US NAVAL MEDICAL RESEARCH INSTITUTE

BIBLIOGRAPHY OF REPORTED BIOLOGICAL PHENOMENA ('EFFECTS') AND CLINICAL MANIFESTATIONS ATTRIBUTED TO MICROWAVE AND RADIO-FREQUENCY RADIATION

Research Report

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CHAPTER 1

Reported Biological Phenomena ('Effects') and Some Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation (See Note)

A. Heating of Organs* (Applications: Diathermy, Electrosurgery, Electrocoagulation, Electrodesiccation, Electrotomy)

1. Whole Body (temperature regulation defects), Hyperpyrexia
2. Skin
3. Bone and Bone Marrow
4. (a) Lens of Eye (cataractous lesions - due to the avascular nature of the lens which prevents adequate heat dissipating (b) Corneal damage also possible at extremely high frequencies
5. Genitalia (tubular degeneration of testicles)
6. Brain
7. Sinuses
8. Metal Implants (burns near hip, pins, etc.)

The effects are generally reversible except for 4a.

B. Changes in Physiologic Function

1. Striated Muscle Contraction
2. Alteration of Diameter of Blood Vessels (increased vascular elasticity), Dilation
3. Changes in the Oxidative Processes in Tissues and Organs
4. Liver Enlargement
5. Altered Sensitivity to Drug Stimuli
6. Decreased Spermatogenesis (decreased fertility, to sterility)
7. Altered Sex Ratio of Births (more girls)
8. Altered Menstrual Activity
9. Altered Fetal Development
10. Decreased Lactation in Nursing Mothers
11. Reduction in Diuresis (Ua+ excretion, via urine output)
12. Altered Renal Function (decreased filtration in tubules)
13. Changes in conditioned Reflexes
14. Increased Electrical Resistance of Skin
15. Changes in the Structure of Skin Receptors of the (a) Digestive and (b) Blood –Carrying Systems
16. Altered Blood Flow Rate

It is also reported that low levels of irradiation produce a cooling effect – "hypercompensation".

Note: these effects are listed without comment or endorsement since the literature abounds with conflicting reports. In some cases the basis for reporting an "effect" was a single or a non-statistical observation which may have been drawn from a poorly conceived (and poorly-executed) experiment.

17. Alterations in the Biocurrents (EEGT) of the Cerebral Cortex (in animals)
18. Changes in the Rate of Clearance of Tagged Ions from Tissue
19. Reversible Structural Changes in the Cerebral Cortex and Diencephalon
20. Electrocardiographic (EKG) Changes
21. Alterations in Sensitivity to Light, Sound, and Olfactory Stimuli
22. Functional (a) and Pathological (b) Changes in the Eyes: (a) decrease in size of blind spot), altered color recognition, changes in intraocular pressure, lacrimation, trembling of eyelids; (b) less opacity and coagulation, altered tissue respiration, and altered reduction-oxidation processes
23. Myocardial Necrosis
24. Hemorrhage in Lungs, Liver, Gut and Brain) At Fatal Levels
25. Generalized Degeneration of all Body Tissues) Radiation
26. Loss of Anatomical Parts
27. Death
28. Dehydration
29. Altered Rate of Calcification of Certain Tissue

C. Central Nervous System Effects

1. Headaches
2. Insomnia
3. Restlessness (Awake and During Sleep)
4. Electroencephalographic (EEG) Changes
5. Cranial Nerve Disorders
6. Pyramidal Tract Lesions
7. ConditIoned Reflex Disorders
8. Vagomimetic Action of the Heart; Sympaticomimetic Action
9. Seizures, Convulsions

D. Autonomic Nervous System Effects

1. Neuro-vegetative Disorders (e.g., alteration of heart rhythm)
2. Fatigue
3. Structural Alterations in the Synapses of the Vagus Nerve
4. Stimulation of Parasympathetic Nervous System (Bradycardia), and lnhibition of the Sympathetic Nervous System

E. Peripheral Nervous System Effects

1. Effects on Locomotor Nerves

F. Psychological Disorders ("Human Behavioural Studies") – the so-called "Psychophysiologic (and Psychosomatic) Responses"

