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Cocaine-Related Deaths in Pima County, Arizona, 1982-1984

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ABSTRACT: A three-year review of toxicology data from medical examiner autopsies in Pima County, Arizona, has demonstrated that cocaine has rapidly become a leading substance of abuse, second only to alcohol in the frequency of drugs detected by toxicologic analysis of all suspicious deaths, motor vehicle accident fatalities, homicides, and suicides. Gastric contents and urine were analyzed by thin-layer chromatography, and nasal swabs, blood, and urine were tested for the combination of cocaine and its metabolite benzoylcegonine by quantitative radioimmunoassay. A total of seventy-two deaths in Pima County from 1982 to 1984 have involved cocaine. Seventy percent of these have occurred in the last fifteen months. Marked variation in the individual response to cocaine compared to the blood concentration of cocaine/metabolite was noted.

KEYWORDS: toxicology, pathology and biology, cocaine, epidemiology

Pima County, Arizona, with Tucson as its population center, has rapidly become a major port of entry for South American cocaine, due in part to the law enforcement crackdown on illicit drug traffic in the eastern United States and Tucson's close proximity to the Mexican border.

The increased cocaine traffic has resulted in cocaine becoming a leading substance of abuse. This marked increase in cocaine popularity in Pima County with the resulting increase in cocaine-related deaths has stimulated this epidemiological study.

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Materials and Methods

A three-year review of all medical examiner cases from 1982 through 1984 was conducted. All cases found to involve cocaine were analyzed according to demographic, circumstantial, pathologic, and toxicologic information available.

Cocaine-related deaths were categorized according to the manner of death and the blood cocaine/metabolite concentration as determined by radioimmunoassay.

Cocaine is inactivated in man by hydrolysis to form benzoylecgonine. The Roche Abuscreen Cocaine metabolite kit was used to quantitate the amount of cocaine and benzoylecgonine in the samples. Iodine-125-labeled benzoylecgonine and unlabeled cocaine and benzoylecgonine compete for binding sites on a benzoylecgonine antibody. No cross-reactivity has been observed with lidocaine, procaine, or tetracaine. The concentrations listed in this report are thus labeled "cocaine/metabolite" to reflect measurement of more than one substance by the Roche Abuscreen method.

Nasal swabs, urine, and blood collections obtained at autopsy were tested for cocaine/metabolite. For the purposes of this report, only the blood concentrations were included. General qualitative analysis of gastric contents and urine were also done by thin-layer chromatography. Opiates were also analyzed by immunoassay.

After experience with the radioimmunoassay method, we found that concentrations between 20 and 50 ng/mL could not be duplicated with precision even though cocaine or its metabolites or both could be consistently demonstrated. The lowest concentration that we could confidently detect cocaine/metabolite was 20 ng/mL. Therefore, blood with concentrations of cocaine/metabolite from 20 to 50 ng/mL was reported only as "positive." Several of the early 1982 cases were only reported qualitatively and were included in the "less than 50 ng/mL" category.

Circumstantial information regarding the deaths was obtained from death reports provided by local law enforcement authorities and investigators for the Pima County Medical Examiner's Office.

Results

A total of 72 deaths in Pima County involved cocaine during the years 1982 through 1984, 70% of which have occurred in the last 15 months. The various causes of death and yearly incidence are presented in Table 1.

A wide range was noted in the blood cocaine/metabolite concentration in the 72 deaths found to involve cocaine. A significant increase was observed in 1984 in both the "less than 500 ng/mL" group as well as in the "greater than 1000 ng/mL" group (see Table 2). The concentrations ranged from positive test results (20 to 50 ng/mL) to a high of 40 000 ng/mL.

There was a history of intravenous administration in 18 deaths and oral ingestion in 2 deaths. In all cases, the nasal swabs were found to be positive for the presence of cocaine/

TABLE 1—Cocaine-related deaths.

Cause and/or Manner of Death	1982	1983	1984	Total
Cocaine overdose	2	4	8	14
Cocaine/opiate overdose	1	1	4	6
Suicidal deaths	3	1	7	11
Homicidal deaths	4	2	8	14
Motor vehicle accident	3	6	10	19
Accidental deaths	1	1	3	5
Natural deaths	2	1	0	3

TABLE 2—*Blood cocaine/metabolite concentrations.*

	1982	1983	1984
< 500 ng/mL	12	9	19
501 to 1000 ng/mL	2	2	4
> 1000 ng/mL	2	5	17

metabolite, even when inhalation was known not to have occurred. This was most likely caused by contamination of the swabs with blood from hemorrhagic pulmonary edema fluid present in the nares.

An increase of 150% was noted in the number of cocaine-related deaths in 1984 as compared to 1983 or 1982. The total number of cocaine deaths remained constant in each of these latter years. This increase occurred in spite of the decrease in cocaine-related deaths during the last quarter of 1984. This decrease is probably related to several local cocaine arrests involving the seizure of large amounts of cocaine, temporarily reducing the local supply.

The age at the time of death was 30 years or less in 71% of the cases examined. The ages ranged from 18 years to 66 years.

Pima County, Arizona, with its population of 531 000 has an ethnic distribution of 82% white, 15% Hispanic, and 3% black. The ethnic distribution in the cocaine-related deaths closely approximated the general population distribution until 1984, when an increase in the number of Hispanic deaths occurred (see Table 3).

Women made up a small number of the cases examined. Seventeen percent of the white deaths and thirteen-percent of the Hispanic deaths involved women.

