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Review Article

Literature Survey On Influence Of Mobile Waves On Rats

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Abstract

The electromagnetic field (EMF) radiation and the biological effect on the growth in the use of cellular phone has raised the concerns about the possible interaction between human tissue or rats , particularly the brain and the human immune system. These concerns have induced a large volume of research studies. However, most of the previous studies are concentrated and no published work took in consideration all possible effects of cell phone radiation on human tissues or rats. This review will provide answers for public concerns about the risk of using cell phone. Our conclusion shows that long-term exposure to EMF radiation from a cell phone could cause health effects, such as brain cancer. Some positive health effect due to the exposure to the EMF radiation such as improve bone healing and reduce toxic effect of chemotherapy are highlighted. Finally, some studies have also showed no effect due to exposure to EMF. More long-term studies and analysis are much needed.

Keywords: Electromagnetic radiation, Mobile waves, risk of mobile phone

Introduction

INTRODUCTION

Electromagnetic radiation is any form of energy carrying radiation created by the interaction of electric and magnetic fields. Its comes in many different types, although the differences between them are quantitative. This book lists the different type that are generally recognised.

Electromagnetic radiation is a wave, so has a wavelength λ and a frequency v. It is also composed of particles called photons, and each photon has an energy E. These three quantities are related, and any of them may be used to define the type of radiation.

The properties of electromagnetic radiation were first investigation by James Clerk Maxwell in 1864. He realised that in a vacuum they would travel at the speed of light, and he correctly reduced that light is radiation of this form[1].

The use of electromagnetic radiation (EMR) is increasing continuously in line with technological advances, leading to a much greater level of exposure to EMR in daily life than that which exists in nature. The recent rise in the use of cell phones and consequently in exposure to EMR has raised the question of its possible side-effects on the living organism and has caused some measure of concern. The discovery of electricity resulted in major changes in human social life. The rapid development of industry and improvements in economic conditions has led to very considerable numbers of electronic devices being used. In the current age, exposure to EMR emitted by various sources like power lines, radios, electrical home devices, computers and phones is an inescapable part of the daily life. However, most people are unaware of the harmful effects on health of EMR which is emitted by these devices. The 900-MHz and 1800-MHz radio waves are used frequently in mobile phone telecommunication. For this reason, an intense exposure to EMR is usually possible in mobile phone usage. It is known that mobile phone emit EMR from 420 V/m at 0.1m to 7 V/m at 1 m.

While the use of cellular phones is increasing very rapidly, this now seems to have become an important health problem, thanks to studies reporting that these radiation waves are harmful to human health. There has thus been considerable scientific focus on this and research into the biological effects of exposure to EMR. A number of experimental studies have shown that EMR in-

crease oxidative stress in various organs and tissues. Furthermore, it was reported that EMR may have hazardous effects on tissues such as liver, testes, heart, lung, brain and kidney. The close proximity of telephone antenna to the abdominal organs has raised various doubts regarding biological interaction between EMR and the kidneys in particular. Of these, it is possible that 900-MHz radiation emitted from the mobile phone devices is absorbed by the kidney with a higher ratio than the other internal organs mobile phones are often carried on belts.

The use of mobile phones results in the production of free radicals, leading to subsequent damage in tissues. At this point; kidney tissues is extremely sensitive to oxidative damage since it is one of the organs involving intense oxidation processes. The continuity of cellular life depends on the balance in the execution of complex biological reaction. Endogenous or exogenous factors that might disrupt this balance lead to cellular damage. Of these, oxidative stress is particularly important because it causes various pathological conditions and numerous studies have been performed on the subject. Radical reaction are a part of the homeostasis. Healthy cell eliminate free radicals by using antioxidants in a homeostatic manner. Cells are protected against the harmful effects of reactive oxygen species by their antioxidant defence systems. An antioxidant defence system is developed by the living tissues to cope with the hazards exerted by the oxygen free radical. The mentioned defence system includes the in-situ production of antioxidants. The removal of the reactive species may be non-enzymatic or, as a more efficient way, enzymatic. The hazardous effect of reactive oxygen species (ROS) may be alleviated by the endogenous and exogenous antioxidant agents via their free radical scavenging activity and thus the immune defence can be boosted and the risk for the development of cancer and degenerative disorders may be reduced. The system of antioxidant defence with the highest capability includes the stimulation of glutathione peroxidise (GPx) catalyse (CAT) and superoxide dismutase (SOD)[2].

