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The Role of Impulsivity and Sensitivity to Reward in Dropout of Addiction Treatment in Heroin Addicts

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Original Article

Abstract

Background: Impulsivity and sensitivity to reward situate at the marrow of pathology of substance use disorders (SUDs). This study examined the role of impulsivity and sensitivity to reward in dropout of addiction treatment in heroin addicts.

Methods: The participants of this study were 216 heroin addicts. The participants were assigned to three different groups including abstinent group (n = 104), relapsed group (n = 45), and dropped out of treatment group (n = 67). The participants completed the semi-structured interview, Carver and White Behavioral Inhibition System/Behavioral Activation System (BIS/BAS) questionnaires, and the Delay Discounting Task (DDT).

Findings: The delay discounting (DD) and reward-seeking rates were high in relapse and dropout groups compared to the abstinence group and this difference was significant in $P < 0.01$ level.

Conclusion: People with substance abuse disorders have impulsive behaviors and often prefer immediate reward related to substance use than long-term and greater rewards.

Keywords: Impulsivity behavior; Reward; Heroin addiction; Heroin

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Introduction

Impulsivity situates at the marrow of pathology of substance use disorders (SUDs).[1,2] Typically, impulsivity has been known as a personality feature that is related to immediate reward-seeking without attention to long-time negative outcomes.[3-6] In addition, the impulsivity, in spite of being one of the underlying factors in addiction, can be one of the factors of continuity of drug misuse and also one of the disruptive factors in the process of abstinence from drug.[7,8] In addition, addicts who quit addiction treatment interventions are with personality disorders, high rate of impulsivity, and sensation seeking and they have less social support than addicts who stay in addiction treatment interventions.[9]

Latterly, studies of clinical neuroscience have showed impulsivity from approaches that assess its behavioral correlates, such as impulsive decision-making and sensitivity to reward.[9-11] Current neurocognitive models are hypothesize that impulsivity and addiction due to an unbalance among the effects of two rival neural systems: a bottom-up system and a current extended top-down system. The bottom-up system has been known as the impulsive or reactive system which encompasses sub-cortical brain areas, especially, dopamine (DA) areas in the midbrain and amygdala.[12,13]

The bottom-up system tends to elevate pleasure and addicted behaviors and reacts to quickly accessible cues, regardless of the long-time negative outcomes. In contrast, the top-down system, known as the executive or reflective system, contains the prefrontal cortex, which has an important role in a broad span of executive and inhibition actions, for example, planning, attention, short-term memory, and resistance to quick rewards in confrontation of long-term rewards.[14] Also, based on Gray's theory[15] the high sensitivity of behavioral activation system (BAS) is due to the high level of the activity of neural circuits of reward. Also, the same mesolimbic dopamine pathway which leads to a brain which is sensitive to reward and behavioral activation to enjoyable stimulants. High level of raising the personality aspects of fun-seeking, drive, and responding to reward in the people with drug misuse are related with the specifications such as impulsivity,[8] risk-taking,[16,17] pleasure-seeking,[18] and novelty-seeking;[19] that these specifications can be related with tendency to using drugs.[20] Therefore, for increasing examination of the significance of defects relevant to impulsivity and immediate reward-seeking in addiction, we should do more studies to become aware of the results of these deficits on treatment consequences.

Therefore, we intend in the present study to examine impulsivity in two variant approaches: 1) we examine the impulsivity as a trait and 2) we examine impulsivity based on its behavioral correlates such as sensitivity to reward in three groups including abstinence, relapse, and dropout for prognosis of treatment in heroin withdrawal.

Methods

Participants: The contributors in this study were 216 heroin addicts that contributed in treatment of heroin withdrawal program in medicine center at University of Tabriz, Tabriz, Iran. Present study was managed by two physicians and one clinical psychologist, who supplied specialized pharmacological service and psychotherapy for cessation of heroin use.

