A32 Estimating the Postmortem Interval (PMI): A Metabolomics/Lipidomics Approach

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The goal of this presentation is to explain the utility of Glycerophospholipids (GPLs) unique to the membranes and organelles of human skeletal muscle tissue cells in estimating Time Since Death (TSD).

This presentation will impact the forensic science community by demonstrating the use of targeted metabolomics and lipidomics assay platforms to provide more accurate and robust biomarkers of the PMI.

During the initial stages of decomposition (within 72 hours), body temperature is used to determine PMI. Prior to the onset of putrefaction, the potassium content of the vitreous humor is also a useful estimator. After this point, visual inspection of the body for color changes, the onset of bloat, and the stage of insect activity can be used to predict TSD; however, longer PMIs are more difficult to estimate with precision using visual inspection, especially if scavengers have consumed some of the soft tissues. Consequently, these estimates are often open-ended and limited in forensic utility (e.g., a minimum of number weeks or months). Biochemical analyses have shown promise, but the actualistic studies were conducted on small samples and lack extensive validation data. Furthermore, the analytical capabilities of mass spectrometers have increased exponentially since these studies were conducted.

This study utilizes high-resolution mass spectrometry analytical platforms to examine biomarkers of time-dependent postmortem tissue degradation. Twenty bodies were placed in protective cages at the University of Tennessee's Anthropological Research Facility. Daily samples (20mg-40mg) were collected from vastus lateralis muscle, four to six inches proximal to the patella and lateral to the femur using muscle tissue biopsy needles. If vastus lateralis muscle was not available, samples were obtained from other thigh muscles or from the leg. Temperature and humidity data were collected daily as well. Samples were stored in a -80°C freezer until transported to Lincoln Memorial University-DeBusk College of Osteopathic Medicine for mass spectrometer analyses. The muscle samples were placed into solution of 50ul standard, 1ml of deionized water and 1ml of methanol. The solution was sonicated with polytron, mixed with 1ml tert-butyl ether 99%, shaken for 30 minutes, and centrifuged for 15 minutes. A 1ml organic layer was extracted, vacufuged for four hours, and 150 ul ammonium acetate was added to sample for mass spectrometry.

The results obtained from the analytical platforms for sterol sulfates, short chain fatty acids, Very-Long-Chain Fatty Acids (VLCFA), Ethanolamine Plasmalogens (PlsEtn), Choline Plasmalogens (PlsCh), and phosphatidyl glycerophospholipids were analyzed with multiple linear regression analysis with stepwise variable selection using Accumulated Degree Days (ADD) as the dependent variable. An r-squared value of 0.81 indicates that these variables account for variation in temperature-related postmortem changes in a corpse. The equations are being tested on a separate validation sample of known-PMI tissues to provide the forensic community with validated equations to derive accurate postmortem interval estimates based on biomarkers of long PMIs.

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Time Since Death, Postmortem Interval, Mass Spectrometry