FROM ADDICTION TO ABSTINENCE: MAXIMIZING THE CHANCES OF SUCCESS

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While advances in neuroscience have clearly delineated the areas of the brain that are affected by mood-altering drugs, the success rate of treatment for people dependent upon or addicted to these drugs remains essentially unchanged over the last several decades. This is due in large part to paying inadequate attention to the craving that occurs after discontinuing a mood-altering drug that produces physical dependency. This article will review the changes that occur when one becomes physically dependent on a mood-altering drug and the process to follow in order to maximize the chances of success in maintaining abstinence when drug use has been discontinued.

Keywords: *addiction*; *abstinence*; *substance abuse*; *mood-altering*; *detoxification*; *maintenance*

INTRODUCTION

Never before has the basic science of drug addiction been more clearly defined. Research has identified neurotransmitters and receptors in the brain that are responsible for the actions of most mood-altering drugs commonly used today (Table 1). Neuroimaging has helped to locate specific sites in the brain affected by mood-altering drugs as well as areas that are responsible for withdrawal effects when these drugs are discontinued (Tables 2–3) (Brick & Erickson, 1998; Galanter & Kleber, 2004; Gutstein & Akil, 2001). Based on our knowledge of these sites and of the neurotransmitters and receptors activated by these drugs, the pharmaceutical industry has developed medications that block the binding of these drugs to their receptors in an attempt to decrease drug use. Multiple therapeutic options are available to the drug user, ranging from pharmacologic therapy to standard psychotherapy to short-term

Table 1
Dependence-Producing Drugs

Group	Examples
Alcohol, Sedatives, Hypnotics, Minor Tranquilizers	Alcohol, barbiturates, chloral hydrate, meprobamate, benzodiazepines
Hallucinogens	Lysergic acid and hallucinogenic amphetamines, mescaline, peyote, khat
Marijuana	Marijuana
Opiates and Opioids	Morphine, opium, heroin, codeine, meperidine, methadone, agonist-antagonists (buprenorphine), stadol, pentazocine
Stimulants	Amphetamines, cocaine, methylphenidate, weight-reducing drugs
Volatile Solvents	Glues, some cleaning fluids

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Table 2
Clinical Symptoms and Sites of Action in Brain*

Clinical State	Site
Physical dependence/withdrawal	Locus Coeruleus
Dysphoria during withdrawal	Nucleus Accumbens Septi (NAS) Ventral Tegmental Area (VTA) Periductal Gray
Conditioning	Amygdala
Tolerance	Dorsal Horn Spinal Cord

* For opiate group of drugs.

Table 3
Why People Continue to Use Dependency-Producing, Mood-Altering Drugs

Reason	Site	Clinical Manifestations
Pleasure (Euphoria)	Nucleus Accumbens Septi (NAS) Ventral Tegmental Area (VTA)	Inability to control use despite negative consequences
Fear of Withdrawal	Locus Coeruleus	Continued drug use even in absence of euphoria
Drug Craving	Alteration of Neural Function Multiple Brain Sites	Abstinence followed by relapse, especially under stress

residence in drug-free rehabilitation centers. Yet despite the scientific advances, the multiple therapeutic options available, and the advocacy for each therapeutic modality, the success rate of treatment for drug use has not changed measurably for the last several decades.

While the reasons for this unchanged success rate have not been clearly defined, research suggests that it may be related to the failure to address the factors present when drug use is initiated as well as those responsible for the return to the use of the specific drug or, as occurs in many cases, the substitution of one mood-altering drug for another.

This article will focus on the factors surrounding drug use, as well as the role these factors play in preventing continued abstinence once drug use has ceased.

WHY PEOPLE USE DRUGS

Numerous theories have been formulated to explain why a person turns to the use of mood-altering drugs (Table 4). The theories range from genetic explanations (Nestler, 2001; Nestler, 2004) (e.g., the existence of male-dominant transmission of genes responsible for the production of excessive alcohol consumption) to environmental (e.g., the simple observation that it is less expensive for inner-city youth to get high by scoring heroin or cocaine than to pay for admission to a movie). At the risk of oversimplification, all drug use is related to the pleasure/pain principle. Mood-altering drugs are taken either to promote pleasure or to relieve pain. On an individual basis, factors promoting the initiation of drug use may vary greatly between individuals. However, they must be addressed in order to maximize the chances of success once drug use is discontinued.

