

# Effects On Human Cells Due To RF And Electromagnetic Field

V. S. Nimbalkar

Research Scholar, Singhania University, Jhunjhunu, Rajasthan

**Abstract** – The general opinion that there is gradual hazardous effect at the cellular level related to human health. The study of the low frequency radio frequency wave revealed that different dimension of EM wave have not shown any DNA damage directly but there is concern about evidence of cellular effect of EM. The static of very low frequency EM field lead to biological effect associated with redistribution of ions. The effects induced by radiofrequency (RF) electromagnetic fields and microwave (MW) radiation in various cellular systems is still increasing. Until now no satisfactory mechanism has been proposed to explain the biological effects of these fields. This study is to investigate effect of MW radiation on cell proliferation.

**Keywords:** cell proliferation, Electromagnetic field, Radio frequency, biological.

## 1. INTRODUCTION

Conventional wisdom has traditionally held that microwave are not genotoxic that is directly damaging to genome or DNA unless high temperature are created. Blank and Goodman (1997). Postulate that mechanism of EM signal transduction in the cell membrane may be explained by direct interaction of electric and magnetic field with mobile charges within enzymes. On the other hand, there are a lot of contrary study published in recent years. Most of them concerned about evidence of biochemical or cellular effects of electromagnetic fields. Marino and Becker have shown that static or very low-frequency electromagnetic fields may lead to biological effects associated with redistribution of ions. Furthermore, many studies demonstrated that biological effects of low-frequency magnetic fields may penetrate into deeper tissues (13). Foletti et al. showed that ELF-EMF may have an effect on several cellular functions such as cell proliferation and differentiation Giladi et al. demonstrated that EMF of intermediate frequency was effective in arresting the growth of cells. Kirson et al. indicated that this direct inhibitory effect on cell growth can be used for therapeutic purposes in the treatment of cancer. The intensity of EMF dependent on thermogenic effect (SAR).

## 2. CELL PROLIFERATION IN DEVELOPMENT

Early development is characterized by the rapid proliferation of embryonic cells, which then differentiate to produce the many specialized types of cells that make up the tissues and organs of multicellular animals. As cells differentiate, their rate of proliferation usually decreases, and most cells in adult animals are arrested in the G<sub>0</sub> stage of the cell cycle. A few types of differentiated cells never divide

again, but most cells are able to resume proliferation as required to replace cells that have been lost as a result of injury or cell death. In addition, some cells divide continuously throughout life to replace cells that have a high rate of turnover in adult animals. Cell proliferation is thus carefully balanced with cell death to maintain a constant number of cells in adult tissues and organs.

The cells of adult animals can be grouped into three general categories with respect to cell proliferation. A few types of differentiated cells, such as cardiac muscle cells in humans, are no longer capable of cell division. These cells are produced during embryonic development, differentiate, and are then retained throughout the life of the organism. If they are lost because of injury (e.g., the death of cardiac muscle cells during a heart attack), they can never be replaced. In contrast, most cells in adult animals enter the G<sub>0</sub> stage of the cell cycle but resume proliferation as needed to replace cells that have been injured or have died. Cells of this type include skin fibroblasts, smooth muscle cells, the endothelial cells that line blood vessels, and the epithelial cells of most internal organs, such as the liver, pancreas, kidney, lung, prostate, and breast. One example of the controlled proliferation of these cells, discussed earlier in this chapter, is the rapid proliferation of skin fibroblasts to repair damage resulting from a cut or wound. Another striking example is provided by liver cells, which normally divide only rarely. However, if large numbers of liver cells are lost (e.g., by surgical removal of part of the liver), the remaining cells are stimulated to proliferate to replace the missing tissue. For example, surgical removal of two-thirds of the liver of a rat is followed by rapid cell proliferation, leading to regeneration of the entire liver within a few days.

## 3. G ZERO PHASE

The G<sub>0</sub> phase (referred to the G zero phase) or 'resting phase' is a period in the cell cycle in which cells exist in a quiescent state. G<sub>0</sub> phase is viewed as either an extended G<sub>1</sub> phase, where the cell is neither dividing nor preparing to

divide, or a distinct quiescent stage that occurs outside of the cell cycle.<sup>[1]</sup> Some types of cells, such as nerve and heart muscle cells, become quiescent when they reach maturity (i.e., when they are terminally differentiated) but continue to perform their main functions for the rest of the organism's life. Multinucleated muscle cells that do not undergo cytokinesis are also often considered to be in the G<sub>0</sub> stage. On occasion, a distinction in terms is made between a G<sub>0</sub> cell and a 'quiescent' cell (e.g., heart muscle cells and neurons), which will never enter the G<sub>1</sub> phase.

