Ketamine and Driving, Cognitive, and Motor Ability

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Ketamine is a medication that has many medical purposes but also has been used illicitly by people for its dissociative properties. While driving under the influence of drugs, drivers are more likely to be involved in and cause more accidents than drivers who do not drive under the influence. A study with ketamine and a ketamine-like medication, rapasitnel, showed that those who were given ketamine experienced more sleepiness and had decreased self-reported motivation and confidence in their driving abilities. Moreover, there seem to be significant differences in the acute versus persistent effects of ketamine, as well as the anesthetic versus subanesthetic doses, both in terms of effects and outcomes. These divergent effects complicate the clinical uses of ketamine, specifically involving driving, drowsiness, and cognitive abilities.

ketamine driving cognitive abilities

1. Introduction

Roadside studies suggest that up to 15% of drivers drive under the influence of one or more substances that can cause impairment [1]. While driving under the influence of drugs, drivers are more likely to be involved in and cause more accidents than drivers who do not drive under the influence. Additionally, when drivers are under the influence of more than one substance simultaneously, the level of impairment they experience behind the wheel is further amplified. The issue with this isn't necessarily with the chronic administration of a substance but rather the acute intoxication of a substance that is of concern. The issue is with the unchecked acute administration and intoxication that changes the reaction time of the people who consume them. This can be especially true in those who are naïve to the substance in question.

Ketamine is a medication that has many medical purposes but also has been used illicitly by people for its dissociative properties. Ketamine has been used for premedication, sedation, and induction/maintenance of general anesthesia for decades [2]. It is an ideal anesthetic agent for trauma victims, those with hypovolemic shock, septic shock, and for patients with pulmonary diseases due to its bronchodilation effects and stimulation of the sympathetic nervous and cardiovascular systems [2]. It has also been used to alleviate the symptoms of treatment-resistant depression and depression associated with other disease states [3]. Ketamine has been studied for various psychiatric conditions ranging from schizophrenia to depression to various substance use disorders [4][5]. Patients have been treated with treatments that focus solely on the monoamine hypothesis of depression [6]. Only around half of patients respond to treatment, and treatment in those who originally respond may become refractory.

There has been a move to look at the glutamate system and its involvement in depressive symptoms, and this is where ketamine plays a role in treatment-resistant cases [6]. This glutamate activity is thought to be through the N-methyl-D-aspartate (NDMA) receptor activity. There is even a thought that ketamine could be a possible treatment through its NDMA receptor activity to treat depression seen in patients with Alzheimer's Disease [3]. Ketamine administration for medical and psychiatric purposes is typically conducted in a specialty clinic or hospital setting under a trained clinician's supervision. Recently, there has been the invention of "at-home ketamine treatments" from various online companies offering people a chance to get this treatment on demand without the direct supervision of a physician when it is used. Although this can be thought of as a way to increase access to treatments for depression that patients may need, it also raises questions regarding ketamine's unsupervised use and the potential consequences that could occur, which can be unintentional. It can raise questions about the safety of acute ketamine use without the direct supervision of a clinician, including the lack of post-administration instructions such as not driving. Most clinics that use ketamine to treat patients with depression specifically state in their instructions for patients not to drive on the day after receiving ketamine and note that monitoring of the patient's mental status would be done for a few hours after ketamine is administered. The issue with at-home use is the acute mind-altering state that ketamine can produce when the person is acutely under the influence of it and whether ketamine can safely be administered without the supervision of a physician.

2. Ketamine and Driving, Cognitive, and Motor Ability

With its abundant psychotropic effects, ketamine is known to cause dissociation, depersonalization, euphoria, anxiety, psychotic experiences, paranoid thoughts, out-of-body experiences, and near-death experiences (collectively referred to as "K-hole") [7]. It should be noted that these side effects are not felt by every patient. For example, dissociation is experienced due to individual patient differences, but it should be noted that it could be an effect of ketamine. Some of these side effects, particularly the out-of-body and near-death experiences, are thought to be why recreational ketamine use has been on the rise. Further possible effects include slurred speech, vomiting, drowsiness, confusion, reduced/increased motor activities with stereotypes and mannerisms, lack of coordination, dystonia, and motor paralysis/rigidity/ataxia [7]. Additionally, ketamine can affect visual acuity by blurring vision and causing visual field narrowing [7]. A study looked at similarities and differences in terms of impulsivity and cognitive abilities among ketamine users, methadone users, and participants who do not use substances [8]. The authors found that ketamine users performed the worst in the 2-back accuracy and stop signal task when compared to methadone users and non-substance users. Ketamine users showed no deficits in decision making but did exhibit strong impulsivity and poor response inhibition, along with poor working memory at levels similar to methadone users [8]. This is not to say that if at-home ketamine was used in the ways that were intended that this would be the same for these patients since the participants in this study were in active addiction to recreational ketamine. However, the abuse potential could be there with unchecked at-home use, thus putting patients at risk for these deficits.

People who self-administer high doses of ketamine may be at risk for cardiovascular and respiratory toxicity [7]. Long-term use of ketamine can lead to tolerance, dependence, withdrawal signs, and flashbacks with symptoms

and perceptual distortions that may persist even after the individual is no longer using ketamine [7]. Up to one-third of individuals with long-term recreational ketamine use have persistent urological symptoms, including dysuria, suprapubic pain, hematuria, and hydronephrosis, collectively known as “K-bladder” [9]. They may also experience intestinal problems, known as “K-cramps” [7].

The growing quantity of subanesthetic doses taken may explain why there has been an increasing number of side effects in individuals using ketamine. Ketamine produces these effects by reducing the spatial tuning of the individual neurons, which leads to a loss of encoded information about the target location at a neuronal level [10]. Ketamine has been shown to affect the neocortex by disturbing the excitation inhibition balance within the prefrontal cortex, which ultimately leads to selective working memory deficits [10].

Ketamine can also affect multiple cognitive domains in rhesus monkeys. These primates were trained on a neuropsychological battery. They were given subanesthetic doses of ketamine and then showed a decline in both visual recognition and working memory in a dose-dependent manner [11]. This test showed that ketamine decelerates the reaction time of these primates and decreases the fine motor coordination [11]. It has also been shown that repeated ketamine-xylazine during early development can significantly impair motor development and learning-dependent dendritic spine plasticity later in life [12]. This reduction in synaptic structural plasticity may underline anesthesia-induced behavioral impairment [12]. Moreover, using ketamine produces long-lasting neuroadaptations that could potentially contribute to addiction [13].

It is widely accepted that individuals who use ketamine may face outcomes that could significantly affect them. In addition to motor-impacting symptoms, these effects could significantly increase the probability of causing an accident for individuals who drive under the influence of ketamine. In addition to the symptoms discussed above, ketamine can cause numbness, muscle weakness, and distorted perception. This can be harmful not only to the individual if it results in a fall but also harmful to others if these effects occur while behind the wheel [7]. Additionally, ketamine has been shown to cause alterations in eye movement, decreased visual search performance, and increased time spent off-target [7]. These impairments suggest that ketamine users may have significant difficulty tracking the road and other objects moving on the road, including people or other cars [7]. It has additionally been demonstrated that the use of recreational ketamine is associated with increased reported fatalities [7]. Not only are those directly under the influence of ketamine more likely to be involved in an accident, but even after ketamine is out of their system, it can still potentially affect the individual. This suggests that individuals who no longer use ketamine are at a higher risk of causing or being involved in a traffic accident. It is clear that ketamine can affect individuals in numerous capacities and that driving under the influence of ketamine puts those on the road in more danger.

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