## K16 Cocaine Related Deaths: An Enigma Still Under Investigation

*Francesco Mari*, Elisa Betta Beraco, and Maria Grazzia Di Miha Hsustani, Forensic Toxicology Division – Anatomy, Histology, and Legal Medicine Department, University in Florence, Viale Morgaghi 85 50134 Firenze, Italy*

The goal of this presentation is to present to the forensic toxicology community several references to aid in the determination of cocaine related death.

This presentation will impact the forensic community and/or humanity by providing information about the interpretation of cocaine related deaths, which is still very difficult and disputed. Although literature offers many toxicological data about cocaine involving death, the correlation of a specific blood or tissue concentration with toxicity is not directly proportional to the height of these levels. Many factors make the interpretation of toxicological findings in cocaine associated deaths more complicated:

- fast absorption of drug assumed by “snorting” or “intravenous”
- different metabolism in chronic or occasional user
- *in vitro* degradation
- postmortem redistribution of cocaine and its major metabolite, benzoylecgonine
- different rates of crossing blood-brain barrier (benzoylecgonine crosses with greater difficulty)
- interactions of cocaine and alcohol or other drugs (such as disul firam, amitriptyline, procanamide, quinidine, vasoactive compounds, etc.)

As a consequence, many authors recommend caution in not misinterpreting toxicological data, especially by untrained and inexperienced operators, (not including real forensic toxicologists), because, with the exception of massive overdose (when the mechanism of death is perfectly clear), most cocaine related deaths occur in chronic drug users. Also, the cocaine concentration found in postmortem blood might not be representative of the concentration present at the time of death.

Isolated blood cocaine levels, without any other parenchymal distribution analytical data, cannot be used to explain the cause of death, because - for example - cocaine associated sudden death is not dose related.

Several studies have demonstrated that blood and brain ratios of cocaine/benzoylecgonine concentrations are greatly important to suggest a parameter to identify and discriminate death due to cocaine overdose from death where the presence of cocaine is simply an incidental finding.

Blood and brain levels used to determine cocaine and benzoylecgonine concentrations ratios are the best matrix for postmortem analytical researches, because even if cocaine blood concentrations change significantly after death, cocaine appears to be more stable in the lipid-rich tissue of the brain.

In Spielher and Reed’s 1985 study, the interpretative value of the determination of cocaine and benzoylecgonine in brain tissue was investigated.

They found that in 37 autopsied cases of cocaine related deaths (overdose) the concentration of cocaine found in the brain is four to ten times higher than in the plasma; where cocaine was only an incidental finding (46 cases - instances of murder, accidental death, etc.), the average blood/brain ratio was only 2:5 for cocaine and 1:40 for benzoylecgonine. In the forensic toxicology division, all suspected cocaine cases (overdoses and incidental deaths) were investigated as to cocaine and its metabolites distribution.

The authors apply Spielher and Reed’s model to cases performed during 1990 to the first six months of 2004 on 77 cocaine overdose fatalities, and 30 cases where cocaine was incidental to the cause of death.

Cocaine and benzoylecgonine were extracted by SPE and derivatized compounds were identified and quantified by means of a gas chromatography-mass spectrometry (GC/MS) using selected ion monitoring detection (SIM).

The findings were in agreement with those of Spielher and Reed. The authors found that in overdose cases the ratios of cocaine/benzoylecgonine in the brain was 10:28 and in the blood 0:69. These ratios were clearly different from those found in incidental cases (brain mean was 0:71 and blood mean was 0:21).

The brain/blood ratios of cocaine and benzoylecgonine concentration in overdose cases were found to be 8:06 for cocaine and 0:67 for benzoylecgonine; in incidental cases the ratios were 2:28 for cocaine and 1:67 for benzoylecganine.

In conclusion, brain tissue appears to be a good sample for the determination of cases of cocaine involved deaths. The brain concentration levels related to the blood provide useful information in the determination of overdose as compared to cocaine as an incidental finding.

**Cocaine, Death, Brain**

 ** Presenting Author*