Chronic Cigarette Smoking Modulates Injury and Short-Term Recovery of the Medial Temporal Lobe in Alcoholics.

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Introduction: Memory function is largely mediated by medial temporal lobe (MTL) structures, including the hippocampus. MTL structures are compromised in both alcohol dependence [1] and chronic cigarette smoking [2], and MR studies in abstinent alcohol dependent individuals demonstrated volume reductions in hippocampi [3], consistent with volumetric abnormalities reported in other brain regions. Previous 1H MRS studies of alcoholics reported lower concentrations of N-acetyl-aspartate (NAA) and choline-containing compounds (Cho) in various brain regions, but the MTL has not been reported on. Furthermore, the majority of alcoholics smoke regularly and cigarette smoking has been shown to be associated with smaller brain volumes and altered brain metabolites in both non-alcoholic- and alcoholic populations [4,5]. Smoking was also associated with less metabolite recovery over the first month of sobriety in abstinent alcoholics [6]. To date, the effects of heavy alcohol consumption and chronic smoking on hippocampal volumes and MTL metabolites, as well as their recovery during abstinence from alcohol, have not been reported. We hypothesized that smoking in alcohol dependent individuals is associated with more hippocampal and MTL injury than non-smoking and with slower recovery during abstinence from alcohol. In exploratory analyses, we correlated our MR measures and their changes with visuospatial learning and memory.

Methods: On a 1.5T MR system, we studied male alcoholics in treatment (ALC) [13 smokers (sALC) and 11 non-smokers (nsALC)], at one week and again at one month of abstinence from alcohol and 14 age-matched, non-smoking light-drinkers (nsLD). Hippocampi were outlined using a semi-automated high dimensional brain warping algorithm [7] on 3D T_1-weighted MPRAGE images acquired with TR/TE/TI=10/7/300 ms, 15^0 flip angle, 1x1mm^2 in-plane resolution, and 1.5-mm-thick slices. A ^{1}H MRSI dataset was acquired with TR/TE=1800/25 ms with PRESS pre-selection of a 100x60x15 mm^3 VOI. Visuospatial learning and memory were assessed in ALC at both scan occasions.

Results: At one week of abstinence from alcohol, hippocampal volumes in sALC were 8% smaller than in nsALC ($p=0.05$) and tended to be 7% smaller than in nsLD ($p=0.08$). There were no significant volume differences between nsALC and nsLD. Compared to nsLD, MTL NAA was 10% lower in sALC ($p=0.02$) and 13% lower in nsALC ($p=0.008$). MTL Cho in both nsALC and sALC was 12% lower than in nsLD ($p<0.02$). Neither NAA nor Cho concentrations were significantly different between sALC and nsALC. At one month of abstinence, NAA and Cho in sALC were 12% ($p=0.02$) and 14% ($p=0.007$) lower than in nsLD, whereas NAA and Cho in nsALC and hippocampal volumes in sALC were not different from nsLD. Hippocampal volumes in both sALC and nsALC were not different from nsLD, but they remained 8% smaller in sALC than in nsALC ($p=0.05$). Longitudinal metabolite concentration changes in both groups were associated with improvements in visuospatial memory ($rho>0.40$, $p<0.025$) but increasing hippocampal volumes correlated with visuospatial memory improvements only in nsALC ($rho=0.60$, $p=0.03$).

Discussion: This is the first study reporting hippocampal volume and MTL metabolite injury in alcohol dependence and during abstinence from alcohol as a function of cigarette smoking. sALC showed greater hippocampal volume reductions than nsALC and similar MTL metabolite injury. It further describes the effects of smoking on their recoveries over the first month of abstinence. These data provide additional evidence that cigarette smoking exacerbates alcohol induced brain injury and arrests brain recovery during short-term abstinence from alcohol. Our MR measures from the MTL appear functionally significant, as they are associated with improvements of cognitive performance.

References:

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