Drugs and the Brain: Implications for Preventing and Treating Addiction

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DRUGS

Addiction
- Neurotoxicity
- Obesity
- AIDS
- Cancer
- Mental illness

Medical
- Neurotoxicity
- Obesity
- AIDS
- Cancer
- Mental illness

Economic
- Healthcare costs
- Productivity loss
- Accidents

Social
- Homelessnessness
- Crime
- Violence
ADDICTION IS A DISEASE OF THE BRAIN as other diseases it affects the tissue function.

Decreased Brain Metabolism in *Drug Abuse Patient*

Control  Cocaine Abuser

Decreased Heart Metabolism in *Heart Disease Patient*

Healthy Heart  Diseased Heart

Sources: From the laboratories of Drs. N. Volkow and H. Schelbert
ADDICTION IS A DEVELOPMENTAL DISEASE

It starts in adolescence and childhood

Brain areas where volumes are smaller in adolescents than young adults.


Age at cannabis use disorder as per DSM IV

Drugs of abuse can produce addiction by hijacking motivation and pleasure pathways in the brain.
movement

Dopamine

motivation

addiction

Reward & well-being
Dopamine Neurotransmission

frontal cortex

nucleus accumbens

VTA/SN

% of Basal Release

Time After Methamphetamine

METHAMPHETAMINE

% of Basal Release

Time After Cocaine

COCAINE
Brain Dopamine System

Anatomy

Dopamine Cell

DA Transporters

DA Receptors

Metabolism

signal
Dopamine D2 Receptors are Lower in Addiction

Reward Circuits

Non-Drug Abuser

Drug Abuser
Effects of Tx with an Adenovirus Carrying a DA D2 Receptor Gene into NAc in DA D2 Receptors

Overexpression of DA D2 receptors reduces alcohol self-administration

ADDICTION INVOLVES MULTIPLE FACTORS

Brain Mechanisms

Addiction

Biology/Genes  ↔  Environment

DRUG
Effects of a Social Stressor on Brain DA D2 Receptors and Propensity to Administer Drugs

Individually Housed

Becomes Dominant
No longer stressed

Group Housed

Becomes Subordinate
Stress remains

According to the Monitoring the Future Study…
Methamphetamine is not Increasing

Percent of Students Reporting Use of Methamphetamine in Past Year, by Grade

8th Grade
10th Grade
12th Grade

P < .05
Methamphetamine Treatment Admissions Have Been Increasing

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Methamphetamine/Amphet
Concerns with Methamphetamine

- **Neurotoxic** in animal models of drug self administration
- Highly **addictive**
- Intoxication associated with behaviors that **increase risks for infection** with HIV and HCV
- Can be **easily manufactured** by small clandestine laboratories
Methamphetamine abusers have significant reductions in dopamine transporters.

\[ p < 0.0002 \]

**Dopamine Transporters (Bmax/Kd)**

- **Normal Controls**
- **Meth Abusers**

Methamphetamine abusers have significant reductions in dopamine transporters.
Dopamine Transporters in Methamphetamine Abusers

**Motor Task**

Loss is associated with slowing of motor reactions.

**Memory Task**

Loss is associated with memory impairment.
Partial Recovery of Brain Dopamine Transporters in Methamphetamine (METH) Abuser After Protracted Abstinence

Proportions of AIDS Cases in Adults and Adolescents by Exposure in the USA

Men who have sex with men (MSM)
Injection drug use
Heterosexual contact
MSM who inject drugs

Source: Centers for Disease Control and Prevention (CDC)
Methamphetamine in the HIV Epidemic

• METH has been shown to alter immune function

• Risky sexual behavior that occurs during METH intoxication increases the risk of HIV infection

• Physiological changes resulting from METH use may increase infectivity (e.g., erosion of normal protective epithelial layer)
Aggressive Action Is Needed To Stop METH Use & Its Serious Consequences

- We Need to Make the Public Aware of the Drug’s Toxic and Addictive Properties
- And to Develop Treatments that will counteract neuroadaptations that underlie the addictive process and reverse METH’s neurotoxic effects
The Partnership Between

NIDA

and

CICAD

Is working to develop...

- A Latin American Epidemiology Work Group that would parallel the US Community Epidemiology Work Group (CEWG)

- A program offering small research grants to students carrying out their post-graduate thesis work at Latin American Universities