Drugs and the Brain: Implications for Preventing and Treating Addiction

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DRUGS

Addiction
NEUROTOXICITY
OBESITY
AIDS
CANCER
MENTAL ILLNESS

Medical
HOMELESSNESS
CRIME
VIOLENCE

Economic
HEALTH CARE
COSTS
PRODUCTIVITY
LOSS
ACCIDENTS

Social
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
addiction

Dopamine

movement

motivation

Reward & well-being
Dopamine Neurotransmission

Frontal cortex

Nucleus accumbens

VTA/SN

Time After Cocaine

Time After Methamphetamine

% of Basal Release

% of Basal Release

COCAINE

METHAMPHETAMINE
Brain Dopamine System

Anatomy

Dopamine Cell

DA Transporters

DA Receptors

Metabolism

signal
Dopamine D2 Receptors are Lower in Addiction

Control

Addicted

Cocaine

Alcohol

Heroin

Meth

Reward Circuits

Non-Drug Abuser

Drug Abuser

DA D2 Receptor Availability
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:

- Biology/Genes
- Environment

Drug use leads to brain mechanisms which result in addiction.
Effects of a Social Stressor on Brain DA D2 Receptors and Propensity to Administer Drugs

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

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

P < .05
**Methamphetamine Treatment Admissions Have Been Increasing**

Methamphetamine Treatment Admissions Have Been Increasing

**Methamphetamine/Amphetamine Treatment Admission Rate: 1992-2002**

2002 SAMHSA Treatment Episode Data Set
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 in Methamphetamine Abusers

Motor Task
Loss is associated with slowing of motor reactions.

Memory Task
Loss is associated with memory impairment.

BNL/UCLA/SUNY
NIDA, DOE (OBER), ONDCP
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

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