Increasing Prevalence of Ketamine in Drivers in New York City Including the Identification of 2-Fluoro-Deschloroketamine

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Abstract

Ketamine is a dissociative anesthetic used in veterinary and human medicine since the 1970s. Its clinical use has expanded to control of seizures, pre-hospital emergency medical services (EMS), and is finding new purpose as an analgesic alternative and antidepressant. Ketamine brings hope for effective management of chronic pain in the absence of opioids, and decreasing suicidal ideations, however, its persistence as a recreational drug for its hallucinogenic properties remains. In the wake of expanding medicinal purposes, the diversity of New York City's population was explored to better understand its misuse. This retrospective study looks at the prevalence of ketamine in driver fatalities over a period of 18 years (2003–2020) and cases involving suspected driving under the influence of drugs (DUID) over a period of 6 years (2015–2020). Ketamine was identified in 6 driver fatalities and in 47 DUID cases. None of the driver fatalities were suspected of ketamine misuse, due to administration either in hospital or EMS administration. In the DUID cases, an increasing trend was observed over the 6-year study period with 100% (N = 47) of the cases confirmed as non-hospital/non-EMS administered ketamine. Of the DUID cases, 94% were male, with the majority between the age of 21–39 years (85%) and were predominantly Hispanic (36%) and Asian (34%). Blood concentrations of ketamine ranged from 27 to > 2000 ng/mL with polydrug use prevalent. The most common drug classes detected in addition to ketamine were cannabinoids (38%), ethanol (32%), benzodiazepines (26%), cocaine (19%), and amphetamines/MDMA (15%). In 2019, 2-fluoro-deschloroketamine (2F-DCK) was identified in two cases for the first time. Despite its increased acceptance for mental health disorders, ketamine's persistence and misuse as a recreational drug remains and should continue to be monitored by relevant toxicological, clinical, and law enforcement communities along with emerging illicit ketamine analogs.

Introduction

In impaired driving cases, while alcohol is still the most common finding for those driving under the influence (DUI), it is often seen in combination with other drugs. Driving under the

influence of drugs (DUID), with or without alcohol, can often have fatal consequences. In 2016, a report by the Governors Highway Safety Association (GHSA) reported that 43.6% of fatally injured drivers in the United States had drug-positive results, where 50.5% and 40.7% were positive for two or more drugs, or drug-positive with alcohol, respectively (1). Legalization of drugs like marijuana or use of prescription drugs like opioid narcotics or sedatives can lead to a perceived acceptance of driving while under the influence of these drugs since they are intended for medicinal purposes.

As the country continues to combat mental illnesses such as opioid use disorder and major depressive disorder (MDD), ketamine brings clinical alternatives to the mental health community to effectively manage chronic pain in the absence of opioids, and to decrease suicidal ideations in those suffering from MDD, respectively (2). Nevertheless, the New York City Police Department (NYPD) laboratory testing has identified an increased presence of ketamine acquired from non-pharmaceutical sources in the first quarter of 2020 (3). This corresponds with an increased presence of illicit ketamine observed in postmortem intoxication cases and antemortem DUID cases at the New York City Office of Chief Medical Examiner (NYC OCME) Department of Forensic Toxicology. In the wake of expanding medicinal purposes, the diversity of NYC's population was explored to better understand ketamine misuse. This retrospective study began with a look at the prevalence of ketamine in driver fatalities over a period of 18 years (2003–2020) and DUID cases over a period of 6 years (2015–2020).

Ketamine, 2-(2-chlorophenyl)-2-(methylamino)cyclohexan-1-one, ($C_{13}H_{16}ClNO$) is a phencyclidine (PCP) analog that was explored in the 1960s as an alternative to PCP as an anesthetic agent. Although structurally and pharmacologically related to PCP, as illustrated in Figure 1, ketamine's shorter elimination half-life and shorter duration of effect (3–4 hours, and 0.5–2 hours, respectively) versus that of PCP (7–46 hours, 2–4 hours, respectively) (4), made it a safer dissociative anesthetic for use in veterinary and human medicine. Ketamine's adverse psychological reactions were less intense versus those associated with PCP (delusions, delirium, hallucinations muscle rigidity and seizures) (4).

