



K68 A Survey of Human Performance and Postmortem Cases Involving Ketamine in San Francisco Between 1997 and 2013

Alexander C. San Nicolas, MSFS*, 300 Davey Glen Road, 3801, Belmont, CA 94002; and Nikolas P. Lemos, PhD, OCME, Forensic Lab Division, Hall of Justice, N Terrace, 850 Bryant Street, San Francisco, CA 94103

After attending this presentation, participants will better understand the frequency of ketamine detection, as well as the concentration ranges of ketamine and its primary metabolite, norketamine, in Human Performance (HP) and Postmortem (PM) forensic toxicology cases in the City and County of San Francisco.

This presentation will impact the forensic science community by adding to the existing body of scientific knowledge of demographic characteristics of ketamine-positive PM cases, Driving Under the Influence (DUI) cases, and drug-facilitated crime cases and their toxicologic findings (including types of analyzed specimens), and ranges of concentrations typically encountered in such cases.

The Forensic Laboratory Division (FLD) of the Office of the Chief Medical Examiner (OCME) examines evidence from HP and PM cases on behalf of 14 law enforcement agencies operating within the City and County of San Francisco. For ketamine, commercially available Enzyme Linked Immunosorbent Assay (ELISA) kits are employed to screen blood (central/cardiac blood in PM cases; venous blood in HP cases) and/or urine received by the FLD. The ELISA blood and urine cutoffs for ketamine are 20ng/mL and 300ng/mL, respectively. Following a positive ELISA screen, confirmation and/or quantitation is performed in blood (peripheral blood in PM cases; a new aliquot of venous blood in HP cases) and/or a fresh aliquot of urine by Gas Chromatography/Mass Spectrometry (GC/MS) with a limit of quantitation of 0.01mg/L and 0.05mg/L for ketamine and norketamine, respectively. The assay uses tripeleamine as internal standard. The Retention Times, Target (underlined), and Qualifier ions for ketamine, norketamine and tripeleamine are presented in the table below.

Analyte	Rt (min)	Ions Monitored (m/z)
Norketamine	5.00	138, <u>166</u> , 168, 195
Ketamine	9.10	152, <u>180</u> , 182, 209
	9.96	58, <u>91</u> , 185, 197

In order to determine those HP and PM cases which involved ketamine and norketamine in San Francisco over the time period of interest, the in-house database was manually interrogated.

Seven HP cases were identified with confirmed ketamine and norketamine in blood, in which subjects averaged 31.7 years (range: 22-40 years), and were predominantly male (n=7; 71%), with a racial distribution of White (71%) and Asian (29%). The ketamine concentrations in these cases were (in mg/L): mean 0.30, median 0.18, range 0.05-0.65, standard deviation 0.24. The norketamine concentrations in these cases were (in mg/L): mean 0.61, median 0.29, range 0.00-1.52, standard deviation 0.56). In HP cases, ketamine was never encountered alone, but was always in the presence of other psychoactive drugs, most commonly ethanol (n=3), cannabis (n=3), benzodiazepines (n=2), and cocaethylene/benzoylecgonine (n=1).

In addition, 25 PM cases were identified involving ketamine. Twenty-one of these had the drug in the decedent's blood and 12 of the 21 also had ketamine confirmed in urine. Two PM cases only had ketamine confirmed in urine while one had ketamine confirmed in muscle, and one in liver. Decedents averaged 40.1 years (range: 19-64 years), were predominantly male (n=25, 88%), with a racial distribution of White (75%), Black (15%), White Hispanic (5%), and Asian (5%). The Manners of Death were: 17 Accidents, four Natural Deaths, two Undetermined, one Homicide, and one Suicide. The ketamine concentrations in these cases measured in peripheral blood (n=14) were: mean 0.91, median 0.29, range 0.01-3.71, standard deviation 1.24). Norketamine was only found in five case bloods (ranging from 0.05-0.16mg/L) and confirmed in four urines. Ketamine was encountered by itself in less than 10% of all PM cases in which it was detected. The most commonly encountered drugs with ketamine were amphetamines (n=8), cocaine (n=7), morphine/codeine (n=6), ethanol (n=4), methadone (n=3), oxycodone (n=3), GHB (n=3), diphenhydramine (n=3), and diazepam (n=3).

This study provides valuable information on the demographic distribution of ketamine users and decedents in the City and County of San Francisco and offers ketamine and norketamine reference blood concentrations. Comparison of the mean concentrations suggests that decedents with ketamine in their peripheral blood have concentrations three times higher than those measured in living individuals; however, comparison of the median values reduces the difference to approximately 60%, suggesting that ketamine blood concentrations should not be considered in isolation, but should instead be reviewed together with all other information available for Copyright 2015 by the AAFS. Unless stated otherwise, noncommercial *photocopying* of editorial published in this periodical is permitted by AAFS. Permission to reprint, publish, or otherwise reproduce such material in any form other than photocopying must be obtained by AAFS.



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a better understanding of the totality of each case. Norketamine in living subjects was detected in concentrations almost twice that of ketamine in the same cases, suggesting a sufficient time interval for metabolism to occur. In postmortem cases, norketamine was rarely detected, suggesting that rapid deaths occurred shortly after exposure allowing little or no time for ketamine to be metabolized. The data presented in this study is useful to forensic toxicologists, pathologists, medical examiners, coroners, attorneys, and other law enforcement agents who need to understand and interpret ketamine and norketamine concentrations measured in HP and PM toxicologic specimens for the purpose of their medicolegal investigations.

Ketamine, Postmortem Toxicology, Human Performance Toxicology