**Roles of unusual DNA structures in regulation of DNA replication**

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Non-B-type DNAs are emerging as crucial genetic determinants for regulation of various chromosome events. Among them, G-quadruplexes (G4) and RNA-DNA hybrids/ R-loop are closely associated and have been implicated in both positive and negative aspects for cellular growth.

We have shown that RNA-DNA hybrid/R-loop/G4s generated in conjunction with transcription play a fundamental role in initiation of DNA replication of bacteria grown under specific genetic or environmental conditions. Furthermore, R-loop generated by artificial transcription of a G-rich sequence can induce DNA replication, that permits maintenance of the entire genome in E.coli. This mode of replication is error prone, increasing the mutation rate. Potential biological and evolutional significance of R-loop/RNA-DNA hybrid will be discussed.

A subset of G4 can be bound by Rif1, an evolutionally conserved nuclear factor, and this binding is required for negative regulation of origin firing in fission yeast cells. Mammalian Rif1 also binds to G4. Rif1 generates a higher-order chromatin structures that regulate a potential of origin firing. This regulation is dictated by the ability of chromatin to interact with nuclear membrane.

Precise understanding of cellular profiles and dynamics of G4 and RNA-DNA hybrids requires development of specific and sensitive probes that can detect these structures, since they cannot be accurately predicted from the sequence information alone. We are using various biological and chemical probes to determine how these structures are distributed and dynamically change on chromosomes and in 3D setting.

We would like to discuss biological significance of RNA-DNA hybrid/R-loop/G4s that emerges out of these studies.