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Professor Gwangrog Lee's research team identifies the gene damage repair mechanism of nucleic acid cleaving enzymes (National Research Foundation of Korea)

- A new function of nucleic acid cutting enzymes involved in recovering DNA base damage that can cause genetic mutations has been identified at the molecular level. It is not only cleaving but also actively creating a structure for restoration.

  - Accumulation of DNA base damage caused by UV rays or oxidative stress can cause gene mutations and cancer. Therefore, rapid damage recovery is essential for all living things.

- GIST (Gwangju Institute of Science and Technology) School of Life Sciences Professor Gwangrog Lee's research team revealed that, during the DNA damage repair process, the AP nucleic acid cleaving enzyme did not simply cut the damaged site but continuously decomposed it to create a DNA niche structure and control the repair process.

  - In addition to previous reports that a large amount of AP nuclease is produced in cancer cells, the results of this study are expected to provide a clue to AP nuclease as a biomarker for cancer diagnosis and a target for drug development.

- The research team observed the interaction between nucleic acid cleaving enzyme and DNA polymerase in real time using single-molecule fluorescence observation technology.

  - Previously, the results were inferred by quantifying product changes using electrophoresis, but this study observed the interactions between enzymes and DNA and enzymes that occur during the base damage repair process at the single-molecule level in real time, and the recovery mechanism was identified.

    ※ Single-molecule fluorescence observation: A fluorescence technique that uses a physical phenomenon called FRET (Fluorescence Resonance Energy Transfer) to observe the actual movement of each molecule at the nanometer level and was used in this study of enzyme kinetics.

- Repair begins when a nuclease cuts a specific site (AP site) and then binds strongly to the AP site to rapidly remove DNA from the damaged site (within ~ 1 second). It was observed that the minimum DNA niche size was controlled by the rigidity of single-stranded DNA.

- Unlike general nucleases that randomly degrade DNA, AP nuclease is strongly fixed to the AP site and does not dissociate, and it continuously breaks down DNA to quickly create a DNA niche.

  - Furthermore, the temporally created DNA niche structure provided a space for the DNA polymerase to function, and it was identified that this process is precisely regulated temporally and spatially.

- The results of this study, which was conducted with support from the Ministry of Science and ICT and the National Research Foundation, were published online in *Science Advances* on July 14, 2021.

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