G94 Age Estimation Using T-Cell Receptor Excision Circles (TRECs) in Forensics

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After attending this presentation, attendees will understand the basic principle of formation of T-Cell Receptor Excision Circles (TRECs) and its change during a lifetime. The feasibility of its use in forensic practice and ethnic difference, if it ever exists, will be discussed and compared with previous reports.

This presentation will impact the forensic science community by providing evidence or techniques using the relationship between TRECs levels and age.

Age estimation using biological remains is one of the hottest topics in forensics. Many different approaches have been tried up to now, and the age estimation using TRECs is gaining interest.

The central role of thymus in the production of T-cells and the generation of T-cell receptors (TCRs) including TCR gene rearrangement is well established, together with thymic changes with time such as thymic involution. During the rearrangement of TCR gene segments, some regions which were not selected to form the parts of TCRs are spliced out as ring-shaped DNA. This exists in naïve T-cells immediately after development and maturation in thymus. Signal-Joint T-cell Receptor Excision Circle (sjTREC), which is one of the by-products of the rearrangement of gene segments encoding the variable parts of T-cell receptor α and β chains, not only replicates during cellular proliferation in the periphery, but also is diluted with each round of cell division. Therefore, it is supposed that the content of these episomal DNA per total number of T-cells or level of constant genes would decrease with aging. In forensic cases, this biological phenomenon could be useful for providing evidence using the relationship between quantitative sjTRECs level and age.

For a long time, measurement of thymic output was indirect, mainly based on the phenotypic markers on naïve T-cells. However, since it is essential to detect the level of TRECs in the peripheral blood precisely and sensitively, it is necessary to utilize the sequence-specific DNA detection method. One of the most promising candidates is real-time quantitative PCR assay. Primers were designed to detect TRECs by targeting only the excised sequences after TCR gene rearrangement. Furthermore, TREC fragment-cloned plasmid was obtained, which is necessary for positive control and quantification using a standard curve. Using this plasmid sensitivity of the test was confirmed. Meanwhile, the immunological conditions such as blood volume or number of T-cells affected by immunological diseases or virus infections vary per person. These conditions also influence the relative level of TRECs in periphery blood. To normalize their level, it was observed that some genes can reflect these conditions or are expressed constantly, such as human serum albumin known to exist in blood plasma, or TCR alpha chain known to be a constant region of T-cell receptor. If it is necessary, various analysis methods which were utilized in other reports will be introduced.

This method is based on an immunologic principle, so the results would be variable depending on different ethnicities. After obtaining ethics committee approval, DNA samples from random Koreans of varying age groups would be tested for the above method. These results would be compared with others previously reported for different populations.

Age Estimation, TRECs, Forensics

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