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Book Review

Brain Edema XI

Edited by A.D. Mendelow, A. Baethmann, Z. Czernicki, J.T. Hoff, U. Ito, H.E. James, T. Kuroiwa, A. Marmarou, L.F. Marshall, and H.-J. Reulen. New York, NY: Springer-Verlag; 2000. Price, \$169.00, 572 pages.

This text represents the Proceedings of the 11th International Brain Oedema Symposium held in Newcastle Upon Tyne, England, in June 1999. It is a compilation of 117 short scientific papers and comprises Supplement 76 of the journal *Acta Neurochirurgica*.

The book provides an excellent summary of current research in the field of brain edema and an interesting look at the use of advanced imaging techniques and experimental therapies. This volume is divided into 11 sections: Imaging; Molecular Mechanisms; Cellular Mechanisms; Experimental Studies/Models; Experimental Ischaemia; Pharmacology/Therapy; Head Injury; Head Injury: Monitoring; Stroke, Subarachnoid and Intracerebral Hemorrhage; Thermal Effects; and Hydrocephalus. Most papers discuss research originating from the lab bench and animal studies, although some clinical research is included as well. Many of the papers focus on causes and prevention of secondary injury resulting from brain edema/inflammation. This secondary injury is caused by a number of factors, including disruption and death of endothelial cells comprising the blood-brain barrier, up-regulation of certain genes, cellular apoptosis, release of neurotransmitters, increased intracranial pressure, and hormonal changes. The figures are of journal quality, and many are in color. The writing is fine; however, because the papers were drawn from an international symposium, there are occasionally problems when English is not the authors' first language.

In the Introduction, the editors point out that brain edema is an important part of the pathophysiology of ischemia, trauma, and hemorrhage. They also note that brain edema is not just a marker or epiphenomenon of trauma and ischemia, but that it "plays an important role in the function, metabolism, regulation of blood flow and biology in relation to brain damage." The editors think that brain edema is still best described as "vasogenic" or "cytotoxic," classifications that were initially proposed during the first two symposia of 1965 and 1972. A review of the previous symposia discusses scientific trends and places the current research in historic perspective.

Most of the papers do not involve the use of imaging modalities, yet they provide insight into the pathophysiology of brain edema and secondary injury. It is impossible to summarize all the research and topics presented in this space; however, important topics include the effects of trauma/ischemia on human brain endothelial cells and up-regulation of specific genes, such as heat shock proteins, which are associated with cellular damage. Free radical formation is

also an important factor in damaging endothelial cells and causing edema, and some of the papers describe efforts to prevent free radical damage. One interesting paper describes the use of plant extracts, which are used in traditional Chinese medicine, in preventing free radical oxidative damage to cytoskeletal proteins. The importance of plasma and tissue mediators, such as bradykinin, is emphasized by the inclusion of numerous papers dealing with cellular receptors and their effects after injury or ischemia. Other papers address factors underlying cerebral vasospasm after trauma and subarachnoid hemorrhage. In addition, several clinical papers discuss outcomes after therapies, including surgical decompression of intracerebral hemorrhage and the use of hypothermia to ameliorate the effects of vasospasm.

In the Imaging section, four of the five papers discuss the use of MR spectroscopy, diffusion-weighted imaging with apparent diffusion coefficients, and perfusion CT in understanding the metabolic and histopathologic changes underlying brain edema associated with trauma. The fifth paper discusses the use of MR spectroscopy on biopsy specimens of the brain to determine the malignancy of brain tumors. Although these papers are interesting, this section is one of the shortest in the book (only 25 pages), and neuroradiologists might find themselves wishing more such papers had been included. Many of the other sections, however, contain some imaging research papers.

The next two sections discuss the molecular and cellular mechanisms underlying brain edema and possible therapies based on these mechanisms. The use of MR spectroscopy in determining absolute NAA concentrations for a rat model of head injury is included in this section. Another paper describes how diffusion-weighted imaging with apparent diffusion coefficient values can be used to monitor the effects of vasopressors in an animal model of traumatic brain injury. In the section on Experimental Studies/Models, two papers discuss MR imaging in animal research. The first paper discusses the use of arterial spin labeling to evaluate the effects of treatment on cerebral blood flow in a rat model of traumatic brain injury. The second describes the use of diffusion tensor imaging to differentiate between types of brain trauma and edema. In the section on Experimental Ischaemia, one paper explains a research group's MR imaging scoring system for stroke prognosis that is based on anatomic location and stroke volume. A second paper discusses MR imaging and diffusion-weighted imaging in a rat model of trauma, which showed an inverse relationship between water con-

tent and apparent diffusion coefficient values as severity of trauma increased. One study in Pharmacology/Therapy discusses the use of diffusion-weighted imaging in evaluating the size of ischemic territories and noted that infarct size did not increase during a 240-minute time period if the rat was treated with a cation channel inhibitor, preventing calcium influx. The section on Head Injury begins with a clinical paper discussing the use of diffusion-weighted imaging and xenon CT in determining that brain swelling after traumatic brain injury may be mostly cytotoxic edema, considering that apparent diffusion coefficient values in injured areas are decreased. Cerebral blood flow, however, is above critical levels, suggesting that factors other than ischemia are responsible for the restricted diffusion.

Although the clinical research is not specifically imaging based, the use of MR imaging and CT is prevalent throughout. In the section on head injury monitoring, the use of xenon CT showed that decreasing cerebral blood flow correlated with increasing levels of the excitatory amino acid glutamate and with increasing levels of lactate and potassium. The use of experimental transcranial Doppler devices in determining cerebral perfusion pressure in patients with head injury is also discussed, as is the correlation between transcranial Doppler sonography and xenon

CT. In Stroke, Subarachnoid and Intracerebral Hemorrhage, one paper describes how the measurement of cerebral blood flow with hexamethylpropylene amine oxime single photon emission CT showed that surgical evacuation of intracerebral hematoma improved blood flow in the surrounding tissue, possibly preventing ischemic damage. Single photon emission CT was also used to evaluate the use of hypothermic therapy in patients with vasospasm after subarachnoid hemorrhage.

By presenting a large spectrum of research, this book provides a summary of research concerning secondary injury resulting from ischemic, traumatic, and thermal brain injury. When comparing the basic science papers with the clinical research papers, it is clear that imaging will be necessary to bridge the gap between the lab bench and the clinics, and yet it is surprising how few of the basic science papers include the use of advanced imaging modalities. There is evidently a need for researchers interested in this work. This book would be a good start for anyone considering neuroradiology research, because this volume provides an overview of basic science research techniques involving the CNS and insight into imaging modalities and how they contribute to the understanding and treatment of secondary brain injury.