Clinical Toxicology (2010) Early Online, 1–4

ISSN: 1556-3650 print / 1556-9519 online
DOI: 10.3109/15563650903586745

ARTICLE

Peyote and mescaline exposures: a 12-year review of a statewide poison center database

SHAUN D. CARSTAIRS[1,2] and F. LEE CANTRELL[3]

[1]*Department of Emergency Medicine, Division of Medical Toxicology, University of California San Diego, San Diego, CA, USA*
[2]*Department of Emergency Medicine, Naval Medical Center, San Diego, CA, USA*
[3]*California Poison Control System – San Diego Division, San Diego, CA, USA*

Background. Peyote, a cactus containing the hallucinogen mescaline, has been used by Native Americans for thousands of years. Illicit use is also known to occur, but reports in the medical literature consist only of isolated case reports. *Objectives*. We sought to identify characteristics of patients with reported exposure to peyote or mescaline. *Methods*. We performed a retrospective review of the California Poison Control System database for the years 1997–2008 for all cases of single-substance human exposure using the search terms "peyote" and "mescaline." *Results*. There were a total of 31 single-substance exposures to peyote or mescaline. Thirty (97%) exposures were intentional; 30 (97%) exposures were through the oral route, whereas one patient (3%) insufflated mescaline powder. Five patients (16%) were managed at home, whereas the remainder patients were managed in a healthcare facility. Commonly reported effects included hallucinations, tachycardia, agitation, and mydriasis. Vomiting was reported in only one case. *Conclusions*. Although uncommonly encountered, use of peyote and mescaline was associated with clinically significant effects requiring treatment in a substantial number of patients. Clinical effects were usually mild or moderate, and life-threatening toxicity was not reported in this case series.

Keywords Toxic plants; Hallucinations; Acute poisoning; Poison control centers

Introduction

Peyote (*Lophophora williamsii*) is a cactus containing the hallucinogen mescaline [2-(3,4,5-trimethoxyphenyl)ethanamine] and is found primarily in the southwestern United States and northern Mexico. The dried tops of the cactus, also known as "buttons," have been used for centuries by Native Americans in religious ceremonies and for the treatment of various physical ailments.[1] Use of peyote is currently illegal in the United States, although an exception has been granted for religious use through the Native American Church. Although illicit use has been well described in nonscientific sources,[2] there are currently no published case series of illicit exposure to peyote in the medical literature. We sought to characterize the clinical symptoms of patients who contacted a poison control center with reported exposures to peyote and mescaline.

Received 28 October 2009; accepted 23 December 2009.
Data from this study were originally presented in poster form at the 2009 North American Congress of Clinical Toxicology, San Antonio, TX, September 2009.

Address correspondence to Shaun D. Carstairs, Department of Emergency Medicine, Division of Medical Toxicology, University of California San Diego, 200 W. Arbor Drive, MC 8925, San Diego, CA 92103, USA. E-mail: shaunc@yahoo.com

Methods

The University of California-San Diego Institutional Review Board approved this retrospective observational case series. A retrospective chart review of the California Poison Control System (CPCS) electronic database (Visual Dotlab, Madera, CA, USA) for cases between the years 1997 and 2008 was performed (standardized data collection in California using this system began in 1997). Search codes included the terms "peyote" and "mescaline"; to ensure all cases were identified, the database was searched both by substance coding and within free text of the cases. Cases were assessed by the principal investigator only after the removal of all patient identifiers. Inclusion criteria included patients of any age with reported single-substance exposures to peyote or mescaline and follow-up to a known outcome. Exclusion criteria included history of any coingestants and inability to follow the patient to a known outcome.

Descriptive data collected included date of exposure, age, gender, dosage form, symptoms, duration of clinical effects, site of exposure, whether exposure was intentional or unintentional, management site, treatment administered, length of symptoms, and clinical outcome. Tachycardia was defined as a heart rate >100 beats per minute (bpm) or the presence of the term "tachycardia" in the free text of the case. Hypertension was defined as a systolic blood pressure >140 mmHg or diastolic blood pressure >90 mmHg or the presence of the

term “hypertension” in the free text of the case. Outcomes were coded as “no effect,” “minor effect,” “moderate effect,” “major effect,” or “death” according to the criteria set forth by the American Association of Poison Control Centers.[3] Coded outcomes were verified by the principal investigator to assure that selected outcomes followed the American Association of Poison Control Centers criteria. All data abstracted were transcribed into a standardized Microsoft Excel 2008 for Mac (Microsoft, Redmond, WA, USA) spreadsheet.

