Short Communication

OVERDOSE OF 2.3 GRAMS OF INTRAVENOUS METHAMPHETAMINE: CASE, ANALYSIS AND PATIENT PERSPECTIVE

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Abstract—The patient-reported toxicity of an overdose of intravenous methamphetamine is described. The authors report the case of a 34-year old man who inadvertently injected himself with approximately 2.3 grams of methamphetamine. The patient reported disorientation, hallucinations, hyperthermia, photophobia, orthostasis and extreme ataxia. He recovered in seven days without apparent sequelae. The case demonstrates the unusual, temporary neurophysiologic consequences of high-dose intravenous methamphetamine.

Keywords—hallucinations, hyperthermia, intravenous, methamphetamine, nystagmus, overdose

This case documents effects and sequelae from the intravenous self-administration of approximately 2.3 grams of methamphetamine. The patient's survival after this potentially lethal dose offers a unique toxicological situation. Further, the patient's description of his subjective experiences provides an opportunity to understand possible symptoms of and reactions to high-dose intravenous methamphetamine. A Medline search (for the years 1966-2001) was conducted using the title word search terms amphetamine or methamphetamine and keyword intoxication. No doses of the above magnitude were found in the literature. There was ample documentation of such side effects as hyperthermia, nystagmus and hallucinations, but none of it was from the patient's perspective.

The following case presents the time course of toxic neurophysiologic effects subsequent to the self-administration of an overdose of methamphetamine, as described by the patient.

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CASE REPORT

A 34-year-old white male presented to the San Francisco VA Substance Abuse Treatment Clinic (SAT) with a chief complaint of "I shot an overdose of MDA (3,4-methylenedioxyamphetamine) five days ago and now I'm all messed up." The patient gave an extensive history of intravenous methamphetamine abuse and was currently HIV positive. He acknowledged having purchased a quarter ounce (7 grams) of methamphetamine five days prior to his appearance at the clinic. That day he and two other IV drug users had gathered at the patient's apartment to shoot the methamphetamine. The patient stated that one of the others prepared the intravenous doses for all of them. Apparently that person did not know how much total drug there was and proceeded to divide all of it into three doses of approximately 2.3 grams each. They each injected themselves with this large dose of the drug. Because the experience was unlike any of his previous methamphetamine injections, the patient concluded that someone might have sold him a different drug, and thought it might possibly be MDA. He was also afraid he might have caused permanent damage to himself so he agreed to record every toxic drug effect he could identify in the hope that the information would be helpful in his treatment.

Due to the unusual nature of the identified drug (MDA), a sample for analysis was requested from the patient. Because the intravenous use of MDA is uncommon, the patient was also asked to write down everything he could remember about his experience from the time he injected the drug through the following two weeks. Such information is normally not requested from patients presenting to the VA Substance Abuse Treatment Clinic requesting treatment for drug dependence. The patient produced a small bit of cotton used to filter his drug and a plastic bag with a minute amount of white powder adhering to it. The patient said he normally would not have saved the cotton or the bag, but he had been so disorganized following his overdose that he had not yet disposed of it. Infrared spectrophotometer analysis revealed that both samples were methamphetamine HCl, not MDA.

PATIENT ACCOUNT

The patient wrote the following account one week after his intravenous drug experience and described what

happened from the moment he injected approximately 2.3 grams of methamphetamine:

