An MDMA abuser or not - a second opinion on interpreting positive hair results

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Case backgound

There is no dispute that on 22nd December 2012 Mr W was off duty and socialising. It seems to be accepted that late in the evening he was given a drink that had been spiked almost certainly with MDMA. He reacted very badly and ended up in hospital. The following day he reported the matter to the Police. At that time blood and urine samples were taken. The matter was the subject of a criminal investigation in relation to the spiking of his drink. It is understood that a man was arrested in connection with the matter.

On 28th December 2012 a hair sample was requested. The exact circumstances of this request are not known but it was believed that the hair sample was requested as part of the criminal investigation into the alleged offence. It was aniticpated that the hair test would return a negative result and undermine any suggestion by the male who had been arrested or others that Mr W. was a regular user of MDMA/Ecstasy.

Hair sample 1 was then analysed in laboratory X and the results were provided to the original criminal investigation team. The report delivered by the expert of laboratory X indicated recreational use of MDMA over a period of time for the reasons that later become part of the forensic report. It appeared therefore that there was a concern about the results.

A further hair sample was taken on 14th February 2013. It was also analysed by the same laboratory and the expert again expressed an opinion regarding the positive result from the hair test.

The case against the accused as having spiked the drink was subsequently dropped although this appeared to be at least in part because the barman who had originally agrred to give evidence to confirm the spiking of the drink, subsequently became reluctant to give evidence.

In view of the results of the analysis of the hair it was decided that Mr W would become subject of a police misconduct investigation. Mr W remained absolutely adamant that he had not taken MDMA other than on the occasion on 22nd December 2012 when his drink was allegedly spiked.

We were asked to review the case and discuss the potential issues with reagrd to interpreatation of hair results.

Analytical data

Police received a report at 23:09 on 22 December 2012 that Mr W. was lying on the pavement. Prior the incident, he had been out drinking. He suspected his drink to be "spiked". The last drink was at 22:00 on that day. He was not taking any other medication.

Blood (at 13:01) and urine (at 13:13) were collected on 23 December, approximately 15 hours after the last drink.

A first head hair sample was collected on 28 December 2012 (approx. 6 days post incident), and a second on 14 February 2013.

All biological material was tested in an independent ISO 17025 accredited laboratory. Urine screened by immunoassay tested positive for amphetamines. Chromatographic methods confirmed the simultaneous presence of ecstasy (MDMA) and its major metabolite, MDA. No other drugs, including ethanol were detected.

In blood, MDMA was identified and quantified at 0.33 mg/L. Its metabolite, MDA was also quantified at 0.04 mg/L.

Both hair test identified MDMA, but not its metabolite;

Hair from 28 December 2012
- segment 0-1 cm: 0.81 ng/mg
- segment 1-1.75 cm: 1.2 ng/mg
- segment 1.75-2.5 cm: 1.0 ng/mg

Hair from14 February 2013
- segment 0-1 cm: < LOQ
- segment 1-2 cm: 0.35 ng/mg
- segment 2-3 cm: 0.30 ng/mg

Based on the sectional hair findings, the expert of the laboratory X concluded that Mr W has been using MDMA on several occasions.

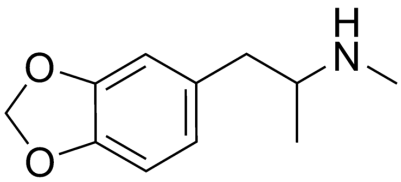
This was challenged by the subject and prior to court hearing, he requested us to review all potential issues in realtion to the hair tests.

Discussion

3,4-methylenedioxymethamphetamine, or MDMA is a ring-substituted derivative

of methamphetamine. It is used as a recreational drug. The drug is usually taken in oral doses of 50-150 mg. MDMA is metabolized by N-demethylation to MDA, that is also active.

After drug administration, the first clear indications of activity usually appear in about 30-45 minutes, although as little as 20 minutes or as long as an hour is not uncommon. During onset the user may feel warm or chilled, have a 'tingling' sensation of the skin, and, as full onset nears, feel



small 'waves' of pleasure/energy flowing through them. Once the drug has taken full effect, hyperactivity and a powerful central analgesic effect is seen, as is an interesting (and very strong) non-sedating anxiolytic effect. In short, the user becomes energized, euphoric, very talkative, and able to discuss virtually any topic without fear. Secondary effects include enhanced appreciation of the senses, including sight, taste, touch, music appreciation, etc.