Results

A total of 31 cases of peyote and mescaline exposure meeting inclusion criteria were reported to the CPCS between 1997 and 2008 (Table 1). Twenty-six patients (84%) were male. Patient ages ranged from 14 to 59 years with a mean of 23 years and median of 21 years; 26 (84%) were 25 years or less. Thirty (97%) exposures were intentional. One patient (patient no. 13) was a 21-year-old female who reportedly ingested an unknown number of peyote buttons that had been surreptitiously placed in her food. She was presented to an emergency department (ED) with a heart rate of 150 bpm and was given activated charcoal; she was discharged several hours later.

Thirty (97%) exposures were through the oral route: 23 (74%) ingested plant material; 6 (19%) boiled peyote buttons and drank the resulting tea; and 1 (3%) ingested a tablet containing mescaline. One patient (3%) insufflated mescaline powder (patient no. 18): in that case, an 18-year-old female was presented to an ED 6 h after exposure; she complained of hallucinations and was noted to have tachycardia and

Table 1. Characteristics of patients exposed to peyote and mescaline

Patient no.	Age (years)/ gender	Dosage form	Tachycardia	Agitation	Hallucinations	Mydriasis	Vomiting	Other symptoms	Treatment site	Treatment
1	25 M	Tea	–	+	–	–	–	HTN, paranoia	ICU	INT, IVF, BZD
2	20 M	Plant	+	+	–	–	–		ICU	BZD, DRO
3	17 M	Plant	+	–	+	–	–		ICU	BZD
4	15 M	Plant	+	+	+	+	–	Psychosis	Ward	IVF, BZD
5	17 F	Plant	+	+	+	+	–	Psychosis	Ward	IVF, BZD
6	22 M	Plant	+	+	–	–	–	Seizure	Ward	AC
7	16 M	Tea	+	+	–	–	–	HTN	Ward	
8	22 M	Plant	+	–	+	+	–	Nausea	ED	IVF, BZD
9	15 M	Plant	–	–	+	–	–		ED	IVF, BZD
10	21 M	Tea	–	–	–	–	–	AMS	ED	IVF, AC
11	24 M	Plant	+	+	+	+	–		ED	IVF
12	19 M	Tea	+	–	+	+	–		ED	AC
13	21 F	Plant	+	–	–	–	–		ED	AC
14	17 M	Plant	+	–	+	+	–		ED	
15	44 M	Plant	–	–	+	–	–		ED	
16	16 M	Plant	+	–	+	–	–		ED	
17	14 M	Plant	–	–	+	–	–		ED	
18	18 F	Mescaline insufflation	+	–	+	–	–		ED	
19	30 M	Plant	–	–	+	–	–		ED	
20	23 M	Plant	–	+	–	–	–		ED	
21	23 M	Mescaline tablet	+	+	+	+	–	HTN	ED	
22	22 M	Plant	+	+	+	+	–	Nausea	ED	
23	41 M	Plant	–	+	–	–	–	Paranoia	ED	
24	59 F	Plant	+	–	–	–	–		ED	
25	17 M	Plant	–	–	–	+	–		ED	
26	17 M	Tea	–	–	–	–	–	AMS	ED	
27	16 M	Tea	–	–	+	–	–		Home	
28	26 F	Plant	–	–	+	–	–		Home	
29	25 M	Plant	–	–	–	–	+		Home	
30	23 M	Plant	–	–	+	–	–		Home	
31	25 M	Plant	–	–	–	–	–		Home	

M, male; F, female; AMS, altered mental status; HTN, hypertension; INT, intubation; IVF, intravenous fluids; BZD, benzodiazepine; AC, activated charcoal; DRO, droperidol; (+), present; (–), not present or not reported.

nystagmus. She was treated supportively and was eventually discharged home from the ED.

