Thirty-Ninth Annual Meeting of the American Society of Neuroradiology

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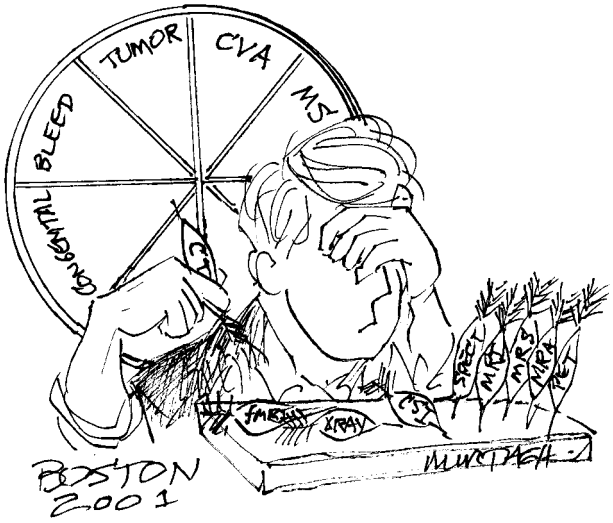
MEETING SUMMARY

Thirty-Ninth Annual Meeting of the American Society of Neuroradiology



The 39th annual meeting of the ASNR was held at the Hynes Convention Center in Boston from April 23 to April 27, 2001 under the direction of Bill Ball, President and Presiding Officer. On Saturday and Sunday preceding the annual meeting, the ASNR sponsored a symposium entitled ''Advances in Neuroimaging,'' which was organized by Bill Dillon, the program chairman and President-Elect of the ASNR. Both the annual meeting (1590 registrants) and the symposium (281 registrants) were well attended. A wide selection of educational sessions was available throughout the meeting including the increasingly popular Electronic Learning Center (ELC) chaired by Hervey Segall. The ELC featured interactive demonstrations of PowerPoint presentations, Photoshop, Web page and teaching-file creation, along with sessions related to digital cameras and voice dictation software. The standing-room-only situation at a number of these presentations attested to the need to feature the ELC as a vital part of every annual meeting. ''How-to'' sessions supported by industry leaders allowed registrants to become involved with systems and applications specific to particular vendors.

Each specialty society within the ASNR formulated its own scientific program within the confines of the overall ASNR program. As in prior years, sessions offered education in every area of neuroradiology. Strong clinical and science presentations were provided with both proffered papers and invited lectures by leaders in the fields of neuroradiology, neurologic surgery, neurology, radiation oncology, and disciplines in the basic sciences. Advanced imaging techniques, most notably in the areas of MR and CT perfusion imaging, diffusion-weighted MR imaging, spectroscopy, MR imaging–guided procedures, and brain mapping with functional MR, were strongly emphasized throughout the week. Importantly, most speakers presented the clinical applications of these techniques. Also, the diagnosis and management of stroke, brain tumors, carotid artery occlusive disease, and degenerative illness were prominent topics during the meeting. Attendees were privileged to hear talks by Nobel Prize winner Stanley Pruisner and Judah Folkman, both internationally known for their work in tumor angiogenesis and prion disease, respectively. Particularly popular were the hands-on workshops for interventional spinal procedures.

A major area of investigation and attention in neuroradiology continues to be imaging and treatment of stroke, and these were reflected in the meeting. CT angiography and CT perfusion imaging are increasingly popular techniques, particularly because the safety of a 150-mL bolus injection of Omnipaque was reported to be safe and effective in patients with acute stroke. As with MR techniques, attempts to determine salvageable brain by using a quantitative mismatch between CT volume and CT perfusion, which might have predictive value, were described. CT perfusion appears to be a promising technique in the examination of patients with acute infarction because it may provide the analysis to which we are accustomed with MR perfusion techniques (eg, relative mean transit time, or rMTT, and relative cerebral blood volume [rCBV] analysis). Also, it potentially can provide quantitative data, including rCBV data. Currently, the most advanced CT perfusion techniques are rele-