While PCP is a Schedule II Controlled Substance and its legal manufacture has been discontinued, ketamine is a Schedule III Controlled Substance and is categorized as having moderate to low potential for physical and psychological dependance (5). As a result, the clinical use of ketamine has expanded beyond the use of dissociative anesthesia in a hospital setting, to pediatric medicine, pre-hospital use by field emergency medical services (EMS) (6) and continues to be explored as an analgesic alternative and antidepressant. Its CNS-related psychedelic effects occur in a dose-dependent fashion at relatively low doses when used in the treatment of chronic pain (7). The psychedelic effects of ketamine can be pleasurable and are a primary reason for its recreational use. In a study of NYC youth that injected themselves with ketamine, intravenous (IV) administration was preferred over the common form of intranasal (IN) administration because a "k-hole"—the intense psychological and somatic state experienced while under the influence—is more reliably achieved and more intensely experienced (8). Users frequently take sub-anesthetic doses which can produce alterations in mood and body image, visual hallucinations, "out of body" experiences and vivid dreams (9).

Ketamine's persistence as an illicit drug amongst drivers has been greatly reported in Asia. As the most misused drug in Hong Kong since 2001 (10), a protocol for effective roadside detection of ketamine-impaired drivers was developed using a series of field impairment tests (FIT) and toxicological testing (oral fluid and urine) and involved testing 62 volunteers exiting from discos between January and December 2004 (11). In this study, oral fluid samples of 39 volunteers tested positive for ketamine. 54% of these ketamine-positive volunteers (N = 21) were found to have ketamine only and 46% (N = 18) were positive for ketamine and other drugs. Retrospective studies of drugged driving cases in Hong Kong from 2010–2011 and 2012–2015 revealed that ketamine was found in 71% and 68% of the cases, and with ketamine blood concentrations of 80–1800 ng/mL and 10–1800 ng/mL, respectively. (9). In Taiwan, ketamine remained the most prominent of the psychoactive substances detected from early 2008 until 2018 (10), and ketamine-related deaths began to appear in 2002 with a ranking of fifth, then gradually moved up to the second place in 2011 (13). Driving data, however, was not available for Taiwan.

Illicit use of ketamine amongst drivers has also been reported outside of Asia. In England and Wales, of 376 drugged-drivers studied, 14 were identified with ketamine blood concentrations ranging from 170–850 ng/mL (14). Oral fluid testing of 853 specimens of drivers in Australia from 2009 to 2010 revealed ketamine at an incidence of 1.5% (15). Polydrug patterns were studied in Italy involving drunk drivers from 2014 to 2017 (16). Of the 243 subjects where polydrug patterns were identified, ketamine was found in three patterns: ketamine by itself (N = 8), ketamine with amphetamine-like drugs and cocaine (N = 1) and ketamine with buprenorphine (N = 1).

Ketamine-related novel psychoactive substances (NPS) have also been identified in the literature. These analogues include methoxetamine (MXE), deschloro-N-ethyl-ketamine (2-oxo-PCE), methoxyketamine (2-MeO-2-deschloroketamine), deschloroketamine (DCK) and 2-fluoro-deschloroketamine (2F-DCK). MXE has been controlled in Europe since 2015 (17). Rat studies have shown it to produce a similar behavioral profile like NMDA receptor antagonists ketamine and PCP, but with greater potency than ketamine (18). By 2018, the number of ketamine misusers had dropped in Hong Kong, which coincided with an emergence of 2-oxo-PCE in drug seizures and DUID toxicological findings (19). In a study of 11 DUID cases submitted during this time, 2-oxo-PCE was detected in four cases at a blood concentration range of 80–310 ng/mL. In France, oral fluid of drivers in the vicinity of two 2017 music festivals were tested to assess the prevalence of consumption and the type of NPS used in this particular population of drivers (20). Of these 17 oral fluid samples, ketamine was identified once and MXE and methoxyketamine were each identified three times. In 2018 and 2019, six cases screened positive for 2F-DCK at the Department of Forensic Medicine, University of Copenhagen in Denmark, which prompted studies on plasma protein binding and intrinsic clearance of ketamine, norketamine, DCK and 2F-DCK to explore the toxicokinetic profile of these NPS (21). Between January and July 2019 in Hong Kong, 20 cases of analytically confirmed 2F-DCK exposure were encountered, and in 19 out of 20 cases, at least one more ketamine-type drug was detected concurrently with it, including ketamine (90%), deschloroketamine (DCK, 50%), 2-oxo-PCE (45%) and tiletamine (10%) (22).

