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Editorial

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A special issue on the DNA damage response and genomic instability

Genomic DNA that stores the genetic information for our lives can be easily damaged by environmental and internal hazards, such as irradiation, various types of chemicals, oxidative species, replication stress, etc. These hazards generate numerous types of DNA lesions that occur on base pairs and ribose sugar-phosphate backbone. Fortunately, during the evolution, our cells develop a DNA damage response system that recognizes and repairs DNA lesions. Over the past few decades, researchers have gradually identified key pathways that are involved in DNA damage response.

Among DNA lesions, DNA double-strand break (DSB) is the most deleterious type of lesion. If it is not repaired, one DSB is able to cause genomic instability and induces diseases such as cancer. In this review series, 11 manuscripts cover different areas in DSB repair field, including the molecular mechanism of the recruitment of DSB repair machinery, the initiation of DSB repair, chromatin remodeling during DSB repair, and DSB end joining. The authors give through introductions on the recent research progress and hypotheses in the DSB repair field. In particular, the chromatin environment plays a key role in the initiating DNA damage response and repairing DNA lesions. Four review articles [1–4] have focused on the recent discoveries on the role of histone modifications, heterochromatin formation, aberrant DNA structure, and telomere maintenance in DNA damage repair. These reviews contribute to the elucidation of important molecular pathways in the DNA damage research field.

It has been well known that DSB is repaired through two different mechanisms, namely non-homologous end joining and homologous recombination. However, the choice of these two pathways remains a huge mystery in DSB repair field. Three review articles [5–7] explain several possibilities from their unique perspectives, which may facilitate to solve this mystery in the near future.

DNA damage response protects the integrity of genomic DNA. Loss of DNA damage repair leads to the accumulation of DNA lesions and induces genomic instability and tumorigenesis. Thus, a number of DNA damage repair proteins are important tumor suppressors. One typical example is BRCA1. Mutations of BRCA1 not only impair DNA damage repair but also cause familial breast and ovarian tumors. Here, two review articles discuss the molecular mechanism of BRCA1-dependent DNA damage response [7,8]. Besides BRCA1, other DNA damage repair factors also play important roles for maintaining genomic stability. Two review articles by Liu *et al.* and Wu *et al.* [9,10] specifically focus on DNA-binding proteins in DNA damage repair and their roles in genomic stability. Moreover, DNA damage-induced genomic instability induces not only cancer but also many other genetic diseases. Liu *et al.* [11] provide another example on MCPH1, an important regulator for DNA damage response and the development in central nerve system and reproduction system.

Taken together, these exciting review articles allow readers to follow the up-to-date research findings in DNA damage repair field and may lead to novel hypotheses and additional discussions, as well as foster collaborations in this competitive field. Finally, further study of DNA damage response pathways will reveal molecular mechanism of tumorigenesis and other genetic diseases induced by genomic instability, which will be crucial for the diagnostics and therapeutics of these diseases in future.

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