The audiological effects of variable degree usage of mobile phones

Thesis

Submitted for Partial Fulfillment

Of

The Master Degree in Otolaryngology

By

Alamir Fiesal Abozied

(M.B.B.CH.)

Supervised

By

Professor Dr. Mohamed Nassar Abd El Rehim

Professor of otolaryngology

Faculty of Medicine

Ain Shams University

Professor Dr. Sabry Magdi Sabry

Professor of otolaryngology

Faculty of Medicine

Ain Shams University

Professor Dr. Amany Ahmed Shalaby

Professor of audiology

Faculty of Medicine

Ain Shams University

Faculty of Medicine

Ain Shams University

2008

بسم الله الرحمن الرحيم

رَبِّ أَدْخِلْنِي مُدْخَلَ صِدْقٍ وَ أَخْرِجْنِي مُخْرَجَ صِدْقٍ وَ اجعَلْ لِي مِنْ لَدُنْكَ سُلْطَانًا نَصِيرًا

ACKNOWLEDGMENT

First and foremost, thanks to god to whom I relate any success in achieving any work inmy life.

I would like to express my deep gratitude to **Professor Dr. Mohamed Nassar Abd El Rehim**, Professor of otolaryngology, Ain Shams University, for his continuous encouragement and guidance.

I offer my warmest thanks and gratitude to **Professor Dr. Sabry Magdi Sabry**, Professor of otolaryngology,Ain Shams University, for his valuable efforts throughout the work.

I give all my thanks to **Professor Dr. Amany Ahmed Shalaby** Professor of audiology, Ain Shams University, for the effort she put in this work.

Finally I would like to thank all my family for their help and cooperation.

Abbreviation list

ABR	Auditory brain stem reflexes
DPOAEs	Distortion product otoacoustic emissions
EMFs	Electromagnetic fields
EOAEs	Evoked otoacoustic emissions
GSM	Global system for mobile communications
IMT	International mobile telecommunication
MRI	Magnetic resonance imaging
NMT	Noradic mobile telephone
OAE	Otoacoustic emission
PTA	Pure tone audiometry
RF	Radio frequency
RFR	Radio frequency rate
SAR	Specific absorption rate
SFOAEs	Stimulus- frequency otoacoustic emissions
SOAEs	Spontaneous otoacoustic emissions
TEOAEs	Transient evoked otoacoustic emissions

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Introduction:

The use of mobile has dramatically increased all over the world. Mobile phones have become a more and more widespread means of communication. The advent of third generation systems will extend the use of most novel forms of communication technologies. Mobile phones are low power radio devices that transmit and receive radio frequency radiation at frequencies in the microwave range of 900-1800 MHZ. The main concerns are about emissions of radio frequency radiation from mobile phones and base stations that receive and transmit signals. (Meo et aldrees 2005)

Since mobile phones have come into widespread use.a lot of possible adverse effects and hazards to health are anticipated due to potentially harmful radiofrequency electromagnetic field. Digital cellular phones transmit in bursts of microwave of 900 MHz. In rat, the direct effect of radiofrequency electromagnetic energy on DNA molecules was found to damage DNA and reduce the repair mechanism in brain cells. (Kerekhanjanarong et al., 2005)

In addition to the anxiety because of electromagnetic pollution in general, this apprehension is mainly related to some basic assumptions. Their are based on conceivable thermal radiation / tissue interactions. that causes damage by heating exposed areas

of the body (thermal effect), in addition, there are indications that electromagnetic radiation may interfere with metabolic and functional activities of cells and tissues (non thermal effect) (Pau,H.W. et al., 2005).

The mobile phones frequencies excite rotations of water molecules and some organic molecules and have been associated with some effects like headaches , the sensation of burning or warmth on the ear , burning sensations in the facial skin and alteration of the blood-brain barrier, Non thermal effects described in the literature include modifications of sleep patterns , an increase in blood pressure and effects on cognitive function and the potential carcinogenic effect of electromagnetic fields (Ozturan et al., 2002).

The main hypothesis, that (GSM) global system of mobile which is the digital one would experience more symptoms than users of (NMT) which is the analogue system users, this was falsified however an interesting side finding appeared the prevalence of subjective symptoms increased with increasing calling time per day and number of calls per day. Since a certain amount of radiofrequency energy will be absorbed by the user during a mobile phone call, it was of interest to go one step further and study whether the prevalence of subjective symptoms increased with increasing rate of absorption and the total absorbed energy per call and per day (wilen et al., 2003).