The NYC OCME Department of Forensic Toxicology performs analysis of postmortem (PM) medical examiner cases, and antemortem DUID cases and drug-facilitated crimes. The illicit use of ketamine in the NYC driving population was evaluated by assessing the PM cases for driver fatalities over a period of 18 years (2003–2020) and DUID cases over a period of 6 years (2015–2020). In this study we present the prevalence of ketamine in DUID cases and highlight the first reported identification of the ketamine analog, 2F-DCK (Figure 2) in New York City and the United States.

Materials

United Chemical Technologies Clean Screen Xcel I solid phase extraction cartridges (Bristol, PA, USA). Certified reference materials ketamine (1mg/mL) and ketamine-d_4 (1mg/mL) from Cerilliant Corporation (Round Rock, TX, USA), 2-fluoro-deschloroketamine (5mg) from Cayman Chemical (Ann Arbor, MI, USA), and methapyrilene HCl from Sigma-Aldrich (St. Louis, MO, USA). Deionized water, heptane, toluene, isoamyl alcohol were obtained from Spectrum Chemical (New Brunswick, NJ, USA); glacial acetic acid, n-butyl chloride, potassium bicarbonate, potassium carbonate, sodium bicarbonate, sodium carbonate, sodium acetate trihydrate, hydrochloric acid, ethyl acetate, ammonium hydroxide from Fisher Scientific (Pittsburgh, PA, USA); methanol from Sigma-Aldrich (St. Louis, MO, USA).

Methods

Screening

Solid phase extraction (SPE) was utilized in combination with a comprehensive full scan screening method including identification of ketamine. This validated assay for basic drugs includes drugs of abuse, therapeutic drugs, and some emerging NPS. The screen method used one milliliter of biological sample (e.g., blood, urine). A single-point calibrator and controls were spiked with stock solutions containing several analytes, including ketamine, and with internal standard methapyrilene. Samples were prepared for SPE by treatment with sodium acetate buffer (pH 4.5), vortexed, sonicated, and centrifuged. Samples were applied to the SPE columns and allowed to pass through under an applied pressure of 2-4 psi at a rate of 1 mL/ minute. Columns were washed with pH 9.0 buffer, 100 mM HCl, methanol, and ethyl acetate. Elution solvent (99:2 solution of ethyl acetate and ammonium hydroxide) was applied and eluent collected. Samples were dried, reconstituted with 100 µL of THI (toluene, heptane and isoamyl alcohol; 39:10:1) and transferred to autosampler vials for full-scan GC–MS analysis.
Identification of ketamine was accomplished using an Agilent 7890B GC System with coupled with a 5977A mass selective detector and 7693 autosampler (Agilent Technologies, Santa Clara, CA, USA). Splitless injection was utilized with an HP-5 MS capillary column (30 m × 250 µm, 0.25 µm). A temperature programming method was employed, starting at 90°C for a hold time of 1.0 min, and ending at 295°C with a hold time of 14 minutes, for a total run time of 26 minutes. The mass selective detector was in full scan mode and its spectral comparisons were performed

against an in-house library created using reference standards, or commercial libraries as needed.

Quantitation

Upon identification, ketamine was quantitated by employing a liquid-liquid extraction (LLE) and running the sample in single ion monitoring mode (SIM). A 7-point calibration curve (25–2000 ng/mL), three positive controls (30, 100 and 1200 ng/mL) and a negative control were prepared by spiking with internal standard ketamine-d_4 and a pH 9.8 buffer, followed by N-butyl chloride. The samples were mixed. A back extraction step was performed by removing the organic layer and placing it in a test tube containing 0.5 N HCl. The upper organic layer was aspirated to waste and the remaining aqueous layer was treated with sodium carbonate, and buffer (pH 9.8). THI was added, samples were capped and mixed as previously indicated. The THI layer was transferred to autosampler vials for GC–MS analysis.

Quantitation of ketamine was carried out on the same model GC–MS and column as described above. Two microliters of the sample were injected. Its temperature programming began with a column temperature 125°C, hold time of 1.0 min, and then ramped at 25°C/min and held at 295°C for 2 minutes. The mass selective detector in SIM mode allowed for the monitoring of ions *m/z* 180, 182 and 209. The total run time was 9.8 minutes. Quantitation was performed using Agilent Mass Hunter data acquisition.

