The abuse of stimulant drugs within the medical education setting

Abstract

The rising abuse of stimulant drugs – traditionally reserved for the treatment of attention deficit and hyperactivity disorder (ADHD) – as cognitive enhancers in academic environments has serious implications in medical education and practice. In this article we report on the nature of these drugs, and the prevalence of their abuse in relation to ADHD diagnosis in Europe and abroad. We also highlight the ethical pitfalls of neuroenhancement in medicine to help forecast cultural and administrative changes that may be necessary to protect the integrity of the medical field in the future.

Royal College of Surgeons in Ireland Student Medical Journal 2013; 6(1): 74-8.

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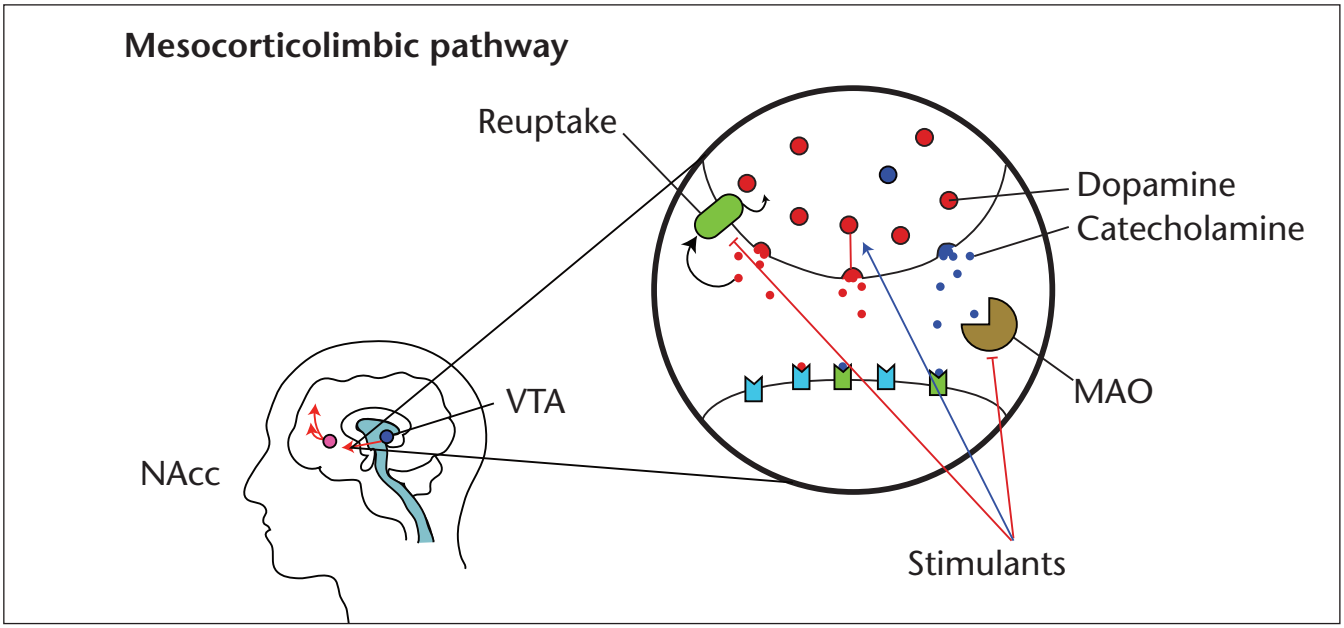

FIGURE 1: The neuropharmacology of stimulants: stimulants exert their effects on the mesocorticolimbic pathway augmenting dopamine and catecholamine transmission by blocking reuptake and degradation by MAO as well as promoting vesicle fusion.
MAO – monoamine oxidase; NAcc – nucleus accumbens; VTA – ventral tegmental area.

Introduction

Stimulant drugs (amphetamine and methylphenidate) used widely to treat attention deficit and hyperactivity disorder (ADHD) have come under scrutiny for their pervasive use as academic enhancers – reportedly as high as 35% in college-aged adults.[1] While their seemingly ubiquitous use in high school and college settings across the United States has gained attention recently in the media,[2] little is known about their use in our area of particular interest, medical education and practice. This is especially true within Europe.
In this article we explore the pharmacology and abuse of stimulant drugs, as well as providing a discussion on the relationship of abuse to ADHD prevalence. We highlight the potential dangers behind such use in a medical academic setting in order to draw attention to a problem that is not widely recognised in Europe.

