Chromosomal aberrations: A 'tool' to evaluate genetic damage in wireless communications research

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1. Abstract

During the last several years a large number of investigations were conducted using rodents, cultured rodent and human cells and freshly collected human blood lymphocytes to determine the genotoxic potential of exposure to radiofrequency radiation (RFR). The 'classical' technique used to examine the genetic damage, i.e., incidence of chromosomal aberrations will be described. The observations published in scientific journals will be reviewed. Probable reason(s) for the conflicting results will be discussed.

2. Introduction

Non-ionizing radiofrequency radiation (RFR) in the frequency range of 300 MHz to 300 GHz has a significant and positive impact in modern society. A large increase in the number of people who are potentially exposed to RFR occurred with the introduction of household microwave ovens which work predominantly at 2450 MHz and wireless communication devices that operate at less than 2000 MHz. With the increasing use of RFR emitting consumer devices, public attention has been drawn to the possibility of adverse human health effects from exposure to RFR. The possible effects of RFR exposure on the genetic material (DNA) are very important since damage in the DNA of somatic cells can lead to the development of cancer.

3. Results and Discussion

Researchers have been using classical cytogenetic methods as well as recently developed experimental techniques to test for the induction of genetic damage following *in vitro* and *in vivo* exposure of prokaryotic and eukaryotic cells to environmental agents (biological, physical and chemical genotoxicants), including RFR. The 'classical' tool to evaluate the genetic damage is the incidence of chromosomal aberrations. Lymphocytes in human peripheral blood have been the predominant choice for such investigations because of the ease with which they can be obtained. The aberrations are best visualized in the metaphase of the cell cycle. In freshly collected peripheral blood, more than 95% of lymphocytes are in resting phase of the cell cycle (G0). In appropriate culture medium, they can be stimulated to enter into the cell cycle by the addition of a mitogen, generally phytohemagglutinin. The cells with then go through different phases of the cell cycle, i.e. the longest preparatory phase (G1), DNA synthesis phase (S), a short lag phase (G2) and metaphase (M) followed by cell division. The cells in metaphase of cell cycle are accumulated by the addition of colchicine (a spindle poison), harvested and chromosomes are fixed on a microscope slide. They are stained and examined under light and/or fluorescence microscope. The incidence of aberrations in control (untreated/unexposed) cells is compared with the cells exposed to genotoxic agents.

During the last several years, researchers have conducted studies which addressed the issue of potential induction of genotoxicity in cells exposed to RFR. The conclusions in the reviews were that the results from a great majority of these studies did not indicate increased damage to the genetic material (assessed not only from incidence of chromosomal aberrations, but also from DNA strand breaks, micronuclei and sister chromatid exchanges) in RFR-exposed cells as compared with sham exposed and/or un-exposed cells. Some investigators have reported an increase in such damage in RFR-exposed cells. The observations from other studies were inconclusive. The probable reason(s) for the conflicting results will be discussed.