It must be noted that the analysis of ketamine has undergone some transition in the laboratory over the 18-year period of the study. The laboratory transitioned from LLE for screening to SPE for screening, quantitation of ketamine by GC–NPD to GC–MS SIM, ChemStation data acquisition to Agilent Mass Hunter data acquisition, and the most recent in 2020, changing the internal standard from methapyrilene to ketamine-d_4. The calibration curve also evolved overtime, lowering the LLOQ from 50 ng/mL to 25 ng/mL. Although various changes occurred during this time, all procedures used were validated and employed in accordance with the standards of the time and most recently the SWGTOX guidelines (23).

Ketamine Positive Cases

Postmortem cases were identified through searching the inhouse databases between 2003 and 2020 for all cases where ketamine was detected and then searching this subset for those cases involving a driver. The data for 2020 was incomplete as at the time of writing as not all cases from 2020 were complete. This was a direct result of a backlog created by the COVID-19 pandemic.

Where available, demographic information was collected including age, sex, race and toxicology findings.

DUI cases required more manual searching to identify cases positive for ketamine due to different databases used over the 6-year study period of 2015 to 2020. Starting in late 2017, the NYC OCME Department of Forensic Toxicology tested all DUI cases for the City of New York. Prior to this, predominantly only blood specimens requiring drug analysis in addition to alcohol were sent to the OCME, while cases identified for alcohol only testing were sent to the NYPD for testing and other specimens sent to an out-of-state laboratory. All specimens submitted to the NYC OCME are tested for ethanol and a wide range of illicit and prescription drugs, subject

to sufficient sample volume. The only exception to this was in 2020 when the laboratory was closed for 3 months at the start of the COVID-19 pandemic. Not all DUID cases were screened for basic drugs including ketamine and therefore, although all the 2020 DUID cases were completed, the number of ketamine positive cases may be an underestimate due to the cases that were not screened by GC–MS.

Results and Discussion:

The NYC OCME Department of Forensic Toxicology receives on average 5,500 postmortem cases annually from across the five boroughs, however, ketamine was identified in only six driver fatalities over a period of 18 years (2003–2020). In all cases the presence of ketamine was attributed to administration by medical staff prior to intubations performed either in the hospital or by pre-hospital EMS which is approved for administration to trauma patients (24).

In five of the six cases summarized in Table I, the cause of death was related to blunt force injuries, and in one case (PM 005) the cause of death was due to smoke inhalation and thermal injuries following a multiple vehicle crash.

Over the course of the study period (2015 to 2020), the laboratory conducted testing of 1,959 road traffic (DUID) cases. This ranged from 183 cases in 2015 to 496 cases in 2019 when the laboratory was receiving all DUID cases for the City of New York. In 2020, the number of DUID cases dropped by almost one-third in comparison to the previous year to 340 cases. This was a direct result of less traffic being on the road during the COVID-19 lockdown and was not unique to NYC.

In sharp contrast to the driver fatalities, all 47 DUID cases where ketamine or a ketamine analog was identified were determined to be from recreational use and not administration by medical personnel. Table II summarizes the available information for all 47 cases including age, race, sex and toxicology findings.

The number of ketamine positive cases increased over the study period from 2 cases in 2015 (1.1%) to 12 cases in 2020 (3.5%) as illustrated in Figure 2. The drivers were predominantly male (N = 44; 94%), were Hispanic (36%) or Asian (34%) and between the ages 21 and 52. Although the total number of cases each year were relatively small, there was an observed change in the proportion of Hispanic drivers with an increase in 2019 and 2020, while in contrast Asian drivers increased from 2017 to 2019 and then sharply decreased in 2020.

Blood concentrations of ketamine ranged from 27 to greater than 2000 ng/mL with polydrug use prevalent. Ketamine was detected in conjunction with other drugs in 77% of the cases. The drugs most frequently detected were, in order, cannabinoids (N = 18, 38%), ethanol (N = 15, 32%), benzodiazepines (N = 12, 26%), cocaine or metabolites (N = 9, 19%), amphetamines/MDMA (N = 7, 15%) and opioids (N = 3, 6%). In 2019, 2-fluoro-deschloroketamine (2F-DCK) was identified in two cases and in one of the cases only 2F-DCK was identified and no ketamine was present.

Case Studies

The information provided varies significantly from case to case and the circumstances surrounding the crash/arrest are not always detailed. While there were no driver fatalities identified who were misusing ketamine, at least two of the DUID cases resulted in the death of a pedestrian and a passenger. It is unknown if other fatalities resulted from critical injuries sustained in the crashes.

