Homicidality and Psychosis Caused by an Over-the-Counter Performance-Enhancing Supplement Containing Dendrobium Extract and L-Dopa

Alexandra Flynn, MD, PhD; Jana Lincoln, MD; and Michael Burke, MD, PhD

Keywords: anabolic steroids, bodybuilding, dendrobium, homicidality, human growth hormone, L-dopa, muscle mass, over-the-counter supplements, performance-enhancing supplements, psychosis

INTRODUCTION

We describe a 30-year-old man who was admitted to our hospital complaining of “being drugged with methamphetamine,” along with psychotic and homicidal features, likely caused by four-month use of an over-the-counter (OTC) performance-enhancing supplement (PES) product containing dendrobium extract and L-dopa (L-3,4-dihydroxyphenylalanine). The patient denied a history of psychotic illness. He had abstained from anabolic steroids for four months and from alcohol for two months before admission. Treatment with oral olanzapine during the patient’s 13-day hospitalization led to the resolution of his psychosis and homicidality. He was discharged to outpatient care with a primary diagnosis of substance (PES)-induced psychotic disorder (resolved).

Because of our inability to ascertain the precise chemical structure of the PES product the patient had used, we based his diagnosis on: 1) the clinical presentation (psychosis, homicidality, and “feeling drugged with methamphetamine”); 2) the longitudinal and recent history (psychiatric and substance-use history, and use of hormones and OTC PES products) obtained from the patient and his family; and 3) the use of a PES containing L-dopa and dendrobium extract, and literature reporting the adulteration of PES products with synthetic methamphetamine analogues.

Current knowledge of the safety profile of PES products and of the risks associated with their use is limited by the lack of Food and Drug Administration (FDA) pre-marketing regulations, by the minimal research into PES products, and by patients’ underreporting of their PES use. With this case report, we wish to bring the risk of potentially severe psychiatric problems caused by the use of OTC PES products to the attention of practitioners.

CASE REPORT

Presentation

A 30-year-old Caucasian male presented to our hospital after he had walked off his job because of a strong urge to kill his boss and a customer while experiencing a visual hallucination of committing the act. During an assessment in the psychiatric emergency service, his mental-status examination showed a distressed, alert, and fully oriented male concerned about his violent thoughts and worried about the loss of his muscle volume. His affect was stable and congruent with his mood. His speech was underproductive and soft, with difficulty finishing sentences because of thought-blocking.

He reported hearing the voice of one of his halfway house housemates for the previous two to three weeks. The patient described the voice as commenting on his activities, except on the day of admission, when the voice instructed him to go to the hospital to get “locked up” to prevent him from hurting someone. The patient believed that one of his housemates had drugged him with methamphetamine because he knew the feeling from past methamphetamine use. For approximately three to four months, he was convinced that women from his gym and his hometown had created a secret group to treat his sexual repression by teasing him, wearing revealing clothes, and acting provocatively around him. In addition, he reported that his family was “after him,” but he couldn’t explain why.

His physical examination was normal except for bilateral gynecomastia and acne on his back. The admitting physician noted hypertrophic musculature consistent with bodybuilding. On admission, laboratory tests (i.e., comprehensive metabolic panel, complete blood count, urinalysis, urine drug screen, and thyroid-stimulating hormone test), a computed tomography scan of the patient’s head, an electrocardiogram, and vital signs were all within normal parameters.

Based on the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5), the patient’s psychiatric and substance-use histories were positive for oppositional defiant disorder and polysubstance dependence (methamphetamine, opiates, and alcohol) at the age of 13, leading to legal problems in his later teenage years. He graduated from an inpatient chemical-dependency treatment center approximately 18 months before his hospital presentation. For the previous five months, he had lived in a halfway house. The patient and his family reported that he occasionally used alcohol and marijuana after his dependency treatment; however, he had not used these substances for two months before his presentation. His medical and family histories were noncontributory. He was not taking any prescription medications before admission.

Hospital Course

After his admission to our hospital, the patient started taking dissolvable olanzapine 5 mg orally at bedtime to treat his hal-

Disclosure: The authors report no commercial or financial interests in regard to this article.

Dr. Flynn is a Psychiatrist in the Veterans Affairs Healthcare System, Robert J. Dole VA Medical Center, in Wichita, Kansas. Dr. Lincoln is an Associate Professor in the Department of Psychiatry and Behavioral Sciences at the University of Kansas School of Medicine in Wichita. Dr. Burke is Chief Medical Officer at Larned State Hospital in Larned, Kansas.
lucinations, delusions, and thought-blocking (Table 1). By the sixth day of his hospitalization, his symptoms had improved, and the olanzapine dose was increased to 10 mg at bedtime.