During calls with cellular or cordless phones, the brain is exposed to microwaves in the range of 400-2000 MHz.The temporal area is a part of the brain with the highest exposure due to physical properties of the phone. However, depending on the site of the antenna and how the phone is held Other parts of the brain may also have substantial exposureAcoustic neuroma develops in an area with higher exposure to microwaves from cellular and cordless phones than other parts of the brain and may thus be a signal tumor for a carcinogenic potential of microwaves (Hardell et al., 2005).

The radio frequency radiation emitted from cellular phones during transmission is absorbed superficially on the skin and bones surrounding the ear and intracranially behind the ear. Radio frequency radiation does not possess sufficient energy to remove electrons from molecules, and causes little increase in the temperature of facial or brain tissue. Despite the lack of a known carcinogenic effect of radio frequency radiation from cellular phones, there are public health concerns about their safety (Muscat et al., 2002).

Although there is no clear evidence to show harmful physiological effects of electromagnetic fields at the levels used by mobile phones, there is widespread public concern that there maybe potential for harm. Mobile phones are usually held close

to the ear, this may lead to relatively high energy deposition on the ear compared to other parts of the body. These may have possible effect on the auditory system. The interaction between mobile phone radiation and inner ear function has been studied by several authors (Grisanti et al., 1998; Kizilay et al., 2003) but there results appear contradictory. Otoacaustic emissions are known to be highly specific non invasive tool to measure integrity of cochlear function mainly outer hair cells. Measurements of outer hair cells both in human and in animals has been reported by some authors (marino et al., 2000 ;Galloni et al., in press) they sometimes found significant changes, but their results need further confirmation. To date there is still limited knowledge on potential adverse effects of electromagnetic field of mobile phones on hearing. Therefore, this work is addressed to study the effect of mobile phone emission on the cochlear outer hair cells function (Parazzini et al., 2005).

Aim of work:

This study aims at detecting the effect of mobile phones, radiofrequency electromagnetic waves on the hearing of its users at variable rates.

- **Biophysics of cellular phones.**

When you talk into a mobile telephone it converts the sound of your voice to radiofrequency energy (radio waves). The radio waves are transmitted through the air to a nearby base station. The base station then sends the call through the telephone network until it reaches the person you are calling. When you receive a call on your mobile phone the message travels through the telephone network until it reaches a base station near to you. The base station sends out radio waves, which are detected by your telephone and converted back to speech. Depending on the equipment and the operator, the frequency that each operator utilises is 900MHz, 1800MHz or 2100MHz

There are three parts to a cellular phone system: the telephone unit, the network of cell base stations; and the mobile telephone switching office. Geographic areas are divided into "cells." Each cell has at its center a base station, where the fixed radio receiver and transmitter are located. Every call made by a cellular phone is first sent to the base station in the cell within which the cellular phone is located. As a call passes from one cell site to another, the call is transferred to an adjoining cell without any noticeable interruption. All cell sites belonging to a particular system are connected together at a mobile telephone switching office, which ties them to the local phone system.

Electromagnetic (EM) radiation

Is a self propagating wave in space or through matter. EM radiation has an electric and magnetic field component which oscillate in phase perpendicular to each other and to the direction of energy propagation. Electromagnetic radiation is classified into types according to the frequency of the wave, these types include (in order of increasing frequency): radiowaves, microwaves, terahertz radiation, infrared radiation, visible light, ultraviolet radiation, X-rays and gamma rays. Of these, radio waves have the longest wavelengths and Gamma rays have the shortest. A small window of frequencies, calledvisible spectrum or light, is sensed by the eye of various organisms, with variations of the limits of this narrow spectrum. The word 'light' is sometimes used in a broader sense, referring to EM radiation.

Electromagnetic spectrum

Legend:

γ = Gamma rays

HX = Hard X-rays

SX = Soft X-Rays

EUV = Extreme ultraviolet

NUV = Near ultraviolet

Visible light

NIR = Near infrared

MIR = Moderate infrared

FIR = Far infrared