gated to research suites with the use of proprietary software. Along with the determination of probability curves for tissue survival, the use of MR techniques to refine the identification of thresholds for the infarct core, the penumbra that progresses to infarction, and the penumbra that remains viable were described. A basic science lecture about the nature of the penumbra served as a backdrop for the clinical papers presented about this issue. The ischemic penumbra (20–40% of normal cerebral blood flow [CBF]) was shown to be the zone below the threshold needed to support synaptic transmission but above the level at which cellular membrane failure occurs. Compensatory mechanisms in these ischemic areas include increased oxygen extraction and increased glucose metabolism. The use of transient time measurements as the sole MR means of evaluating perfusion was the focus of an ensuing discussion in one of the sessions about stroke; the belief that cerebral blood volumes (CBVs) and flow maps provide an accurate picture of the ischemia present was expressed. Regional CBF measurements were low in prospective infarct areas, but the threshold for irreversible cell damage could not be determined.

Presentations dealing with the apparent normalization of diffusion-weighted images in subacute infarctions indicated that renormalization of apparent diffusion coefficient (ADC) values during reperfusion do not indicate an improvement in the condition of the damaged neurons, but rather, they are associated with more severely shrunken and damaged neurons. The pseudonormalization of ADC maps typically occurs at about 1–2 wk after symptom onset and was believed to result from early reperfusion, with superimposition of vasogenic edema on cytotoxic damage. Despite the common belief that the signal intensity of infarcts on diffusion-weighted images is thought to return to normal by 2 wk after the event, this does not occur if quantitative methods are used for evaluation; signal intensity remained abnormal for as long as 33 d after infarction. A low percentage (3%) of abnormalities on diffusion-weighted images of stroke were found to be reversible, but these abnormalities occurred in relatively small ischemic lesions. Precautions were expressed in a number of presentations in which abnormalities mimicking stroke on diffusion-weighted images were shown; these abnormalities included diseases that cause myelin vacuolization or spongiform changes in the brain and are highly cellular or composed of turbid or viscous material. Because of the number of diseases other than stroke that cause increased signal intensity on diffusion-weighted images, the nonspecificity of this finding was emphasized. Concepts in diffusion imaging are undergoing relatively rapid evolution; for instance, diffusion-weighted imaging with very high b values, diffusion tensor imaging, and supertensor diffusion-weighted imaging was described.

Nicely interspersed with scientific papers were invited lectures that summarized the state of the art in stroke imaging with MR and CT perfusion imaging and with arterial spin labeling. Because of the desire to have an MR technique that is sensitive to the intracerebral hematoma and because patients with this condition often present with signs of a stroke, the value of a T2-weighted spin-echo echoplanar imaging with a b value of 0 was pointed out. In fact, this technique has greater sensitivity in depicting hematomas than that of routine T2-weighted gradient-echo imaging. Similarly, hemorrhagic transformation in an acute ischemic stroke was predicted by using ADC values at initial MR examination. The value of MR spectroscopy and MR perfusion imaging in evaluating patients with leukoariosis was shown; specifically, a decreased *N*-acetylaspartate (NAA)–creatine ratio in the centrum semiovale and hypoperfusion in areas of hyperintensity on T2-weighted images of the occipital periventricular region were noted.

With such advances in the imaging of stroke, the need to evaluate advances in stroke treatment arises. The issue of what constitutes the true therapeutic window was reflected in papers that described safe and successful intraarterial thrombolysis after usual 6-h window. Several investigators reported notable findings with the use of a variety of techniques in intraarterial thrombolysis for acute stroke. One group reported the use of IV Integrilin in conjunction with intraarterial recombinant tissue plasminogen activator (rtPA), which resulted in a high rate of vessel recanalization, while another group indicated improved patient outcome with intraarterial thrombolysis with rtPA.

