OPEN ACCESS Freely available online

ISSN: 2157-2518
Journal of Carcinogenesis & Mutagenesis

Commentary

The DNA-Damage Response in Human Biology

Nimrat Chatterjee*

Department of Biology, Massachusetts Institute of Technology, Cambridge, United States

DESCRIPTION

Damage to DNA occurs when the chemical structure of the molecule changes, either naturally or chemically. Some of the chemical agents that cause DNA damage include reactive oxygen radicals, alkylating agents, and reactive carbonyl species.

For several years, there has been a growing understanding that drinking alcohol increases the risk of cancer. Now, new evidence from a mouse study reveals a possible explanation: drinking alcohol causes DNA damage in stem cells.

"While some damage occurs by chance, our findings suggest that drinking alcohol can increase the risk of this damage," said lead author Ketan J. Patel, MD, PhD, MRC Laboratory of Molecular Biology, Cambridge Biomedical Campus, United Kingdom, noting that some cancers are linked to DNA damage in stem cells.

When mammalian cells are subjected to endogenous or external DNA-damaging substances, DNA repair mechanisms are activated to protect genetic stability and integrity. Deregulation of DNA repair mechanisms has been linked to cancer onset and progression. Ionizing radiation and chemotherapeutic agents are the primary anti-cancer therapies and cell death by directly or indirectly causing DNA damage. Dysregulation of the DNA damage response may contribute to cancer cells' hypersensitivity or resistance to genotoxic agents, and targeting the DNA repair pathway can improve tumour sensitivity to cancer therapies. As a result, targeting DNA repair pathways could be a promising cancer treatment strategy. A deeper understanding of the biology and regulatory mechanisms of DNA repair pathways may make it easier to build inhibitors of nuclear and mitochondrial DNA repair pathways, which could improve the anticancer effects of DNA damage-based therapy.

Mismatches, single-strand breaks (SSBs), double-strand breaks (DSBs), chemical modifications of the bases or sugars, and interstrand or intrastrand cross-links can all be caused by a variety of endogenous and exogenous DNA-damaging agents such as UV light, ionising radiation (IR), and chemotherapeutic agents. If the damage is not repaired, it will result in genomic instability and mutation, which is a hallmark of cancer. Cells have evolved a series of mechanisms known as the DNA damage response (DDR) to deal with such damages in order to avoid this predicament. Signal transduction, transcriptional regulation, cell-cycle checkpoints, induction of apoptosis, damage tolerance processes, and diverse DNA repair pathways are all part of the DDR network, which targets distinct DNA lesions in different ways.

DNA repair pathways play an important role in the maintenance of genome stability and integrity through correcting the impaired DNA that may contribute to carcinogenesis. Numerous studies have indicated that certain cancers are associated with the defect or mutation in the proteins of nuclear or mitochondrial DNA repair pathways. For example, the defect in the ATM–Chk2–p53 pathway, which plays a crucial role in DNA double-strand breaks repair, promoted glioblastoma multiform (GBM) formation and contributed to GBMs radiation resistance. The human syndrome hereditary no polyposis colorectal cancer (HNPCC), which connects with high degrees of microsatellite instability, is caused by germ line mutations in MMR genes and the tumor genesis of this disease is connected with the defect in the MMR pathway.

DNA repair processes are critical for maintaining genome stability and integrity by fixing damaged DNA that might contribute to carcinogenesis. Several studies have linked certain malignancies to a deficiency or mutation in proteins involved in nuclear or mitochondrial DNA repair mechanisms. Glioblastoma multiform (GBM) growth was aided by a disruption in the ATM–Chk2–p53 pathway, which is involved in DNA double-strand break repair and contributes to GBM radiation resistance. Germ line mutations in MMR genes induce the human syndrome hereditary no polyposis colorectal cancer (HNPCC), which is linked to high levels of microsatellite instability and the tumor genesis of this illness, is linked to a failure in the MMR pathway.

Correspondence to: Nimrat Chatterjee, Department of Biology, Massachusetts Institute of Technology, Cambridge, United States, E-mail: Nimrat@chatterjee.edu

Received: 01-Mar-2022, Manuscript No. JCM-22-382; **Editor assigned:** 04-Mar-2022, Pre QC No. JCM-22-382 (PQ); **Reviewed:** 18-Mar-2022, QC No. JCM-22-382; **Revised:** 22-Mar-2022, Manuscript No. JCM-22-382 (R); **Published:** 30-Mar-2022, DOI: 10.35248/2157-2518.22.13.382

Citation: Chatterjee N (2022) The DNA-Damage Response in Human Biology. J Carcinog Mutagen.13:382