A number of drivers were observed with powder in or near their nose and mouth and many admitted to using ketamine and voluntarily stated the powder within their vehicle was ketamine. Most common observations related to the driver being combative and, on several occasions, required a taser to be used to subdue them. In contrast, for one case (RT 035) the driver was found sleeping behind the wheel, however only urine was collected and detection of alprazolam and ethanol confirmed. This was the second time this same driver was arrested for DUID and ketamine identified. Approximately 18 months previously, the same driver was stopped by police and observed with powder residue on his nose. Again, a urine specimen was collected.

The identification of the ketamine analog, 2F-DCK was initially identified by library match only and then confirmed by purchasing the analytical reference standard. In the first case (RT 029) only 2F-DCK was identified. Ketamine was not detected or any other drugs or ethanol. The driver was initially combative but became violent and continued to resist even after he was tased. He was found running around in the street and later admitted to using “ketamine”.

Figure 3 is the spectrum for 2F-DCK for case RT 029 compared with the MS library from Cayman (2019). 2F-DCK was later confirmed for both cases (RT 029 and RT 032) when the reference standard was purchased.

In the second case (RT 032), a urine specimen was submitted and 2F-DCK in addition to ketamine and metabolites were identified. Although no blood was submitted for analysis, a drug recognition expert (DRE) was at the scene to evaluate the driver and concluded his behavior was consistent with use of a dissociative anesthetic. A vial of alleged ketamine was later observed in plain view within the driver’s car.

Conclusion

Ketamine has many advantages when used in a range of clinical settings but the potential for misuse as a recreational drug presents a real concern. In this study we highlighted the risks associated with ketamine use amongst drivers and the identification of a ketamine analog, 2F-DCK for the first time in two cases where drivers were involved in motor vehicle crashes. Forensic and clinical toxicology laboratories and law enforcement communities should continue to monitor ketamine along with emerging illicit ketamine analogs.

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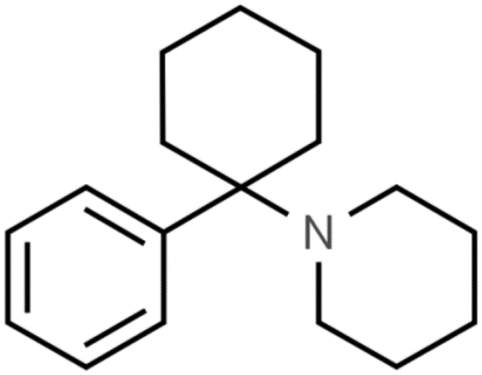
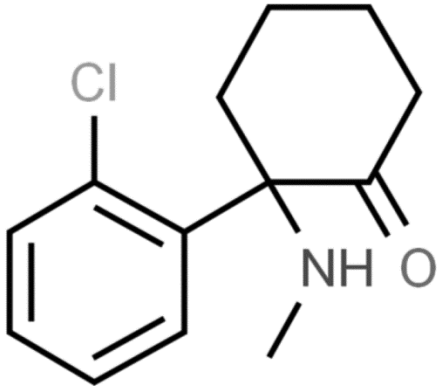
figure captions

Figure 1. Chemical structures of (a) PCP, (b) ketamine and (c) 2-fluoro-deschloroketamine (2F-DCK).



(a)



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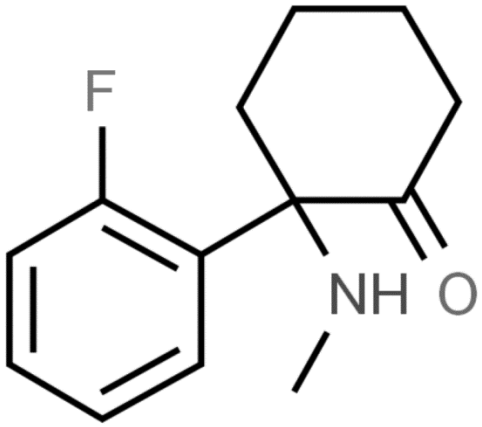

(c)

Figure 2. Ketamine-positive DUI cases by year and by race.

