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The WCC Note™

Presented by Stephen J. Pomeranz, M.D.

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MRI BRAIN

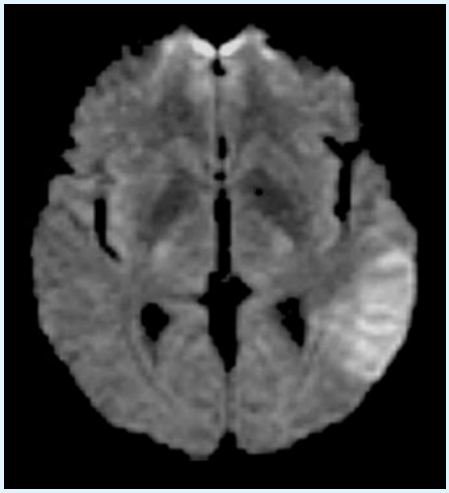
## MRI Useful as Marker of Response to Treatment for Cerebral Small Vessel Disease

Vascular dementia is a common condition, most often caused by cerebral small vessel disease. Researchers from the University of London in the United Kingdom studied the MRI findings in such patients, then correlated them with the patients' clinical executive function. Neuropsychological testing, along with MRI, including diffusion tensor imaging (DTI), were performed on 35 patients with small vessel disease of the brain, and performed again after one year on 27 of these patients. The researchers found that patients' executive function correlated strongly with their brain volume and fractional anisotropy. At one-year follow-up, parameters on DTI such as mean diffusivity and fractional anisotropy showed detectable change.[1] **Conclusion: Patient executive function correlates with MRI findings in cerebral small vessel disease. "This supports the use of MRI, in particular diffusion tensor imaging," as a surrogate marker in treatment trials, the authors concluded.**

## WHAT IS DIFFUSION IMAGING?

### Diffusion-weighted imaging (DWI)

- DWI is a type of MRI, most often used in neuro-imaging, that measures the movement, or diffusion, of extracellular water molecules. Diffusion is restricted in areas of damage from such causes as trauma, stroke, or some tumors.
- What does restricted diffusion look like?
  - On a diffusion-weighted image, it looks bright.
  - On an **apparent diffusion coefficient (ADC)** map – a so-called "map of velocities" – it looks dark (the ADC is decreased). ADC is a quantitative measure of the extracellular water molecules in a particular voxel.
- Common uses of DWI include:
  - Detection of early stroke in the brain
  - Differentiation of benign from malignant tumors in many organs, including the brain, thyroid gland, and abdomen
  - Differentiation of active from dormant plaques in multiple sclerosis



*Diffusion-weighted image taken three hours after a stroke shows an acute lesion as a region of hyperintensity (brightness) in the left temporal lobe (arrow).*

### Diffusion tensor imaging (DTI)

- DTI is a type of diffusion-weighted imaging that detects white-matter tracts in the brain by finding the water molecules within them that diffuse only in the direction of the tract.
  - **Anisotropy** is a directionally dependent flow or orientation; water molecules typically flow anisotropi-

cally, or in one direction, along normal white-matter tracts.

– **Isotropy** is a homogeneous or random flow/orientation in all directions; the flow of water molecules in a damaged white-matter tract is isotropic.

- Common uses of DTI include:
  - Specific localization of white-matter lesions, such as trauma, infarcts, or demyelnization, localized to a specific white-matter tract
  - Determination of tumor involvement of white-matter tracts
  - Determination of tumor relationship to white-matter tracts for surgical planning

MRI CANCER

## EPRI with MRI May Determine Tumors' Potential Response to Treatment

In a study from the National Cancer Institute from Bethesda, Maryland, researchers evaluated a new technique called pulsed **electron paramagnetic resonance imaging (EPRI)**, which can provide quantitative maps of oxygen concentrations in tissues. By combining EPRI with MRI, anatomic oxygen maps were successfully created. On their study of tumors in mice, they found that, even in regions with significant blood flow, some areas of hypoxia exist. This is important in treatment planning, because tumors with lower levels of oxygen tend to be more resistant to both radiation and chemotherapy.[2, 3] **Conclusion: EPRI with MRI can make anatomic maps of oxygen levels in tumors, to help determine their potential responsiveness to radiation and chemotherapy.**

**SOURCES:**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2. Matsumoto S, Hyodo F, Subramanian S, *et al*. "Low-Field Paramagnetic Resonance Imaging of Tumor Oxygenation and Glycolytic Activity in Mice." *Journal of Clinical Investigation*, published online April 22, 2008.
3. http://www.healthday.com/Article.asp?AID=614770, accessed online May 1, 2008.


**NEXT ISSUE: MORE NEWS AND TRENDS IN CLINICAL TRIAL IMAGING**


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