Table 4
Factors Thought to Play a Role in Inappropriate Use of Mood-Altering Drugs

- Genetic Predisposition
- Inadequate Parenting
- Peer Pressure/The Need to Fit In
- Risk-Taking
- Inappropriate Role Models
- Relaxation
- The Need to Feel Good

While initiating the use of a mood-altering drug is volitional, with continual use changes in the brain may cause a conditioning effect that may exist after drug use is discontinued. This conditioning effect, which results in the phenomenon commonly called craving, must also be addressed in order for a therapeutic effort to be successful.

In order to better understand this process, it will be helpful to review the patterns of drug use as well as what happens when a person takes a mood-altering drug associated with physical or psychological dependency. The basic patterns of drug use can be divided into appropriate use, misuse, abuse, dependency, and addiction.

Appropriate use of a drug needs little or no explanation. It is taking a drug at the frequency and dose recommended by a physician or drug manufacturer.

Misuse of a drug occurs when a person inadvertently feels that a better effect can be obtained if his/her own method of using a drug is instituted. A common example of this would be taking three aspirin rather than two to relieve a headache, believing that the increased dose would be effective.

Abuse, or inappropriate use of a drug, occurs when a person uses a drug not for its intended use but for another effect that is obtained during use. For example, a person is initially prescribed benzodiazepine for sleep. When the person discovers that this drug also produces a slight euphoric effect or "high," this becomes the primary goal.

When used on a continuing basis, a number of drugs can cause physical or psychological dependency (Table 1). Once dependency develops, the user will experience psychological and/or physiologic effects if use is discontinued. Interestingly, if dependency develops while taking an opiate appropriately and solely for pain relief, it is relatively easy to discontinue its use, and addiction rarely results (Porter & Jick, 1980; Fishbain, Rosomoff, & Rosamoff, 1992). However, if an opiate is taken for its euphoric effect, the dependency becomes much more difficult to address. It is only when the drug is taken for reasons other than its intended therapeutic effect that addiction develops.

Addiction is best defined as the continued administration of a drug despite its association with untoward side effects and the need to take the drug in order to continue daily function (Table 5). Street drugs that are considered to have high addictive potential include heroin and cocaine. Licit drugs with a high addictive potential include alcohol and tobacco.

The potential for a drug to become addictive varies greatly among substances. For example, while stimulants—which range from caffeine to nicotine to hardcore drugs such as amphetamines and cocaine—cause very little physical dependency, the psychological dependency and craving associated with cocaine and amphetamines are considerable. Although it is not commonly realized that dependency on caffeine can exist, it has been documented in literature. However, it is a dependency that is not difficult to overcome and

Table 5
Definitions of Addiction, Physical Dependence, and Tolerance

Addiction: Addiction is a primary, chronic, neurobiologic disease, with genetic, psychosocial, and environmental factors influencing its development and manifestations. It is characterized by behaviors that include one or more of the following: impaired control over drug use, compulsive use, continued use despite harm, or craving.
Physical Dependence: Physical dependence is a state of adaptation that is manifested by a drug class-specific withdrawal syndrome that can be produced by abrupt cessation, rapid dose reduction, decreasing blood level of the drug, and/or administration of an antagonist.
Tolerance: Tolerance is a state of adaptation in which exposure to a drug induces changes that result in a diminution of one or more of the drug's effects over time.

Sources: The American Academy of Pain Medicine, the American Pain Society, and the American Society of Addiction Medicine.

has rarely presented a problem in a clinical setting. Tobacco is another issue; it is quite difficult for individuals who have become dependent on cigarettes to stop smoking, with a recidivism rate greater than those of illicit mood-altering substances, including heroin and cocaine. Dependence upon cocaine is perhaps the greatest stimulant dependency to overcome. In fact, in the animal model, an animal made dependent on cocaine will choose to self-inject the drug over obtaining food and water, until it subsequently dies (Stimmel & Glick, 1978; Stimmel & Kreek, 2000).

Sudden cessation of a drug with subsequent withdrawal symptoms was initially considered to be a psychological phenomenon. It has since been established that withdrawal symptoms are not psychological, but the physical result of the release of neurotransmitters in the brain. Withdrawal can be mild, as in the case of stimulant drugs, or severe, when it is associated with alcohol and opiates.

The neurophysiological phenomenon of craving has become established in the drug treatment world over the last decade or so (Stimmel & Kreek, 2000; Adinoff et al., 2007). The concept is not new. In fact, people addicted to heroin who have been drug free due to incarceration or going through a treatment process, would often describe an overwhelming need to start using heroin again when walking through a neighborhood where drugs were being injected. While in the past this was considered to be a sign of moral weakness, it has now been established that physiologic changes are responsible for the craving phenomenon.