Inclusion criteria were: satisfying to voluntarily participate in study, being 18 years and older, and rightly completing the pre-treatment evaluation scales. Exclusion criteria were: use of the medications that were inconsistent with the pharmacological treatment used in this therapy, existence of a serious diagnosed mental disorder, and contemporary dependence on other substances. After ethical approval by the Ethics Committee of University of Tabriz, manner of implementation of this study was explained to participants. Participants after being informed of aims of study provided signed informed consent (IR.UTBZ.REC.1398.146). The participants were assigned to three different groups including abstinence group (n = 104), relapse group (n = 45), and dropout of treatment group (n = 67) (Table 1).

Instruments

Semi-structured interview for heroin addicts: This scale prepares information about demographic data, rate of daily use (g), and number of years that the individual is addict (Table 1).

Delay Discounting Task (DDT): DDT is a computerized task[21] and includes 27 dichotomous-choice items. Based on this task, participants can choose two choices between a smaller immediate reward and a larger reward with a time delay.

Table 1. Baseline demographic variables and variables related to participant heroin addicts

Factor	Groups		
	Abstinence	Relapse	Dropout
Age (year)	44.6 ± 8.8	47.7 ± 6.1	46.4 ± 7.9
Gender			
Male	77	19	37
Female	27	26	30
Education			
Elementary school	21	6	11
Secondary school	11	5	5
Bachelor	20	11	17
Associate degree	19	8	12
College degree	19	7	14
PhD	14	8	8
Career			
Janitorial	38	28	26
Administrative and service personnel	65	22	17
Teachers	5	3	3
Researchers	5	2	2
Duration of heroin addiction (year)	2.6 ± 3.6	2.8 ± 2.7	2.7 ± 3.5
Rate of daily use (g)	135.2 ± 11.2	83.7 ± 12.9	123.9 ± 12.3

Data are presented as number or mean ± standard deviation (SD)

Delay discounting (DD) describes how rapidly rewards miss their value when the time delay in receiving immediate rewards increases, and it also elucidates how inattention to long-term outcomes of a behavior reduces their ability to control intended behavior. In this task, individual should select options with a relative value. For data analysis, we use Analysis of variance (ANOVA). Participants can gain a large amount of money after a period of time (time delay) or obtain a little amount immediately.[22] Implementation of DD takes nearly 20 minutes. Before the evaluation, the experimenter explained to all the participants how to use the computer mouse.

Behavioral Inhibition System/Behavioral Activation System (BIS/BAS) Scale: In this study, Carver and White[23] BIS/BAS questionnaires were used to measure the reward-seeking behavior pattern. They consist of 24 items that are scored by Likert method. Of these 24 items, 7 items belong to the BIS scale and 13 items belong to the BAS scale. The BAS scale consists of three subcategories: drive, reward-seeking, and a response to a reward, and 4 items are divergent items that are not graded. Internal consistency (Cronbach's alpha) for the BIS subscale was 0.74 and internal consistency for the BAS subscales, a response to a reward, drive, and reward-seeking was reported to be 0.73, 0.76, and 0.66, respectively, by Carver and White. In Iran, their reliability and validity have been obtained by Abdollahi Majareshin et al.[24] According to their reports, the alpha coefficient for the BIS scale was 0.66 and for the BAS subscales, i.e., rewards, drive, and reward-seeking, was 0.64, 0.70, and 0.61, respectively.

Results

Actually, using group variables (maintained abstinence, relapse, and dropout) as factors, an inter-group unifactorial design was performed. Also, BAS variables of the Carver and White BAS questionnaire (drive, reward-seeking, and reward response) were used as dependent variables. These ANOVAs found statistically significant differences in reward-seeking ($F = 5.187$, Minimum Classification Error (MCE) = 858.497, $P = 0.01$). In addition, impulsivity (DDT) was used as dependent variable and this AVOVA showed statistically significant differences ($F = 5.789$, MCE = 0.413, $P = 0.01$) (Table 2).