> I got a feeling/flavor moving up from my chest, through my throat to my mouth. Then my mouth formed an O and my eyes began to bounce from side to side (ear to nose and back again like an intense fluttering). I could not move. My hands, arms and feet became very hot, and by body began to buzz all over. Almost immediately after my mouth formed an O, I noticed my breathing changed to deep and slow with hesitation between each lung action. I slowly and deeply said "wow" with each exhale. I then remember flashing [reflecting] on a dream I had two days before where I saw this fluttering and saw my company through bouncing blurred vision. I then very slowly exclaimed in a deep voice, "I dreamed this. I saw this in my dream." The initial buzz lasted 20 to 30 minutes, then the other people in the room asked me to turn out the bright lights. I tried to stand up but couldn't, so I crawled to the light switch. I turned off the spot light then crawled to the plate of paraphernalia, picked it up and somehow crawled up the cupboard and put the plate on the top shelf. [The paraphernalia consisted of three syringes, the empty plastic bag that had contained the drug, the spoon used for heating the drug solution and the cotton swab used to filter the drug solution.] I then sat down for another half-hour or so. Then I realized I was burning up and disrobed. I made my way to the couch where the other two people were and began to help them disrobe, because I heard their complaints of burning up. I began to massage their feet and legs. Somehow I got up, soaked a towel with cold water and stroked it across the other people's bodies to help cool them off. Then I regained my composure and stood up. I couldn't walk for the first four hours. I then became very hyper and turned the music up, picked up my small organ and began playing it and dancing about the room. I first remember hallucinations occurring well after the initial rush.

The patient wrote the following day-by-day account for the two weeks following his overdose:

Day 1. Did lethal dose. Up all night, couldn't walk for first four hours, hallucinations.

Day 2. Up, high all day. Crash at 10 pm with Librium. Restless sleep, dizzy spells, coordination off.

Day 3. Muscle tension in back and neck, dizziness when standing up, coordination off, hallucinations, disorientation, dreamy state, anger.

Day 4. Loss of self, disorientation, hallucinations, dreamy state, confusion, dizziness on standing, muscle tension in neck, high emotional swings, crying.

Day 5. Loss of self, easily distracted, disoriented, dizziness on standing, dreamy state, confusion, hallucinations, high emotions, anger, crying.

Day 6. Loss of self, high emotions, disoriented, tight neck muscles, hallucinations, some self recognition, restless sleep, confusion. Went to SAT Clinic at VA.

Day 7. Gain of self, sore feet, ringing in ears, recognition of overdose dangers, high emotions, light hallucinations, good sleep.

Day 8. Woke up as if it never happened; memory distortion, gain of self, energy up, self realization, sore back.

Day 9. Regained self, confronted problem, mind clear, energy up, hunger apparent, good sleep (8.5 hours).

Day 10. Normal, energy high, hunger, self reassurance, slight loss of eye control, good sleep (8 hours).

Day 11. Normal, energy high, light hallucinations, hunger, light emotions, gratitude, good sleep (9 hours)

Day 12. Above normal, exercised, jogged, hungry, gratitude, normal emotions, good sleep (8 hours).

Day 13. Above normal, high energy, hungry, good sleep (8 hours).

Day 14. Normal, hungry, up late, good sleep (8.5 hours).

The following "neurological happenings and body dysfunctions" were thought by the patient to have occurred as a direct result of his overdose (not in chronological order):

1. Numbing of extremities (fingers, hands, feet, toes – not constant).
2. Eyes – constant switching at unpredictable times. Lasts from 10 to 60 seconds. Had to concentrate to make it stop, often had to close eyes to stop it. Heavy blurred vision afterwards.
3. Light pulsations above right ear and around right temple.
4. Constant plugging of ears (similar to that occurring with elevation changes.)
5. Short, sharp electrical shock-like feeling above and behind right ear that coincided with head movement. Right eye also blinked with each tilting of head to right side.
6. Emotional outbursts, usually involving anger, confusion and feeling very tense, usually ending in tears and sometimes involving heavy intrusive thoughts.
7. Heavy pulsations in inner ears on both sides at the same time, ending with ringing or buzzing in ears.
8. Migraine-like headaches that happened with high emotion or heavy concentration for long periods of time.
9. Left hip and left knee get sharp shocks after two to three hours of walking.
10. Momentary memory lapses.
11. Hallucinations and tracers (multiple images of moving objects, movement of walls, etc.).
12. When I stare at people it's almost like being on acid. My eyes flash for a split second and the person just looks different. It happens frequently.
13. Repeating words or reversing multiple word statements (e.g., straight up/up straight).

