

Neurobiology of Addiction

A Brief Overview

Percy Menzies, M. Pharm.
TA Guest Ranch, Buffalo, WY
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Drive States

- Higher organisms have inherent instincts that are essential for the survival of the species
- These instincts drive them to:
- Seek/obtain food; Seek/make shelter
- Seek/obtain water; Protect the young
- Seek/have sex

These drive states are located in the specific part of the brain and connected by complex neurocircuitry to the reward/pleasure centers

Drive States

- Each drive state has two aspects:
- 1. If the drive state is achieved the organism experiences 'reward' which is pleasure, satisfaction and sense of well being
- 2. If the drive state is frustrated or cannot be met, the organism experiences dysphoria, anxiety, irritability and anger

How Do Drugs Work?

Drugs bypass the instinctual drives and cause an abnormal stimulation of the reward/pleasure system

- Stimulation of the reward/pleasure system by drive states = PHYSIOLOGY
- Stimulation of the reward/pleasure system by drugs = PATHOLOGY

What is Addiction?

- Addiction is a disorder/disease of the REWARD/PLEASURE system of the brain. It is characterized by four primary symptoms:
- Craving
- Loss of control
- Tolerance
- Continued use despite adverse consequences

The Pleasure Pathways of the Brain

- Ventral Tegmental Area
 - Lateral Hypothalamus
 - Nucleus Accumbens
 - Prefrontal Cortex
- Drug addiction affects the reward circuitry within the motivational and memory centers co-located in the limbic system. Memory plays a critical role in relapse.

Neurotransmitter of Addiction

- Dopamine
- Serotonin
- Endorphins
- Gama Amino Butyric Acid (GABA)

Dopamine

- "Reward" neurotransmitter
- Found in the medial forebrain bundle
- May be stimulated directly by drugs like cocaine
- Stimulated by the release of endorphins

Serotonin

- “Normalizing” neurotransmitter
- Found in the limbic system
- Key role in the ‘deficiency hypothesis’ of depression and craving
- SSRI drugs increase levels of serotonin to alleviate depression

Endorphins

- ‘Analgesia’ neurotransmitters
- Found in the hypothalamus and the limbic system
- Key role in stress, pain, craving and relapse
- Stimulation of the dopamine system
- Act specifically on the ‘opioid’ receptors

Gamma Amino Butyric Acid (GABA)

- ‘Inhibitory’ neurotransmitter
- Role in the loss of ‘inhibitions’ and acute intoxications
- Unproved theory that GABA deficiency causes alcoholism
- Benzodiazepines act on this neurotransmitter

Progression of Addiction Neuroadaptation

A process by which receptors in the reward/pleasure centers of the brain ‘adapt’ to higher concentrations of the neurotransmitters. The receptors become insensitive to normal levels of neurotransmitters.

Effects of Neuroadaptation

- Under unstimulated conditions there is a profound interference in the ability to experience pleasure – the user feels an unmet instinctive drive leading to craving dysphoria, anxiety and frustration
- TOLERANCE- Forces the user to escalate the dose to experience a 'high'. Using an inadequate dose causes withdrawal symptoms

Effects of Neuroadaptation

- Length of use and intensity of the drug are factors predicting the damage to the reward/pleasure centers called 'COUNTERADAPTATION'. The patient has to use drugs/alcohol just feel less 'bad'

Factors Contributing to Addiction

- Genetics
- Learning/behavioral factors
- Familial
- Co-morbidities
- Access

Role of Genetics

- There is no single gene that determines or protects from addiction
- Genes interact with the environment to influence susceptibility
- Genes can predispose, but cannot determine the level of risk
- Genetic predisposition is a warning not fate

Components of Drug Treatment

- Detoxification – the use of medications to treat withdrawal symptoms. If in adequately treated, the patients feels compelled to use drugs. Inadequate detoxification procedures are a major cause of lapses and relapse
- Relapse Prevention – Behavioral modification extinguish triggers that lead to cravings; controlled reentry to cue rich environments