To compare data for the DDT and reward-seeking variables, "post hoc" multiple comparison tests (Tukey test) for three groups were used which have been shown in table 2. Scores of dropout and relapse groups in reward-seeking variable were higher than the abstinence group scores and this difference was significant in $P < 0.01$ level. Similarly, scores of DDT variable were higher in dropout and relapse groups than the abstinence group and this difference was significant in $P < 0.01$ level.

Table 2. Mean, standard deviation (SD), significance level, and "post hoc" multiple comparison tests (Tukey test) for the three groups (abstinence, relapse, and dropout) in the variables analyzed

Factor	Groups			F	Eta	P#
	Abstinence (mean ± SD)	Relapse (mean ± SD)	Dropout (mean ± SD)			
Reward-seeking	63.70 ± 8.20	74.10 ± 6.40	72.80 ± 7.90	5.187	0.091	0.01**
Respond to reward	56.30 ± 11.10	57.60 ± 10.30	54.90 ± 12.20	2.491	0.031	0.16
Drive	51.10 ± 13.40	52.60 ± 13.90	50.80 ± 14.50	0.989	0.028	0.18
DDT	0.51 ± 0.25	0.59 ± 0.18	0.61 ± 0.15	5.789	0.096	0.01**

**P < 0.01, #Tukey test
DDT: Delay Discounting Task; SD: Standard deviation

Discussion

Our results showed that the higher rates of DD and reward-seeking were related with relapse of heroin use and constant use of heroin. In other words, higher rates of DD and reward-seeking can affect the relapse and dropout of heroin addiction treatment and maintenance of heroin use.

Some studies[25-28] suggested that heroin addicts typically have impulsive tendencies and this factor leads to inability in abstinence from heroin use and increases the possibility of relapse. People with substance abuse disorders have impulsive behaviors and often prefer immediate reward related to substance use than long-term and greater rewards, for example, health, good family relations.[29,30]

In addition, in agreement with our study, Oscar-Berman and Blum[31] showed that SUD group increased the tendency to opt in favor of the immediate reward (loss strategy) more than the long-term option (win strategy) compared to the control group. Secondly, higher reward-subscale scores (BAS) were observed in SUD. Thirdly, SUD showed an increase in left-hemisphere activation in response to losing (with immediate reward) choices in comparison with the control group.

Based on studies that were implemented on drug addiction, relation between impulsivity and addiction included two distinct but rival systems in decision-making control.[11] One of them is located in amygdala and operates as indicator of pain and pleasure of immediate perspectives and has been known as impulsive system. Another one is located in prefrontal cortex and its function is to show pain or pleasure of future perspectives and has been known as reflexive system.[11,14] The bottom-up system tends to elevate rewarding and habitual behaviors and responds to immediately available cues, regardless of the long-term negative consequences. Besides, based on Gray's theory,[16] the high sensitivity of BAS is due to the high level of the activity of neural circuits of reward, or the same mesolimbic DA pathway which leads to a brain which is sensitive to reward, behavioral activation to enjoyable stimulants, and high rate of responding to reward that these specifications can be related to tendency to using drugs. In addition to the agreement with the Reward Deficiency Syndrome (RDS) theory,[31] the intense seeking of pleasure and high level of impulsivity in the people with this syndrome is to reach a similar level of reward which normal people experience. In fact, a person with the fault in the ability of pleasure and reward attainment finally can gain a similar amount of enjoyment and reward by addictive stimulants (impulsive behaviors). In other words, the inability of reward attainment from usual stimulants and anhedonia leads to impulsive and risky behaviors such as drug use. Based on reward cascade theory,[32] release of serotonin in hypothalamus causes stimulation of enkephalin and it causes inhibition of gamma-aminobutyric acid (GABA) in substantia nigra and finally, it regulates released DA in nucleus accumbens (NAc). Therefore, impairments in brain reward cascade lead to lack of DA receptors. This trait leads to drug-seeking behavior.

