Cognitive Impairment in Addiction
Core or Comorbidity

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ABSTRACT

Background: Addiction is one of the most prevalent mental disorders in the world. It affects the individual and the population as a whole on the social, moral and economic levels. It manifests as drug seeking behavior in addition to drug use and persistent craving even after considerable periods of abstinence. Some theories suggested that the core of this disorder from the neuropsychological point of view is impaired cognition. 

Aim: assessment of different cognitive domains in opioids addicts comparing them with healthy controls.

Methods: Multiple cognitive tests were used including Processing speed using the Digit Symbol task from the Wechsler Adult Intelligence Scale, visual-spatial functions, constructional ability and visual memory by using -Rey-Osterrieth Complex Figure Test, visuo-constructive abilities by using block design task from the Wechsler Adult Intelligence Scale, auditory verbal working memory by using digit span task from the Wechsler Adult Intelligence Scale, abstraction and verbal concept formation by using similarities task from the Wechsler Adult Intelligence Scale and active attention in addition to speed of processing by using Trail A and Trail B making test.

Results: There was no significant statistical difference in the digit symbol, block design, digit span and similarities between the two groups reflecting no significant impairment in attention, recent memory and abstraction.

Conclusion: Addiction is not always associated with cognitive impairment. However, its presence leads to worsening of prognosis and more vulnerability to relapse. However, further studies are needed with larger samples to verify its role in the addictive process.

Keywords: Addiction, cognition, core

1. INTRODUCTION

Addiction is one of the most prevalent mental disorders especially if behavioral addiction is included. It has many negative consequences that affect the individual and the population as a whole on the social, moral and economic levels(1). It manifests as drug seeking behavior in addition to drug use and persistent craving even after considerable periods of abstinence. Some theories suggested that the core of this disorder from the neuropsychological point of view is impaired cognition. There are different brain regions that are implicated in both essential cognitive functioning such as attention, learning and also implicated in addiction. Substance use change normal brain structure and functioning producing cognitive impairment that in turn leads to persistent need for substance. This occurs through maladaptive way of learning and suppression of other behaviors that promote abstinence(2).
One of the important facts concerning addiction is the high vulnerability to relapse when addicts return to their main environment where the addictive behavior developed\(^3\). Many studies related that to the cues associated with substance that leads to pathological conditioning and craving\(^4\).

Addiction was described as a process that is formed of two stages. At the beginning, it starts with occasional intake that increases gradually to become chronic and uncontrolled. The brain’s reward system is affected in this stage causing multiple symptoms. Normally, dopamine in this system which is composed mainly of the ventral striatum and the nucleus accumbens is responsible on producing pleasurable feeling. This pushes different organisms including human beings to seek different activities, such as eating, and having sex. In the addictive process, hyperactivation of this system occurs leading to significant increase in the dopamine signaling inside the nucleus accumbens. This in turn leads to high sensations that encourages additional drug taking, and allow the formation of pathological drug-stimulus associations\(^5\).

As for the second stage, the cognitive process takes the upper hand. There are different additional features such as the withdrawal symptoms in the early abstinence, persistent ability to relapse, and changes in decision making besides other cognitive processes. In this stage, alteration of the dopamine in the reward system is important but actually it is not sufficient to allow these complex changes. Kalivas and Volkow explains the role of glutamate from the brain area that is responsible for judgment—the prefrontal cortex—to the nucleus accumbans\(^6\). Le Moal and Koob explained the changes in brain circuits related to stress and the negative reinforcement (i.e., effects that promote drug intake). Therefore, early drug use allows maladaptive drug associations that promote drug seeking and use and the later stages disrupt cognitive processes that are necessary for successful abstinence\(^7\).

The exact extent of drugs’ impacts on cognitive process is not yet well known, but many researches indicate that there are alterations in brain regions including the striatum, hippocampus and the prefrontal cortex\(^8\). These regions are responsible for declarative memory which is the memory that defines an individual. It is very important in generation and maintaining a concept of self\(^9,10\). Drugs’ capacity to act upon the components of declarative memory suggests that they have extremely important impact on cognition.

Moreover, it was proved that many drugs produce cognitive impairment that leads to difficult abstinence. Studies concerning cocaine and opioids showed deficits in cognitive flexibility. Other studies showed impairment in working memory and attention associated with alcohol abuse\(^11,12\). Also, amphetamine abuse leads to deficit in attention and impulse control\(^13\). In this research, the aim was to assess different cognitive domains in opioids addicts comparing them with healthy controls in order to clarify the type of cognitive impairment associated with this type of substance use.

2. METHODS

This was a cross sectional study. The sample consisted of two groups. The first group included 14 participants presenting with history of substance abuse selected from the inpatient and outpatient of the psychiatry department. It was homogenous to the control group. There were no symptoms of intoxication or withdrawal. They reported no history of head trauma or dementia. There was no current mood disorder or psychosis.

The cases were subjected to Semi-structured interview which was applied by using a modified clinical sheet of psychiatry department designed to diagnose different psychiatric disorders according to DSM IV-TR criteria. This clinical sheet starts by covering all the basic demographic data including name, age, sex, address, occupation, education, etc. This is followed by the complaint reported by the patient and the informant, history of presenting illness, past psychiatric history, substance history, family history, .Present mental state, risk assessment diagnosis and current treatment.