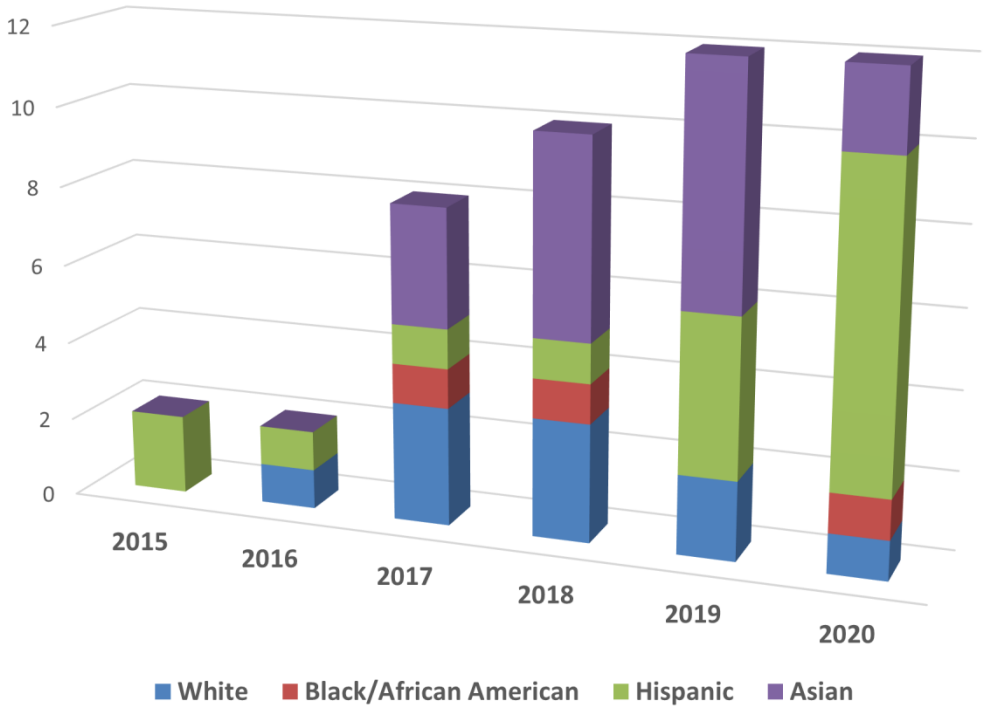

Figure 3. Mass spectrum of 2F-DCK identified in blood in case RT 029.