Also, based on low arousal theory/hypothesis,[33,34] the people with high rate of impulsivity such as anti-social personality disorder seek self-stimulating in order to decrease their abnormal low arousal mode and in comparison with the people with low impulsivity, show lower heartbeat in rest time, while they show more and more intense reactions to encountering immediate rewards. Moreover, based on Marvin Zuckerman theory,[16,35] people with high sensation-seeking in comparison to the people with low sensation-seeking repeatedly engage in high-risk and impulsive behaviors such as dangerous motor riding and driving, drug and gambling, and parachuting. Therefore, in consideration of these

results, it is suggested that more examination and perception of impulsivity and other factors that are related with reward-seeking behaviors can bring important outcomes for the prevention and treatment of substance abuse especially for heroin addiction treatment.

Also, studying social and environmental factors in tendency to drug use and dropout of addiction treatment is important and studies showed that job factors (e.g., lack of permanent job), economic factors (e.g., strain of life expenses and poverty), educational factors (e.g., illiteracy), and familial factors (e.g., marital problems), also drug availability and interaction with addicted friends are important, because all of these factors in the environment can play a key role in increasing the craving and desire to using drugs. Therefore, we suggest that the future studies examine the role of social and environmental factors in dropout of addiction treatment.[36,37]

Conclusion

Overall, higher rates of DD, reward-seeking, and impulsivity were related with relapse of heroin use and constant use of heroin. In other word, higher rates of DD and reward-seeking behaviors can affect the relapse and dropout of heroin addiction treatment and maintenance of heroin use.

Conflict of Interests

The Authors have no conflict of interest.

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Authors' Contribution

Main investigator, designed the study, collected the data, performed analysis and wrote the first draft: AKV; Supervision: ABR; study advisors: AKV. All authors read and approved the final revision of the manuscript.

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نقش تکانشگری و حساسیت به پاداش در خروج از درمان اعتیاد در معتادان به هروئین

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مقاله پژوهشی

چکیده

مقدمه: تکانشگری و حساسیت به پاداش، از جمله مؤلفه‌های اساسی در سبب‌شناسی اختلالات مصرف مواد محسوب می‌شود. پژوهش حاضر با هدف بررسی نقش تکانشگری و حساسیت به پاداش در خروج از درمان اعتیاد در معتادان به هروئین انجام شد.

روش‌ها: ۲۱۶ نفر از معتادان به هروئین، در این مطالعه شرکت نمودند و در سه گروه پرهیز (۱۰۴ نفر)، عود (۴۵ نفر) و خروج‌کننده از درمان (۶۷ نفر) قرار گرفتند. برای جمع‌آوری داده‌ها، از مصاحبه نیمه ساختار یافته، مقیاس بازداری رفتاری/ فعال سازی رفتاری Carver و White (Behavioral Inhibition System/Behavioral Activation System یا BIS/BAS) و همچنین، آزمون رایانه‌ای کاهش ارزش تأخیری (Delay Discounting Task یا DDT) استفاده گردید.

یافته‌ها: میزان ارزش تأخیر و جستجوی پاداش در گروه‌های عود و خروج‌کننده از درمان، نسبت به گروه پرهیز بالاتر بود و این تفاوت در سطح $P < ۰/۰۱$ معنی‌دار بود.

نتیجه‌گیری: افراد دارای اختلال مصرف مواد مخدر، رفتارهای تکانشی دارند و اغلب پاداش‌های فوری مرتبط با مصرف مواد را به پاداش‌های بزرگ‌تر و طولانی مدت ترجیح می‌دهند.

واژگان کلیدی: رفتار تکانشی؛ پاداش؛ اعتیاد به هروئین؛ هروئین

ارجاع: بخشی‌پور رودسری عباس، کریم‌پور وظیفه‌خورانی علیرضا. **نقش تکانشگری و حساسیت به پاداش در خروج از درمان اعتیاد در معتادان به هروئین.** مجله اعتیاد و سلامت ۱۳۹۹؛ ۱۳ (۱): ۵۱-۴۵.

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