The most frequently reported effect was the presence of hallucinations, which occurred in 18 patients (58%). Tachycardia was also commonly reported, occurring in 16 patients (52%). Of those 16 patients, 12 had a documented heart rate demonstrating tachycardia, ranging from 101 to 190 bpm (mean 127 bpm, median 120 bpm). One patient (patient no. 6) was reported as having experienced a seizure at home after ingestion of peyote; evaluation in the ED (including computed tomography of the head) was normal and he was admitted to the hospital overnight.

Five patients (16%) were managed at home; one of these patients was referred to an ED but declined to be evaluated. The remaining patients (n = 26) were evaluated in the ED with hospitalization occurring in seven patients [ICU (n = 3) or inpatient ward (n = 4)]. Therapies administered included benzodiazepines (n = 7), intravenous fluids (n = 7), activated charcoal (n = 4), and droperidol (n = 1). One patient (patient no. 1) underwent endotracheal intubation after being found drooling and unconscious several hours after boiling peyote buttons and drinking the tea; he was extubated the following morning and was subsequently discharged.

Outcomes were as follows: no effect, n = 1 (3.2%); minor, n = 9 (29.0%); moderate, n = 20 (64.5%); major, n = 1 (3.2%). No deaths occurred. Symptoms lasted <24 h in all patients with the exception of one case (patient no. 7): a 16-year-old male boiled an unknown number of peyote buttons and drank the resulting tea; he presented with tachycardia, hypertension, and agitation and was hospitalized for 3 days before his symptoms resolved.

Discussion

Native Americans have used peyote for centuries, not only for its hallucinogenic effects but also for its purported medicinal effects. Lumholtz in 1903 described its use in the treatment of snakebites, burns, wounds, and rheumatism.[4] It has also been used for the treatment of toothache, fever, scorpion stings, arrow wounds, and for "strength in walking."[1,5] Although it is classified as a Schedule I substance by the U.S. Drug Enforcement Administration and is therefore illegal for general use, a specific exemption has been granted for its use by members of the Native American Church for "bona fide traditional ceremonial purposes"[6] and has been used with apparent safety for many years within this group.[7] Serious effects from peyote ingestion have been described only rarely and include Mallory–Weiss lacerations from severe vomiting[8] and botulism from ingestion of improperly stored peyote buttons.[9]

Mescaline, the primary active component in peyote (and which is also found in the San Pedro cactus, *Echinopsis pachanoi*, and the Peruvian Torch cactus, *Echinopsis peruviana*), is a phenethylamine derivative and, as such, would be expected to cause symptoms consistent with a sympathomimetic toxidrome. In this case series, symptoms of sympathetic excess including tachycardia, agitation, and mydriasis were seen in a substantial number of patients. Hallucinations were also noted in a majority of patients. The methoxy side chains are likely responsible for mescaline's hallucinogenic effects and are found in similar compounds that are known hallucinogens, including 2,5-dimethoxy-4-methylphenylisopropylamine (also known as STP or DOM), a "designer" street drug.[10] The addition of other methoxy groups has been shown to increase the hallucinogenic properties of mescaline analogs.[11]

Exposures to peyote reported to poison control centers are uncommon compared to those of other drugs of abuse such as marijuana, amphetamines, and cocaine. In 2007, a total of 116 peyote/mescaline exposures were reported to U.S. poison control centers out of more than 2.8 million total reported exposures, accounting for 0.004% of all exposures.[3] Of those, 31 (27%) were intentional exposures. A total of 32 patients (28%) were treated in a healthcare facility; no major effects and no deaths were reported. Additionally, among youths aged 12–17, lifetime prevalence of peyote and mescaline use has been reported to be significantly less (0.4 and 0.3%, respectively) than that of other hallucinogens including ecstasy (3.2%), LSD (3.1%), or psilocybin-containing mushrooms (2.1%).[12]

In this case series, the vast majority of exposures occurred in adolescents and young adults, which is in accord with other common drugs of abuse. Life-threatening symptoms did not occur and most cases of peyote exposure were associated with mild or moderate clinical effects, with tachycardia and CNS effects most frequently seen. The duration of symptoms in almost all cases was <24 h. Most patients treated in a healthcare facility typically did not require anything more than sedation and supportive measures.