Assessment of both the extracranial and intracranial vasculature with various MR techniques is now routine in stroke workup, and a number of papers and presentations addressed advances in MR angiography (MRA). High-resolution axial MRA of carotid plaques defined areas of associated inflammation with such detail that detection of the earliest changes in atherosclerotic disease is possible, and furthermore, if abnormal areas are detected, the effectiveness of treatment conceivably could be monitored. The basic cellular and biochemical underpinnings of the inflammatory changes that occur in the wall of the carotid showed how high-resolution MR examination and the basic science of vascular disease intersect. The clinical implementation of MRA to evaluate the carotid artery is evolving to time-resolved angiography, which may provide information similar to that available with digital subtraction angiography. This evolution is made possible by the innovative k-space sampling techniques that allow higher spatial resolution with shorter acquisition times. Concomitant with better methods of noninvasive evaluation of the carotid arteries is the need to successfully deal with substantial atherosclerotic narrowing; presentations in this area indicated the favorable outcome in high-risk patients who are treated with angioplasty and stent placement, particularly with embolic protection devices, compared with the outcomes of patients treated with carotid

endarterectomy. Percutaneous transluminal angioplasty (PTA), as a primary technique for achieving mechanical thrombolysis when patients are treated in the first 6 h after the onset of symptoms, provides an effective means with which to rapidly reopen arteries occluded by thrombus.

Intracranial aneurysms and vascular malformations of the spinal cord received a great deal of attention from both diagnostic and therapeutic standpoints. Work continues on optimizing CT angiography for the visualization of the circle of Willis and the region of the cavernous carotid, whereas investigations into the timing of contrast-enhanced MRA to improve visualization of the carotid arteries while minimizing or eliminating venous opacification continues. Interest related to new and more effective ways of treating aneurysms continues to increase. Techniques involving liquid agents, stents, bioactive materials for treatment, as well as imaging methods that provide superior visualization of aneurysms and their parent arteries, were described. In a large number of consecutively enrolled patients who underwent embolization with Guglielmi detachable coils (GDCs) (in one series of more than 1000 embolized aneurysms), immediate total occlusion was achieved in 90%, and 3 y later, 90% of small aneurysms remained occluded. The procedural morbidity and mortality rates were less than 2% and the posttreatment rebleeding rate was less than 1%. Importantly, the use of a combination of stent and coil placement was reported, expanding the number and types of aneurysms that may be treated with only endovascular techniques. Other modifications of coil placement were described; these included the use of a device that allows coil placement in wide-necked aneurysms, GDCs modified to enhance and accelerate the healing response that occurs after coil placement, stents and a liquid polymer (Onyx) to treat complex aneurysms, and collagen stent-grafts. These modifications indicate enhanced endovascular management of cerebrovascular disease in the near future. Relative to brain arteriovenous malformations (AVMs), a paper describing a 1-y experience with Onyx indicated that this material may be used to successfully treat AVMs.

Evaluation and treatment of brain neoplasms with new techniques and image-guided interventional procedures were the bases of a number of papers. Attempts to establish a positive correlation between CBV and enhancement patterns were unsuccessful; however, alterations in diffusion anisotropy distant to brain tumors were shown, and these might result from deformity of the brain caused by the tumor, spreading edema, tumor extension, or a combination of one or more of these factors. Diffusion imaging and the application of ADC mapping in brain tumors received attention; in immunocompetent patients with primary CNS lymphoma, pretreatment ADC values of primary CNS lymphoma were normal or decreased and in methotrexate-treated patients, the average ADC ratios increased. In some patients whose condition responded to therapy, ADC changes preceded or mirrored changes in tumor volume, as measured with MR techniques. Spectroscopy, which was used to separate varying degrees of malignancy of tumor, was performed by using a tumor index of choline and NAA and was successfully used to distinguish grade 2 gliomas from grade 3 gliomas. As expected, higher levels of choline were associated with malignant progression, and the presence of lipids in neuroepithelial tumors is a strong indicator of necrosis and is associated with a poor clinical prognosis. Research into disruption of the blood-brain barrier followed by antitumoral viral gene therapy revealed variability in the amounts of viral load delivered. Dr Folkman explained how endostatin, currently in phase 3 clinical trials, is more than 90% effective in blocking oncogenes that promote tumor angiogenesis and, therefore, tumor growth. He also elaborated on other defective blood-brain barriers in the evaluation of angiogenesis. Interestingly, areas of high-grade glioma showed zones of increased CBV that did not necessarily coincide with zones of highest choline-creatine ratios. Image guided–therapy of brain tumors, including new laser techniques for tumor ablation, was the topic of a number of papers. Importantly, physical setup of the surgical suite for MR imaging–guided interventions were described.

