Hair Analysis for Cocaine Continues to be a Valuable Tool in Forensic and Clinical Toxicology

To the Editor:

Recently, LeBeau and Montgomery (1) informed readers that the FBI Laboratory decided to suspend cocaine analysis in hair except children’s hair. This decision was explained by newer research findings, according to which the criteria of the Substance Abuse and Mental Health Services Administration (SAMSHA) for a hair sample positive for cocaine (2) can also be met in contaminated hair specimen (3,4). These criteria, which are generally accepted for forensic purposes, consist of a cocaine concentration ≥ 500 pg/mg and either a benzoylecgonine concentration ≥ 50 pg/mg plus a benzoylecgonine-to-cocaine ratio ≥ 0.05 or, alternatively, a concentration ≥ 50 pg/mg of the non-hydrolytic cocaine metabolites norcocaine or cocaethylene. In principle, cocaethylene could be expected only if cocaine is consumed in combination with alcohol.

The harmful effects of cocaine use on physical and mental health, social life, and criminal behavior are undisputed. Hair analysis for cocaine proved to be an essential and very helpful tool to obtain evidence about the exposure of this drug in cases of driving ability examination, workplace testing, drug trafficking, criminal liability, child custody, or drug use during pregnancy. The advantage of the sample material hair in comparison to blood, urine, sweat, or oral fluid is the extended time window, allowing the retrospective detection of chronic consumption up to years. Generally, exposure can mean consumption or external contamination. The debate about the possibility of distinguishing between them is not new (5,6) and has led to criteria based on metabolite concentrations on one hand (2) and specific washing procedures on the other (7).

Indeed, the very thorough experimental investigations by Ropero-Miller and Stout (4) show that external contamination of hair with street cocaine under certain conditions can lead to deposition of cocaine, benzoylecgonine, norcocaine, and cocaethylene in concentrations and concentration ratios that fulfill the aforementioned criteria and cannot be discriminated from incorporation after drug use even by extensive decontamination and washing procedures of the specimen. Benzoylecgonine as a hydrolysis product of cocaine is present in various concentrations in street cocaine and, in addition to that, is slowly formed from cocaine within the hair samples or during sample preparation. Norcocaine is a minor natural concomitant in cocoa leaves (8) but is formed mainly by treatment with KMnO₄ during illicit cocaine manufacturing (9). Cocaethylene arises from transesterification of cocaine in a newer clandestine purification procedure of crude cocaine base with ethanol (10). According to the results of Ropero-Miller and Stout (4), the usual content of both non-hydrolytic metabolites in street cocaine from these sources is rather low (not detected to 0.33% and not detected to 0.012%) but may rise up to 8.7% and 2.3%, respectively, in exceptional powder specimens that were selected for their contamination experiments.

In summary, until now there has been no unambiguous analytical proof for cocaine consumption as the reason of a cocaine positive hair sample, and it remains a question of probability whether an external contamination could lead to a positive result. This probability is relatively high for persons who are professionally or illegally in a steady close contact to the drug, such as narcotic officers and subjects involved in illicit cocaine manufacturing or distribution. However, it is not very probable that the contaminating drug contains high concentrations of norcocaine and cocaethylene, and it is quite unlikely that an innocent citizen in his daily environment might contaminate his hair to such an extent leading to a cocaine-positive result according to the criteria. A possible approach to estimate the likelihood of a hair sample belonging to a cocaine user or be a contaminated sample of a non-drug user is the statistical discrimination analysis described by Hoelzle et al. (11) with additional inclusion of eegonine methyl ester, eegonine, and anhydroeegonine methyl ester.

First of all, the detection of cocaine in hair means that the person had contact with cocaine. This is confirmed by the detection of benzoylecgonine, norcocaine, and cocaethylene. If the SAMSHA criteria is fulfilled, there is a high probability but no final proof that the drug was consumed. The newer results show once more that in hair analysis, criteria must not schematically and uncritically be applied but should always be questioned in context of the case history and other findings. In case of doubt, additional evidence is required. This could be provided, for example, by additional investigation of non-head hair, which is much less prone to external contamination.
The announcement of the FBI’s suspension of hair testing for cocaine has led to a general uncertainty with respect to the value of hair analysis for drugs. However, this suspension concerns mainly a very specific group of suspected cocaine consumers. After 30 years of successful experience, hair analysis continues to be a suitable tool in the majority of application fields, including testing for cocaine exposure. In principle, this is demonstrated also by the FBI Laboratory in excluding children’s hair samples from the suspension.

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References


The authors’ reply:

Thank you for the opportunity to respond to the Letter from Drs. Pragst, Sachs, and Kintz. We agree with the letter’s intent, and concur that situations exist in which establishing that an individual has been exposed to cocaine is useful investigative information.

In the past, our laboratory used the SAMHSA-proposed guidelines (1) in evaluating hair testing results. As we stated in our Letter, Ropero-Miller and Stout (2) found that the previously proposed SAMHSA criteria could be met in hair specimens contaminated with cocaine. Many of the hair samples sent to the FBI Laboratory for cocaine testing are from individuals who have legitimate reasons for potential exposure to cocaine. Our testing has been temporarily halted in these cases so that we, in conjunction with other laboratories, can conduct the necessary research to allow for an assessment of the ability to better differentiate cocaine exposure from cocaine use. We would like to reiterate that the majority of the cases received by our laboratory involving requests for cocaine analysis in hair specimens have asked that