One of the most interesting findings in our study was the lack of reported vomiting in patients ingesting peyote. Vomiting has frequently been associated with peyote ingestion.[2] The reason for this is not entirely clear but is likely because of the very bitter taste of the plant[5] rather than the active substance, mescaline. Indeed, a volunteer study in which subjects were administered synthetic mescaline did not describe vomiting in any participants.[13] Several methods have been described for reducing emesis by mixing the plant material with fruit juices or gelatin or by pulverizing the buttons and placing the powder into gelatin capsules.[1] Whether any of these methods were employed by our study subjects is unclear.

Our study has several limitations. This was a retrospective study, which limits the amount of data that we were able to retrieve from each case. Some symptoms (such as vomiting) may have been present but were not reported to CPCS, and our frequency of clinical effects may not represent actual frequency of effects. Our study likely did not capture all cases of peyote exposures evaluated in a healthcare facility, given that reporting of such cases by healthcare practitioners to CPCS is

voluntary. Additionally, confirmation of exposure in all cases was not possible because assays for measurement of plasma mescaline levels are not widely available. We also could not exclude the possibility of coingestants that may have contributed to the patients' symptoms.

Conclusions

Although uncommonly reported, peyote and mescaline use was associated with clinically significant effects and hospital evaluation in a substantial number of patients reported to a poison control center. Most exposures occurred in adolescent and young adult males. Vomiting, which has been anecdotally described in peyote intoxication, was not encountered in the majority of patients in this series, and its absence should therefore not be used to rule out peyote intoxication. Most peyote intoxications appear to be mild in nature and are unlikely to produce life-threatening symptoms.

Declaration of interest

The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the United States Government.

References

1. McLaughlin JL. Peyote: an introduction. Lloydia 1973; 36:1–8.
2. Erowid Peyote (*Lophophora williamsii*) Vault. Available at: http://www.erowid.org/plants/peyote/peyote.shtml. Accessed 27 October 2009.
3. Bronstein AC, Spyker DA, Cantilena LR Jr, Green JL, Rumack BH, Giffin SL. 2007 Annual report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 25th annual report. Clin Toxicol (Phila) 2008; 46:927–1057.
4. Lumholtz C. Unknown Mexico. London: MacMillan and Co., Limited; 1903:356–379.
5. Schultes RE. The appeal of peyote (*Lophophora williamsii*) as a medicine. Am Anthropol 1938; 40:698–715.
6. US Code: Title 42, 1996a. Traditional Indian religious use of peyote. Available at: http://www.law.cornell.edu/uscode/search/display.html?terms=1996a&url=/uscode/html/uscode42/usc_sec_42_00001996—a000-.html. Accessed 27 October 2009.
7. Bergman RL. Navajo peyote use: its apparent safety. Am J Psychiatry 1971; 128:695–699.
8. Nolte KB, Zumwalt RE. Fatal peyote ingestion associated with Mallory-Weiss lacerations. West J Med 1999; 170:328.
9. Hashimoto H, Clyde VJ, Parko KL. Botulism from peyote. N Engl J Med 1998; 339:203–204.
10. Shulgin AT. Mescaline: the chemistry and pharmacology of its analogs. Lloydia 1973; 36:46–58.
11. Aboul-Enein HY. Mescaline: a pharmacological profile. Am J Pharm Sci Support Public Health 1973; 145:125–128.
12. The NHSDA Report: Racial and Ethnic Differences in Youth Hallucinogen Use. Available at: http://www.oas.samhsa.gov/2k3/youthHallucinogens/youthHallucinogens.pdf. Accessed 18 December 2009.
13. Hermle L, Fünfgeld M, Oepen G, Botsch H, Borchardt D, Gouzoulis E, Fehrenbach RA, Spitzer M. Mescaline-induced psychopathological, neuropsychological, and neurometabolic effects in normal subjects: experimental psychosis as a tool for psychiatric research. Biol Psychiatry 1992; 32:976–991.