One day later, the patient reported using testosterone and human growth hormone (HGH) shortly after he had graduated from chemical-dependency treatment. He identified himself as a recreational bodybuilder who achieved his muscle bulk with exercise and with “cycles” of “testosterone boosters” combined with the “stacking” of HGH, both obtained from a street source. He alternated one month “on hormones” with one month “off hormones” for seven cycles (Table 2). While “on drug,” he felt “bulky” and energetic, was able to lift more weights, had an increased libido and appetite, and rated his self-esteem as “nine out of 10.” At the same time, however, he felt irritable, punched walls, had aggressive thoughts (not homicidal), and would isolate himself. While “off drug,” he experienced anabolic steroid withdrawal symptoms, including feelings of depression, anxiety, and fatigue; insomnia; appetite loss; the loss of self-esteem; a decreased libido; and a desire to restart steroid use.³⁻⁷ After 14 months, he interrupted “cycling” of the hormones because of the cost, the development of bilateral nipple tenderness, and the discovery of a lump under his right nipple. His last “cycle” of testosterone occurred approximately four months before his presentation to our hospital.

Despite vigorous exercise and the occasional use of HGH, the patient felt that his muscle mass was decreasing, and he started using an OTC PES product derived from the dendrobium orchid and L-dopa. His family reported that his behavior dramatically changed during those four months of OTC PES use (Table 2). According to his sister, the patient became even more obsessed with exercise, withdrew from his family, and began to feel that they were conspiring against him. He also started to make bizarre statements about women and sexual repression, and expressed the feeling that somebody had “drugged” him with methamphetamine. Later, he started to complain about hearing a male voice commenting on his behavior. He began to develop aggressive thoughts and eventually experienced a visual hallucination along with an unprovoked urge to kill his boss and a customer at his workplace. At that point, the patient quit his job and presented voluntarily at our hospital. The patient stated that he had never experienced his psychotic and homicidal symptoms before he used OTC PES products.

During days 7 through 10 of his hospitalization, the patient’s psychosis continued to improve (Table 1). He occasionally went to the cafeteria and interacted with the staff and his peers. At this time, he informed the health care team of his OTC PES use, and his olanzapine dose was increased to 15 mg at night on hospitalization day 11. After two days on this regimen, the patient reported the resolution of his psychotic symptoms. He became more socially oriented, ate in the cafeteria, participated in group therapies, and interacted with his peers on the unit. During these last two days of hospitalization (days 12 and 13), the patient participated in psychoeducation regarding the health risks associated with the use of hormones and PES products, and improved his insight regarding their use.⁷⁻¹⁰ However, he remained ambivalent about his own abstinence from these substances (the contemplation stage in the Stages of Change–Substance Abuse model).¹² In addition, extended discussion of this topic distressed him to the point of needing to take extra olanzapine. His dose was further increased to 20 mg at night.

Before his discharge, the patient’s psychosis and homicidality were fully resolved, and he no longer felt “drugged with methamphetamine.” His preoccupation with the state of his musculature also improved. Using DSM-5 criteria, his discharge diagnoses...
included substance (PES)-induced psychotic disorder (resolved); anabolic steroid use disorder in early sustained remission (per the patient’s verbal report); stimulant and opioid use disorders (severe) in full and sustained remission; and alcohol and marijuana use disorder (moderate) in full and early remission.

The patient’s discharge instructions were to continue taking olanzapine 20 mg orally at bedtime, and to follow up with outpatient psychiatric, chemical-dependency, and general medical providers.

**DISCUSSION**

Since the 1980s, performance-enhancing drugs and supplements have posed a public health concern. While the long-term health consequences of these substances remain unclear, the medical community is aware of their association with a variety of medical and psychiatric adverse effects.6–11 The true incidence of these events remains elusive, however, because of the underreporting of PES use, as well as the bewildering array of clinical presentations that can follow patients’ use of or withdrawal from single or multiple substances.4–7

The case that we have described involved psychosis and homicidality that were likely secondary to the use of a PES product containing dendrobium extract and L-dopa, possibly complicated by the long-term use of anabolic steroids and HGH. Acromegaly, fluid retention, and endocrine disorders have been associated with high levels of HGH, but increased use of HGH is not known to cause psychosis or violence.7,13,14 Reports of aggression due to the use of anabolic steroids are common in the medical literature, but we found only five case reports describing homicidality during the active use of these drugs.4,15,16 The use of L-dopa and dopamine precursors can precipitate agitation, psychosis, hypersexuality, and compulsive and addictive behaviors.17,18 A review of the literature did not yield any case reports of L-dopa–induced homicidality.