Symptoms of MDMA toxicity include excessive sweating, visual hallucinations, confusion, agitation, hyperpyrexia, rhabdomyolysis, hypoglycemia, panic disorder and in severe cases hepatic and renal failure, hypotension, ventricular fibrillation and coma.

The major practical advantage of hair testing compared to urine or blood testing for drugs is that it has a larger surveillance window (weeks to months, depending on the length of the hair shaft, against 2-4 days for most drugs). For practical purposes, the two tests complement each other. Urinalysis and blood analysis provide short-term information of an individual's drug use, whereas long-term histories are accessible through hair analysis.

By providing information on exposure to drugs over time, hair analysis may be useful in verifying self-reported histories of drug use in any situation in which a history of past rather than recent drug use is desired. In addition, hair analysis may be especially useful when a history of drug use is difficult or impossible to obtain. Numerous applications have been described in the literature where hair analysis was used to document the case: suspicious death, evidence of drug administration, evidence of long-term poisoning, discrimination between single and chronic exposure, demonstration of tolerance, pattern of drug use, crime under the influence of drug.

Although there is reasonable agreement that the qualitative results from hair analysis are valid, the interpretation of the results is still under debate owing to unresolved questions such as the influence of external contamination. More research is required before all of the scientific questions associated with hair drug testing will be satisfied. There is still a lack of consensus among the active investigators on how to identify external contamination.

Contamination of hair would be a problem if from a negative specimen the findings of a drug and/or metabolites(s) will lead to a positive interpretation. It is unlikely that anyone would intentionally or accidentally apply anything to his or her hair that would contain a drug. The most crucial issue facing hair analysis is the avoidance of technical and evidentiary false-positives. Technical false-positives are caused by errors in the collection, processing and analysis of specimens, while evidentiary false-positives are caused by passive exposure to the drug. Approaches for preventing evidentiary false-positives due to external contamination of the hair specimens have been described since 1992 (1).

These criteria do not endorse a general acceptance (2, 3). Excluding laboratory mistakes, a false positive hair result can be observed in case of contamination from environmental pollution (external contamination) or after drug incorporation into the hair from the individual body fluids, such as sweat.

Most laboratories use a wash step; however, there is no consensus or uniformity in the washing procedures. Among the agents used in washing are detergents such as shampoo, surgical scrubbing solutions, surfactants such as 0.1% sodium dodecylsulfate, phosphate buffer, or organic solvents such as acetone, diethyl ether, methanol, ethanol, dichloromethane, hexane or pentane of various volumes for various contact times.

From the papers in the literature, a single washing step is generally done, although a second identical wash is sometimes performed. If external contamination is found by analysing the wash solution (this is only possible when analysis is achieved just after contamination, and not several days latter, when the subject has regularly used shampoos during that time), the washout kinetics of repeated washing can demonstrate that contamination is rapidly removed. Baumgartner and Hill (1), published that the concentration of drug in the hair after washing should exceed the concentration in the last wash by at least ten times. This was confirmed by Tsanaclis and Wicks (4).

According to Romano et al (5), even using the most sophisticated decontamination procedures, it is not possible to distinguish a drug-contaminated subject from an active user. However, these results and comments were challenged by Cairns et al (6).

Thus, while a negative result excludes both chronic use and contact with drugs, a positive result cannot be interpreted as a sure sign of drug addiction.

Detection of drug metabolite(s) in hair, whose presence could not be explained by hydrolysis or environmental exposure, was proposed to unequivocally establish that internal drug exposure had occurred.