ANATOMY AND PHYSIOLOGY OF RAT LIVER

The liver occupies the anterior third of the abdominal cavity. Unlike the situation in reference to the mouse, the descriptions of the gross anatomy of the liver of the rat vary from author to author: the liver is divided into four major lobes, via, the median or cystic lobe, which bears a deep fissure; the right lateral lobe, which is partially divided into cranial and caudal lobes: a large left lobe; and a small caudate lobe divided into cranial and caudal part which fit around the esophagus, the liver is made up of several lobes separated from one another by deep indentation the largest lobe is the left lateral lobe; the right lateral lobe is situated in the most dorsal position; ventral to it lies the right medial lobe or right accessory lobe and caudal to the right lateral lobe lies the caudate lobe; which is sometimes also designated as papillary process the right lateral lobe and the more detailed description provided by which follows. Deep fissures divide the liver into a left, middle, and right lobe. The left lobe consists of a great left lateral lobe joined to the other lobes only by means of interstitial tissues and vessels, and a smaller left medial lobe, situated mainly cranial to the first. It is separated from the middle lobe by a deep fissure which receives the insertion of the falciform ligament. The supraportal part of the narrow intermediate lobe extends cranially and to the right overlaps the right part of the liver. From its visceral surface arises the pointed caudate process, which projects dorsally and to the right. Its dorsal surface adjoins the ventral aspect of the kidney. Two disk like papillary processes arise left of the hepatic portal. The dorsal one extends on the right of the esophagus across the lesser curvature to the caudal surface of the stomach. The ventral papillary process attaches to the cranial surface of the stomach. The smaller right lobe of the liver is not subdivided. These descriptions of the gross anatomy of the liver are given nearly verbatim in order that it will be appreciated that no uniform opinion exists regarding the nomenclature of the lobe of the liver in the rat[3].

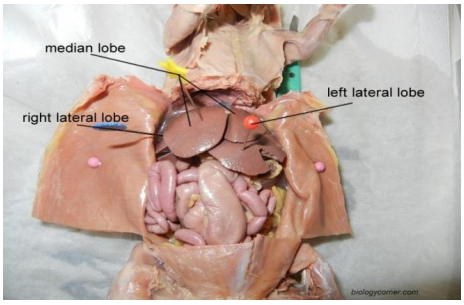

Figure: Anatomy of rat liver

FUNCTION OF LIVER

Carbohydrate metabolism

When blood glucose level is low liver can break-down glycogen to glucose and release it into blood stream. The liver also convert amino acid and lactic acid to glucose.

Lipid metabolism

Hepatocytes store some triglycerides, break down fatty acid to generate ATP, synthesize lipoproteins, which transport fatty acid, triglyceride, and cholesterol to the from body cell, synthesize cholesterol and use cholesterol to make bile salts.

Protein metabolism hepatocytes deaminate remove the group, NH2,)from amino acids so that the amino acids urine. Hepatocytes also synthesize most plasma proteins, can be used for ATP production or converted to carbohydrates or fats. The resulting toxic ammonia (NH3) is then converted into the much less toxic urea, which is excreted in urine. Hepatocytes slaso synthesize most plasma proteins such as alpha and beta globulins, albumin, prothrombine, and fibrinogen.

PROCESSING OF DRUGS AND HORMONES

The liver can detoxify coil substance such as alcohol and excrete drugs such as penicillin, erythomycine, and sulphonamides into bile. It can also chemically alter or excrete thyroid hormones and steroid hormones such as estrogens and aldosterone. Excretion of bilirubin. As previously noted, bilirubin, derived from the heme of aged red. Blood cell, is absorbed by the liver from the blood and secrete into bile. Most of the bilirubin in bile metabolism in the small intestine by bacteria and eliminated in feces.

Synthesis of bile salt. Bile salt are used in the small intestine for the emulsification and absorption of lipid.

Storage. In addition to glycogen, the liver is a prime stirage for certain vitamins (A, B12, D, E, and K) and minerals (iron and copper), which are released from the liver when needed elsewhere in the body.

Phagocytosis. The stellate reticuloendothelial (Kupffer) cell of the liver phagocytise aged red blood cells, white blood cells and some bacteria.

Activation of vitamin D. The skin, liver, and kidney particles blood cells, and some bacteria pate in synthesizing the active form of vitamin D[4].

TABLE 20.1 A list of liver (hepatic) functions and the common markers in plasma for the impaired function

Hepatic function	Common plasma/serum marker(s) for impaired function
Heme catabolism	↑Bilirubin
Enzymes	↑Alanine transaminase ↑Aspartate transaminase ↑γ-Glutamyltranspeptidase
Protein synthesis	↓Albumin ↑Prothrombin time
Protein catabolism	↑Urea ↑Ammonia
Lipid metabolism	↑Cholesterol ↑Triglycerides
Drug metabolism	↑Half-lives of drugs
Bile acid metabolism	↑Bile acids

LIVER FUNCTION TESTS

MARKERS OF LIVER FUNCTION

Bilirubin: Bilirubin is a bile, and is excretory end product of haemoglobin degradation. It is conjugated in liver to form bilirubin deglucorinid and excreted in bile.