A number of important issues were addressed in the area of degenerative, metabolic, and demyelinating diseases of the brain. Both rCBV and relative CBF (rCBF) were reduced bilaterally in the temporal and parietal regions in patients with Alzheimer's disease, and these findings correlated well with those of hexamethylpropylene amine oxime, or HMPAO, SPECT imaging, giving hope that perfusion MR imaging may be used in the evaluation of early dementia.

In multiple sclerosis, acute lesions have local hypoperfusion and elevated choline and normal NAA levels. Compared with magnetization transfer ratios, fractional and isotrophic findings were more sensitive in the detection of abnormalities in the normal-appearing white matter in periplaque regions. Because of demyelination, mass lesions can mimic brain tumors at routine MR imaging. A number of papers were directed to newer techniques, such as perfusion MR imaging, which may be useful in distinguishing brain tumors and areas of tumefactive demyelination. Low rCBV and elevated choline levels at MR spectroscopy are typical of demyelination, while perfusion MR imaging may show characteristic venous structures along the margins of demyelinating lesions that are not seen in tumors. These structures, perpendicularly oriented to the lateral ventricle surface, coursed directly through the large demyelinating lesions, a finding not seen with a review of more than 700 perfusion images of various neoplasms. Also, diffusion tensor imaging was sensitive in the evaluation of multiple sclerosis lesions, because it showed abnormalities in normal-appearing perilesional white matter. Therefore, diffusion tensor imaging may be

better in quantifying lesion load than conventional MR imaging and techniques such as magnetization transfer imaging. Work continues on imaging and pathophysiologic mechanisms in hypertensive encephalopathy (HTE). Increased rCBF and rCBV in regions of signal intensity abnormality on T2-weighted images of HTE indicates that regional hyperperfusion and loss of autoregulation are integral in the pathogenesis of HTE. Prognostic information revealed by diffusion imaging in HTE demonstrated facilitated diffusion secondary to local vasogenic edema. Areas of signal intensity change on T2-weighted images of HTE with normal ADCs that progressed to infarction were, in reality, pseudonormalization of ADCs due to a combination of vasogenic edema and early cytotoxic edema caused by ischemia. It was also shown that abnormalities in HTE are more widespread than previously thought; areas included the frontal lobes, cerebellum, brain stem, and basal ganglia.

Burgeoning interest in interventional spinal procedures was reflected in the large registration of the hands-on spinal sessions and presentations about vertebroplasty. A major criticism of the proliferation of vertebroplasty has been that the literature is based on uncontrolled nonrandomized studies with small sample sizes. Although those performing vertebroplasty in patients with pain and osteoporotic compression fractures are impressed with the immediate and dramatic results, the placebo affect on symptomatic improvement has not been evaluated. Besides the use of vertebroplasty in osteoporotic compression fractures, the antitumoral effects of polymethylmethacrylate in which tumor burden remained stable over time in those levels treated with vertebroplasty was illustrated; it was believed that this effect may have been related to the exothermic thermal necrosis of tumor and that this effect potentially extends the usefulness of vertebroplasties. Future technical improvements in vertebroplasty include new cements with decreased toxicity, materials that are ready to use and that set rapidly, and mechanical guidance systems. The imaging correlates of other causes of back pain, as in degenerative disk disease and spinal instability, were reported. Specifically, measurement of lumbar spine axial rotation was found to vary between healthy control subjects and patients with degenerated intervertebral disks. The greatest rotation was present in patients with back pain and disk degeneration; this finding may be valuable in quantifying spine instability.