The properties of stimulants

The stimulants methylphenidate (Ritalin) and amphetamine (Adderall) are two common and highly efficacious treatments for ADHD, a neuropsychiatric disorder.[3] These drugs act through the augmentation of catecholamine and dopamine neurotransmitters by driving their release from the synaptic cleft, inhibiting their reuptake, and inhibiting the catabolic monoamaine oxidase (MAO) system.[4,5] The dopaminergic effects of these drugs are mediated mainly by the mesocorticolimbic system, originating from the ventral tegmentum of the midbrain and projecting to the nucleus accumbens, as well as most of the cortical mantle – the function of which is the mediation of response reinforcement (reward).[5]
More importantly, the noradrenergic effect of these drugs is exerted primarily on the central noradrenergic network originating in the locus coeruleus and projecting to the median forebrain bundle, the limbic system, and generally throughout the brain.[5,6] This system arbitrates selective cognitive functions including the orienting response (an organism's reaction to a gradual change in the environment), selective attention and vigilance.[5] The deregulation of the noradrenergic system has been implicated in the pathogenesis of ADHD corresponding with the therapeutic effect of stimulants for this condition.[7,8]
Stimulants have the ability to dramatically improve patient performance in sustaining attention – especially for tedious or monotonous tasks.[9] While the therapeutic impact of stimulants on ADHD can be significant, it is clear that their effects would be desirable for anyone wishing for an increased ability to sustain focus. Thus, their potential for illegitimate use as so-called academic doping agents is broad.

Adverse effects of stimulants

While stimulants such as methylphenidate and amphetamine are effective treatments of ADHD, and are generally well tolerated in the short term, they do have similar reinforcing properties to cocaine, with a potential for dependence.[10,11] In addition, while the long-term effects of protracted stimulant use are not known, they may contribute to sensitisation to dependence on other substances or trigger psychiatric disorders such as panic, aggressive behaviour and increased risk of suicide (particularly at high doses).[11,12] Furthermore, stimulant abuse has been shown to have adverse cardiovascular effects, as well as causing insomnia, anorexia, hypertension and headache.[13] Withdrawal effects of stimulants, while well characterised in amphetamine, are less understood in

methylphenidate use.[14] Nonetheless, in their study on rats, Ferreira *et al.* showed an increase in anxiety secondary to sensitisation of an anxiety-provoking brain region after methylphenidate infusion.[14]
In spite of these adverse effects, stimulants are generally considered safe and their narrow side-effect profile, coupled with their augmentation of focus and concentration, make them ideal for intellectual enhancement. While the distinction between the term misuse, or improper use of prescription drugs, and the term abuse, implying the use of the drug outside of a prescription, may be made, for simplicity, the term abuse will be used for both of these definitions for the remainder of the article.

ADHD: the world-wide problem

The easy accessibility of stimulant drugs such as methylphenidate stems from the high prevalence of ADHD.[1] ADHD is a worldwide problem, but there is no consensus on prevalence. US studies suggest that ADHD affects 6-8% of children and 4-5% of adults.[15] By contrast, in 2008, the influential UK-based National Institute for Health and Clinical Excellence (NICE) published a clinical summary of best practice in the UK for ADHD, which included the following statement: "Based on ICD-10, hyperkinetic disorder is estimated to occur in about 1-2% of children and young people in the UK. In contrast, using the DSM-IV, ADHD is thought to affect about 3-9% of school-age children and young people in the UK, and about 2% of adults worldwide".[16] The discrepancy in prevalence rates between the US and the EU stems from differences in diagnotic and cultural methodology (discussed below).
ADHD is associated with a high level of comorbid psychopathology and has significant deleterious impacts on a patient's functional life.[17] Moreover, while many cases of ADHD can persist into adulthood, symptoms tend to decrease by 50% every five years from ages 10-25,[18] suggesting that prescription rates should also experience a concurrent plateau. Nonetheless, the manufacturing of methylphenidate for medical use has increased by 40% since 1993 in the US.[19]
Originally, ADHD was thought to be most prevalent in the US due to pathogenesis models, which implicated societal factors common in America as triggers for the disease – some studies even citing a 20-fold greater prevalence in America.[15,20] This purported discrepancy in prevalence was largely the result of several technical and societal factors. Foremost, ADHD has historically been much more readily diagnosed in the US owing to the extensive research conducted on the subject in the country, and thus a heightened awareness on the topic compared to European countries.[15]
In addition, several methodological differences have extenuated the inconsistency in prevalence rates of ADHD between the US and Europe. For example, variation in diagnostic paradigms such as the use of the DSM criteria for ADHD in the US, which utilised a broad, more inclusive diagnostic category, and its ICD equivalent of hyperkinetic disorder in Europe – which has a narrower, less inclusive criteria – have likely contributed to lower reported levels of ADHD in Europe as reported by the NICE summary.[15,16] Moreover, these criteria systems tend to be less strictly applied to patient populations in Europe.[15]
Finally, cultural dynamics such as misconceptions of the severity of adverse effects of ADHD as well as apprehension towards the use of stimulant treatment in Europe have simulated lower prevalence rates.[15] It is also worth pointing out that some of the medications commonly used in North America are either not licensed in Europe or are not licensed for the treatment of adults.
Nonetheless, in their meta-analysis comparing the prevalence rates of ADHD in the USA and other countries, Faraone *et al.* indicate that initial differences in prevalence of ADHD were due primarily to confusion regarding the diagnostic criteria and that the rates of ADHD may be as high in other countries as in the USA.[15] As stimulant abuse stems indirectly from the prevalence of ADHD and the availability of stimulant drugs,[14] this information would suggest that a similar potential for abuse of stimulant drugs used to treat ADHD exists in Europe as it does in the USA.

