AJNR

Diagnostic Pathology of Nervous System Tumours

AJNR Am J Neuroradiol 2006, 27 (6) 1385-1387
http://www.ajnr.org/content/27/6/1385

orientation that can be visualized by coloring the anatomy according to a coded direction with intensity proportional to diffusion anisotropy. The color direction maps seen in this atlas and available on clinical scanners visualize the local white matter orientation by using 3 colors—red, green, and blue—representing the 3 axes. In this atlas, red is left-right, green is anteroposterior, and blue is inferior-superior. Note, however, that these colors are not always consistent on different scanners and systems. Tracts at oblique angles are represented by combinations of the colors corresponding to the orthogonal axes and thus are more difficult to interpret.

The authors point out an important limitation of DTI that is essential in interpreting the color maps. Because of the relatively large size of the pixels in the DTI data (2–3 mm), a pixel often contains an intermingling of axonal tracts with multiple orientations. As a result, these pixels have diminished anisotropy and will appear as dark regions. It is important that these regions of low anisotropy are not interpreted as having a low content of axonal fibers.

Chapter 2 describes the data and methods used for the creation of this atlas.

The most difficult aspect of the methodology is the identification of tracts with the aid of tractography methods. The FACT (fiber assignment by continuous tracking) method developed by the authors allows for the detailed identification of tracts throughout the white matter. This method uses a combination of automated tracking with local integration of the diffusion directions, assisted by manual delineations. The manually defined regions of interest help to edit and sort out those fiber paths with similar trajectories. This process, based on the known anatomic courses of the tracts, enables the subdivision and labeling of the white matter and the creation of the parcellation maps shown in chapter 4.

Chapter 3 provides a 3D atlas of 4 groups of white matter fibers: tracts in the brain stem, and projection, association, and commissural tracts in the cerebral hemispheres. Five tracts were reconstructed in the brain stem: the superior, middle, and inferior cerebellar peduncles, the corticospinal tract, and medial lemniscus. The images of the 3D trajectories of the tracts are accompanied by multiplanar images at various section levels and orientations. 3D trajectories, accompanied by multiplanar images at various section levels and orientations of the following association fibers, are demonstrated: the superior longitudinal, inferior longitudinal, superior fronto-occipital, inferior fronto-occipital, and uncinate fasciculi. Also presented are the 3 major fiber tracts of the limbic system: the cingulum, fornix, and stria terminalis, as well as the commissural fibers of the corpus callosum.

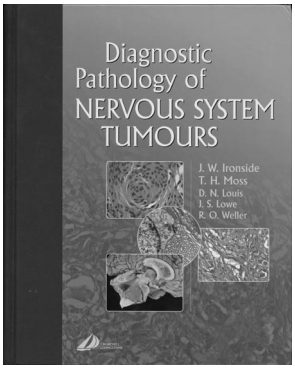
Chapter 4 constitutes by far the greatest segment of this book and is a 2D atlas of the previously mentioned white matter tracts. The 2D atlas is arranged in a series of axial, coronal, and sagittal images. Two types of color images are shown: direction maps and parcellation maps. Multiple sequential 2D color direction maps of the various tracts are presented, accompanied by parcellation maps shown with matching T1-weighted images and superimposed color-coded tracts derived from the tractography and parcellation methods described in chapter 2. The parcellation map shows the segments of the tracts seen at each level. The level of each color map and the accompanying T1-weighted parcellation image is indicated by a line on 2 orthogonal T1-weighted sections. Colors have been arbitrarily assigned to the tracts that have been delineated and are indicated by the color of the label on the direction maps. White labels indicate structures that have not been specifically delineated or represent alternate nomenclature, such as the external capsule. The corticospinal tract is, however, confusingly also labeled white. Labels, unfortunately, are not indicated directly on the parcellation maps, which can lead to confusion, especially for many similar-appearing colors. In contradistinction to the excellent labeling of the color direction maps, the utility of the parcellation maps is significantly limited by the lack of labeling. Also, the image quality of the underlying T1-weighted image in the parcellation map, especially in the sagittal and coronal sections, is diminished by the size of the pixels, though it may not have been technically feasible to interpolate. In general, the utility of the parcellation maps is reduced by the somewhat arbitrary-appearing delineations (gaps, extraneous portions) that are an artifact of the parcellation process. Tractography and parcellation are still quite challenging problems, and current methods at current resolutions do not yield perfect maps.