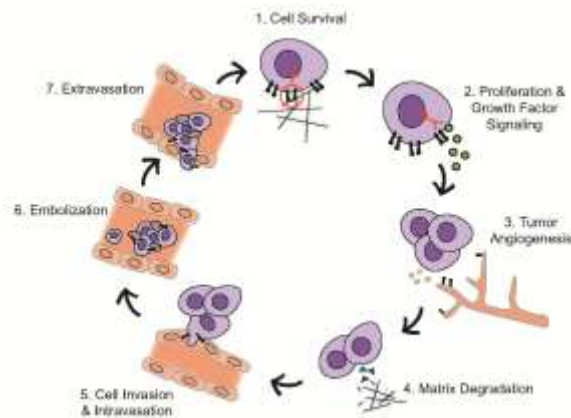


Fig. 1. G<sub>0</sub> stage

Other types of differentiated cells, including blood cells, epithelial cells of the skin, and the epithelial cells lining the digestive tract, have short life spans and must be replaced by continual cell proliferation in adult animals. In these cases, the fully differentiated cells do not themselves proliferate. Instead, they are replaced via the proliferation of cells that are less differentiated, called stem cells.

A good example of the continual proliferation of stem cells is provided by blood cell differentiation. There are several distinct types of blood cells with specialized functions: Erythrocytes (red blood cells) transport O<sub>2</sub> and CO<sub>2</sub>; granulocytes and macrophages are phagocytic cells; platelets (which are fragments of megakaryocytes) function in blood coagulation; and lymphocytes are responsible for the immune response. All these cells have limited life spans, ranging from less than a day to a few months, and are continually produced by the division of a common stem cell (the pluripotent stem cell) in the bone marrow. Descendants of the pluripotent stem cell then become committed to specific differentiation pathways. These cells continue to proliferate and undergo several rounds of division as they differentiate. Once they become fully differentiated, however, they cease proliferation, so the maintenance of differentiated blood cell populations is dependent on continual proliferation of the pluripotent stem cell.

#### 4. GOMPERTZ MODEL

Another model use to describe tumor dynamics is a Gompertz curve or Gompertz function. It is a type of mathematical model for a time series, where growth is slowest at the end of a time period:

$$n(t) = N_0 \exp \left[ \ln \left( \frac{N_\infty}{N_0} [1 - \exp(-bt)] \right) \right]$$

where N<sub>∞</sub> is the plateau cell number which is reached at large values of t and the parameter b is related to the initial tumor growth rate. Even with Gompertzian growth, a single set of

growth parameters is insufficient to model the clinical data. Tumor cells almost certainly have different growth characteristics in different patients, and individual micrometastases within a single patient may also have different growth parameters. To properly understand or derive a mathematical model for cancer growth, we must first understand the process of the ontogenetic development of an organism. This process is fueled by metabolism and follows a certain pattern which occurs primarily through cell division. In a recent paper, a mathematical model based on energy conservation was derived to model such growth and showed that regardless of the different masses and development times, all taxons share a common growth pattern<sup>2</sup>. It may be possible that cancer growth may be modeled in very much the same way. As the total energy that goes into an organism's development either goes into the maintenance of existing tissue or the creation of new tissue.

Studies have evaluated the electroencephalography (EEG) of humans and laboratory animals during and after Radiofrequency (RF) exposures. Effects of RF exposure on the blood-brain barrier (BBB) have been generally accepted for exposures that are thermalizing. Low level exposures that report alterations of the BBB remain controversial. Exposure to high levels of RF energy can damage the structure and function of the nervous system. Much research has focused on the neurochemistry of the brain and the reported effects of RF exposure. Research with isolated brain tissue has provided new results that do not seem to rely on thermal mechanisms. Studies of individuals who are reported to be sensitive to electric and magnetic fields are discussed. In this review of the literature, it is difficult to draw conclusions concerning hazards to human health. The many exposure parameters such as frequency, orientation, modulation, power density, and duration of exposure make direct comparison of many experiments difficult. At high exposure power densities, thermal effects are prevalent and can lead to adverse consequences. At lower levels of exposure biological effects may still occur but thermal mechanisms are not ruled out. It is concluded that the diverse methods and experimental designs as well as lack of replication of many seemingly important studies prevents formation of definite conclusions concerning hazardous nervous system health effects from RF exposure. The only firm conclusion that may be drawn is the potential for hazardous thermal consequences of high power RF exposure.