Acute drug intoxication with cocaine was the cause of death in twelve cases occurring over the three-year period ending 31 Dec. 1984. Fifty-eight percent of these deaths occurred in 1984. Five of the cases involved cocaine only, with blood cocaine/metabolite concentration ranging from 800 to greater than 15 000 ng/mL. Ethanol was found in an additional four cases in concentrations ranging from 900 to 1100 mg/L. Opiates, in low concentrations (less than 50 ng/mL by radioimmunoassay) were detected in three of the cocaine deaths. The opiates and ethanol, detected in these small to moderate amounts, were not considered to be significant factors in the deaths. In those seven cases where other drugs were detected, cocaine/metabolite were found in blood concentrations ranging from 1050 to 40 000 ng/mL.

The major route of intake in three cases of acute cocaine intoxication was by nasal inhalation. It has been reported by VanDyke et al. [1] that intranasal application of cocaine in amounts as small as 1.5-mg/kg body weight can result in blood concentrations ranging from 120 to 474 ng/mL for up to 6 h. Seven cases involved intravenous injection. Two cases involved combined nasal inhalation, intravenous injection, and oral ingestion resulting in the highest blood concentrations of cocaine/metabolite greater than 15 000 ng/mL in one case and 40 000 ng/mL in the other.

TABLE 3—*Ethnic distribution.*

	1982	1983	1984
White	12	13	21
Hispanic	3	3	17
Black	1	0	2

Case Reports

Three cases were worth noting because they demonstrate the wide variety of individual response to cocaine.

Case 1

A 32-year-old Hispanic man with a history of habitual cocaine use had been continually using cocaine (by nasal, oral, and intravenous routes) for 8 h before his death. According to his wife, he began to have seizures, at which time she summoned the paramedics. In spite of a blood cocaine/metabolite concentration in excess of 15 000 ng/mL, the man was still capable of fighting violently with the paramedics before having a fatal seizure upon arrival at the hospital.

Case 2

A 23-year-old white woman, a novice to cocaine, suffered a fatal seizure 2 min after her first intravenous cocaine injection. Her blood cocaine/metabolite concentration was 2275 ng/mL.

Case 3

A 23-year-old white man, another chronic user of cocaine, was found dead following an intravenous injection of cocaine. His blood cocaine/metabolite concentration was 1800 ng/mL.

Discussion

A common finding at autopsy was generalized visceral congestion and pulmonary edema.

Seven percent of the cocaine-related deaths involved both cocaine and opiates in overdose concentrations. All of these deaths involved intravenous injection with the concentration of both drugs in the lethal range. An additional two cases (of cocaine-related deaths) were included in this study in which opiate overdose was the primary cause of death, with cocaine/metabolite present in concentrations less than 100 ng/mL.

Cocaine was found to be present in eleven suicide victims. Ten of these deaths involved self-inflicted gunshot wounds, the other death occurred by hanging. Three of these deaths had blood cocaine/metabolite concentrations in excess of 1000 ng/mL, a concentration of equal magnitude with the previously described instances of death attributed to acute cocaine intoxication.

Fourteen homicide victims in Pima County, during the three-year study period, were found to have blood concentrations of cocaine/metabolite ranging from positive (20 to 50 ng/mL) to 12 750 ng/mL. Over 50% of the homicides occurred in 1984. In one particular case, a twenty-year-old Hispanic man was being treated by local paramedics for a stab wound in the chest. The victim was alert and conscious at the scene when he suddenly became hypotensive and died. The autopsy revealed that the stab wound extended through the right lung and left ventricle of the heart causing bilateral hemothorax and hemopericardium. Toxicologic analysis revealed that he had a blood cocaine/metabolite concentration of 12 750 ng/mL. With the reported normal level of consciousness and mental status, it is conceivable that the victim may have survived high cocaine concentration as a result of adaptation following chronic cocaine abuse if not for the fatal stab wound.

Motor vehicle fatalities involving cocaine were by far the most common cause of death in the study, comprising over 26% of the cocaine-related deaths. Twelve of the cases were driv-

ers who were found to be at fault with five of these involved in single car accidents. In all nineteen cases, ethanol was found to be present with blood concentrations ranging from 100 to 2500 mg/L. The cocaine/metabolite blood concentrations were found to be less than 200 ng/mL in almost every case.

As in the motor vehicle fatalities, cocaine and ethanol were combined factors in the accidental deaths, of which drowning was the most common. One case involved a twenty-seven-year-old Hispanic man with a history of seizures during his most recent cocaine use. Unwitnessed drowning and possibly a seizure followed an intravenous injection of cocaine. Seizures and other central nervous system (CNS) effects have been found to be common effects of cocaine abuse [2]. The autopsy blood cocaine/metabolite concentration was 4750 ng/mL.

In two of the three natural deaths found to involve cocaine, cocaine concentrations, although low, probably directly contributed to the cause of death. In one instance, a twenty-eight-year-old Hispanic man, with a history of a recent myocardial infarct, was found at autopsy to have a blood cocaine/metabolite concentration of 60 ng/mL. Although death was a result of congestive heart failure, it is highly probable that the cocaine, even in low amounts, adversely affected an already compromised heart. Recent evidence has shown a direct correlation between recreational cocaine use and clinical myocardial infarct [3,4].

In the second case, a 34-year-old Hispanic woman was found to have an autopsy blood cocaine/metabolite concentration of 420 ng/mL. Her daughter reported that she had left her mother alone and in good health for only 10 min. When she returned, her mother was unconscious. The cause of death was a ruptured berry aneurysm. Cocaine, with its vasospastic effects, was probably the precipitating factor leading to the rupture [5].

Conclusion

As the popularity and availability of cocaine continues to increase, cocaine will become a more frequent factor to evaluate in determining the cause of death. In this study it has been demonstrated to be a factor not only in direct chemical intoxication, but also in vehicular fatalities, other accidental deaths, suicides, and homicides.

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