

Effects of Electromagnetic & Radio Frequency on Human Body

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Abstract— This paper deliberates the effects of Electromagnetic in human beings and heat (energy) in a biological or non-biological system is frequency and also discussed on the exposure of microwaves from cellular networks. While it is not certain that RF radiation generally poses any risks to human health, some reasons exist for being concerned about human health effects from the cellular phones themselves. These concerns exist because the antennas of these phones deliver much of their RF energy to small portions of the user’s head. It describes the energy content, interaction of microwave with biological system, measurement techniques and safety standards. In the era of wireless communication, the exposure to electromagnetic radiations is increasing. Most of these radiations fall in the category of microwaves. In addition, domestic appliances and medical treatments also use microwaves for various purposes. Though the human body could compensate for and handle the extra energy load through the thermoregulatory mechanisms without obvious increase in temperature, stress could still.

Index Terms—: Radiofrequency, Electromagnetic, Frequency Spectrum, Bio Effects.

I. INTRODUCTION

The effects of Electromagnetic Fields (EMF) on humans are observational in nature, which renders problematic the assessment of causality. Radiofrequency (RF) electromagnetic waves may interrelate with biological tissue through a number of mechanisms. It has not been established though that any of those proposed so far could result in adverse health effects at radiation levels below guidelines. Indeed Adair [2003], in a recent appraisal, noted that the interactions were all weak compared with the endogenous interactions and concluded that it was most unlikely that RF fields of intensity less than 100 W/m² incidents on humans could affect physiology significantly. The aim of the present study is to give a Qualitative Discussion of some of the more recently published work.

II. ELECTROMAGNETIC RANGE

The electromagnetic (EM) spectrum contains an array of electromagnetic waves increasing in frequency from Extremely Low Frequency and Very Low Frequency (ELF/VLF), through Radio Frequency (RF) and Microwaves, to Infrared (IR) light, Visible Light, Ultraviolet (UV) light, X-rays, and Gamma rays.

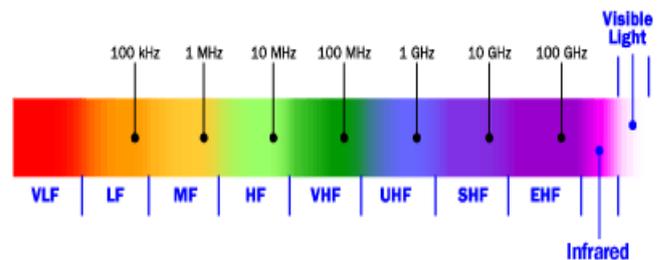


Fig. 1: Frequency bands

The microwave frequency spectrum ranges from 300 MHz-300 GHz and RF Radiation from 0.5MHz - 300 MHz. The sources of microwave and RF radiation are Air Traffic Control Systems, Police and Military Radar.

III. MICROWAVE BIO EFFECTS

The power of each field source and the field strength it produces at the location of interest. Relevant considerations are whether the source uses adaptive power control, produces intermittent transmissions, and whether it can produce multiple carriers. Earth to Satellite Television Broadcast Systems, Long Distance Telephone Equipment, Medical Diathermy Devices, Cancer Diagnostic & Therapeutic (Hyperthermia) Equipment, Microwave Ovens, Industrial Applications and Microwave Generators. The standards that limit microwave exposure were set at 0.4 W/kg SAR for occupational and 0.08W/Kg for public exposure. The averaging time for determination of SAR was 6 minutes. The mechanisms of interaction have been described as thermal effects, with rise in body/tissue temperature of more than 1oC, non-thermal effects, with no obvious increase in body temperature and micro thermal with thermo elastic expansion in the brain giving rise to microwave hearing effect. The radiation pattern generated by the source, phenomenon which is the spatial distribution of the EM field with respect to the source. In the near-field, angular field distributions change greatly as a function of distance from the source. In the far-field, there should be no significant change in the angular field pattern with distance from the source, but reflecting objects in the far-field often make this assumption incorrect. The frequency spectrum of the source(s), as energy may be distributed over several decades of frequency. The latest ultra wideband (UWB) sources have energy spread over ranges as great as 3.1-10.6 GHz [2].

IV. RF EXPOSURE AND MOLECULAR EFFECTS

Microwaves produce thermal effects on biological systems at high power levels .

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The energy absorption at high power levels probably leads to nonspecific stimulation of hypothalamic-hypophyseal-adrenal axis with liberation of corticosterone that causes sequestration of cells, an effect induced by any known stressor. Some of the thermal effects reported include cataract formation, fetal abnormalities, decreased thyroid function (through hypothalamic-hypophyseal-thyroid axis inhibition), suppression of behavioral responses, gonadal function and natural killer cell activity, increase in the number of complement receptor positive cells and increased phagocytic activity of peritoneal macrophages [2]. Mechanism responsible for a given observed biological effect is of scientific interest because they help in analyzing relationships among various observed biological effects in different experimental models and subjects. They serve as guides for comparison and extrapolation of experimental results from tissue to tissue, from tissue to animal, from animal to animal, from animal to human and from human to human undergoing RF exposure. RF was applied for 5 s in a microwave oven at 2.45 GHz and 800 W, causing a ~0.3°C temperature increase in the protein solution. In the first publication (Bohr and Bohr 2000a) using optical rotational dispersion, the authors showed that exposure accelerated conformational changes of the protein and in a second paper (Bohr and Bohr 2000b) they reported an enhancement of folding and denaturation of the protein. These observations were interpreted as evidence of coherent RF excitation of irrational or torsional modes leading to altered conformation of the protein molecules. However, their discussion did not consider the difficulty of direct excitation of irrational modes by RF nor the effects of damping.

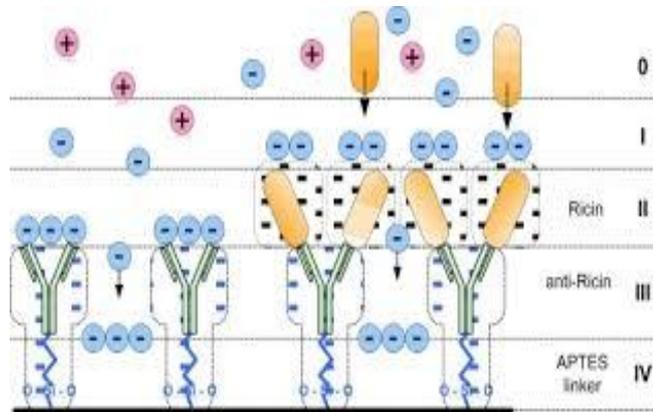


Fig. 1: Molecular effects

For studies of health effects on people exposed to RF fields it is must to estimates the exposure over time. Instruments have been developed to estimates the exposure using personal exposure monitors worn on the body.

V. EFFECTS ON NERVOUS SYSTEM

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 [1]. 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.⁹ 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”.

VI. CONCLUSION

In this paper we observed that a major determinant for the initiation of current or heat in a biological or non- biological system is frequency.

The unit of authentication is current density (A/m^2) which depends on the field strength (H in A/m), the frequency and the body length. The most apparent biological effects of RF energy to living cells are due to heating. While it is not certain that RF radiation generally poses any risks to human health, some reasons exist for being concerned about human health effects from the cellular phones themselves.

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