Because spinal vascular malformations often are insidious in their presentation, subtle in their imaging abnormalities, and controversial in their clinical management, sessions about vascular lesions of the spine drew considerable attention. The metameric organization of the vascular nidus, which can assist in establishing an accurate diagnosis, was emphasized. The utility of contrast-enhanced MRA in the diagnosis of spinal dural arteriovenous fistulas (SDAVFs) was stressed, and subsequent management of spinal dural arteriovenous malformations (AVMs) was shown to rely on the obliteration of the intradural vascular nidus. While debate about whether dural AVMs should be treated with surgery or neurointerventional techniques continues, it appears that, in the hands of an experienced neurosurgeon, a surgical approach allows relatively easy isolation of the nidus without the risk of distal venous occlusion. Concerning the imaging of spinal malformations, the anterior spinal artery and the artery of Adamkiewcz were demonstrated by using multidetector CT, and detection of abnormal vessels, and particularly the nidus of a SDAVF, may be possible with this CT technique.

The pediatric sessions combined pertinent focus sessions with the presentation of papers about a wide array of common and not so common CNS diseases in children. In the presentations about profound asphyxia in neonates, hypoxic ischemic injury, gestational age, ability of the neonate to initiate compensatory neuroprotective mechanisms, and the characteristics of the insult itself (eg, severity and duration) were discussed. The importance of acquiring normative MR spectroscopic data from different regions of the brain at different stages of maturation was addressed because metabolite concentrations were shown to vary according to patient age and brain region. New MR spectroscopic techniques are being applied in the evaluation of various pediatric diseases, including pediatric brain tumors, by using single-voxel spectroscopy and MR spectroscopic imaging. A new X-linked creatine transporter defect was evidence by decreased levels of creatine. The use of elevated lipid and/or lactate levels in localizing epileptic foci in children with hippocampal seizures was presented. Magnetic source imaging was also helpful in identifying epileptogenic lesions. More important, when a lesion is not visible at conventional MR imaging, the abnormalities identified with this technique correlated well with the epileptic region detected with electroencephalography. As more pediatric patients undergo seizure surgery, identification of the eloquent areas of the brain becomes increasingly important. In this regard, functional MR imaging was shown to be useful in localizing language centers before surgery; however, the testing paradigms must be accurately constructed.

Many scientific papers dealt with cerebrovascular abnormalities in children. Findings from a large series of children with vein of Galen aneurysmal malformations demonstrated that factors such as birth weight, prematurity, and quality of intracranial venous development could affect the prognosis in these children. Transcranial Doppler (TCD) imaging in siblings of patients with sickle cell disease (SSD) revealed that a high concordance of elevated TCD velocities in siblings exists; this finding suggests a familial predisposition to cerebral vasculopathy. A multiinstitutional cooperative study of patients with SSD showed that, unlike clinically silent infarcts, cerebral atrophy does not appear to have the same poor neuropsychological implications in SSD. Phase-contrast MRA measurement of CBF showed

the ability of this technique to document higher regional and total CBF in children with SSD.

Pediatric neuro-oncology sessions dealt with the advantages of intraoperative MR imaging, MR spectroscopy, and cerebral oxygenation mapping in determining areas of recurrent tumor. As in adult brain tumors, low-grade tumors in children demonstrate high levels of *myo*-inositol at short-TE MR spectroscopy. Newer methods and the future potential of treating pediatric brain tumors were presented; these included proton-beam therapy, which, compared with other methods, leads to better results with less detrimental sequelae. Targeted drug therapy, including antiangiogenic drug therapy, gene therapy, and local delivery of chemotherapy by means of infusion or wafers, was discussed. In addition, toxins that may be bound to carrier molecules that can be used to identify antigenic factors on only the surface of tumor cells may have a role in tumor treatment effects.