ANALYSIS

Both of the two samples mentioned, the crystalline residue from the evaporation of water from the cotton filter used, and the raw solids removed from the original plastic container, were analyzed by infrared spectroscopy utilizing standard sample preparation technique. Mineral oil mulls were made, and run on NaCl plates on a Beckman AccuLab 2 grating spectrophotometer. The fingerprint peaks at 700 and 750 cm-1, and the definitive six-peak cluster centered at 1060 cm-1 (at 1020, 1048, 1061, 1081, 1100 and 1112 cm-1) corresponded excellently with the reference spectrum for dl-methamphetamine HCl (Gunn, Sobol & Moore 1970). Both samples were devoid of apparent inorganic impurities and the absence of organic contaminants (purity >95%) excluded MDA contamination. The samples appeared to be identical.

DISCUSSION

There are very few studies describing the pharmacology and pharmacokinetics of intravenously administered methamphetamine or amphetamine in humans.

Kramer, Fischman and Littlefield (1967) described the use of high-dose intravenous methamphetamine by chronic users and its effects. The doses they described ranged from 100 to 300 mg. every two hours. One of his subjects reported using 1 gram every two hours, up to 15 grams in a day.

Three clinical studies involving oral administration of methamphetamine HCl used much smaller doses (10 to 20 mg.) (Caldwell, Dring & Williams 1972; Beckett & Rowland 1965; Cook et al. 1992). Two clinical studies of intravenous methamphetamine HCl used doses of 15 mg. and 30 mg. (Mendelson et al. 1995; Cook et al. 1993).

A Swedish study measured plasma amphetamine levels and urinary amphetamine excretion in patients hospitalized for amphetamine psychosis (Anggard et al. 1970). The patients were split into two groups. One group was treated with ammonium chloride to acidify their urine to pH 5-6 while the other group was treated with sodium bicarbonate to alkalinize their urine to pH 6.5-7.1. Changes in the psychotic symptoms (lack of concentration, paranoid delusions, hallucinatory behavior and disorganization of thoughts) were measured over a one-week time period. These symptoms scores remained elevated until the plasma levels dropped to about 100 ng/ml. From that time on, the decrease in symptom scores paralleled the decrease in plasma levels. The symptom scores began to decrease after one day in the acidic urine group and after three days in the alkaline urine group. The symptoms had resolved in three days in the acidic urine group and five days in the alkaline urine group. In this study doses of 160 to 200 mg. intravenous amphetamine sulfate were also administered to nonpsychotic amphetamine-dependent volunteers. Plasma amphetamine levels and urinary amphetamine excretion were also measured. None of these subjects developed psychotic symptoms, although their plasma amphetamine levels were comparable to those of the psychotic patients.

The doses used in the reported studies ranged from about 0.3 mg./kg. (Mendelson et al. 1995; Cook et al. 1993; Cook et al. 1992; Caldwell, Dring & Williams 1972; Beckett & Rowland 1965) to 3 mg./kg. (Anggard et al. 1970). The dose described by our patient was about 30 mg./kg. This case lacks the plasma drug levels of the Anggard study, but the pattern of decline of psychotic symptoms is similar. In the Anggard study it was not stated exactly how long before their hospitalization the psychotic patients had used amphetamine, although they had marks of recent injections over superficial veins.

Our patient's psychotic symptoms began to decline about five days after his use of methamphetamine. His symptoms resolved in seven days. In both the Anggard study and in our case the time from the beginning of the recovery to its total resolution was about two days.

The patient stated that the other two users lived through their overdose experience, but no further information was available about them.

The authors had only the patient's word that he took 2.3 grams of methamphetamine, but his story of having divided their seven-gram purchase into thirds was plausible and his story was consistent. We do know the samples provided were pure methamphetamine. The fact that the sample from the cotton and the sample from the original container were identical supports the patient's assertion that the methamphetamine was injected without adulteration. We did not determine whether it was a racemic mixture of *d* and *l*-methamphetamine or just *d*-methamphetamine.

It was unclear why three presumably experienced intravenous methamphetamine users made such a dangerous dosing error. The patient attributed this error to lack of communication. Because the sample was pure methamphetamine HCl with no other material, it was possible they were used to adulterated, diluted (cut) methamphetamine.

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