MedicalXpress

Single traumatic brain injury may prompt long-term neurodegeneration

July 18 2011

Years after a single traumatic brain injury (TBI), survivors still show changes in their brains. In a new study, researchers from the Perelman School of Medicine at the University of Pennsylvania suggest that Alzheimer's disease-like neurodegeneration may be initiated or accelerated following a single traumatic brain injury, even in young adults.

Over 1.7 million Americans suffer a traumatic brain injury each year, and beyond the immediate effects, growing evidence demonstrates that a single TBI may initiate long-term processes that further damage the brain. TBI is an established risk factor for later development of cognitive impairments, such as Alzheimer's disease.

"A single traumatic brain injury is very serious, both initially, and as we're now learning, even later in life," said Douglas Smith, MD, professor of Neurosurgery and director of the Center for Brain Injury and Repair at Penn's Perelman School of Medicine, the study's co-senior author. "Plaques and tangles are appearing abnormally early in life, apparently initiated or accelerated by a single TBI."

The study appears online in *Brain Pathology*, and was done in conjunction with neuropathologist Dr. William Stewart, from the University of Glasgow and Southern General Hospital in Glasgow, UK.

The researchers found both tau tangles and amyloid-beta plaques in survivors, years after a single moderate-to-severe TBI. In repetitive head

injury, previous studies have shown a tau accumulation as the signature pathology of a condition called chronic traumatic encephalopathy. In studies of people less than 4 weeks after dying from a single TBI, no similar tau pathology was found. In addition, while widespread amyloid-beta plaques have been found in about 30 percent of people shortly after injury, previous work showed that plaques disappeared within months.

In this study, researchers examined post-mortem brains from 39 long-term survivors of a single TBI, extending the survival time from 1-47 years survival after TBI, and compared them to uninjured, age-matched controls.

TBI survivors showed a high density and wide distribution of neurofibrillary tau tangles and amyloid-beta plaque pathology far beyond what was found in controls. Specifically, about a third of the cases showed tangle pathology years after a single TBI, similar in appearance to the tangles found after repetitive TBI and in neurodegenerative diseases such as Alzheimer's disease. Moreover, the amyloid-beta plaques were not only found years after TBI, but the majority of cases displayed diffuse as well as "neuritic" plaques with the same character as "senile" plaques also found in Alzheimer's disease. This suggests that years after a single TBI, amyloid-beta plaques may return and become neuritic.

The present findings, showing that two hallmark pathologies of Alzheimer's disease can be found years after a single TBI, may provide a pathological link with the epidemiological observation of an increased risk of developing Alzheimer's disease. Moreover, future research to better understand this long-term neurodegenerative process after a single TBI may reveal important targets for treatment with emerging anti-tau and anti-amyloid therapies.