MAPPING ABNORMAL BRAIN STRUCTURE ASSOCIATED WITH METHAMPHETAMINE ABUSE

K.M. Hayashi[1*]; P.M. Thompson[1]; S.L. Simon[2]; J.A. Geaga[1]; M.S. Hong[1]; Y. Sui[1]; J.Y. Lee[1]; A.W. Toga[1]; W. Ling[3]; E.D. London[2,3,4]

1. Neurology, 2. Psychiatry, 3. Molec Med Pharm, 4. Brain Res Inst, UCLA School of Medicine, Los Angeles, CA, USA

MRI, DRUG, HIPPOCAMPUS, ADDICTION

We visualize, for the first time, the profile of structural deficits in the human brain associated with chronic methamphetamine (MA) abuse. Studies of human subjects who have used methamphetamine (MA) chronically have revealed deficits in dopaminergic and serotonergic systems and cerebral metabolic abnormalities. Using MRI scanning and new computational brain mapping techniques, we determined the pattern of structural brain alterations associated with chronic MA abuse in human subjects, and related these deficits to cognitive impairment. We used high-resolution MRI and surface-based, computational image analyses to map regional abnormalities in the cortex, hippocampus, white matter and ventricles, in 22 human subjects who used MA and 21 age-matched, healthy controls. Cortical maps revealed severe gray matter deficits in the cingulate, limbic, and paralimbic cortices of MA abusers (averaging 11.3% below control, $p<0.05$). On average, MA abusers had 7.8% smaller hippocampal volumes than control subjects ($p<0.01$; left: $p=0.01$, right: $p<0.05$), and significant white matter hypertrophy (7.0%; $p<0.01$). Hippocampal deficits were mapped and correlated with memory performance on a Word Recall Test ($p<0.05$). MRI-based maps suggest that chronic methamphetamine abuse causes a selective pattern of cerebral deterioration that contributes to impaired memory performance. MA may selectively damage the medial temporal lobe and, consistent with metabolic studies, the cingulate/limbic cortex, inducing neuroadaptation, neuropil reduction, and/or cell death. Prominent white matter hypertrophy may result from altered myelination and adaptive glial changes, including gliosis secondary to neuronal damage. These brain substrates may help account for the symptoms of MA abuse, providing therapeutic targets for drug-induced brain injury.

Support Contributed By: DA50038, EB01651