1. Serum bilirubin the normal concentration of bilirubin is in range of 0.2 to 1 mg/dl, while the unconjugated bilirubin is 0.2 to 6 mg/dl.
2. Bilirubin in urine the conjugate bilirubin being water soluble, is excreted in urine. This is in contrast to unconjugated bilirubin which is not excreted. Bilirubin in urine can be detected by fouchets test or Gmelin test.
3. Bromosulpthalein is in dye used to assess the excretory function of liver. It is a non toxic compound and almost exclusively excreted by the liver, (through bile). BSP is administered intravenously (5mg/kg body weight) and its serum concentration is measured at 45 min and at 2 firs. In normal individuals, less than 5% of the dye is retained at the end of 45 min. Any impairment in liver. Function causes an increased retention of the dye. This test is quite sensitive to assess liver abnormality with particular reference to excretory function.

Serum Enzymes Derived From Liver

Liver cells contain several enzymes which may be released into the circulation in liver damage. Measurement of selected enzymes in serum is often used to assess the liver function. It must, however, be noted that there is no single enzyme that is absolutely specific to liver alone. Despite this fact, serum enzymes provide valuable information for LFT. Some of these enzymes are

discussed here under.

Transaminases or Aminotransferases

The activities of two enzymes namely serum glutamate pyruvate transaminase (SGPT; recently called as alanine transaminase ALT) and serum glutamate oxaloacetate transaminase (SGOT; recently known as aspartate transaminase fiST) are widely used to assess the liver function. ALT is a cytoplasmic enzyme while fiST is found in both cytoplasm and mitochondria. The activity of these enzyes is low in normal serum (ALT 5-40IU/I; fiST 5-40IU/I). Serum ALT and fiST are increased in the liver damage. However, alanine transaminase is more sensitive and reliable for the assessment of LFT. The normal AST/ALT ratio is around 0.8. this ratio is increased (>2) in myocardial infraction, alcoholic hepatitis and cirrhosis. AST/ALT ratio is decreased (i.e ALT higher) in acute hepatocellular damage and cholestasis.

Alkaline phosphate (ALP)

Alkaline phosphate is mainly derived from bone and liver (the cells living the bile canaliculi). A rise in serum ALP (normaly 3-13 KA units/dl), usually associated with elevated serum bilirubin is an indicator of biliary obstruction (obstructive/ posthepatic, jaundice). ALP is elevated in cirrhosis of liver and hepatic tumors.

Serum albumin

Albumin is solely synthesized by the liver. It has a half-life of about 20-25 days, therefore, it is a good marker to assess chronic and not acute liver damage. Low serum albumin commonly observed in patients with severe liver damage must, however, be noted that serum albumin concentration is also decreased due to other factors such as malnutrition[5].

Fifteen albino rats used throughout this study and received appropriate animal care, the animals were divided into groups (A&B). The first group (A) served as control where it composed of 5 rats and the 2nd group (B) composed of 10 rats and served as mobile phone group.

The rat of 2nd group were put in cage on were free in motion in their cage, the cage containing opened mobile phone are called intermittently (1H/day for 4 week). During the study, all the animals including the control group were fed on laboratory diet and water. At the end of the study period, the animals were sacrificed under anaesthesia and their liver was dissected into small strips. The specimens were immediately fixed in 4% formalin solution foe 24 h and embedded in paraffin. Then tissues were sectioned and examined fo histopathological changes using light microscope.

RESULT sections control liver (grA). Showed central vein with radiating cords of liver cells. These cells had vesicular nuclei and granular cytoplasm. Sinusoids were evident between the cord. In the section exhibited congestion of th sinusoids and central vein[6].

Liver in albino rats after exposing them to the EMF for 3 and 6 months. Albino rats were divided into 3 groups, 1st group control animal (10) without near source of EMR, 2nd rats constantly exposed to EMR (20) animal, for 3 months and rat exposed to EMR (20) animals), for 6 months, rats were exposed to 900MHz continuous mobile waves for 1hr, 7 days per week.

RESULT showed that electromagnetic exposure caused significant decrease in a albumin but the significant increases in serum aminotransferase ALT, and total bilirubin were recorded. After three and six months of phone radiation exposure, there were the more severe fatty vacuolation, diluted and infiltration of a large amount of inflammatory cells with the sinusoids were moderately destroyed in liver[7].

