Mechanisms of geomagnetic field influence on gene expression using influenza as a model system: Basics of physical epidemiology

Zaporozhan V., Ponomarenko A.
Odessa State Medical University, Valekhovsky lane 2, 65082, Odessa, Ukraine

Abstract: Recent studies demonstrate distinct changes in gene expression in cells exposed to a weak magnetic field (MF). Mechanisms of this phenomenon are not understood yet. We propose that proteins of the Cryptochrome family (CRY) are "epigenetic sensors" of the MF fluctuations, i. e., magnetic field-sensitive part of the epigenetic controlling mechanism. It was shown that CRY represses activity of the major circadian transcriptional complex CLOCK/BMAL1. At the same time, function of CRY, is apparently highly responsive to weak MF because of radical pairs that periodically arise in the functionally active site of CRY and mediate the radical pair mechanism of magnetoreception. It is known that the circadian complex influences function of every organ and tissue, including modulation of both NF-κB- and glucocorticoids-dependent signaling pathways. Thus, MFs and solar cycles-dependent geomagnetic field fluctuations are capable of altering expression of genes related to function of NF-κB, hormones and other biological regulators. Notably, NF-κB, along with its significant role in immune response, also participates in differential regulation of influenza virus RNA synthesis. Presented data suggests that in the case of global application (example-geomagnetic field), MF-mediated regulation may have epidemiological and other consequences.

Author Keywords: Circadian transcription; Cryptochrome; Electromagnetic fields; Epidemiology; Gene expression; Influenza; NF-KB; Pair radical reactions; Solar cycles

Year: 2010
Source title: International Journal of Environmental Research and Public Health
Volume: 7
Issue: 3
Page : 938-965
Link: Scorpus Link
Document Type: Article
Source: Scopus

Authors with affiliations:

1. Zaporozhan, V., Odessa State Medical University, Valekhovsky lane 2, 65082, Odessa, Ukraine
2. Ponomarenko, A., Odessa State Medical University, Valekhovsky lane 2, 65082, Odessa, Ukraine