The value of brain specimens in post-mortem forensic toxicology

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AIMS: Most articles concerning drugs-of-abuse in human brain specimens were published in the 1980s; recent publications, however, are rare. This study aims to show that new developments in techniques for sample preparation and automation, in combination with the routine use of stable isotope internal standards, promise reproducible and therefore more comparable results and could lay the foundation for a data collection of reliable reference values for drugs-of-abuse in the human brain.

METHODS: Samples from specific regions of the brain (medulla oblongata and cerebellum) from one case of therapeutic morphine use and six cases of suspected opiate intoxication were frozen immediately after autopsy. From each region, approximately eight segments weighing 100mg to 200mg were sampled. The resulting 116 samples were then homogenized in a buffer of pH 7.4 and extracted via automated solid phase extraction (Isolute™ 101, 100mg; IST Limited, Hengoed, UK) with a pressure sensor-controlled ASPEC™XL (Gilson Inc., Middleton, WI, USA) followed by liquid-liquid extraction [1, 2]. After silylation, GC-MS-SIM was performed, with stable isotope internal standards used for quantification.

RESULTS: Approximately eight segments from each medulla oblongata and cerebellum were sampled in order to determine the concentration gradient for the detected drugs-of-abuse within these regions of the brain. Relative standard deviations for these concentrations in the medulla oblongata samples ranged from 2.8% to 8.1% and similar values could be found in the cerebellum samples, which ranged from 3.9% to 6.7%. Morphine, dihydrocodeine and benzoylecgonine were evenly distributed within the investigated regions of the brain; however, in each of the seven cases, significantly different concentrations were found in the medulla oblongata and in the cerebellum.

CONCLUSIONS: Brain samples show several advantages over all other specimens in postmortem forensic toxicology.
Firstly, the brain is an isolated compartment and therefore the process of putrefaction is delayed after death. Moreover, metabolic activity is lower in the brain than in other tissues or in blood, resulting in slower decomposition. Drugs-of-abuse establish their effects, including fatal side effects such as respiratory depression, via the central nervous system. It can be assumed that concentrations of drugs-of-abuse measured in postmortem brain specimens are close or equal to perimortem concentrations of the drug at its site of action.

This study clearly demonstrated that the applied method resulted in reproducible, quantitative data from very small amounts of brain specimens, allowing for the detection of drugs-of-abuse in distinct regions of the brain. A homogenous distribution for unconjugated morphine was found in therapeutic and in toxic concentrations as well as within a postmortem interval over a wide range of between 16 and 225 hours.

When applying automated extraction procedures, GC-MS, and stable isotope internal standards, added at the earliest stage of sample preparation, comparable results are produced which could be used to create a data collection of reliable reference values in order to enable an accurate interpretation of the role of drugs-of-abuse in the cause of death.

REFERENCES:

1 Stimpfl T., Jurenitsch J., Vycudilik W., General unknown screening in postmortem tissue and blood samples: a semi-automatic solid-phase extraction using polystyrene resins followed by liquid–liquid extraction. J. Anal. Toxicol. 25 (2001) 125-129.

2 Stimpfl T., Optimizing an Automated Solid-Phase Extraction Procedure for Postmortem Tissue Samples, in Spiehler V. (Ed.), Proceedings of SOFT-TIAFT-FBI 2004

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