From his experience and several experimental studies, Kintz (7) concluded that his standard decontamination procedure (dichloromethane washes) is not able to completely neither remove external contamination nor differentiate without any doubt between artefact(s) or drug use. It was his opinion that the presence of water-containing fluid, such as sweat may be in favour of contamination when hair is in contact with. The presence of homogenous consecutive concentrations after segmental analysis may be considered as indicative of potential contamination from an individual's body fluids or tissues. In this paper, Kintz described the case of a 24-year old man, found dead in a friend's house. He was not known as a drug addict. The analysis of femoral blood was interpreted as ecstasy poisoning (MDMA = 770 ng/ml, MDA = 56 ng/ml). Hair (9 cm, brown) was collected at the time of the autopsy. Segmental MDMA hair analysis was as follows: 0.94 ng/mg (0-3 cm), 0.87 ng/mg (3-6 cm) and 0.90 ng/mg (6-9 cm). No MDA was detected (LOQ at 0.05 ng/mg). It was concluded that the presence of MDMA in hair could be explained by excessive sweating associated to hyperthermia (as documented by the interview of his partner) during the time between ingestion and death.

The same situation was also described for methadone after children poisoning (8).

In the case of Mr W, the following was established:

- consecutive concentrations of MDMA in the hair collected on 28 December 2012: 0.81 - 1.2 - 1.0 ng/mg. These concentrations are more or less 1.0 ng/mg +/- 20 % (that is also the precision of the method). Therefore these concentrations can be considered as identical and indicative of contamination by sweat;

- consecutive concentrations of MDMA in the hair collected on 14 February 2013: ND - 0.35 - 0.30 ng/mg. These concentrations are more or less 0.325 ng/mg +/- 10 %. Therefore these concentrations can be considered as identical and indicative of contamination by sweat;

- no metabolite (MDA) was found in hair;
- the amount of drug ingested (> 400 mg when calculated) is very high in comparison with usual recreational doses (50 to 150 mg) ingested by drug regular users;

- MDMA poisoning is associated with excessive sweating.

The differentiation between drug use and external contamination has been frequently referred to as one of the limitations of drug testing in hair. The detection of relevant metabolite(s) has been proposed to minimise the possibility of external contamination causing a misinterpretation. Difficulty arises when a metabolite is not detected either due to the absence of specific metabolite or to low doses of the drug used. Moreover, in toxicology, the presence of a metabolite cannot be considered as a discrimination tool, as it can also be present in the biological (sweat, sebum, putrefactive fluids) material.

Results from a single segment of hair should not be used to discriminate long-term exposure to a drug. It must be emphasized that with a single hair result, it is not possible to determine the exact amount of drug that was used during the previous period. One should encourage active investigators to perform multi-sectional analyses, which homogenous results can be indicative of contamination.

Conclusion

We concluded that the positive hair findings of Mr W are more likely corresponding to a single high exposure to MDMA at the time of the incident and external contamination of the consecutive segments by excessive sweating due to the pharmacology of the drug.

The Court Panel could not decide which view they prepared and consequently, as the burden of proof was on the 'prosecution', they found the allegation of drug abuse not proved and Mr W kept his job.

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About the author

Dr Kintz is widely recognised as the leading global authority on drugs in hair testing with many years experience of developing the science and publishing internationally on the subject. Dr Kintz first graduated as a Pharmacist at the University of Strasbourg in 1985 and after a period of research in molecular pharmacology, undertook his PhD on analytical methods for drugs of abuse at the Louis Pasteur University, Strasbourg.

Dr Kintz has held positions as Associate Professor of Legal Medicine (1990-2004), Associate Director of the Institute of Legal Medicine of Strasbourg (1990-2004) and joined Chemtox Laboratory in 2004 where he became the Head of Scientific Affairs before leaving in 2010. Dr Kintz is now a senior consultant in Forensic Toxicology and specifically Drugs in Hair Testing.

Dr Kintz has a well established and truly international perspective on Drugs in Hair Testing: he is Past President of the International Association of Forensic Toxicologists (TIAFT); Founding Member and Past President of the Society of Hair Testing (SoHT); Member of the Gesellschaft für Toxicologische und Forensische Chemie (Germany); Member of the Society of Forensic Toxicologists (USA) and is a certified 'Expert' for the French and German legal systems.

Dr Kintz has written over 300 papers and edited 6 books in two languages on forensic toxicology and is a regular guest speaker at scientific meetings and conferences around the world.