Repair enzyme also reboots genome copying

DNA polymerase IV enzyme involved in damage tolerance also aids in DNA synthesis

A special bacterial enzyme involved in repairing the genome also helps restart DNA replication after the process has stalled. The finding, from researchers at NAIST in Japan, could shed light on the source of genetic mutations — a major cause of cancer and other age-related diseases.

When the cell is exposed to a dangerous chemical, sometimes a piece of DNA will form a bond with the chemical agent. This creates what is known as a DNA lesion. These lesions will block the genetic copying machinery, but fortunately the cell has a class of enzymes to deal with these kinds of obstruction.

Humans and other eukaryotes use one set of enzymes, while bacteria and other prokaryotes use another. Through a process known as translesional synthesis (TLS), these specialized enzymes help overcome DNA lesions so that the standard gene copying enzyme can continue its normal function.

In the rod-shaped bacterium Escherichia coli, an enzyme called DNA polymerase IV was not thought to be involved in TLS for major lesions (see figure). However, a team led by Hisaji Maki at NAIST, along with collaborators in France and the United States, has now discovered multiple new functions of this enzyme.

“Polymerase IV can transiently and efficiently work in the replication fork, instead of the normal type of DNA polymerase,” Furukohri says. “Our finding suggests the possibility that polymerase IV may play some role in genomic DNA replication.” Polymerase IV is known to make more copying mistakes than standard replication enzymes, and the mutations it introduces have been linked to drug resistance in bacteria. The human equivalent of polymerase IV has also been implicated in different forms of cancer. Knowing the role of polymerase IV in genomic replication is thus “an important issue,” says Furukohri, because it could reveal the genomic triggers of mutation-driven diseases.

Reference