How does alcohol affect your brain's signaling?

Excessive alcohol consumption strengthens presynaptic D2R MSN to postsynaptic D1R MSN glutamatergic transmission.

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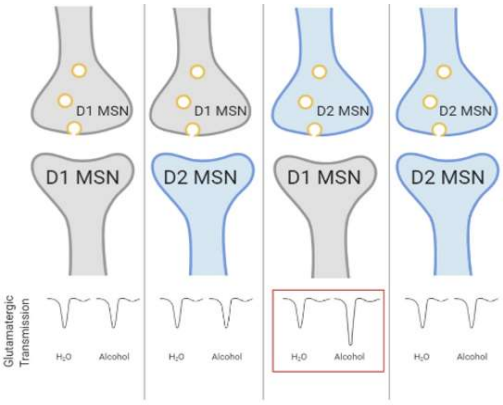

Figure 1. Excessive consumption of alcohol induces longer-lasting glutamatergic transmission in D2 to D1 synapses

The dorsomedial striatum is a brain region essential for goal-directed behaviors and addiction. The neurons located in the DSM are called medium spiny neurons. Neurons are the basic unit of the brain and allow for messages to be sent from one brain area to another. The MSNs that are expressed in the DSM have receptors: dopamine 1 receptors and dopamine 2 receptors. These receptors are able to modulate dopamine; is a chemical messenger that plays a role in pleasure and reward. An article published in Neuropsychopharmacology by Lu and colleagues wanted to observe how addictive substances alter the glutamatergic (related to the excitatory neurotransmitter glutamate) strength of synapses that express these dopamine receptors.[4] They analyzed synaptic activity in presynaptic and postsynaptic dopamine receptor-expressing medium spiny neurons. D1 to D1, D1 to D2, D2 to D1, and D2 to D2 synapses. Since dopamine plays a critical role in reward-driven behaviors and understanding this would allow them to gain information about the mechanism behind brain reward circuitry that is modulated by dopamine.

To do this, the researchers used CRE mice and gave them intermittent access to two bottle choices: 20% alcohol and water for 8 weeks. Fluorescent imaging was used to observe the expression and projections of the medium spiny neurons in the dorsomedial striatum. Electrophysiology is a method used to observe the electrical activity neurons. This method was used to observe the electrical activity at the D1 to D1, D1 to D2, D2 to D1, and D2 to D2 synapses. The data collected were analyzed using a two-tailed t-test, one-way ANOVA, and two-way ANOVA to analyze if there was a significant difference among the groups.

They found that synapses that with D2R on the presynapse and D1R on the postsynapse had stronger glutamatergic connectivity than any of the other tested synapses. In addition to this, mice that drank an excessive amount of alcohol had long-lasting potentiation of glutamatergic transmission. Their final finding was that when D2R inhibition of glutamatergic transmission was controlled by presynaptic and postsynaptic mechanisms. This means that there was something on the sending synapse and the receiving synapse that was controlling the D2Rs that were inhibiting glutamatergic signals. This gave researchers some insight about the alcohol evoked circuit plasticity in the DMS which could potentially be the cause of excessive alcohol consumption. In addition to this, the study gave insight into the role that dopaminergic modulation plays in reward circuitry, specifically in the striatum.

References

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