1.Neurasthenia
2.Depression
3. Impotence
4.Anxiety
5.Lack of concentration
6. Hypochrondria
7. Dizziness
8. Hallucinations
9. Sleepiness
10. Insomnia

11. Increased Irritability
12. Decreased Appetite
13. Loss Memory
14. Scalp Sensations
15.Increases Fatigability
16. Chest Pain
17. Tremor of the Hands

G. Behavioural Changes (Animal Studies)

Reflexive, Operant, Avoidance and Discrimination behaviours

H. Blood Disorders (V = in vivo) (v = in vitro)

Changes in:

1.Blood and Bone Marrow
2.Phagocytic (polymorphs) and bactericidal functions of liver (V,v)
3.Hemolysis rate (increase), (a shortened lifespan of cell)
4.Sedimentaion rate (increase)…
5. Number of Lrythrocytes (decrease), also number of Lymphocytes
6. Blood glucose concentration (increase)
7. Blood Histamine content
8. Cholesterol and Lipids
9. Gamma (also *a* and *b*) Globulin, and Total Protein Concentration
10. Number of eosinophils
11. Albumin/Globulin Ratio (decrease)
12. Hemopoiesis (rate of formation of blood corpuscles)
13. Leukopenia (increase in number of white cells), and leukocytosis
14. Reticulocytosis

I. Vascular Disorders

1.Thrombosis
2. Hypertension

J. Enzyme and Other Biochemical Changes

Changes in activity of:

1. Cholinesterase (V,v)
2. Phosphatase (v)
3. Transaminase (v)
4. Amylase (v)
5. Carboxydismutase
6. Protein Denaturation
7. Toxin, Fungus, and Virus Inactivation (at high radiation dose levels), Bacteriostatic Effect
8. Tissue Cultures Killed
9. Alteration in Rate of Cell Division
10. Increased Concentration of RNA in Lymphocytes, and Decreased Concentration in Brain, Liver, and Spleen
11. Changes in Pyruvic Acid, Lactic Acid, and Creatinine Excretions
12. Change in Concentration of Glycogen in Liver (Hyperglycemia)
13. Alteration in Concentration of 17-Ketosteroids in Urine

K. Metabolic Disorders

1. Glycosuria (sugar in urine; related with blood sugar?)
2. Increase in Urinary Phenol (derivatives? DOPA?)
3. Alteration of Rate of Metabolic Enzymatic Processes
4. Altered Carbohydrate Metabolism

L. Gastro-Intestinal Disorders

1. Anorexia (loss of appetite)
2. Epigastric Pain
3. Constipation
4. Altered Secretion of Stomach “Digestive Juices”.

M. Endocrine Gland Changes

1. Altered Pituitary Function
2. Hyperthyroidism
3. Thyroid Enlargement
4. Increased Uptake of Radioactive Iodine by Thyroid Gland
5. Altered Adrenal Cortex Activity
6. Decreased Corticosteroids in Blood
7. Decreased Glucocorticoidal Activity
8. Hypogonadism (usually decreased testosterone production)

N. Histological Changes

1. Changes in Tubular Epithelium of Testicles
2. Cross Changes

O. Genetic and Chromosomal changes

1. Chromosome Aberrations (eg, linear shortening, pseudochiasm, diploid structures, amitotic division, bridging, "sticky" chromosomes, irregularities in chromosomal envelope)
2. Mutations
3. Mongolism
4. Somatic Alterations (changes in cell not involving nucleus or chromosomes, cellular transformation)
5. Neoplastic Diseases (eg, tumors)

P. Pearl Chain Effect (Intracellular orientation of subcellular particles, and orientation of cellular and other (non-biological) particles)
Also, orientation of animals, birds, and fish in electromagnetic fields

Q. Miscellaneous Effects

1. Sparking between dental fillings
2. Peculiar metallic taste in mouth
3. Changes in Optical Activity of Colloidal Solutions
4. Treatment for Syphilis, Poliomyelitis, Skin Diseases
5. Loss of hair
6. Brittleness of hair
7. Sensations of Buzzing Vibrations, Pulsations, and Tickling about the Head and Ears
8. Copious Perspiration, Salivation, and Protrusion of Tongue
9. Changes in the Operation of Implanted Cardiac Pacemakers
10. Changes in Circadian Rhythms