

Epigenetic changes induced by cigarette smoke

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The smoke released by cigarettes when comes in contact with the internal organs of the body poses a great threat not only to the physiology of the organs or tissues (say cardiovascular diseases or inflammations), but also trigger various damages in a molecular level, and causes epigenetic alterations like DNA modification through methylation, post-transcriptional changes like ubiquitination, phosphorylation, acetylation and changes in the non-coding sequences of RNA. Cigarette smoking induces DNA methylation at numerous CpG sites (regions of DNA containing a cytosine nucleotide followed by a guanine nucleotide), which later affects gene expression and susceptibility to lung or causes respiratory tract diseases. At the same time, cigarette smoking also causes post-transcriptional modifications such as histone acetylation. It leads to a decrease in the enzymatic activity and expression of histone deacetylases, which eventually results in increased histone acetylation of H3 and H4 proteins in the lungs. Cigarette smoking also activates several kinases, such as ribosomal S6 kinase (RSK), mitogen and stress activate kinase (MSAK), which results in histone phosphorylation of the H3 proteins. Moreover, cigarette smoking activates the ubiquitin-proteasome system (UPS) which results in the development of various disorders like skeletal muscle atrophy where the level of protein degraded exceeds the level of new protein synthesised in the cells. Exposure to cigarette smoke also leads to alteration in miRNA (micro RNA). It was found that long exposure to environmental cigarette smoke causes downregulation of miRNAs by twofold or threefold, depending on the gender and age of the exposed person. Hence, cigarette smoking leads to various abnormalities at the cellular and molecular levels. As a result, it is important to understand the epigenetic changes induced by cigarette smoke as smoking leads to various harmful diseases.

Keywords: Epigenetics, Cigarette-smoking, Transcription, DNA modification, Gene expression, Post-transcriptional modification

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