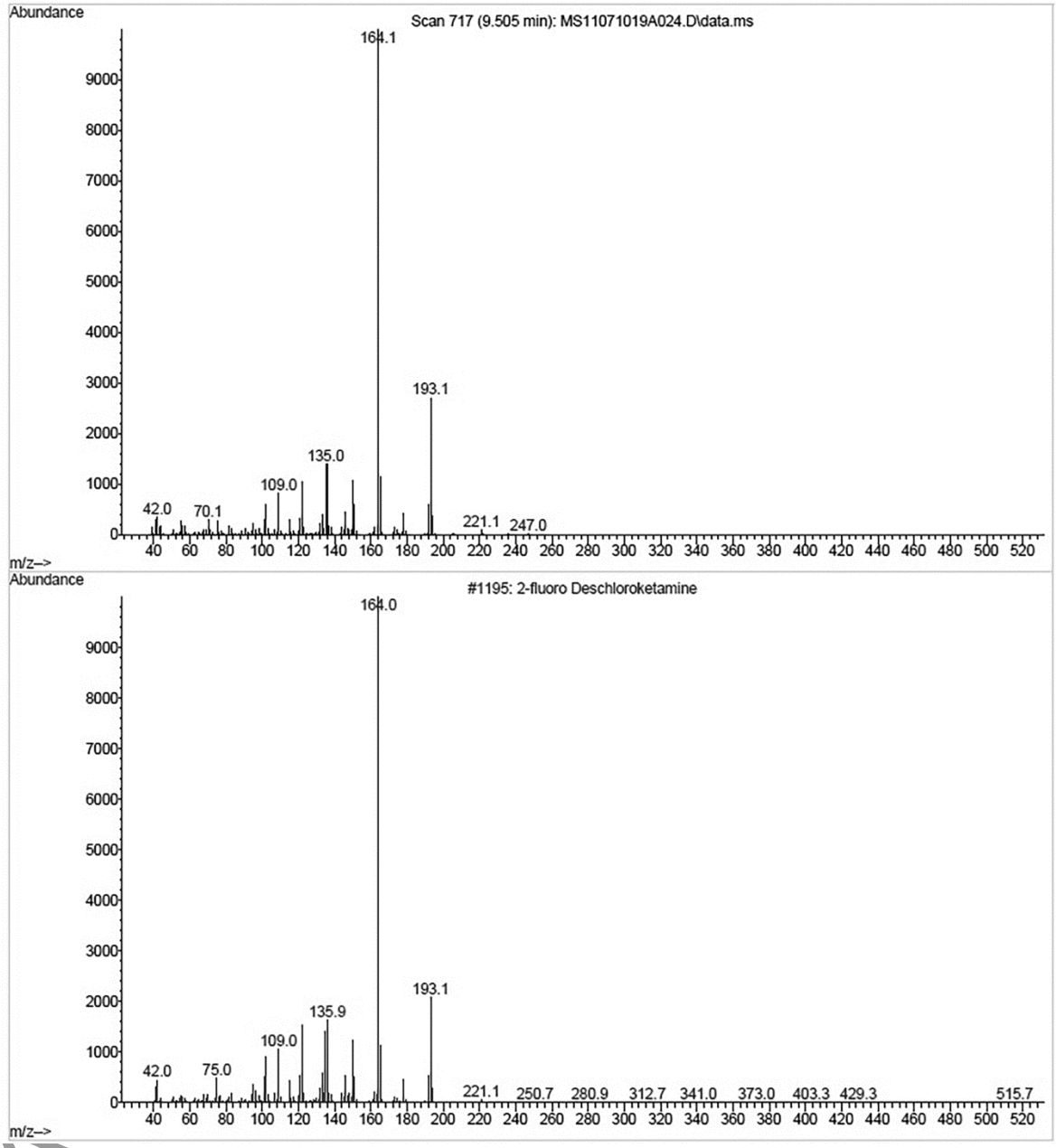

Table I. Driver Fatalities with Ketamine Present Due to Medical Intervention

Case Number	Demographic (Age, Race/Sex)	[Ketamine] (ng/mL)	Other Drugs Detected (ng/mL in peripheral blood unless otherwise specified; compounds with no quantitative value were qualitative only or detected outside of the calibration range)
PM 001	26 B/M	210	Norketamine, lidocaine
PM 002	14 B/M	1,400	Laudanosine (420)
PM 003	19 B/M	980	Cannabinoids
PM 004	69 B/M	20	Diphenhydramine (90), nordiphenhydramine, etomidate (<100), midazolam (40), morphine (<50), 7-Aminoclonazepam (<10), salicylates (<10 mg/L), acetaminophen (<10, mg/L); Bile – morphine
PM 005	51 W/M	<100	Carbon monoxide (46% saturation), lidocaine; Urine – ketamine, norketamine
PM 006	49 A/M	940	No other drugs; Heart blood – ketamine

W = White, B = Black/African-American, A = Asian, H = Hispanic, M = male, F = female

Table II. Ketamine-Positive DUID Cases in NYC from 2015 to 2020

Case Number	Demographic	[Ketamine] (ng/mL)	Other Drugs Detected (ng/mL unless otherwise specified; compounds with no quantitative value were qualitative only or detected outside of the calibration range)
RT 001	37 H/M	79	Norketamine, cannabinoids
RT 002	36 H/M	360	Norketamine
RT 003	38 W/F	50	Norketamine, amphetamine (<100), methamphetamine (<100)
RT 004	21 H/M	<50	EtOH (0.03 g%), alprazolam (45), benzoylecgonine (93), etizolam, cannabinoids, lidocaine, cotinine
RT 005	35 W/M	Urine - Detected	Ketamine metabolite, lorazepam, alprazolam, furanyl fentanyl, 4-ANPP, bupropion threo-amino metabolite, bupropion erythro-amino metabolite, morphine, codeine, norcodeine, hydrocodone
RT 006	37 U/M	<50	EtOH (0.06 g%), ketamine metabolite, venlafaxine, midazolam, lidocaine, lidocaine metabolite, cotinine, cannabinoids
RT 007	41 W/M	960	Norketamine
RT 008	26 A/M	180	Norketamine, cotinine
RT 009	32 H/M	540	Norketamine, benzoylecgonine, levamisole, cotinine
RT 010	28 A/M	Urine - Detected	Methamphetamine, norketamine, nicotine

