Effect of electromagnetic field exposure on some hepatic, hematological and metabolic parameters in rats

Thesis
Submitted in partial Fulfillment of M.D. Degree in Physiology

By

Doaa Mohamed Abd el-Wahed

Assistant lecturer, Physiology Department
Faculty of medicine, Ain Shams University

Supervised by

Prof. Dr. Fatma Ahmed Mohamed
Professor of Physiology
Faculty of Medicine, Ain Shams University

Prof. Dr. Ebtessam Ahmed Abu-Shady
Professor of Physiology
Faculty of Medicine, Ain Shams University

Dr. Sahar Sobhy Thabet
Assistant Professor of Physiology
Faculty of Medicine, Ain Shams University

Dr. Sahar Mohamed Tawfik El-Agaty
Assistant Professor of Physiology
Faculty of Medicine, Ain Shams University

Physiology Department
Faculty of Medicine - Ain Shams University
2011

بسم الله الرحمن الرحيم

(يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ
وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ)

صدق الله العظيم

{سورة المجادلة آية ١١}

Acknowledgement

*First of all, I thank **God** for blessing this work as a part of his generous help throughout my life.*

*I would like to express my sincere gratitude and deepest thanks to **Prof. Dr. Fatma Ahmed Mohamed**, Professor of Physiology, Faculty of Medicine, Ain Shams University, for her meticulous supervision, scientific support and judicious guidance throughout this work.*

*I am profoundly grateful to **Prof. Dr. Ebtessam Ahmed Abu-Shady**, Professor of Physiology, Faculty of Medicine, Ain Shams University, for her wise council, expert guidance, and keen supervision.*

*I am greatly thankful to **Dr. Sahar Sobhy Thabet**, Assistant Professor of Physiology, Faculty of Medicine, Ain Shams University, for her limitless help, kind encouragement and generous assistance throughout the whole work.*

I wish to express my gratitude to ***Dr. Sahar Mohamed Tawfik El-Agaty****, Assistant Professor of Physiology, Faculty of Medicine, Ain Shams University, for her continuous supervision and faithful advice.*

I would like to acknowledge my appreciation to ***Prof. Dr. Faten Mahmoud Aly Diab****, Head of Physiology Department, Faculty of Medicine, Ain Shams University, for her continuous encouragement and support.*

I would also like to display my deepest thanks to ***Prof. Dr. Salwa Saad Lashin,*** *Professor of Anatomy, Faculty of Medicine, Ain Shams University, for her generous assistance and valuable comments in the histological studies included in the present work.*

Last but not least, I would like to thank all members of the Physiology Department for their cooperation and support.

To

My Family

Contents

List of Tables

List of Figures

List of Abbreviations

ADA : Adenosine deaminase.
ALT : Alanine aminotransferase.
ALP : Alkaline phosphatase.
AST : Aspartate aminotransferase.
AI : Atherogenic Index.
APTT : Activated partial thromboplastin time.
ATP : Adenosine triphosphate.
CAT : Catalase.
ELF : Extremely low frequency.
EMF : Electromagnetic field.
EMR : Electromagnetic radiation.
FAD : Flavin adenine dinucleotide.
FSH : Follicle stimulating hormone.
γ-GT : Gamma glutamyl transferase.
GHz : Gega Hertz.
GSH : Glutathione.
GSH-Px : Glutathione peroxidise.
HDL-C : High density lipoprotein-cholesterol.
Hx & E : Haematoxylin and Eosin.
Hz : Hertz.
IR : Infrared.
KHz : Kilo Hertz.

LDH : Lactate dehydrogenase.

LDL-C : Low density lipoprotein-cholesterol.

LH : Leutinizing hormone.

MDA : Malondialdehyde.

MHz : MegaHertz.

MPO : Myeloperoxidase.

NADPH : Nicotinamide adenine dinucleotide phosphate.

NO : Nitric oxide.

NOS : Nitric oxide synthase.

PAI : Plasminogen activator inhibitor.

PAS : Periodic Acid Schiff's reaction.

PT : Prothrombin time.

RF : Radiofrequency.

ROS : Reactive oxygen species.

SOD : Superoxide dismutase.

T_3 : Triiodothronine.

T_4 : Thyroxin.

TBA : Thiobarbituric acid.

TC : Total cholesterol.

TCAA : Trichloroacetic acid.

TG : Triglycerides.

TNF-α : Tumor necrosis factor-alpha.

TSH : Thyroid stimulating hormone.

XO : Xanthine oxidase.

UV : Ultraviolet.

INTRODUCTION

Introduction

Almost all populations are exposed in the present time to Electromagnetic fields (EMFs), a documented form of stress ***(Salem et al., 2005)***, as a result of the vast distribution of power lines, wiring, cellular phones and home appliances, which generate electromagnetic fields. These EMFs were accused of posing health risks ***(Bediz et al., 2006).***

Further, the widespread use of wireless telecommunication devices, particularly cellular phones, resulting in increased human exposure to radiofrequency (RF) fields, raised concerns still exist about the potential for adverse health outcomes to occur in relation to RF field exposure despite the establishment of safety guidelines by national and international agencies ***(Krewski et al., 2007)***.

In fact, the use of mobile phones has increased significantly over the past decade. This widespread use of mobile phones in recent years has raised the research activities in many countries to determine the consequences of exposure to the electromagnetic radiation (EMR) of

mobile phones ***(Ilhan et al. 2004)***, and to highlight the negative effects of exposure to cell phone-EMF on human health ***(Makker et al., 2009)***.

Bediz et al. (2006) reported that exposure to EMF could cause cell damage in various tissues and ***Torres-Duran et al. (2007)*** stated that among the most susceptible tissues to EMF exposure is the liver. The impact of exposure to cell phone-EMF on liver integrity, hemostatic function and metabolic activities was, therefore, intriguing.