G67 Determination of Postmortem Interval Using Non-Invasive Magnetic Resonance Imaging Measurement of the Apparent Diffusion Coefficient and 1-Dimensional Spectroscopy

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After attending this presentation, attendees will: (1) understand the application of non-invasive magnetic resonance Imaging; (2) become familiarized with Magnetic Resonance Spectroscopic Imaging (MRSI); and, (3) understand what this advanced technology entails and how this technology will aid in the determination of postmortem interval.

This presentation will impact the forensic science community by showing how this rarely used technology in forensic investigation can potentially help address important forensic questions such as postmortem interval.

Postmortem Magnetic Resonance Imaging (MRI) with Diffusion Weighted Imaging (DWI) to produce an Apparent Diffusion Coefficient (ADC) map is being refined as a method for determining Postmortem Interval (PMI) over the 2-14 day range. DWI can be used to monitor decomposition, because tissue breakdown results in increased diffusivity of tissue water corresponding to an increased ADC value. It was hypothesized that the addition of Magnetic Resonance Spectroscopic Imaging (MRSI) will enable the decomposition mechanism (autolysis only vs. putrefaction) to be identified. Spectroscopy enables the identification of specific chemical species, in this case metabolites resulting from decomposition. Currently, these methods are being tested using mammal models with known PMI. In the future, the combination of ADC mapping and MRSI is expected to provide a non-invasive method of determining PMI in specimens or decedents whose time of death is not known.

Examination using MRI with ADC mapping is performed on a 1.5 T MRI scanner on *in situ* mammal brains over the period of two weeks. The mammal specimens decompose at room temperature. Five specimens have been imaged thus far. At each postmortem time point, six echo planar images are acquired with an increase in the diffusion weighting with b-values of 0, 500, 1,000, 1,500, 2,000 and 2,500 s/mm^2. B-values are a measure of the strength of the diffusion sensitizing gradients used during DWI. The individual pixel elements are plotted as a function of the b-value. The slope depicts the ADC in units of mm^2/s. All the ADC values from the six echo planar acquisitions are calculated together to create an ADC map. Regions of Interest (ROI) are obtained from common tissues within the brain; i.e., gray matter and white matter. The ADC values obtained from these ROI are plotted versus PMI, enabling the creation of standardized curves quantifying the continuous change in the ADC of the tissue with increasing PMI. Volume-selective 1D MRSI is currently being added to the above protocol to identify and quantify specific metabolites in the decomposing tissue.

Preliminary data from five specimens reflects two distinct ADC vs. PMI curves that were hypothesized and corresponded to decomposition by different mechanisms: autolysis and putrefaction. The autolyzed tissue follows a steady incremental incline in the ADC curve and levels off with a lower numeric ADC value ≈ 22 mm^2/s. The lower numeric value signifies the tissue has less fluid movement and is more intact. The putrefied tissue demonstrates a rapid incline in the ADC curve and levels off at a higher numeric ADC value ≈ 37 mm^2/s. Putrefied tissue exhibits more diffusion, or water movement, due to more complete cellular breakdown of the tissue. Thus far, the five specimens studied follow one of the two curves described above, presumably based on the nature of decomposition. The identification of the two curves as “putrefaction” and “autolysis” is based on standard MR anatomic imaging of each specimen, which shows that the tissues that yield a higher ADC value also demonstrate more significant gross structural changes and more gas inclusions, highly suggestive of bacterial putrefaction.

To confirm these results, further ADC studies of mammal models are underway to create statistically significant and reproducible results. To elucidate the nature of the two different ADC vs. PMI curves observed, MRSI, a non-invasive method to chemically analyze tissues, is being added to the protocol to reveal if the tissue is undergoing bacterial decomposition or autolysis. The analysis of the spectral data obtained will focus on identifying metabolites that differentiate biotic from abiotic decomposition. The outcome of the spectral analysis is therefore expected to indicate which of the two observed ADC curves the tissue should follow, which will allow accurate interpretation of ADC values obtained from tissues with unknown PMI in future studies.

Forensic Radiology, Magnetic Resonance, Postmortem Interval