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Virtual Biopsy May Allow Earlier Diagnosis of Brain Disorder in Athletes

In a study of ex-pro athletes, researchers found that a specialized imaging technique called Magnetic Resonance Spectroscopy (MRS) may help diagnose Chronic Traumatic Encephalopathy (CTE), a disorder caused by repetitive head trauma that currently can only be definitively diagnosed at autopsy. Results of the study were presented at the annual meeting of the Radiological Society of North America (RSNA).

"The devastating effects of brain injuries suffered by pro football players who repeatedly suffered concussions and subconcussive brain trauma during their careers have put the spotlight on CTE," said Alexander P. Lin, Ph.D., a Principal Investigator at the Center for Clinical Spectroscopy at Brigham and Women's Hospital in Boston. "However, blows to the head suffered by all athletes involved in contact sports are of increasing concern."

According to the Centers for Disease Control and Prevention, an estimated 3.8 million sports- and recreation-related concussions occur in the U.S. each year. In addition, subclinical concussions -- injuries that cannot be diagnosed as concussions but have similar effects -- are often unrecognized.

Studies have shown that individuals who suffer repetitive brain trauma are more likely to experience ongoing problems, from permanent brain damage to long-term disability.

CTE is a degenerative brain disease caused by repeated brain trauma and marked by a buildup of abnormal proteins in the brain. CTE has been associated with memory difficulty, impulsive and erratic behavior, depression and eventually, dementia.

"Cumulative head trauma invokes changes in the brain, which over time can result in a progressive decline in memory and executive functioning in some individuals," Dr. Lin said. "MRS may provide us with noninvasive, early detection of CTE before further damage occurs, thus allowing for early intervention."

In Dr. Lin's study, conducted in collaboration with the Boston University Center for the Study of Traumatic Encephalopathy (CSTE), five retired professional male athletes from football, wrestling and boxing with suspected CTE and five age- and size-matched controls between the

ages of 32 and 55 were examined with MRS. In MRS, sometimes referred to as "virtual biopsy," a powerful magnetic field and radio waves are used to extract information about chemical compounds within the body using a clinical MR scanner.

The results revealed that compared with the brains of the control patients, the brains of the former athletes with suspected CTE had increased levels of choline, a cell membrane nutrient that signals the presence of damaged tissue, and glutamate/glutamine, or Glx. MRS also revealed altered levels of Gamma-aminobutyric Acid (GABA), aspartate, and glutamate in the brains of former athletes.

"By helping us identify the neurochemicals that may play a role in CTE, this study has contributed to our understanding of the pathophysiology of the disorder," Dr. Lin said.

For example, the amino acid and neurotransmitter glutamate is involved in most aspects of normal brain function and must be present in the right places and at the right concentration in order for the brain to be healthy -- too much or too little can be harmful.

"Being able to diagnose CTE could help athletes of all ages and levels, as well as war veterans who suffer mild brain injuries, many of which go undetected," Dr. Lin said.

Results of CSTE neuropathological studies of retired football players and other athletes have led to significant changes in the NFL, as well as collegiate and youth sports. Recently, the researchers found evidence of CTE in 21-year-old Owen Thomas, the University of Pennsylvania football captain who committed suicide in April 2010.

Coauthors are Saadallah Ramadan, Ph.D., Hayden Box, B.S., Peter Stanwell, Ph.D., and Robert Stern, Ph.D. Dr. Lin's research team is led by Carolyn Mountford, D.Phil. Other collaborators include Ann McKee, M.D., Robert Cantu, M.D., and Christopher Nowinski.