Once again, the animal model is instructive (Table 6). If one takes a laboratory animal and makes it dependent upon an opiate drug, the animal will continuously inject the drug to avoid withdrawal. If the animal is on a narcotic and one then injects a narcotic antagonist that will produce withdrawal, and then slowly takes the animal off the narcotic drug so that it is drug free, several months later the injection of the narcotic antagonist alone in the animal will produce withdrawal symptoms. Similarly, if one uses the same model and also flashing a red light when injecting the narcotic antagonist for the first time, flashing a red light several months later will cause a withdrawal process indistinguishable from when the animal was maintained on the drug. This emphasizes the need for a treatment modality to consider both the factors leading to drug use as well as the effects of craving or need for the medication.

Table 6
Animal/Human Correlates of Narcotics Dependency

	Laboratory Evidence	Clinical Counterpart
Brain Stimulation & Drug Craving	Selecting better-tasting fluids despite adverse stimuli	Precedence of narcotic-seeking behavior over other activities
	Choice of self-injection over food and water	
	Increase in rate of self-injection with stress	Increased narcotics use with anxiety and with cocaine
Dependence & Tolerance	Rapid development after several injections	Develops after 2–3 days
	Stabilizes after 4–6 weeks	Object is euphoria; dose constantly increases
	Abnormal results in abstinence state persist for up to 12 months	Alteration of respiratory center to CO2 for months post-abstinence
Withdrawal Syndrome	Conditioned withdrawal produced in narcotic-free state	Conditioned withdrawal produced by saline and environment even when narcotic-free

Table 7
Pharmacologic Approaches to Treat Use of Mood-Altering Drugs

- Detoxification
- Maintenance
- Production of adverse effects if illicit drug use continues
- Reduction of craving
- Treatment of coexisting psychological states
- Relaxation
- Vaccination

Table 8
Nonpharmacologic Approaches to Treat Use of Mood-Altering Drugs

- Acupuncture
- Brief interviews
- Psychotherapy (individual or group)
- Comprehensive outpatient therapy
- Employee assistance programs
- Sociocultural support (e.g., residency houses, self-help groups, spirituality)

MAXIMIZING SUCCESS

As noted above, there are a variety of available treatment modalities for those who are addicted to or dependent on mood-altering drugs (Tables 7–8). No single modality will be effective for everyone. There is a street saying: "Different strokes for different folks." Those involved in providing treatment ignore this at times and advocate their own method of treatment to the exclusion of others. Unfortunately, this guides many individuals into therapies that are inappropriate for them.

DETOXIFICATION AND MAINTENANCE

A detailed review of the available treatment modalities is outside the scope of this article. However, detoxification and maintenance are two pharmacologic modalities that warrant further explanation, as they are frequently misunderstood. This is not to say that these modalities are better than others used for addiction.

Detoxification is the process of slowly withdrawing a person from a drug that has caused dependency and addiction. It can be accomplished by either slowly decreasing the dose of the drug that has produced the dependency or by substituting a similar but longer-acting drug that eases the discomfort of decreasing drug levels in the body. Withdrawal may occur if the levels are decreasing too rapidly. It should be emphasized that detoxification is only a first step of therapy; it does not by itself assure abstinence.

Until recently, the most common form of maintenance for opiate addiction was the use of methadone. Methadone maintenance for opiate dependency or addiction is based on the observation that individuals who are maintained on opiate drugs at their tolerance level for medical reasons function completely normally. Indeed, their use of opiates is not detected unless specific testing is performed. Therefore, maintenance allows an individual to function normally while addressing physiologic changes that result from the introduction of an opiate into one's system.

In order to develop a better understanding of maintenance therapy, it is helpful to review what happens when an individual uses an opiate—heroin in particular—on the street. An individual who is naïve to the use of heroin will inject the drug and experience euphoria for a short time. The euphoric feeling will subside and the individual will return to normal function. If the person injects the drug at sufficiently long intervals, no drug remains in the brain, and the individual will not become physiologically dependent. On the street, individuals may shoot up heroin once every several days, once a week, or even less frequently and never become physically dependent, a phenomenon called "chipping." However, when more frequent injection occurs due to the effects of the drug, a level of the drug remains in the brain and the individual becomes tolerant to the blood level. When one is tolerant to the effects of the drug, euphoria is no longer experienced. In order to overcome this, the individual injects additional doses of the drug. Consequently, the individual develops a tolerance threshold above which euphoria will occur and below which withdrawal symptoms start.