Structured Clinical Interview for DSM IV (SCID) for diagnosis of psychotic disorder was done (Spitzer et al., 1992). Multiple cognitive tests were used including Processing speed by using the Digit Symbol task from the Wechsler Adult Intelligence Scale, visual-spatial functions, constructional ability and visual memory by using -Rey-Osterrieth Complex Figure Test, visuo-constructive abilities by using block design task from the Wechsler Adult Intelligence Scale, auditory verbal working memory by using digit span task from the Wechsler Adult Intelligence Scale, abstraction and verbal concept formation by using similarities task from the Wechsler Adult Intelligence Scale and active attention in addition to speed of processing by using Trail A and Trail B making test.
3. RESULTS

The two groups were homogenous in age and sex. Mean age was 30 years with no significant statistical difference with the control group. Onset of substance intake (cannabinoids and opiates) varied from one year to 15 years. The other group consisted of twenty healthy participants homogenous to the other group in age and sex with no history of head trauma or dementia and no current mood disorder or psychosis.

There was no significant statistical difference in the digit symbol, block design, digit span and similarities between the two groups reflecting no significant impairment in attention, recent memory and abstraction. Also, in trail A and B, there was no significant statistical difference between the substance group and the control group (table 1).

Table 1: Comparison of the mean values of Cognitive functioning between the patients and control groups

<table>
<thead>
<tr>
<th></th>
<th>Patient group</th>
<th>Control group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td>Digit symbol</td>
<td>8.7(3.05)</td>
<td>9.15(3.1)</td>
<td>0.21</td>
</tr>
<tr>
<td>Block design</td>
<td>9(2.48)</td>
<td>7.45(1.7)</td>
<td>0.07</td>
</tr>
<tr>
<td>Digit span</td>
<td>9.7(3.51)</td>
<td>6.55(2.8)</td>
<td>0.06</td>
</tr>
<tr>
<td>similarities</td>
<td>9.57(2.59)</td>
<td>9.65(1.95)</td>
<td>0.43</td>
</tr>
<tr>
<td>Rey ostrich (copy)</td>
<td>32.57(3.9)</td>
<td>31.5(4.81)</td>
<td>0.92</td>
</tr>
<tr>
<td>Rey ostrich (Recall)</td>
<td>17.21(7.2)</td>
<td>15.2(8.18)</td>
<td>0.41</td>
</tr>
<tr>
<td>Trail A (in seconds)</td>
<td>67(24.6)</td>
<td>85.55(65.5)</td>
<td>0.08</td>
</tr>
<tr>
<td>Trail B (in seconds)</td>
<td>182.14(77.15)</td>
<td>203.8(87.5)</td>
<td>0.073</td>
</tr>
</tbody>
</table>

4. DISCUSSION

The aim of this study was to assess cognitive impairments in patients presenting with substance abuse in different cognitive domains including the problem solving abilities, as an indicative of executive function, the auditory verbal short-term (working) memory and the verbal concept formation. Also, we assessed the visuo-constructive abilities, the visual memory, attention and task switching.

Cognitive impairment has a dimensional nature in different psychiatric disorders such as schizophrenia and substance abuse. Cognitive research has an important impact on understanding more about the normal physiology of the brain and the related cognitive processes in normal individuals not only in patients presenting with substance abuse. In this study, there was no significant impairment between the two groups in different psychometric tests. This was consistent with a recent study that found no significant impairment after substance abuse. On the contrary, they found improved memory which raised a big questionmark(14). On the other hand, it was not consistent with another study that discussed the use of opioids and showed impairment in different cognitive skills, including verbal fluency, planning, and shifting attention from one task to another. This may be attributed to assessment of different type of opioids in the study in addition to the longer term of abuse(15).

One of the most important clinical implications here is the need for highlighting the past and present cognitive functioning during the management of patients with addiction. The presence or absence of cognitive changes may guide patients toward actions that could promote or inhibit the cycle of addiction. Clinicians face an important challenge which is helping patients master to overcome the pathological associations that may lead to relapse when patients go back to the environments with their past substance use. Moreover, cognitive impairment may prevent patients’ ability to accept and understand counseling, and more sessions that may be necessary to help these patients in maintaining different strategies that promote abstinence into their daily routines.

Research in the cognitive impairment that accompanies the addictive process and the neural changes of learning is still in its primary steps but has the ability to reshape different theory in addiction. Some theories proposed that cognitive impairment is the core that triggers the addictive process. Other theories assume that it is a co-morbidity or a consequence of substance abuse. A recent discovery that was interesting in the addiction field is that smokers who suffered from damage to the insula usually lose their desire to smoke(16). The authors here explained that the insula has an important role in the urge to smoke and that modulation of the function of insula may promote smoking cessation. It can be also
explained that damage to the insula may affect the desire to use other drugs of abuse\(^\text{[17]}\).

So, we can say that the more the understanding of the mechanism underlying cognitive impairment in substance abuse, the ability to develop new therapeutic agents will be more successful in both treating addiction and improving cognitive deficits. This is a complex task because different drugs of abuse seem to change many cognitive domains and cell signaling pathways. Also, there are different factors that affect the type and the degree of cognitive impairment. It differs according to the variations and differences in environmental factors and genetics. In the future research, it is important to understand the effect of an individual’s genetic background on the symptoms in order to tailor more effective treatments according to the individual’s genotype\(^\text{[18]}\).

5. **CONCLUSION**

Addiction is not always associated with cognitive impairment. However, its presence leads to worsening of prognosis and more vulnerability to relapse.

**REFERENCES**

1. Effertz T., Mann K. The burden and cost of disorders of the brain in Europe with the inclusion of harmful alcohol use and nicotine addiction. European Neuropsychopharmacology. 2013; 23(7), 742–748