The abuse of stimulants

In their American review, Wilens *et al.* reported a non-prescription stimulant abuse rate for both academic enhancement and recreation to be 5-9% in grade school- to high school-aged children, and from 5-35% in college-aged adults.[1] The highest rates of abuse were found in studies that focused on individual academic institutions (as opposed to multiple), which suggests that the competitiveness of a college environment may predict which groups are likely to abuse the drugs.[1,21] Demographic studies reported that men are more likely to abuse than women,[12] and that the Caucasian race is more likely to abuse and divert (illegally sell prescriptions) stimulants than other races.[1] Further information concerning the social classes and academic disciplines most likely to abuse stimulants remains unknown.[1,21]
McCabe *et al.* report that the majority of those who abuse stimulants obtain them from their peers.[21] Thus it would appear that the growing prescription of these drugs by physicians has directly contributed to their availability for abuse.[19] In a separate report, Jardin *et al.* document that as many as 11% and 22% of those ADHD patients with legitimate prescriptions sell or abuse their medications, respectively.[1,22] Teter *et al.* reported that of college students who misuse stimulants, 58% did so to concentrate, 43% for alertness, and 43% to get high, showing that the majority of abuse within the academic sphere is for performance enhancement.[12]
The rates of abuse in graduate and professional school (i.e., schools awarding postgraduate doctorate degrees such as PhD, MD and JD) are less well characterised. White *et al.* describe similar patterns but with lower rates of abuse of methylphenidate in graduate students respective to college students at the University of New Hampshire.[19] A study conducted at a medical school in Iran showed that 8.7% of students questioned had taken methylphenidate at least once on their lifetimes.[23]
Given the significant abuse in the undergraduate setting, more rigorous and multi-geographical studies are needed to determine the true prevalence of stimulant abuse within medical schools worldwide, as no research into this has currently been conducted. In addition, as many of these studies base their analysis on anonymous internet-based surveys, more rigorous sources of data such as

prescription databases should be studied. Finally, there is little written in the standards of good practice either within the UK General Medical Council or the Irish Medical Council specifically offering guidelines regarding the abuse of stimulant drugs within the medical workplace.[24,25]

The dangers of stimulant abuse in the medical education setting

As new methods of neuroenhancement are likely to become more available in the future (related to advancements in the treatment of Alzheimer's disease),[26] it is important to determine how medical students may use these drugs and how that will impact on their education. Practically speaking, stimulants improve a student's ability to perform in academic situations – they increase IQ scores on neuropsychological measurement tests,[27] enhance focus for the preparation of examinations, and allow increased wakefulness for prolonged writing or study.[19] Within the US, stimulants are used by college students both with and without a diagnosis of ADHD to enhance academic performance.[1,28]

This data raises several questions about the use of stimulants:

1. Are overachieving students trying to push their capabilities and should this be constituted as cheating?
2. Are students who have not been diagnosed with ADHD simply and appropriately self-medicating for an undiagnosed (but real) ADHD?
3. Are stimulants any different from other forms of psychiatric medication, which treat disabling mental illness and potentially improve academic outcome?
4. What are the professional ramifications of stimulant abuse to the practice of medicine?

