K43 Comparison of Blood Concentrations for Commonly Encountered Drugs in Postmortem and Human Performance Forensic Toxicology Cases in the City and County of San Francisco

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After attending this presentation, attendees will be able to better interpret blood drug concentrations in both postmortem as well as human performance forensic toxicology cases.

This presentation will impact the forensic science community by allowing forensic practitioners and others to refer to this study's blood drug concentration data when attempting to evaluate concentrations encountered in their own casework.

In Human Performance (HP) and Postmortem (PM) toxicology case investigations, body fluids and tissues are routinely collected and submitted to the laboratory for toxicological analysis to help determine if alcohol, drugs, and poisons played any role. The interpretation of measured concentrations is often the source of debate and legal challenge, as there exists a limited volume of literature upon which to base opinions and draw inferences. The present study examines and compares blood drug concentrations measured in two groups: (1) living persons (alleged victims or suspects) involved in police investigations (group HP); and, (2) deceased persons who came under the jurisdiction of the San Francisco Office of the Chief Medical Examiner (SFOCME), regardless of case circumstances (group PM). The goal was to assess blood drug concentrations in living and deceased San Franciscans and to better characterize any observed differences between these two groups. Each group theoretically had access to and used similar drug preparations, thereby removing bias based on geolocation and bloods were analyzed by the same American Board of Forensic Toxicologists (ABFT) -accredited laboratory, thus removing analytical-capability bias.

Method: A retrospective examination of the electronic and printed records of the SFOCME from January 2012 to December 2014 was undertaken in order to identify and categorize all subjects of interest. Group 1 subjects gave venous blood (or blood plasma) as part of their case investigation. Peripheral blood specimens were collected at autopsy from Group 2. Blood specimens from both groups were analyzed by the same laboratory using identical procedures for volatiles by headspace gas chromatography and drugs using commercially available screening techniques, including enzyme-linked immunosorbent assay and full-scan gas chromatography/mass spectrometry. Following a positive drug screen result, fresh aliquots of Group 1 bloods and Group 2 peripheral bloods were subjected to confirmations/quantitations utilizing various analytical techniques as required. Commercially available spreadsheet software was used to tabulate and analyze all drug concentrations.

Results: During the three years examined, 2,398 HP and 2,250 PM investigations involving blood drug quantitations were undertaken. A smaller subset of PM cases (*n*=309) had hospital admission specimens (group AM) associated with them and their blood concentrations were compared to both PM and HP blood concentrations. In groups 1 and 2, ethanol, in %(w/v), was the most commonly encountered substance, ranging from 0.01 to 0.41 (median: 0.16; *n*=2,073) and from 0.02 to 0.59 (median: 0.09; *n*=587) in HP and PM cases, respectively. The following table presents blood concentrations in HP and PM cases for the top five most frequently encountered drugs other than ethanol.

Substance (Units)	HP (Blood Range) (median; sample size)	PM (Blood Range) (median; sample size)
THC (ng/mL)	1.0-22.0 (3; *n*=202)	1.0-81.0 (4; *n*=261)
Cocaine (mg/L)	0.05-0.30 (0.02; *n*=30)	0.05-4.0 (0.09; *n*=114)
Methamphetamine (mg/L)	0.05-2.39 (0.27; *n*=142)	0.05-9.9 (0.65; *n*=182)
Methadone (mg/L)	0.05-0.36 (0.24; *n*=32)	0.05-18 (0.58; *n*=232)
Morphine (mg/L)	0.05-0.12 (0.06; *n*=12)	0.05-4.0 (0.17; *n*=212)

Other drugs commonly encountered included benzodiazepines, hydrocodone, oxycodone, codeine, citalopram, zolpidem, mirtazapine, fentanyl, and trazodone.

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Analysis Of Variance (ANOVA) between HP and PM blood concentrations showed statistically significant differences for THC (p=1.96 x 10^{-7}), methamphetamine (p=1.13 x 10^{-6}), and methadone (p=3.58 x 10^{-3}), but cocaine and morphine did not behave in the same manner. When AM blood concentrations of the PM cases were evaluated for variance against HP blood concentrations, methamphetamine was the only drug among the top five most frequently encountered drugs to exhibit statistically significant differences (p=1.49 x 10^{-4}). Finally, statistically evaluating any differences in blood concentrations between AM and PM cases identified methadone as the only substance exhibiting statistical differences (p=8.29 x 10^{-3}).

Conclusion: This study has undertaken a review of blood concentrations in both living and deceased subjects who came under the jurisdiction of the SFOCME. Overall, ethanol, THC, stimulants (cocaine/methamphetamine), opioids, and benzodiazepines were the most commonly encountered substances in both groups. ANOVA identified statistical differences for certain drugs which may be due to sampling differences, postmortem redistribution, and/or postmortem interval. The aforementioned blood concentration ranges may serve as references to others and allow them to better evaluate drug blood concentration in their case investigations

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Postmortem Toxicology, Human Performance Toxicology, Drug Concentrations