A140 Postmortem Interval (PMI) Estimation Using Bone Lipidomics

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After attending this presentation, attendees will understand the potential of lipids in marrow cavities and epiphyses for predicting PMI of skeletal remains.

This presentation will impact the forensic science community by providing preliminary data on lipidomic techniques for estimating PMI in skeletonized human remains that are more precise and accurate than gross observations of taphonomic processes.

Common methods for estimating PMI of skeletonized remains are qualitative observations of taphonomic processes, such as bone weathering, staining, sun bleaching, and cortical exfoliation.[1,2] Histological techniques are available but not well validated due to variation caused by microbes.[3,4] Bone degradation garners interest as a means of predicting time since death, yet controlled experimental studies on human remains are limited in the scientific literature.

Successful lipid fraction of bone has been reported in forensic toxicology and archaeology research, but few studies describe the capacity of this methodology for estimating PMI.[5] It has been demonstrated that glycerophospholipids and very long chain fatty acids in the membranes of skeletal muscle tissue accurately predict long-term PMIs up to 30,000 accumulated degree days.[6,7] Lipids are abundant biomolecules with powerful predictive capacity for PMI.

Bone marrow is a rich source of lipid mediators. N-acyl amino acids are one class of lipid mediator monitored in bone, and they also modulate bone metabolism in the case of oleoyl serine. A pilot study was conducted to investigate the diversity of N-acyl amino acids in human bone. Bone marrow was extracted from trabecular bone in a dry human calcaneus with a PMI of approximately seven years. Utilizing a high-resolution electrospray ionization lipidomics analytical platform, 76 potential N-acyl amino acids were identified in the bone marrow sample.[8] The structural identities of these lipids are undergoing validation utilizing tandem mass spectrometry. The structural identities of palmitoyl and oleoyl serine were validated via generation of the MS^2 product ion for serine (<1ppm mass error). The number of lipids identified in the extracted bone marrow support the findings of toxicological studies reporting lipid extraction in skeletonized remains with a PMI of up to five years.[9] The results of this pilot study are being used to evaluate the postmortem metabolism of lipid mediators on an autopsy sample of sternal rib ends and vertebral bodies from cases with known medical histories and PMI.

This study expands previous research on skeletal muscle metabolites to bone, providing a quantitative method for estimating PMI of skeletonized remains. Successful bone lipid extraction after an interval of seven years provides preliminary data that will be used to validate a methodology for predicting PMI of severely decomposed, mummified, and skeletal remains with greater precision and accuracy.

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