G106 Age Estimation Using T-Cell Receptor Excision Circles (TRECs) in Tissue Samples for Forensics

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After attending this presentation, attendees will understand the basic principle of T-Cell Receptor Excision Circles (TRECs) formation, applicability of the method for other types of tissues, and characteristics of quantifying TREC patterns in each tissue.

This presentation will impact the forensic science community by providing the possibility of age estimation using tissue samples.

Age estimation using biological remains is one of the interesting topics in forensics. Various approaches have been performed to estimate age, and quantifying DNA molecules existing in T cells is one of the recent promising methods. However, quantification of that molecule has only been performed in blood samples; it has never been tried in any other type of human tissue, nor has its applicability in forensics been verified.

The central role of the thymus in T-cell production and T-Cell Receptor's (TCR's) gene rearrangement is well established, together with thymic changes with time (i.e., thymic involution). During the rearrangement of TCR gene segments, some regions, which were not selected to form parts of TCRs, are spliced out as circular DNA. One of these DNA is a signal-joint T-cell Receptor Excision Circle (sjTREC), which exists in naïve T-cells which have undergone development and maturation in the thymus. SjTRECs do not replicate during cellular proliferation, but rather are diluted by each round of cell division. Therefore, it is supposed that the content of these episomal DNA per total number of T-cells would be decreased with aging. In forensics, the application of these molecules for estimating age is being investigated.

In some forensic cases, the condition of blood samples would be not applicable to quantify sjTREC contents. For example, blood obtained from decomposed bodies could be putrefactive or even non-existent, since the decomposition of tissues containing a larger quantity of water would be processed earlier than that of other tissues. The investigation of alternative body samples could be helpful to such cases. In this report, the thymus and spleen were selected as potential samples, as they are the primary and secondary lymphoid organs, respectively. It is thought that these tissues are closely related with thymopoiesis and T-cell homing.

Three tissues, blood, thymus, and spleen, were obtained from dead bodies in the age range of 4-70 years through autopsies, and genomic DNA was extracted. The measurement of sjTREC contents was performed using real-time TaqMan® Polymerase Chain Reaction (PCR), since it is essential to detect sjTREC in the peripheral blood precisely and sensitively. The probe is sequence-specific and primers allow only excised-out sjTREC DNA from TCR gene rearrangement to amplify.

The quantification of sjTREC molecules was possible and declining trends with aging were confirmed in the samples extracted from both the thymus and spleen. The pattern of sjTREC levels with age in each tissue was not identical, and its level of samples from blood, thymus, and spleen showed a different pattern in one individual. Further research is required to understand the meaning of or reasons for this difference.

Age Estimation, Thymus, TRECs

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