Dopamine: The Culprit Behind Alcohol Addiction

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Recent studies have shown that dopamine is a major factor in the development of alcohol dependence in the brain. When dopamine receptors were increased in mice, the mice substantially increased their alcohol consumption, according to an early study in the Journal of Neuroscience (Rishi Sharma et. al, 2022). Among many other prominent findings, this study explores how dopamine (one of the prominent "happiness" neurotransmitters) plays a fundamental role in addiction to alcohol—and possibly other substances. New discoveries like this, could lead to a whole new realm of treatment options for addiction. However, before addressing alcohol addiction rehabilitation itself, it's important to understand the biomechanical effects of alcohol in the brain.

Dopamine is a molecule that is heavily involved in the reward pathway within the brain, meaning that dopamine plays a role in pleasure and motivation. Additionally, dopamine is an important aspect to learning behaviors. Typically, dopamine is released when encountering specific motivators such as hobbies, family, a job, or food and it encourages a person to perform, or repeat, a specific behavior (Di Chiara, 1997).

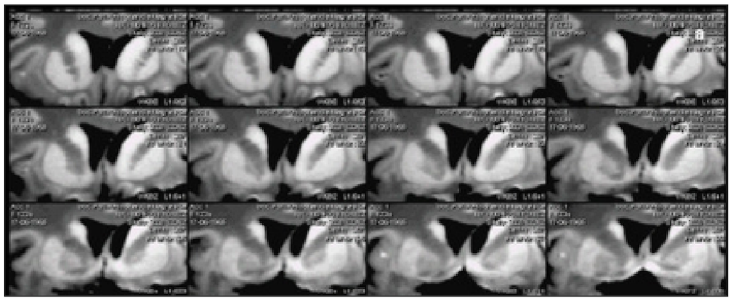

Figure 1. An MRI image of a Human Nucleus Accumbens. Retrieved from a study done by Lia Lucas Neto and others.

Alcohol causes a significant increase in the release of dopamine within the brain. When dopamine is released, its behavioral and motivational regions are activated. The person consuming the alcohol enjoys the rewarding effects of dopamine, which makes them experience intense feelings of pleasure while drinking alcohol. Dopamine also influences the nucleus accumbens (Di Chiara, 1997), the region of the brain involved in motivation and reinforcement. Specifically, it influences the person to remember the rewarding response and encourage participation in that behavior—namely drinking—again. This aspect of dopamine contributes to the craving of alcohol after it is no longer in the bodily system, a key feature of alcohol dependence. This dependence can become so strong over time that the other motivational factors mentioned above (hobbies, family, jobs, or food) no longer have the same motivational effect that they once possessed.

What separates alcohol from typical motivational reinforcement is that in typical motivational reinforcement, habituation occurs. Habituation, in this context, is when dopamine is no longer released, or is released at lower levels, when the motivational factor is repeatedly presented. However, when alcohol is repeatedly presented, similar levels of dopamine are released every time (Di Chiara, 1997). This repeated release of similar levels of dopamine strengthens alcohol's control of the brain, eventually leading to alcohol addiction.

The receptors of dopamine are also heavily involved in alcohol addiction. According to an article from the Shanghai Archives of Psychiatry, when dopamine receptors are destroyed in the brain, the subjects showed a decreased preference for alcohol (Hui Ma & Gang Zhu, 2014). Meaning that without these dopamine receptors, the rewarding effects of alcohol are nearly shut off. Additionally, during alcohol withdrawal, levels of dopamine are considerably decreased, contributing to the disgruntled state people often find themselves in during alcohol withdrawal. In essence, dopamine ensures that the user feels a surplus of positive emotions when they consume alcohol then feel a surplus of negative emotions when it is no longer in the system, encouraging the user to want to drink more alcohol to experience the rewarding effects.

This effect can also be applied to other addictive substances. For example, a more recent study by the Biochimica et Biophysica Acta (BBA) established a correlative relationship between dopamine receptors in the brain and cocaine addiction (Juan Li et. al., 2023). According to the study, the activity of the dopamine receptors was increased by the ingestion of cocaine. When these receptors were inoperative, the substance was unable to change the learning and memory pathways within the hippocampus. Meaning the subject was unable to become addicted to the normally addictive substance.

Understanding the relationship between dopamine and alcohol dependence provides a new perspective to the treatment of alcoholism. Experiments dealing with this discovery have already begun. One showing that medications that increase the activity of dopamine receptors have shown that these medications can reduce alcohol intake and alcohol tolerance in the body, decreasing the effects of alcohol addiction in the subjects (Hui Ma and Gang Zhu, 2014). With continued research, new approaches to addiction rehabilitation and treatment have the potential to help countless individuals with their battle against alcoholism and other addictive substances.

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