H178 The Utility of Postmortem Vitreous Beta-Hydroxybutyrate (BHB) Testing for Distinguishing Sudden From Prolonged Deaths and for Diagnosing Ketoacidosis

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Learning Overview: After attending this presentation, attendees will better understand the utility of postmortem vitreous BHB levels in prolonged and sudden natural and non-natural deaths and will be provided with values that may be used to establish a diagnosis of ketoacidosis.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing postmortem vitreous BHB threshold levels for the diagnosis of ketoacidosis as a cause of death.

Elevated BHB has been used in the diagnosis of Diabetic (DKA) and Alcoholic (AKA) ketoacidosis, with BHB values above 2.5mmol/L in blood often utilized as a threshold. Recently, vitreous BHB has been established as a reliable alternative to blood. It has been shown that vitreous BHB levels above 6mmol/L (with glucose levels above 200mg/dl) are strongly associated with DKA. Slightly elevated levels of BHB have been noted in other stressful states, including infection and hypothermia. The objective of this study was to determine whether elevated postmortem vitreous BHB can be used to predict stressful types of deaths and to establish a vitreous BHB threshold for the diagnosis of ketoacidosis as a cause of death.

A retrospective cross-sectional analysis of vitreous BHB was performed during a two-year study period. Extracted data included history of diabetes mellitus and alcoholism, vitreous glucose, electrolytes and BHB levels, and cause of death, in addition to demographic information. Cases were excluded if the decedent was less than 18 years of age, where collection of samples was not possible, or where the cause of death was not determined. Analysis of BHB was performed using enzymatic quantification by beta-hydroxybutyrate dehydrogenase. Cases were sorted into six categories of death: (1) sudden non-natural death (ST); (2) sudden natural death (SN); (3) prolonged non-natural death (PT);, (4) prolonged natural death (PN), (5) DKA; and (6) AKA. Statistical comparisons were made between sudden and prolonged natural and non-natural deaths using the Student's *t*-test. Comparison between alcoholic and diabetic ketoacidosis cases used the non-parametric Mann-Whitney method. Analyses were conducted using Microsoft® Excel® and Minitab® 16.

Nine hundred sixty-seven cases met the inclusion criteria. The mean age was 51.7 years (median=53 years) with a range from 18–97 years. Six hundred twenty-six cases were male and 341 were female. One hundred twenty-two cases had a known history of diabetes and 121 a history of alcoholism (17 cases overlapped). The mean BHB for all cases was 1.67mmol/L (17.4 mg/dl), and ranged from 0.11–18.02mmol/L. For the categories of death, the number of DKA, AKA, PN, PT, SN, and ST deaths were 21, 5, 155, 258, 275, and 253, respectively. Their mean vitreous BHBs were as follows: 11.04mmol/L (DKA), 8.88mmol/L (AKA), 1.56mmol/L (PN), 1.55mmol/L (PT), 1.26mmol/L (SN), and 1.38mmol/L (ST). There was a statistically significant difference between the mean BHBs of the prolonged and sudden natural deaths (t=3.54; p-value <0.001). A significant difference was also seen between the mean BHBs of the prolonged and sudden non-natural deaths (t=2.92; p-value=0.004).

In addition, this study sought to identify a threshold for vitreous BHB levels where ketoacidosis was determined to be the cause of death. BHB levels between 2.5 and 5mmol/L produced specificities in the high nineties and sensitivities above ninety.

While these results show a statistically significant difference of vitreous BHB levels between prolonged and sudden natural and non-natural death, the values do not appear to hold clinical significance. This study has, however, shown that vitreous BHB levels in the range of 2.5–5mmol/L can be set as a threshold for determining ketoacidotic deaths, in line with results previously published for blood BHB.

Beta-Hydroxybutyrate, Vitreous, Ketoacidosis

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