The concept of maintenance using a pharmacologic agent under medical supervision is to create a tolerance threshold that is too high for the street use of heroin to overcome. With a sufficiently high tolerance threshold, the individual will experience no positive gain from injecting the drug, as there will be no euphoria associated with injection. In simple terms, this is the basis of the use of opiates for maintenance therapy in heroin addiction.

Methadone was initially chosen as the opiate of choice because it is a long-acting drug to be taken only once a day. Its levels increase slowly, thereby avoiding overdose when small and progressively increasing doses are used. Similarly, when one is ready to be taken off methadone, it may be accomplished by slowly decreasing the dose without undue signs of withdrawal. In addition to increasing one's tolerance when being maintained on an opiate under medical supervision, treatment must address the issues that directed an individual to initiate use. Unless such an effort is made, the factors that initiated the use of the narcotic will persist unchanged. As a result, the individual could attempt another mood-altering drug or return to opiate use.

Table 9
Current Public Opinion Toward Methadone Maintenance

Opinion	Fact
1. It does not work. People still use heroin.	1. Opiophobia results in inadequate methadone doses (even in those dispensed in methadone programs).
2. It results in the use of alcohol and cocaine.	2. Methadone maintenance never meant to diminish use of other mood-altering drugs, hence the need for a multidisciplinary approach to treatment.
3. Patients can never come off maintenance.	3. If lifestyle changes occur, then abstinence is easy to achieve. However, persons remaining at tolerance threshold function normally.
4. Buprenorphine must be a better drug since it is not controlled and any physician may dispense it in his office.	4. While buprenorphine is not controlled, it is actually more potent than methadone.

Dr. Vincent Dole and Dr. Marie Nyswander first introduced the use of methadone as an maintenance agent in the late 1960s. Although methadone has been shown to be exceptionally effective in the therapeutic process—and despite the fact that opiates are perhaps the most benign class of drugs in a physician's armamentarium (Joseph, Stangliff, & Langrod, 2000)—there is still significant public concern over prescribing an opiate drug for any length of time. Public acceptance of various myths about methadone persists (Table 9).

Most recently, buprenorphine has been promoted and utilized for opiate dependency in a maintenance manner. This drug combines the effects of an agonist, producing euphoria or high, with those of an antagonist, which will block the effects of a street narcotic when administered (Fiellin, 2007). While this agent has been advanced as a substitute for methadone without hazard of using a pure opiate agonist for maintenance, there is evidence that buprenorphine, like methadone, can be used inappropriately (Vlahov et al., 2007).

Maintenance therapy with methadone or buprenorphine is just one therapeutic model that, when used appropriately, can be quite effective. However, it should be emphasized that the use of residency houses, psychotherapeutic modalities, and day clinics can also be quite effective and should be considered as alternatives on an individual basis.

Stimulant abuse is perhaps the most difficult to treat, as no specific pharmacologic method has shown to be effective for the treatment of cocaine or methamphetamine addiction. In such cases, the reasons for initiating use become even more important, as does the appropriate therapeutic setting for dealing with dependency.

Regardless of the treatment modalities chosen, it is important to consider the entire individual when deciding the therapeutic approach to address the use of illicit, mood-altering drugs. It is equally important to address the factors that brought the person to his or her state of drug use, rather than to isolate the individual in the therapeutic setting and to expect continued abstinence upon a return to the initial environment (Hser, 2007).

It is quite unfortunate that incarceration is the most common form of therapy currently practiced by society for substance use. There is often a total lack of therapy when a person is incarcerated, and there is a very high recidivism rate upon release. This is not surprising, as incarceration is used as punishment and not rehabilitation. Most recently, drug courts have attempted to arrange specific treatment plans for nonviolent offenders in possession of drugs. When the individual is released, he or she is required to attend treatment sessions, to undergo urine toxicology screening, and to participate in rehabilitation. Most programs

are 30–60 days in duration and are followed by at least 1 year of supervision. An evaluation of these programs by the Department of Justice found that the recidivism rate for patients who complete the treatment process is less than 4%, compared to an arrest rate of almost 50% within 2–3 years for those incarcerated for drug possession. The ability of drug courts to decrease the burden on the criminal justice system has resulted in greater support from both the judicial system and police agencies (Second Policy Report of the Physician Consortium on Substance Abuse Education, 1998; Egan, 1999; Wren, 1999).

CONCLUSION

Although the treatment of illicit drug dependency and addiction is far from easy and has a success rate that leaves much to be desired, effective treatment modalities can maximize the chance of becoming drug free when tailored to individual needs. The importance of addressing issues that lead an individual to drug use cannot be underestimated. It is only by utilizing a comprehensive approach to treatment that abstinence can be assured when the treatment cycle is completed.

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