Case Report

Tissue Distribution of Methylenedioxymethamphetamine

Timothy P. Rohrig and **Richard W. Prouty**
Office of the Chief Medical Examiner, Oklahoma City, Oklahoma

Abstract

Two cases of death involving methylenedioxymethamphetamine (MDMA) are reported; one case is a fatal acute overdose and the other is a drug-related death. The tissue distribution of MDMA is reported in both cases.

Introduction

Methylenedioxymethamphetamine (MDMA) is a ring-substituted derivative of methamphetamine, which was first synthesized in the early part of the century (1). MDMA was initially developed as an anorectic, but the drug was never marketed as such because of its marked psychoactive properties. In the early 1970s, a number of clinicians began prescribing MDMA as an adjunct to psychotherapy (2). The drug induced a state of reduced anxiety and lowered defensiveness, allowing the therapist to speed up to therapeutic process (3). In addition to its use in psychotherapy, MDMA has become a popular recreational drug and is known to the drug culture as Ecstasy, XTC, Adam, and MDM. MDMA produces psychoactive effects similar to those following a mild dose of mescaline. The drug produces fewer of the visual, auditory, and tactile hallucinations generally associated with other psychedelics, such as lysergic acid diethylamide (4). In 1985, the United States Drug Enforcement Administration placed MDMA in Schedule I of the Controlled Substance Act (5), thus effectively removing its use from clinical practice. Relatively few cases of death due to or associated with MDMA use have been reported (6–8). This report describes the postmortem distribution of MDMA in an acute overdose death and a drug-related death.

Case Histories

Case 1. A 35-year-old white male was reported to be "down the alley." Police arrived and found the subject to be extremely intoxicated. The police returned to the scene approximately two hours later and found him dead. An empty wine bottle was found next to the body. There was no trauma noted.

Case 2. Two adults, male and female, were found stuporous adjacent to a motel swimming pool. Several syringes with needles and several small plastic bags containing a white powder were also found next to the subjects. They were aroused by law enforcement officers and placed under arrest. Upon questioning, the male subject stated that he and his female companion had been "shooting Ecstasy" over a three-day period. Two days subsequent to their arrest, the female subject committed suicide by hanging herself with a towel in jail.

Materials and Methods

Reagents. Methylenedioxymethamphetamine, methylenedioxyamphetamine, and methylenedioxypropylamphetamine were purchased from Alltech–Applied Science. All other reagents were analytical reagent grade and were purchased from Fisher Scientific or Baxter.

Identification procedure. Blood and urine were screened for basic drugs with a modified Foerester and Mason procedure (9), with alphaprodine and *n*-propylamphetamine as internal standards. The extract was initially analyzed on a Hewlett-Packard (HP) 5890 gas chromatograph equipped with 15-m J&W DB-5 megabore column and a nitrogen–phosphorus detector (NPD). The column operating conditions were 130–300°C at 10°C/min with a final hold of 5 min. The second chromatographic system employed an HP 5890 equipped with a 15-m J&W DB-1 narrowbore column and a flame ionization detector (FID). The column operating conditions were 100–300°C at 5°C/min. Absolute structural identification was obtained on an HP 5890 gas chromatograph coupled to a mass selective detector (HP Model 5970 MSD), equipped with a 12-m HP-1 capillary column. Normal AUTOTUNE procedures were followed for EI tuning. The column operating conditions were 80–300°C at 10°C/min.

Quantitation procedure. Quantitative analysis of methylenedioxymethamphetamine and methylenedioxyamphetamine was accomplished by gas chromatography (GC) using methylenedioxypropylamphetamine as the internal standard. The GC system (Case 1) was an HP 5890 equipped with a J&W DB-1 narrowbore column and an FID. The column was operated isothermally at 160°C. The GC system (Case 2) was an HP 5890 equipped with a J&W DB-5 megabore column and an NPD. The column oper-

ating conditions were 150–190°C at 10°C/min. The peak height ratio of each analyte to internal standard was compared to a calibration curve prepared from whole blood controls.

Results

Case 1. The qualitative drug screen of the urine and blood was negative for acidic, basic, and neutral drugs, except for methylenedioxymethamphetamine and methylenedioxyamphetamine. The blood ethanol concentration was 0.21% w/v. No gross or microscopic anatomical cause of death was noted upon autopsy.

