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Letter to the Editor

Cocaine Excretion in the Semen of Drug Users

To the Editor:

The belief that cocaine has aphrodisiac properties has prevailed among drug users for decades. Cocaine use is frequently linked with stimulated sexual behavior; addicts often rate cocaine as the most effective drug for increasing libido and sexual responsiveness. Animal studies with radiolabeled cocaine indicate that the drug is deposited in genital and extragenital organs, including the epididymis and seminal vesicles (1). Specific binding sites have been characterized on human spermatozoa (2), but in vivo studies have not been performed on the kinetics of excretion of cocaine in human semen.

We report results of a controlled dosing study of cocaine with five experienced, drug-free cocaine users who provided informed consent. Cocaine hydrochloride was administered by the intravenous and intranasal routes, and cocaine base ("crack") was administered by the smoking route. Semen samples collected prior to cocaine use were negative for cocaine and metabolites, whereas semen samples collected 1 h after cocaine use contained parent drug and metabolite in concentrations ranging from 60 to 80% of plasma concentrations (Table I). At 24 h, semen concentrations of cocaine had declined to trace or nondetectable levels, but small amounts of benzoylecgonine were still present. No discernible effects were noted on semen/plasma ratios by changing the route of cocaine administration.

Although mean semen/plasma cocaine ratios were less than unity, occasional ratios were obtained that were greater than unity (range, 0.08–1.88 at 1 h). Generally, prostatic fluid is more acidic than plasma, causing ion trapping of the weak base, cocaine, to occur in the prostate. This would lead to semen/plasma ratios greater than unity. However, semen also contains vesicular fluid that is alkaline (3). The wide fluctuations in semen/plasma ratios were likely due to variations in prostatic and vesicular fluid pH and corresponding differential contributions to ejaculate volume.

The presence of cocaine and benzoylecgonine in semen raises concern regarding the effects of cocaine intake by the male partner engaged in sexual activity. Drug effects could potentially be expressed in the drug taker, in the sexual partner (as a result of exchange of body fluids), and in offspring. Studies of male offspring of alcoholics have provided evidence of specific cognitive impairment as a result of chronic alcohol consumption (4,5). Sons of early onset alcoholics were impaired on tests measuring attention and verbal intellectual capacity compared with control subjects. Cicero (6) offered

Table I. Mean Cocaine and Benzoylecgonine Concentrations in Semen and Plasma Following Cocaine Administration by the Intravenous, Intranasal, and Smoked Routes*

Dose (mg)	Route	*N*	Time (h)	Semen weight (g)	Semen cocaine (ng/g)	Semen BZE (ng/g)	Plasma cocaine (ng/mL)	Plasma BZE (ng/mL)	Cocaine semen/plasma ratio	BZE semen/plasma ratio
0	IV	5	1	2.7 ± 1.0	0	0	–†	–	NA	NA
1	IV	5	1	2.6 ± 0.7	0	0	–	–	NA	NA
2.5	IV	5	1	2.5 ± 0.6	3 ± 4	4 ± 5	–	–	NA	NA
5	IV	5	1	2.4 ± 0.6	6 ± 7	9 ± 10	–	–	NA	NA
10	IV	5	1	1.6 ± 0.6	21 ± 11	24 ± 21	–	–	NA	NA
25	IV	5	1	1.9 ± 0.6	47 ± 32	70 ± 29	–	–	NA	NA
25	IV	5	1	2.2 ± 0.6	45 ± 47	81 ± 39	64 ± 13	114 ± 32	0.71 ± 0.69	0.74 ± 0.39
25	IV	5	24	1.8 ± 0.5	1 ± 3	15 ± 14	–	–	NA	NA
32	IN	5	1	1.9 ± 0.4	39 ± 28	51 ± 19	65 ± 15	86 ± 18	0.66 ± 0.54	0.59 ± 0.14
32	IN	5	24	1.8 ± 0.4	0	10 ± 7	–	–	NA	NA
42‡	SM	4	1	2.1 ± 0.9	54 ± 51	50 ± 26	68 ± 31	82 ± 50	0.73 ± 1.14	0.71 ± 0.41
42	SM	4	24	2.2 ± 0.7	0	15 ± 19	–	–	NA	NA

Abbreviations: BZE, benzoylecgonine; IV, intravenous; IN, intranasal; SM, smoked; and NA, not applicable.
* Standard deviation values accompany mean values.
† – = Plasma specimens were not collected in this phase of the study.
‡ One subject failed to inhale the complete smoked dose and was excluded from analysis.

three possible mechanisms to explain the effect of paternal alcohol consumption on offspring: (1) alcohol could directly affect the characteristics of sperm by causing genetic mutations; (2) sperm could be subjected to a selection process, such that only a specific sperm population is functionally intact following prolonged alcohol exposure; and (3) alcohol consumption could alter the chemical composition of semen so as to influence the activity of ejaculated sperm.

Cocaine is also known to influence the characteristics of sperm. Animal studies have demonstrated that rats treated chronically with cocaine had a significant increase in spermatozoa with heads separated from tails and other anomalies (7). In human studies, cocaine use has been associated with depressed sperm counts, low sperm motility, and an increase in numbers of abnormal spermatozoa (8,9). In vitro binding studies with radiolabeled cocaine have demonstrated that cocaine binds with high affinity to human spermatozoa, leading to the suggestion that sperm may act as a vector to transport cocaine into an ovum (2). The association of a cocaine-laden sperm cell with a mother's egg could lead to abnormal development in the offspring.

There is less likelihood of effects developing in the sexual partners of male cocaine users as a result of exposure to cocaine in semen. The total content of cocaine and benzoylecgonine in ejaculate did not exceed 0.001 mg in specimens collected 1 h after cocaine administration. Considering that cocaine concentrations in semen were 60–80% of plasma concentrations and the half-life of cocaine in plasma ranges from 0.75 to 1.5 h (10), it can be assumed that peak semen concentrations would have contained approximately double the amount of total cocaine seen in the current measurements (i.e., 0.002 mg). Chronic or heavy acute use of cocaine in amounts 100-fold greater than that administered in the present study could occur in tolerant users; however, even with this excessive use of cocaine, the estimated total amount present in semen would only be 0.2 mg. Although absorption of cocaine from the vagina or rectum is generally efficient, this amount of cocaine is substantially less than that amount found necessary to produce a positive urine specimen for cocaine metabolite at a cutoff concentration of 300 ng/mL. Cone et al. (11) reported that 1–2.5 mg of cocaine hydrochloride administered by the intravenous route was needed for subjects to produce at least one positive urine specimen. Even greater amounts of cocaine hydrochloride administered by the intravenous route, in the range of 10–20 mg, are necessary for production of pharmacological effects.

As a result of these findings, it can be concluded that passive exposure to cocaine via the ejaculate of cocaine-using male partners as a result of sexual activity would not produce positive test results in the nondrug user. However, these data raise grave concerns over the possibility that offspring of cocaine-using males could be impaired as a result of their fathers' cocaine use.

Edward J. Cone, Kenichi Kato, and Mary Hillsgrove
Addiction Research Center
Intramural Research Program
National Institute on Drug Abuse
National Institutes of Health
P.O. Box 5180
Baltimore, MD 21224

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