Changes in alcohol consumption post-trauma are significantly associated with reward—related brain activation


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Background

• Posttraumatic stress disorder (PTSD) and problematic alcohol use frequently co-occur, and the neural factors that contribute to the development of problematic alcohol use after acute trauma exposure are unknown.

• Using a multi-site longitudinal study design, we explored whether the change in alcohol consumption pre-trauma to 8 weeks post-trauma was associated with reward-related brain reactivity and functional connectivity (FC) measures gathered 2-8 weeks post-trauma.

• Exploring reward-related brain alterations in PTSD is important to potentially uncover the underlying mechanisms promoting alcohol use.

Research Question

1. Explore associations between alcohol change scores (pre-trauma to 8 weeks post-trauma) and reward-related reactivity and functional connectivity (2-weeks post-trauma).

2. Determine whether significant differences in brain measures exist between three alcohol change groups: those who increased use, decreased use, or showed no change in alcohol use.

Methods

• Participants were recruited from emergency departments across the U.S. as part of the AURORA study (n=286; n=178 Female).

• Alcohol consumption (drinks per month; PhenX Toolkit) was measured for the month prior to the trauma and again 8 weeks post-trauma.

• Trauma-related change in drinking was quantified as the change in 30-day total drinking at 8 weeks, relative to pre-trauma.

• Reward-related neural reactivity was assessed at 2 weeks post-trauma using functional magnetic resonance imaging (fMRI) during a monetary reward task (Fig. 1) and analyzed in FMRIprep and SPM12. Structural regions of interests (ROIs) were extracted using the Reinforcement Learning Atlas.1 R (v4.2.1) was used to conduct statistical analyses.

• Seed-based FC analyses examined the association between reward-related reactivity and change in alcohol consumption using a modified CONN Toolbox (v2.1a).

• Reward-related neural reactivity was compared across those whose alcohol consumption increased (n=99, n=60 Female), decreased (n=103, n=67 Female), or did not change (n=84, n=51 Female), (Fig. 2).

Monetary Reward Task

Condition 1
Reward $1.00
Condition 2
Punishment - .50c
Condition 3
Neutral ---

Fig. 1. Overview of the modified monetary reward task from Delgado et al., 2000

Results

Correlational Analyses

Table 1. Correlation Matrix Across Alcohol Change Scores and Reward-Related Reactivity (Gain > loss)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alcohol Consumption Change Scores</td>
<td>17.38</td>
<td>-</td>
<td>.22**</td>
<td>-</td>
<td>.12</td>
<td>.20**</td>
<td>-</td>
<td>.02</td>
</tr>
<tr>
<td>2. VTA</td>
<td>-.02 (.54)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-.05</td>
<td>.07</td>
<td>-.20</td>
<td>-.25</td>
</tr>
<tr>
<td>3. Nucleus Accumbens</td>
<td>-.56 (.42)</td>
<td>.12</td>
<td>.20**</td>
<td>-</td>
<td>-.12</td>
<td>.20**</td>
<td>-</td>
<td>-.20</td>
</tr>
<tr>
<td>4. Globus Pallidus External</td>
<td>.01 (.31)</td>
<td>.02</td>
<td>-.12</td>
<td>.20**</td>
<td>.12</td>
<td>-.20**</td>
<td>.02</td>
<td>.20**</td>
</tr>
<tr>
<td>5. Globus Pallidus Internal</td>
<td>-.01 (.31)</td>
<td>.02</td>
<td>-.20**</td>
<td>.12</td>
<td>-.20**</td>
<td>.02</td>
<td>-.12</td>
<td>.20**</td>
</tr>
<tr>
<td>6. Caudate</td>
<td>.17 (.41)</td>
<td>.02</td>
<td>-.20**</td>
<td>.12</td>
<td>-.20**</td>
<td>.02</td>
<td>-.20**</td>
<td>.12</td>
</tr>
<tr>
<td>7. Putamen</td>
<td>.16 (.36)</td>
<td>.03</td>
<td>.13</td>
<td>.36**</td>
<td>.48**</td>
<td>.21**</td>
<td>.55**</td>
<td>-</td>
</tr>
</tbody>
</table>

A significant positive correlation was found between VTA reactivity to the Gain > Loss contrast and change scores in alcohol consumption.

Functional Connectivity Analyses

Greater FC between the VTA seed and the precuneus (MNI, x=28, y=-60, z=18) was associated with greater change in alcohol consumption, cluster-level P<.001, K=607, (Fig. 3).

Greater FC between the VTA seed and lateral occipital cortex (MNI, x=28, y=-76, z=50) was associated with greater change in alcohol consumption, cluster-level P<.001, K=607, (Fig. 3).

Implications

• Clarifying the relationship between PTSD symptoms and alcohol use will lead to intervention development for those recently exposed to trauma.

• The findings presented provide evidence that changes in alcohol consumption early post-trauma may contribute to reward alterations in trauma-exposed individuals.

• Uncovering the neural correlates of alcohol use in recently trauma-exposed participants is pivotal in determining who would benefit most from early interventions to prevent the development of trauma-related psychopathology.

Future Directions

• These findings align with previous research that suggest an initial increase in reward-related brain activation may contribute to the reinforcing effects of substances contributing to increased use of the substance, potentially leading to dependence.

• Latent class analysis can be used to determine different longitudinal trajectories of alcohol use after trauma exposure and whether significant differences exist between these classes in reward-related neurocircuity.

References