Dendrobium extract, a popular Chinese folk medicine, is obtained from the stems of the dendrobium orchid. Its chemical structure is complex, containing several alkaloids along with bibenzyl and coumarin compounds.19–22 Studies of the neurological effects of dendrobium are rare.21,22 Data on the effects of dendrobium in humans are limited to a single study sponsored by Driven Sports, Inc., the manufacturer of Craze, a workout supplement.23 The study focused on the hemodynamic safety of Craze and on subjects’ exercise performance while taking the supplement. The authors concluded that Craze is safe to use, although they did not investigate its behavioral effects. The study participants reported insomnia, increased concentration, and increased energy, which are also present with methamphetamine use. According to its label, Craze contains Dendrobex, a mixture of several phenethylylamine-type alkaloids, including dendrobine, dendroxine, dendramine, B-phenylethylamine, and N,N-dimethyl-B-phenylethylamine, as well as caffeine.23 Denbrodex has also tested positive for N,alpha-diethyl-phenylethylamine, a methamphetamine analogue, which is not listed as an ingredient in Craze and which has an unknown safety profile in humans.24 Moreover, the FDA has stated that the alkaloids contained in Dendrobex are “not naturally present in the dendrobium orchid” and that the safety of Dendrobex is not supported by the available data. Consequently, the agency issued a warning letter in April 2014 advising the manufacturer that Craze was considered an adulterated product under the federal Food, Drug, and Cosmetic Act and should be recalled and destroyed.25

The story of Craze is not an isolated one. OxyElite Pro (USPLabs), an OTC weight-loss and muscle-building supplement, caused severe hepatitis and one death before its recall in 2013.26 Cohen et al. found a nondeclared synthetic stimulant, 1,3-dimethylbutylamine (DMBA), in 12 different PES products, despite the fact that DMBA has never been studied in humans.27 In 2014, it was estimated that more than 500 weight-loss or muscle-building OTC supplements had been identified by the

---

**Table 2 Patient’s Use of Performance-Enhancing Substances and Associated Symptoms and Behaviors**

<table>
<thead>
<tr>
<th>Months Before Admission</th>
<th>Substance Use</th>
<th>Symptoms and Behaviors</th>
</tr>
</thead>
</table>
| 18–4                    | “On” anabolic steroids | • Increased self-esteem  
• Increased energy  
• Increased muscle volume and weight-lifting performance  
• Increased libido and appetite  
• Irritability and aggression toward objects |
|                         | “Off” anabolic steroids | • Decreased self-esteem  
• Decreased mood  
• Fatigue and decreased energy  
• Insomnia  
• Decreased libido and appetite loss  
• Desire to restart use  
• Bilateral nipple tenderness and small lump in right breast |
| 4–0                     | Over-the-counter performance-enhancing supplement | • Feeling of being “drugged with meth”  
• Withdrawal from family  
• Paranoid delusions toward family and housemate from halfway house; delusions with sexual themes; auditory and visual hallucinations  
• Urge to exercise  
• Strong urge to kill his boss and a customer |
FDA as adulterated products. These findings raise questions about the overall safety of PES products. So-called dietary supplements are not evaluated by the FDA, and this lack of regulation can lead to questionable drug purity. This, in turn, may pose significant health risks to consumers.

We cannot say with certainty that our patient’s PES was adulterated. However, his feeling of methamphetamine intoxication and his psychosis suggest the presence of impurities. We hypothesize that our patient’s OTC PES product was responsible for his psychosis and homicidal behavior, because both features emerged only after he started using the supplement, without a history of major mental illness, and with a urine drug screen that was negative for methamphetamine or amphetamine. We also wonder whether the patient’s previous use of anabolic steroids could have caused pathological changes in his brain that predisposed him to his dramatic clinical presentation.

With this case report, we hope to increase practitioners’ awareness of the underreported use of anabolic steroids and OTC PES products and their potential to cause a variety of psychiatric presentations. We would also like to encourage practitioners to incorporate an assessment of PES use into patients’ histories. Further, we encourage practitioners to educate their colleagues about this important topic through appropriate channels, such as hospital P&T committees.

REFERENCES