RT 011	28 A/M	590	Cannabinoids, cotinine, norketamine
RT 012	29 W/M	Urine - Detected	Morphine, codeine, hydromorphone, cannabinoids, cotinine, norketamine
RT 013	23 B/M	<50	EtOH (0.07 g%), fentanyl (0.35), cotinine
RT 014	52 W/M	Urine - Detected	Norketamine, alpha-hydroxyalprazolam, alprazolam, cocaine, benzoylecgonine, levamisole, norcocaine, ecgonine methyl ester, trimethoxycinnamoylcocaine
RT 015	43 A/M	150	EtOH (0.03 g%), norketamine, cotinine
RT 016	36 H/M	Urine - Detected	Norketamine, diphenhydramine, nicotine, cotinine, cannabinoids
RT 017	28 W/M	<50	Diazepam (4.0), fentanyl (2.4), norfentanyl (0.61), acetylfentanyl (0.25), 4-ANPP (<0.10 ng/mL), cannabinoids, cotinine
RT 018	28 A/M	Urine - Detected	Cannabinoids, norketamine
RT 019	31 W/M	<50	Methylenedioxymethamphetamine (<100), alprazolam (40), alpha-hydroxyalprazolam (1.2), oxazepam (1.0), diazepam (1.3), nordiazepam (22), cocaine (<50), benzoylecgonine (1,108), ethylbenzoylecgonine (<50), lidocaine, levamisole, cotinine
RT 020	26 A/M	60	EtOH (0.21 g%), norketamine, alprazolam (19), alpha-hydroxyalprazolam (1.6), cannabinoids, cotinine
RT 021	29 A/M	350	EtOH (0.04 g%), dehydronorketamine, norketamine, cotinine
RT 022	30 A/M	Urine - Detected	Dextromethorphan, norketamine, cocaine, benzoylecgonine, ecgonine methyl ester, amphetamine, methamphetamine, cannabinoids, cotinine, nicotine
RT 023	49 B/M	150	EtOH (0.25 g%), lorazepam (24), diphenhydramine (110), midazolam, norketamine
RT 024	30 A/F	660	Norketamine, cotinine
RT 025	33 H/M	Detected	Phencyclidine, cocaine, benzoylecgonine, norketamine, nicotine
RT 026	27 W/M	600	EtOH (0.19 g%), cotinine
RT 027	29 H/M	Urine - Detected	Benzoylecgonine, methamphetamine, norketamine, nicotine, cannabinoids
RT 028	25 H/M	Urine - Detected	Dehydronorketamine, norketamine, flualprazolam, cannabinoids
RT 029	30 A/M	N/A	2-fluorodeschloroketamine
RT 030	25 A/M	50	Cotinine

RT 031	29 A/M	Urine - Detected	Dehydronorketamine, norketamine, nicotine
RT 032	32 A/M	Urine - Detected	Norketamine, 2-fluorodeschloroketamine, dehydronorketamine, methylenedioxyamphetamine, methylenedioxymethamphetamine, ephedrine, olanzapine, nicotine, cotinine, THC-COOH
RT 033	41 W/F	450	Norketamine, cotinine
RT 034	41 A/M	260	Norketamine, cotinine
RT 035	37 H/M	Urine - Detected	EtOH (0.04 g%), norketamine, dehydronorketamine, alpha-hydroxyalprazolam, alprazolam, nicotine, cotinine, levamisole, THC-COOH
RT 036	24 H/M	20	Phencyclidine (40), norketamine, flualprazolam, THC, THC-COOH, lidocaine, cotinine
RT 037	47 H/M	Urine - Detected	Dehydronorketamine, norketamine, cetirizine
RT 038	30 H/M	600	EtOH (0.23 g%), benzoylecgonine (155), norketamine
RT 039	39 H/M	Urine - Detected	EtOH (0.18 g%, norketamine, midazolam
RT 040	38 H/M	>2,000	EtOH (0.25 g%); Blood 2 – EtOH (0.27 g%), ketamine
RT 041	34 A/M	505	Norketamine
RT 042	29 A/M	44	Norketamine, zolpidem, oxycodone, mirtazapine, trazodone, cotinine
RT 043	38 H/M	Urine - Detected	Norketamine, levamisole, lidocaine, fentanyl, norfentanyl, 4-ANPP, b-hydroxyfentanyl, cocaine, benzoylecgonine, methamphetamine, THC-COOH
RT 044	22 H/M	230	Norketamine, midazolam, ethanol (0.14g%), THC, 11-OH-THC, THC-COOH
RT 045	28 W/M	Urine - Detected	Norketamine, dehydronorketamine, cocaine, benzoylecgonine, THC-COOH
RT 046	32 B/M	109	Norketamine, cotinine, ethanol (0.16g%), THC (10), 11-OH-THC (5.1), THC-COOH
RT 047	25 H/M	500	Norketamine, dehydronorketamine

W = White, B = Black/African-American, A = Asian, H = Hispanic, U = not indicated, M = male, F = female