Medical Xpress

Personalized brain mapping technique preserves function following brain tumor surgery

April 1 2013

Neurosurgeons can visualize important pathways in the brain using an imaging technique called diffusion tensor imaging (DTI), to better adapt brain tumor surgeries and preserve language, visual and motor function while removing cancerous tissue. In the latest issue of *Neurosurgical Focus*, researchers from the Perelman School of Medicine at the University of Pennsylvania review research showing that this ability to visualize relevant white matter tracts during glioma resection surgeries can improve accuracy and, in some groups, significantly extend survival (median survival of 21.2 months) compared to cases where DTI was not used (median survival of 14 months).

"We can view the brain from the inside out now, with 3D images detailing connectivity within the brain, making a virtual intraoperative map," said senior author Steven Brem, MD, professor of Neurosurgery, chief of the Division of Neurosurgical Oncology and co-director of the Penn Brain Tumor Center. "Penn is at the forefront of a major shift in the field - we now have such detail about each individual's brain tumor - combining diffusion tensor imaging and advanced imaging with the entire personalized diagnostics analysis available for all brain tumor patients at Penn Medicine."

Diffusion tensor imaging (DTI) provides a rendering of axon pathways, by tracking water molecules in the brain as they travel in a direction parallel to axonal fibers, in a 3D model known as "the diffusion tensor."

The diffusion tensor directly represents the direction of water and indirectly represents the orientation of white matter fibers. The colorful images, captured as part of an 8 minute sequence during an MRI, show representations of clusters of axon fibers, where each color indicates a direction of travel, and offer a glimpse of the interwoven communication superhighways of the brain.

"The DTI images can be overlaid with structural and functional MRI images, providing a hybrid map showing topography layered with a road map," said Neurosurgery resident Kalil Abdullah, MD, lead author of the paper. "This rendering gives us increased clarity to visualize important white matter tracts in the brain and adapt our surgical approaches to each person's case. Rather than focusing on solely taking the tumor out, we can avoid damage to healthy tissue and preserve important pathways responsible for speech, vision and motor function. "

Relying heavily on the expertise of radiologists who process and analyze the DTI images, including Ronald L. Wolf, MD, PhD, associate professor of Radiology at Penn, the research on DTI is being translated into clinical practice to guide surgical procedures. Further research efforts are targeted at defining language deficits before surgery and following-up post-operatively to determine any changes or improvements following treatment based on the use of DTI.

Working collaboratively with colleagues in Penn's departments of Neurosurgery, Neurology, Radiology, Radiation Oncology, Nursing, Pathology and Laboratory Medicine and the Abramson Cancer Center, the Penn Brain Tumor Center combines the latest imaging, biomarker and genetic tumor testing to provide a personalized treatment plan for all types of brain cancers. Brain tumors are among the first areas of interest for Penn's Center for Personalized Diagnostics (CPD), a joint initiative by Penn Medicine's Department of Pathology and Laboratory Medicine and the Abramson Cancer Center, which integrates Molecular Genetics,

Pathology Informatics, and Genomic Pathology for individualized patient diagnoses and to elucidate cancer treatment options for physicians.

Provided by University of Pennsylvania School of Medicine