Cell Biology: Research & Therapy

Perspective A SCITECHNOL JOURNAL

Neurocellular Mechanisms of Drug Addiction and Substance Abuse

Hitoshi Kin*

Department of Occupational and Environmental Health, Xuzhou Medical University, Xuzhou, China

***Corresponding author:** Hitoshi Kin, Department of Occupational and Environmental Health, Xuzhou Medical University, Xuzhou, China; E-mail: kinhitoshi251@gmail.com

Received date: 21 February, 2023, Manuscript No. CBRT-23-93176;

Editor assigned date: 23 February, 2023, Pre QC No. CBRT-23-93176(PQ);

Reviewed date: 07 March, 2023, QC No. CBRT-23-93176;

Revised date: 14 March, 2023, Manuscript No. CBRT-23-93176(R);

Published date: 24 March, 2023, DOI: 10.4172/2324-9293.1000167

Description

Drug addiction and substance abuse are complex and multifaceted disorders that result from a combination of genetic, environmental, and social factors. At the neurocellular level, addiction and substance abuse involve changes in the structure and function of various brain regions and neurotransmitter systems [1]. The neurocellular mechanisms of drug addiction and substance abuse, including the neural pathways involved, the role of neurotransmitters, and the impact of chronic drug use on the brain [2].

Mesolimbic pathway

The mesolimbic pathway , also known as the mesolimbic dopamine system, is a group of neurons that span several brain regions, including the Ventral Tegmental Area (VTA), the Nucleus Accumbens (NAc), and the Pre-Frontal Cortex (PFC). This system is responsible for regulating the comfort,motivation and reward in response to various stimuli, including natural rewards such as food, sex, and social interactions, as well as drugs of abuse[3].

The mesolimbic dopamine system is activated when the brain detects a rewarding stimulus, causing the release of the neurotransmitter dopamine from neurons in the VTA. Dopamine then travels to the NAc, where it binds to dopamine receptors on the surface of neurons, triggering a cascade of intracellular signaling events that ultimately result in the release of the neurotransmitter Gamma-Aminobutyric Acid (GABA) [4]. GABA, in turn, inhibits the release of another neurotransmitter, glutamate, which is involved in the process of learning and memory. This inhibition of glutamate release reduces the brain's ability to learn from the rewarding stimulus, reinforcing the behavior that led to the reward [5].

Role of neurotransmitters

Several neurotransmitter systems are involved in drug addiction and substance abuse, including dopamine, GABA, glutamate, and opioid peptides [6]. Dopamine is particularly important, as it is involved in the process of reward and reinforcement. Chronic drug use can lead to changes in the brain's dopamine system, making it less responsive to natural rewards and more sensitive to drug-related stimuli. This can result in an increased craving for drugs and a reduced ability to regulating comfort and motivation from other activities [7].

GABA and glutamate are also involved in addiction and substance abuse, with GABA acting as an inhibitor of neural activity and glutamate playing a role in learning and memory. Chronic drug use can alter the balance between these two neurotransmitters, leading to a decrease in inhibitory signaling and an increase in excitatory signaling. This can result in changes in neural plasticity, making it easier for drug-related cues to trigger cravings and relapse [8].

Opioid peptides, such as endorphins, also play a role in addiction and substance abuse. These peptides bind to opioid receptors in the brain, they plays an important role in regulating pain and other physiological process.Chronic drug use can lead to dysregulation of the brain's endogenous opioid system, making it less responsive to natural rewards and more sensitive to drug-related stimuli [9].

Impact of chronic drug use on the brain

Chronic drug use can have a significant impact on the brain, leading to changes in neural plasticity and function. One of the most well-known effects of chronic drug use is the development of tolerance, which occurs when the brain adapts to the presence of a drug, reducing its effects over time. This can lead to a cycle of increasing drug use to achieve the same level of euphoria, eventually resulting in addiction [10].

Chronic drug use can also lead to changes in the structure of the brain, particularly in areas involved in reward processing and decision-making. For example, studies have shown that chronic cocaine use can lead to a decrease in gray matter volume in the prefrontal cortex, an area important for decision-making and impulse control. Finally, chronic drug use can lead to long-lasting changes in gene expression and epigenetic modifications.

References

1. Li X, Yu H, Gong Y, Wu P, Feng Q, et al (2022) Fuzheng Xiaozheng prescription relieves rat hepatocellular carcinoma through improving anti-inflammation capacity and regulating lipid related metabolisms. J Ethnopharmacol 284:114801.
2. Liu F, Wang Z, Wei Y, Liu R, Jiang C, et al (2021) The leading role of adsorbed lead in PM2. 5-induced hippocampal neuronal apoptosis and synaptic damage. J Hazard Mater 416:125867.
3. López-Merino E, Cuartero MI, Esteban JA, Briz V (2022) Perinatal exposure to pesticides alters synaptic plasticity signaling and induces behavioral deficits associated with neurodevelopmental disorders. Cell Biol Toxicol 8:1-23.
4. Lu Y, Xu W, Nie H, Zhang Y, Deng N, et al (2019) Mechanism and kinetic analysis of degradation of atrazine by US/PMS. Int J Environ Res Public Health 16:1781.
5. Margolis AE, Liu R, Conceição VA, Ramphal B, Pagliaccio D, et al (2022) Convergent neural correlates of prenatal exposure to air pollution and behavioral phenotypes of risk for internalizing and externalizing problems: Potential biological and cognitive pathways. Neurosci Biobehav Rev 31:104645.
6. Ouattara BS, Puvvula J, Abadi A, Munde S, Kolok AS, et al (2022) Geospatial distribution of age-adjusted incidence of the three major types of pediatric cancers and waterborne Agrichemicals in Nebraska. GeoHealth 6:e2021GH000419.
7. Patel R, Aschner M (2021) Commonalities between copper neurotoxicity and Alzheimer's disease. Toxics 9:4.

8. R, Gartside SE, Morris CM, et al (2015) Low-level repeated exposure to diazinon and chlorpyrifos decrease anxiety-like behaviour in adult male rats as assessed by marble burying behaviour. Neurotoxicology 50:149-156.
9. Hara M, Morita A, Kamei S, Yamaguchi M, Homma T, et al (2011) Anti-N-methyl-Daspartate receptor encephalitis associated with carcinosarcoma with neuroendocrine differentiation of the uterus. J Neurol 258(7):1351-3.
10. Pranzatelli MR (1996) The immunopharmacology of the opsoclonus-myoclonus syndrome. Clin Neuropharmacol 19:1-47.