The application of newer MR techniques to the investigation of functional disorders in children included presentations about the attention deficit hyperactivity disorder in which routine imaging revealed no abnormalities, but MR spectroscopic findings suggested metabolic derangements in the right frontal lobe, specifically decreased creatine and elevated glutamate-glutamine levels. Spectroscopy also was used to investigate the difference between cortical tubers and polymicrogyria in which reduction of NAA in cortical tubers probably is due to the presence of immature neuroglial elements, whereas the normal level of NAA in polymicrogyria implies the presence of mature neurons.

In the head and neck section of the meeting, considerable attention was directed to the diagnosis and staging of nodal disease in the neck, functional endoscopic sinus surgery, nasopharyngeal carcinoma, and hearing loss. Concerning nodal imaging, sessions addressed CT and MR imaging criteria for diagnosing adenopathy, patterns of drainage from primary disease sites, PET scanning in nodal abnormalities, and clinical correlations with these imaging findings. Physiologic and/or anatomic correlates on 18F-fluorodeoxyglucose, or FDG, PET demonstrated uptake in a variety of normal tissues, including the lymphatic tissue, muscles of mastication, salivary glands, and the mucosa of the palate and nasopharynx. Functional endoscopic sinus surgery failure, as seen on pre- and postsurgical sinus CT scans, served as a reminder of the anatomic variants that may result in treatment complications. Methods to induce adoptive immunotherapy with ex vivo expanded T cell populations and an update on modern 3D intensity-modulated radiation therapy were topics in the treatment of nasopharyngeaal carcinoma. Sessions about temporal bone imaging included information on high-resolution imaging in which a 3D steady-state free precession, or SSFP, sequence was used; with this sequence, data from the refocused echo and the free-induction decay is acquired. A large flip angle resulted in heavily T2-weighted imaging, which provided high contrast between tissue and fluid. This technique is not prone to the susceptibility artifacts seen with constructive interference in the steady state, or CISS, and gradient acquisitions in the steady state, or GRASS, acquisitions. Improvement in imaging of oral cavity abnormalities was described; the technique involved the simple maneuver of having the patient blow out his or her cheeks during CT scanning or the instillation of 60 mL of water or Gastrografin just prior to scanning. These techniques improved the CT display of the anatomy and pathology of the oral cavity and particularly improved the conspicuity of lesions obscured by the tongue opposing mucosal surfaces. In oropharyngeal squamous cell carcinoma, CT findings obtained approximately 6 wk after radiation therapy were reported as predictors for control of the tumor at the primary site. Also reported was the use of CT results obtained after radiation therapy to plan neck dissection in patients with metastatic disease from squamous cell carcinoma.

The worldwide perspective regarding neurologic disease and training in neuroradiology is increasingly recognized. With that in mind, a special session was focused on the international perspectives on training, practice, and research. Professor Takahashi reviewed the history of the Japanese Society of Neuroradiology (which, incidentally, is 2 y older than the ASNR), described the pioneers of neuroradiology in Japan, and spoke of the practice of neuroradiology there. Neurosurgeons routinely perform interventional neuroradiology procedures, and a large number of neurosurgeons participate in the Japanese Society of Neuroradiology. In a provocative and at times philosophical presentation, Professor Lasjaunias urged the audience not to confuse standards with quality of care. Both Professor Salvolini and Dr Matthews discussed research training opportunities and the need for radiology research both abroad and in North America. The need for keeping young investigators in radiology was discussed, and the point that both our research and training programs should provide people with in-depth knowledge, not simply preparation for jobs, was stressed.

The members of the Society look forward to the 2002 ASNR meeting, which will be held May 11 through May 17, in the invigorating city of Vancouver, British Columbia, Canada.

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