Although the authors acknowledge that the identification of the fiber tracts on DTI would not be possible without the anatomic knowledge gained from postmortem anatomic studies, the anatomic section in the reference list is surprisingly limited. The authors may have benefited from a larger selection of anatomic references, which includes more of the anatomic dissection studies, and the correlative anatomic and MR studies, which have been published in the past 20 years. The readers would benefit from an expanded anatomic and MR reference list.

Overall, this book is an important contribution to the field of DTI and is a very valuable new contribution in this burgeoning area. The major section of the book, consisting of the numerous sequential color maps with their level identified in the 3 orthogonal planes is a helpful guide to the interpretation of DTI, despite the limitations of the parcellation maps. We highly recommend this book for neuroradiologists and other investigators who are working with DTI.

BOOK REVIEW

Diagnostic Pathology of Nervous System Tumours



J.W. Ironside, T.H. Moss, D.N. Louis, J.S. Lowe, and R.O. Weller, eds. New York: Churchill Livingstone; 2002, 664 pages, 800 illustrations, $269.

In this beautifully crafted textbook, the editors and authors have presented, in a visually pleasing, highly readable, and informative format, the gross and histologic features of central nervous system (CNS) tumors. There is,

however, more to this book than the pathology per se; the authors have correlated many key clinical, genetic, and imaging features with the pathology, so this book will be intensely interesting to the neuroradiologist.

Here[3] is how the book is set up. There are 20 chapters, and the major portion of the book (chapters 4–20) deal with the major categories of tumors, namely, astrocytic tumors, oligodendrogliomas, ependymal and choroid plexus tumors, embryonal tumors, neuronal tumors, pineal tumors, germ cell tumors, lymphoreticular neoplasms, metastasis, meningiomas, vascular/melanocytic/soft tissue tumors, peripheral nerve tumors, pituitary fossa tumors, cysts/tumor-like lesions, extension from adjacent tumors, dysgenetic syndromes, and complications of tumors/effects of treatment. The fact that the entire book is written just by 5 authors (that is, there is not the usual host of contributors) gives the book a uniform appearance and high level of consistency throughout. The first 3 chapters ("Introduction to CNS Tumors"; "Practical Approach to the Diagnosis of Neurosurgical Biopsies"; "Intraoperative Diagnosis") contain information that all neuroradiologists will find useful. As just a couple of examples there are, in tabular presentations, descriptions of the major molecular assays used in cancer diagnosis: DNA analysis, RNA analysis, and protein analysis, polymerase chain reaction, and more; the different color stains, (Masson-Fontana, Luxol blue, periodic-acid-Schiff, van Gieson, and so forth) and what they demonstrate, and antibodies used in diagnosing various types of tumors. Not only should this type of basic information be required reading for all neuroradiologists, but many would want to copy some of these tables and have them ″at the ready″ when reading journal articles, reviewing papers, or presenting radiology/pathology correlations at conferences. For those interested in a summary of what are often arcane terms in the electron microscopy of tumors (such as, desmosones, annulate lamellae, microtubular sheaves, Birbeck granules), there are explanations and excellent images of these and other more commonly encountered electron microscopic structures in these early chapters.

With the above as the overall construction of the book, the question arises: How is it useful for the neuroradiologist? The answer is that the authors describe many of the issues and pathology information we face in our daily practice but about which many neuroradiologists have less than a full understanding. Although the authors attempt to bring some neuroimaging into the book, the imaging itself is no more than a brief survey in each chapter. One would have liked to have seen correlated imaging of each of the pathologic entities described—perhaps in a future edition the authors will expand that part of the text—but to this reviewer this limited amount of imaging is acceptable because such illustrations were not intended to be a significant part of the book. In fact, in the radiology parts of some chapters, the descriptions of the imaging are clearly introductory, because the findings are described in a manner that would apply to someone who was not significantly involved in CT and MR interpretation (eg, "black areas" or "white spots" on CT or "white areas" on MR). That is easily forgiven because the remainder of the book is so informative. Beautiful histopathology along with gross pathology specimens (all in sparkling color), along with a number of electron microscopy sections are abundant throughout. The publisher certainly did not skimp on the use of color, and such usage vividly makes the pathology points stick with the reader. A few examples will hopefully suffice to describe the value of this book, but this reviewer emphasizes the need for any potential buyer to actually look through the book to fully appreciate its astonishing visual impact.