##### A. Cardio-vascular System

With the exception of a well-designed but small study (which therefore requires confirmation in larger and independent investigations) reporting early effects on blood pressure in volunteers exposed to a conventional GSM digital mobile phone position close to the head, available findings provide no consistent evidence of an effect of mobile phones on the heart and circulation.

##### B. Neurobehavioral effects

People are generally exposed to MPBS radiation under far-field conditions, i.e. radiation from a source located at a distance of more than one wavelength. This results in relatively homogenous whole-body exposure. MPBS exposure can occur continuously but the levels are considerably lower than the local maximum levels that occur when someone uses

a mobile phone handset.<sup>9</sup> A recent study that measured personal exposure to radiofrequency electromagnetic fields in a Swiss population sample demonstrated that the average exposure contribution from MPBSs is relevant for cumulative long-term whole-body exposure to radiofrequency electromagnetic fields. However, as expected, it is of minor importance for cumulative exposure to the head of regular mobile phone users. Personal exposure measurements assess the total radiation absorbed by the whole body, whereas spot measurements quantify short-term exposure in a single place, usually the bedroom.

Among people exposed to radio waves or otherwise exposed to electromagnetic fields, there have been case reports or reports of small series of cases of subjective symptoms (fatigue, stress, sleep disturbances, depression, burning sensations, rashes, muscular pain, ear, nose, and throat problems, as well as digestive disorders etc.) in individuals that have been characterized as “hypersensitive”.

## 5. CONCLUSION

This study is based on methodology and architecture of useful and effectiveness biological effects of electromagnetic and RF microwave signals. Although electronic devices and the development in communications make the life easier, it may also involve negative effects. These negative effects are particularly important in the electromagnetic fields in the Radiofrequency (RF) zone which are used in communications, radio and television broadcasting, cellular networks and indoor wireless systems. Cell proliferation is the increase in cell number as a result of cell growth and division due to radio frequency and electromagnetic field.

## REFERENCES

- [1] Zamanian and CY Hardiman Fluor Corporation, Industrial and Infrastructure Group, Electromagnetic Radiation and Human Health: A Review of Sources and Effects b July 2005.
- [2] Zhang D, Pan X, Ohno S, Osuga T, Sawada S, Sato K (2011) No effects of pulsed electromagnetic fields on expression of cell adhesion molecules (integrin, CD44) and matrix metalloproteinase-2/9 in osteosarcoma cell lines. *Bioelectromagnetics*. 2011 Apr 7. doi: 10.1002/bem.20647.
- [3] Kalluri Sri Nageswari, 1988 A Review on immunological Effects of Microwave Radiation. *IETE Technical review (India)*,5:203-210
- [4] Hawkins B.T., Egleton R.D., 2008. Pathophysiology of the blood-brain barrier: animal models and methods. *Curr Top. Dev. Biol.* 80,277-309.
- [3] William R. Hendee, John C. Boteler. 1994. The Question of Health Effects from Exposure to Electromagnetic Fields. *Health Physics* 66: 127-136.
- [4] Bohr H, Bohr J. Microwave enhanced kinetics observed in Optical Rotational Dispersion studies of a protein. *Bio electromagnetics* 21:68-72; 2000a.
- [5] Bohr H, Bohr J. Microwave enhanced folding and denaturation of globular proteins. *Phys Rev E*61:4310– 4314; 2000b.
- [6] K. Sri Nageswari, Biological Effects of Microwaves and Mobile Telephony, (ICNIR 2003).
- [7] T.G. Cooper, S.M.Mann, R. P.Blackwell, and S.G.Allen “Occupational Exposure to Electromagnetic Fields at Radio Transmitter Sites”, Centre for Radiation, Chemical and Environmental Hazards, Didcot, Oxfordshire, 2007.