HDFT latest game-changer in neurosurgical field

The history of the Department of Neurological Surgery at the University of Pittsburgh has been highlighted by the developper-ment and implementation of important advances in neurosurgery that have altered the manner in which neurological care is delivered. Initially, these changes were viewed with pharmacological and, at times, have taken decades to be widely accepted into neurosurgical practice. Implementation of these novel approaches has ultimately resulted in paradigm shifts for mainstream neurosurgery.

The most notable examples of such transforming technical advances include microvascular decompression for trigeminal neuralgia, hemispheric spasm and other neurovascular compressive pathologies, skull base surgery for complex skull base pathologies, neurosurgery for vascular malformations, tumors and functional disorders; and finally endoscopic endonasal surgery for anterior skull base lesions.

Each one of these advances, in their own way, revitalized the care of neurosurgical patients. These approaches provided options to patients who, either had no options, or significantly reduced the overall morbidity and mortality for the treatment of their specific diseases. We are extremely proud of the remarkable impact these advances have made in our field.

A new game-changer in the care and management of neurosurgical patients is the application of High Definition Fiber Tracking (HDFT). As described in this issue of our newsletter, the broad application of HDFT for surgical planning, intraoperative management and for prognosticating head trauma is far reaching. As neurosurgeons, having the ability to see what we have never been able to see (i.e. the actual connections within the brain), provides opportunities that we previously could only have imagined. The potential of HDFT is boundless and is now changing the practice of neurosurgery as Pittsburgh. I look forward to its broad implementation in the years to come.

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Using high resolution white matter mapping to detect traumatic brain injury

There are an approximately 1.7 million cases of traumatic brain injury (TBI) each year in the U.S. and current medical imaging (CT, MRI, DTI) rarely (5-30%) visualize or detects damage caused by most TBI. Even in cases with visible lesions (e.g., persistent coma) current imaging techniques do not provide information about the specific degree and location of axonal damage. The team at the University of Pittsburgh Medical Center developed a novel imaging modality, High Definition Fiber Tracking (HDFT), based on diffusion imaging principles. HDFT is a non-invasive imaging technique that has the potential to detect traumatic brain injury that has not been demonstrated by conventional imaging techniques. The details of white matter damage identified by HDFT may be useful for prognostic purposes and aid in rehabilitation strategies customized for each patient in the future.

Current techniques of imaging TBI mainly involve CT and MRI. While CT can only detect hemorrhage or encephalomalacia, MRI has shown some promise through diffusion imaging methods, which are sensitive to underlying white matter integrity. A diffusion imaging modality known as diffusion tensor imaging (DTI) has gained significant interest for its potential utility for TBI imaging in the last decade. However, DTI still lacks the fine resolution for distinguishing white matter tracts and is prone to false representation of the tract anatomy. HDFT for TBI cases in the near future as the imaging quality of HDFT is further refined.

These test findings suggest that HDFT may one day provide a definitive imaging modality for TBI. This will also become important in the future as various therapeutic options for TBI will become available, and optimal management of TBI will be tailored to the patient’s unique neuroanatomy.

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