In the chapter on astrocytic tumors, there is at first a description of astrocytes, normal, reactive, and tumoral, which lays the histologic ground works for what follows. Here the authors begin by stressing basic cellular considerations of astrocytes, from their embryologic beginnings to their mature forms. One reads about the common astrocytes (protoplasmic and fibrous) and the specialized astrocytes (tanocytes and Bergman glia), their function, their role in metabolism, and their staining characteristics. Following this basic information, the epidemiology, incidence, WHO classification, and genetic considerations of astrocytomas are followed by a discussion of each individual subtype of astrocytoma. For example, under pilocytic astrocytoma the incidence, clinical features, and radiology are described and illustrated. Here one sees all the histologic features of the typical pilocytic astrocytomas (the hairlike pilocytic processes, deposits of Rosenthal fibers, typical tumor vasculature) and the histologic differences in the variations of pilocytic astrocytomas (diffuse, anaplastic, pilomyxoid astrocytoma). It is important to note that the authors stress the differential diagnosis from a histopathologic point of view (including medulloblastoma, ependymoma, ganglioglioma, hemangioblastoma, and metastasis). Later in this chapter, when dealing with diffuse astrocytic tumors, the authors go through the differential diagnosis for non-neoplastic processes, which often masquerade as these tumor types. In particular, there are complete descriptions of that frequently encountered entity "reactive gliosis," along with acute multiple sclerosis, progressive multifocal leukoencephalopathy, infarction abscess, and radiation. Nearly all neuroradiologists have encountered situations in which a suspected tumor has turned out to be one of the above lesions. By reading this section, one learns the potential difficulties the pathologist may have in separating these lesions. As stated in the book, "A high percentage of major misdiagnoses detected in neuropathology consultation practices are non-neoplastic cerebral conditions that have been diagnosed as neuroepithelial tumors." There is of course a discussion of other neoplasms that enter into the differential diagnosis of diffuse astrocytomas. As an aside, the references are highly useful; for instance, instead of listing all 273 citations together, they are subdivided according to the specific topic within that chapter. This brief description of the chapter on astrocytic tumors serves to give the reader of this review an idea how all the subsequent chapters are written. The detailing of information on each tumor and tumor-like condition follow in general the pattern of presentation as described above for astrocytic tumors.

What specific parts of the book were found to be of most interest to this reviewer? The histopathology of certain lesions, for example, gliomatosis cerebri, subependymoma, dysembryoplastic neuroepithelial tumors, paragangliomas, dysplastic cerebellar gangliocytoma (Lhermitte-Duclos), tuberous sclerosis, malignant fibrous histiocytomas; differentiation of tumors by their immunocytochemistry features; meningiomas and their variants/mimickers such as meningioangiomatosis, hemangiopericytomas, and arachnoid hyperplasic (overlying a glial tumor fibrous tissue tumor); peripheral

nerve tumors with all the variants of Schwannomas and neurofibromas, such as nerve sheath myxonas, malignant peripheral nerve sheath tumors, granular cell tumors; the pathology of various primary cystic lesions such as enterogenous cysts, epidermoid cyst (the authors incidentally mistakenly call the hyperintense signal intensity on a T2-weighted image similar to fat when the fat in other areas of the scan are isointense), dermoid cyst, colloid cyst, neuroglial cysts, craniopharyngioma, perineural cysts, pineal cysts; tumor-like abnormalities such as heterotopias, hamartomas, lipomas, nasal glial heterotopia, and the various vascular malformations; and the inherited malformative syndromes such as tuberous sclerosis, neurofibromatosis 1/neurofibromatosis 2, von Hippel-Lindau, and Sturge-Weber.

In comparison with what many would consider the gold standard in this field, Russell and Rubinstein's *Pathology of Tumors of the Nervous System,* this text is vastly preferred. The widespread use of summary tables, the exquisite color reproductions on high-quality paper, the divisions of the chapters into well-defined subheadings, and the straightforward descriptive material elevate this book into the "must-have" category for any neuroradiologist. The next time you attend a major medical meeting, make it a point to visit publisher's row, seek out this book, and judge the quality of information yourself. You will be impressed. Of all the nonimaging textbooks on this reviewer's bookshelf, this volume, along with *Neurology in Clinical Practice,* is the most valued. It is recommended in the strongest terms.