NICoE
National Intrepid Center of Excellence

Neuroimaging at the NICoE

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A part of the NICoE's Research Directorate, the Neuroimaging Research Core seeks to identify and characterize the neurological attributes of comorbid traumatic brain injury and psychological health conditions. With six complementary imaging machines located in the same hallway, NICoE has the ability to use each machine's temporal resolution, spatial resolution and biological specificity capabilities to investigate complex questions related to TBI and PH comorbidity.

Investigating the Science

The brain is a resilient organ and, with therapy, is often able to rearrange its circuits to accomplish a task. To evaluate the brain's performance and anatomical circuitry, researchers conduct detailed examinations of the brain's anatomy and ask subjects to perform various tests to capture functional brain activity.

Partnering with organizations such as Walter Reed National Military Medical Center and the Uniformed Services University of the Health Sciences, the Neuroimaging Research Core has been able to develop one of the largest databases of TBI images in the world. While clinical benchmarks are being established, NICoE researchers continue to work on characterizing the disease state and developing the tools and software needed to detect and display characteristics of comorbid TBI and PH conditions.

Service Member Participation

NICoE patients are recruited to participate in neuroimaging research within their first two weeks of the NICoE program. Approximately 90% of the NICoE patient population chooses to participate in neuroimaging research with MRI and PET being the most popular imaging techniques. Since its opening in October 2010, more than 225 research subjects have been imaged at the NICoE.

Neuroimaging Tools

Magnetic resonance imaging (MRI): Aligning its magnetic field with the resonance frequency of substances naturally occurring in the body (e.g. water), the MRI provides slices of cross-sectional anatomic images to create a three-dimensional image. The MRI scanner provides the best spatial resolution to aid in visualizing detailed anatomic structures.

Positron emission tomography (PET): With the help of radioisotope tracers, the PET scanner provides images of biological function by tracking enzyme-specific processes throughout the body. At the NICoE, researchers use these capabilities to follow the production, usage and clearance of brain chemicals to understand the processes of diseases that may be related to TBI and PH conditions.

Computed tomography (CT): The CT scanner rotates around the subject using advanced X-rays to generate cross-sectional anatomical images. When stacked on top of each other, the images form a three-dimensional representation of the body. CT excels at detecting bone fissures and shrapnel.

Magnetoencephalography (MEG): The MEG measures magnetic signals due to nerve conduction in the brain. As subjects perform various functional tests, the MEG images the brain's changing electrical signals, producing a map of brain function or "thoughts" over time. The MEG scanner offers the best temporal resolution of any imaging tool in the NICoE's neuroimaging suite.

Electroencephalography (EEG): Using an array of sensitive electrodes placed on the scalp, the EEG measures the electrical activity of the brain. In service members with comorbid TBI and PH conditions, this helps researchers understand the functional rewiring of the brain necessary to accomplish a given task. The EEG has similar temporal resolution as the MEG, but the technology is more widely available.

X-Ray: The most familiar imaging tool, the X-Ray machine uses electromagnetic radiation to image bone, examine disease processes in soft tissue and detect obstructions such as shrapnel.