings) are particularly well done throughout the book. The amount of anatomy-based imaging issues varies in length from section to section and includes key concepts, imaging recommendations, the approach to imaging, and pitfalls. Under the subheading of clinical implications, clinical importance and functional anatomy are described. Take the pterygopalatine fossa (6 pages) as just 1 small isolated example. This area, composed of different named spaces containing a complex mixture of vascular structures and nerves and irregularly shaped bony borders, is illustrated and described so that these anatomic points stick. One can easily flip back and forth from the drawings to the CT images to gain an appreciation of the exact relationship between the vidian nerve, the pterygopalatine (sphenopalatine) ganglia, and the foramen rotundum and how (where) the nerves interconnect. The critical role this fossa plays in the interconnection of numerous spaces and the subsequent spread of disease is emphasized. Although it may be added work for the authors, this reviewer suggests that a future edition contain 2 images at each level: 1 as currently shown and the 2nd directly adjacent to it showing in color the critical structures running through that space. This could be done in many other sections of the book also. The information under "Function-Dysfunction" briefly describes the innervation of structures in this area. This excellent section is detailed in this review to give the reader a flavor of what type of information to expect in every area of the book.
- Some pathology (limited) is included to emphasize the anatomy under review, such as a submucosal/mucosal mass in the parapharyngeal space or an abscess in the prevertebral/retropharyngeal space.
- Both the text material (written in phrases, not sentences) and the figure legends (written in sentences, not phrases) contain important information. Take the 8-page description and corresponding illustration of the limbic system—one quickly gains an appreciation of the components of the limbic system and limbic lobe, the "arches" of which the limbic system is composed; its MR imaging details; and the details of the inner zones of the hippocampus. The T2- and T1-weighted MR images of this area are excellent and allow an appreciation of the key imaging features of the limbic system. This segment exemplifies again the persistent high quality throughout the book.

