K17 Vitreous Humor Chemistry of Heroin-Related Deaths as Compared With the General Population of Non-Drug-Related Deaths in the City and County of San Francisco From 2010 Through 2013

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After attending this presentation, attendees will better understand the vitreous humor chemistry results of heroin-related deaths as compared to the vitreous humor chemistry results of the general population of decedents who had no drugs detected at the San Francisco Office of the Chief Medical Examiner from 2010 to 2013.

This presentation will impact the forensic science community by offering the forensic community a deeper insight into the relative vitreous humor chemistry in heroin-related deaths and non-drug-related death populations in the city and county of San Francisco.

Heroin (diacetylmorphine) is metabolized to 6-monoacetylmorphine, which is frequently a target analyte in forensic toxicology laboratories as confirmation of heroin abuse. One of the most popular specimens employed for this confirmation in recent times is vitreous humor. This fluid is often examined for the concentrations of electrolytes and compounds such as sodium, potassium, chloride, glucose, vitreous urea nitrogen, and creatinine. The Forensic Laboratory Division at the Office of the Chief Medical Examiner in San Francisco routinely tests vitreous humor on behalf of the Pathology Division for signs of diabetic ketoacidosis, dehydration, and general electrolyte imbalance. Review of the data involving both sets of information (i.e., presence of opioids and vitreous chemistry) may assist analysts in relating to these types of deaths in comparison to non-opioid-related fatalities.

Method: A meta-analysis was performed on the vitreous humor chemistry data obtained from previously analyzed specimens in both heroin-related deaths and those from non-drug-related deaths to determine if there exists a direct relation between heroin death and the results obtained during postmortem chemistry studies using a sample population from the City and County of San Francisco. This was performed by accessing data obtained from a commercially available spread sheet data base populated by results obtained by staff at the Forensic Laboratory Division. The hypothesis is that there exists a significant difference in vitreous humor chemistries between the two populations; whereas a null hypothesis suggests there would be no significant differences in terms of electrolyte concentrations in the populations.

Data was reviewed from the analyses performed using a vitreous humor chemistry analyzer employed at the Forensic Laboratory Division and the San Francisco Office of the Chief Medical Examiner. This database was interrogated from the period of 2010 to 2013. This data included the determined concentrations of sodium, potassium, chloride, glucose, vitreous urea nitrogen, and creatinine, the presence of 6-monoacetylmorphine, age, gender, as well as cause and manner of death. A total of 5,190 cases were reviewed. Exclusions were applied to those deaths of subjects less than 16 years of age and greater than 65 years of age, and in those cases in which the potassium concentrations were greater than 30mmol/L.

Cases for inclusion listed 6-monoacetylmorphine or diacetylmorphine in the Forensic Laboratory Division's and the Medical Division's databases. From this review of the cases and the respective electrolyte concentrations in vitreous humor, the data was exported to commercially available spreadsheet software and Analysis of Variance (ANOVA) was used for statistical calculations and assessment.

Results: The Pathology Division of the Office of the Chief Medical Examiner requested vitreous humor chemistry analysis in 8 of 36 heroin-related deaths. The control samples were comprised of 128 randomly selected, non-drug-related deaths. The concentrations of sodium ranged from 72mmol/L to 146mmol/L in the heroin-related deaths, while the range was 92mmol/L to 207mmol/L for non-heroin-related deaths. In the case of chloride concentrations, 65mmol/L to 125mmol/L were found in heroin-related deaths; the corresponding values in the non-heroin-related cases were found to be 70mmol/ L to 138mmol/L. From this data, it was determined that both sodium and chloride showed statistical significance ($p<0.05$) using 95% confidence interval when comparing heroin-related deaths to the control population. Most other electrolytes did not show any statistically significant differences. Glucose and ketone were not analyzed for variance because in almost all of the heroin-related deaths, glucose results were <25mg/dL and ketones were almost always negative.

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Conclusion: In this three-year study comparing the vitreous humor chemistry of heroin-related deaths to a control population of non-drug-related deaths in the City and County of San Francisco, it was found that the relationship between sodium and chloride concentrations showed statistically significant differences between the two populations. If poor nutrition or dehydration in the opioid population was a controlling factor, one would expect to see elevation in sodium or chloride concentrations, which is not being observed. The statistical evaluation of the concentrations of other vitreous humor electrolytes will remain the subject of further studies at the Forensic Laboratory Division of the San Francisco Office of the Chief Medical Examiner.

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