In the following discussion, we offer a cursory evaluation of these questions, acknowledging the limitations of a rhetorical discussion in determining an absolute right or wrong answer.

The initial question with regard to stimulant abuse is whether it can be constituted as cheating, much as doping is for athletic competitions. Students who misuse stimulants may gain an unfair advantage over students who refrain from misuse.[2] However, in their study examining print media, public health literature and other sources, Forlini *et al.* reported ambivalence in regard to whether this can be construed as cheating.[26] Many sources cited likened stimulant abuse to access to private tutors, or any resources only available to a select group of students, which improve academic outcome.

In this regard a better understanding of the cognitive benefit delivered by stimulants vs. tutorial and their relation to long-term clinical performance is needed. For example, private tutorial is typically undertaken to improve comprehension of material, and thus an increased clinical performance is expected as a result. It is unclear if stimulants purely offer a temporary cognitive enhancement and improved concentration, or if they actually improve understanding, and long-term retention.

Secondly, given the high incidence of ADHD, it is possible that subsets of students who abuse stimulants are treating an undiagnosed ADHD. This confounds the argument that stimulant abuse in the academic setting may represent dishonest behaviour, as a proportion of these abusers may in fact be returning to a baseline cognitive status, as may be considered for a depressed patient benefiting from antidepressants. However, this argument can only apply to a fraction of those students taking these medications. If we were to accept the upper level estimate of 5% of the entire young adult population having ADHD, then any figure in excess of this implies misdiagnosis or misuse.

Furthermore, stimulant abuse differs from the treatment of other psychological disorders such as depression and anxiety in that they are directly nootropic – or neuroenhancing. Antidepressant or anxiolytic medication would not improve the cognitive function of a student with pre-existing mental illness. For example, a student taking antidepressants for depression would typically never exceed his intellectual potential, while it is easily conceivable for some students using stimulants for the treatment of ADHD to supersede their baseline cognitive ability.

Finally, our particular interest is in students of the health sciences, especially medical students. There are some obvious and important moral factors that are more likely to apply to clinical students, namely, that the transition to direct clinical responsibility is immediate upon graduating, with licensed access to prescribing. Both undergraduate and postgraduate medical studies are notoriously intense and competitive, with the potential for very long clinical hours, stress,[29] and the need to achieve academically present long after graduation. For these reasons, most medical schools give considerable emphasis to the use of sets of professional examinations as indicators of competence and fitness to practice. Stimulant use may blur the effectiveness of such instruments as they enhance the users' ability for focus and concentration.[9] At one extreme, students who may have initially failed an exam, but who pass with the aid of stimulants and are allowed to progress in their careers, may become liabilities in future practice. More likely is a scenario where a student who uses this type of medication may rightly or wrongly be convinced that their examination success is dependent on the stimulant, which raises questions about their confidence as future medical practitioners. By abusing these drugs, students may be committing to lifelong use of stimulants to perform in the medical setting.

While many medical students may gain temporary enhancement from the use of such drugs, the consequences of withdrawal and return to normal cognitive function also raises ethical questions regarding patient care. It is possible that students may return to an even lower cognitive ability once the effects of the drugs have worn off due to physiological anxiety, dependence and other cognitive side-effects of the drugs.[11,13] These factors are likely to decrease their clinical judgment as well as their ability to cope with stressful situations in a medical setting.

Conclusion

In conclusion, it is possible that neuroenhancement may become commonplace in the future as many drugs in development for the

treatment of disorders such as Alzheimer's disease may have the potential to augment cognitive ability.[26] Even current medications for cognitive enhancement are generally so ubiquitous, and well tolerated over long-term courses, that they might seem a smart choice for a struggling student. As competition becomes more intense, stimulants could seem a realistic option for improving chances of success. Nonetheless, the use of stimulants by individual medical students and healthcare professionals remains fraught with both medical and ethical issues.

Future studies into the prevalence of stimulant abuse on medical school campuses are required. Many of the current studies examining this problem make use of potentially biased internet-based surveys to determine level of use and thus have limitations on the impact of their evidence. In addition, further studies exploring the ethical qualitative and quantitative impact of attention-enhancing medication on healthcare are required.

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