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Epigenetics that lead to inherited diseases

Fatima Enaya
Jordan University of Science and Technology, Jordan

Epigenetics involves genetic control by factors other than an individual's DNA sequence, Epigenetic changes can switch genes on or off and determine which proteins are transcribed, this theory can go against the old theory of the known inherence of genetic material, It means that a parent's experiences, in the form of epigenetic tags, can be passed down to future generations, As unconventional as it may be, there is little doubt that epigenetic inheritance is real. In fact, it explains some strange patterns of inheritance geneticists have been puzzling over for decades, histone modification is the basic cause of epigenetics according to the alteration in their methylation pattern, here are two main ways histones can be modified: acetylation and methylation. these are chemical processes that add either an acetyl or methyl group, respectively, to the amino acid lysine that is located in the histone. Acetylation is usually associated with active chromatin, while deacetylation is generally associated with heterochromatin, so this can lead to the possibility of causing diseases by activation or silencing of genes. Such disruptions have been associated with cancer, syndromes involving chromosomal instabilities, and mental retardation, cancer is the first disease that was linked to epigenetics, also the most common one, because methylated genes are typically turned off, loss of DNA methylation can cause abnormally high gene activation by altering the arrangement of chromatin. On the other hand, too much methylation can undo the work of protective tumor suppressor genes, also some mental retardation syndromes are caused by epigenetics such as fragile X syndrome, finally we should mention that there no defined environmental causes during mother pregnancy to methylation alteration to the embryo, but there are evidences such as High-fat diet, Lack of essential vitamins and nutrients, such as choline, B vitamins, and folic acid, and alcohol and medication intake. Deoxynucleoside analogues such as 5-aza-2-deoxycytidine (depicted by Z) are converted into the triphosphate inside S-phase cells and are incorporated in place of cytosine into DNA. Ribonucleosides such as 5-azacytidine or zebularine are reduced at the diphosphate level by ribonucleotide reductase for incorporation (not shown). Once in DNA, the fraudulent bases form covalent bonds with DNA methyltransferases (DNMTs), resulting in the depletion of active enzymes and the demethylation of DNA. Pink circles, methylated CpG; cream circles, unmethylated CpG.

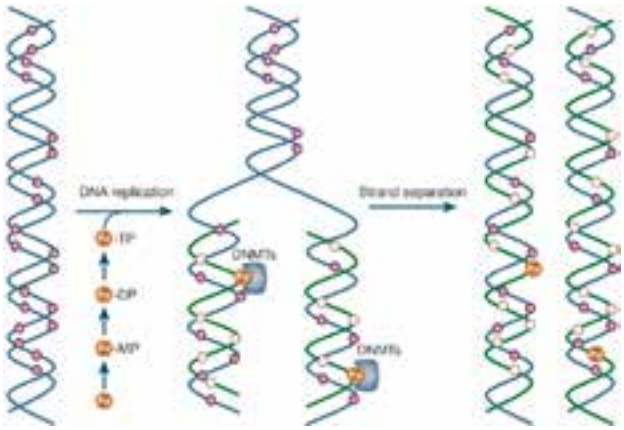

Figure 1: Mechanism of action of nucleoside analogue inhibitors.

Recent Publications

1. Simmons Danielle (2008) Epigenetic influence and disease; Nature Education 1(1):6.
2. Egger G, et al. (2004) Epigenetics in human disease and prospects for epigenetic therapy. Nature 429(6990):457-63.
3. Penagarikano O, et al. (2007) The pathophysiology of fragile X syndrome. Annual Review of Genomics and Human Genetics 8:109–129.

Biography

Fatima Enaya completed her MSc in Diagnostic Molecular and Human Genetics from Jordan University of Science and Technology and; Bachelor Degree in Biotechnology and Genetics Engineering from Philadelphia University. She has worked in research field in molecular and cytogenetics for five years and; in Chemotherapy and Genotoxicity, Genetic Counseling and Diagnosis. She teaches molecular and cytogenetics in Medical and Applied Medical School at Jordan University of Science and Technology (JUST). Her interest is in Epigenetics.

fattoomdna@gmail.com

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