Case 2. The qualitative drug screen of the blood disclosed the presence of methylenedioxymethamphetamine, methylenedioxyamphetamine, benzoylecgonine, diazepam, and nordiazepam. No other acidic, basic, or neutral drugs were detected, and the blood was negative for ethyl alcohol. The autopsy findings were consistent with hanging.

Results of the toxicological analysis for methylenedioxymethamphetamine and methylenedioxyamphetanmine are presented in Table I.

Discussion

A review of the literature revealed little information regarding the distribution of MDMA in man (6–8). The reported blood concentrations in acute fatal overdoses have ranged from 1.0–2.0 mg/L. In an experimental trial following a single oral dose of 50 mg, a peak plasma concentration of MDMA was 0.106 mg/L has been reported (6).

Table I. Tissue Distribution (mg/L)

	Specimen	MDMA*	MDA*
Case 1**	Heart blood	10.9	<0.5
	Femoral blood	2.8	ND‡
	Liver	20.2	ND
	Brain	13.7	ND
Case 2†	Femoral blood	0.58	0.10
	Liver	1.8	<0.33
	Brain	<1.6	ND

* MDMA: methylenedioxymethamphetamine; MDA: methylenedioxyamphetamine.
** No other drugs detected.
† Blood (heart): diazepam, 0.34 µg/mL; nordiazepam, 0.66 µg/mL; benzoylecgonine, <0.20 µg/mL.
‡ ND: not detected.

In Case 1, the heart blood concentration of MDMA was 10.9 mg/L. This concentration is two orders of magnitude greater than peak concentrations seen in therapeutic dosing and is significantly higher than the few overdose cases reported to date. In consideration of the circumstances surrounding the death, the autopsy findings, and the toxicological studies, the cause of death was certified as toxic effects of MDMA and ethyl alcohol, and the manner of death as accidental.

Case 2 represents the tissue distribution of MDMA and MDA in a traumatic death in a drug-abusing individual. The cause of death was certified as hanging and the manner of death as suicide.

Acknowledgments

The authors are grateful to the Office of the Chief Medical Examiner, Toxicology Laboratory staff for their analytical analyses, and to Mrs. Barbara Mock for her assistance in the preparation of this manuscript.

References

1. *Clandestinely Produced Drugs, Analogues and Precusors,* M. Klein, F. Sapienza, H. McClain, Jr., and I. Khan, Eds., Department of Justice, Washington, D.C., 1989 pp. 195–206.
2. *Cocaine, Marijuana, Designer Drugs: Chemistry, Pharmacology and Behavior,* K.K. Redda, C.A. Walker, and G. Barnett, Eds., CRC, Boca Raton, Florida, 1989, pp. 181–84.
3. D.E. Nichols. Differences between the mechanism of action of MDMA, MBDB and the classic hallucinogens. Identification of a new therapeutic class: Entactogens. *J. Psychoactive Drugs* **18(4):** 305–13 (1986).
4. R.V. Suarez and R. Riemersma. "Ecstasy" and sudden cardiac death. *Am. J. Forens. Med. and Path.* **9(4):** 339–41 (1988).
5. J.C. Lawn. *Fed. Reg.* **50:** (105): pp 23118–20, May 31, 1985.
6. K. Verebey, J. Alrazi, and J.H. Jaffe. The complications of "ecstasy" (MDMA). *J. Am. Med. Assoc.* **259:** 1649–50 (1988).
7. G.P. Dowling, E.T. McDonough, and R.O. Bost. "Eve" and "Ecstasy": A report of five deaths associated with the use of MDEA and MDMA. *J. Am. Med. Assoc.* **257(12):** 1615–17 (1987).
8. R. Bost. Deaths associated with MDMA and MDME in Dallas county. Presented at the spring meeting of the Southwestern Association of Toxicologists, Austin, Texas, April 1990.
9. E.H. Foerester and M.F. Mason. Preliminary studies on the use of *n*-butyl chloride as an extractant in a drug screening procedure. *J. Forens. Sci.* **19(1):** 155–62 (1974).

Manuscript received September 30, 1990.