40 immature Wistar rat weighing 10±60g were prepared and divided into 4 groups of 10 categories, including: control experiment 1, experiment 2, respectively. Control group received on radiation, control on the subject of mobile phone, but no phone cells similar to that used in the experimental group (with the same condition) were used. Experimental groups 1 to 5 times per day for 1 month, and every 10 minutes on the phone cells were exposed and experimental groups 2 to 5 times per day for 1 month, and 20 min were exposed to mobile cells. Then at the end of a month, changes in liver enzymes ALT, AST, ALK and liver weights were measured to compare the effects of different doses of the toxin, the statistical analysis of ANOVA followed by Tukey's post hoc test was used.

RESULT liver weight was significantly increased in the experimental group than the control group is 2. Enzymes AST and ALK experimental group 2 (20 min) showed a significant increase compared to the control group ($p<0.05$). ALT en-

zymes level in the experimental group 1 (10 min) and experimental group 2 had a significant increase compared to the control group ($p<0.05$)[8].

Increasing use of mobile phone in daily life with increasing adverse effect of electromagnetic radiation, emitted from mobile on some physiological processes, cause many concerns about their effect on human health. Therefore, this work was designed to study the effect of exposure to mobile phone emits 900MHz EMR on the liver of male albino rats. 30 male adult rats were random;ly divided into 4 group (10each) as follows: control group (rats without exposure to EMR), exposure group (exposed to 900MHz EMR for 1h/d for 60 days) and withdrawal group (exposed to 900MHz electromagnetic wave for 1h/d for 60 d then left for 30 d without exposure). EMR emitted from mobile phone led to a significant increase in malondialdehyde (MDA) level and significant decrease total antioxidant capacity (TAC) levels in liver tissues. The sera activity of alanin transaminase (ALT), aspartate aminotrasferase (AST) were significantly increased ($p<0.05$). while serum catacholamines were insignificantly higher in the exposed rats. These alteration were corrected by withdrawal. In conclusion, electromagnetic field emitting from mobile phone might produce impairments in some biochemicals changes and oxidative stress liver of albino rats. These alteration were corrected by withdrawal[9].

The goal of the study is to evaluate liver function tests and histological alteration of the rat liver cells after exposure to the mobile phone radiation. To perform the liver function test aspartate transaminase (AST) UV kinetic test kit produced by CYPRESS diagnostics and spectrometer was used wistar rats (male, 5 week old, approximate body weight 30-40 gm) (n=12) were exposed to 900MHz mobile phone radiation of global system mobile signal modulation (GSM), whole body average specific absorption rate SAR of 1.090 wt/kg. 12 male rats were used for the study divided into 3 groups of 4 rat each. Group B and C were exposed to 4 hr/day and 8 hr/day mobile phone radiation during calling mode for 2 months respectively while group A serves as control. There was significant reduction in total protein globulin, while there was significant increase in glutamate oxal acetate transaminase (GOT). Alkaline phosphate (ALP), albumin, total bilirubin in the rat group B and C exposed to mobile phone radiation when compare to the control group but there was no histological alteration in the arrangement of cells in the both control and exposed group[10].

The aim of the study was to evaluate the impact of a 50Hz electromagnetic field generated by high voltage alternating electric current transmission lines, a 900MHz electromagnetic field emitted by mobile phone, and simultaneous exposure to those forms of electromagnetic fields on prooxidant and antioxidant processes in the liver tissues of 40 male rats randomly divided into 3 experimental groups exposed to different forms of electromagnetic field and a control sham exposed one. After completing 28 daily exposures in obtained liver tissue homogenates we determined the content of markers of prooxidant processes (total oxidant capacity and Malone dialdehyde), as well as activity of selected antioxidant enzymes (superoxide dismutase, its isoenzymes Cu, Zn-SOD and Mn-SOD, catalase and glutathione peroxidise). Moreover, cells ultrastuctures in specimans from liver samples were examined under electron microscope. A 4 week exposure to a high voltage 50Hz electromagnetic field did not affect the prooxidant/antioxidant balance in the liver tissues of the rats, while exposure to the radio frequency electromagnetic field emitted by a mobile phone simultaneous exposure to the both forms of electromagnetic field significant inhibited the intensity of prooxidant processes and decreases the activity of antioxidant enzymes in liver tissues, especially in the case of simultaneous action of both field probably due to their excessive use for restoring prooxident/ antioxidant balance without causing any structural changes in liver cells visible in an electronmicroscope[11].

In this study, the liver of rat born to mothers exposed to electromagnetic field (EMF) were examined 60 days postpartum for biochemical and histopathological changes.

METHODS: Pregnant rat were exposed to radiation (900MHz EMF, 24 h/day for 20 days) using a digital signal generator by placing the divice centrally under the cage, while formed the study (EMF) group, while untreated matching rats served as controls. Livers and blood were obtained from litters (7 male and 7 female) of both group 60 days after birth, which were used for biochemical and histopathological analysis.

RESULT: there was a significant increase in the levels of malondialdehyde (MAD) ($p<0.05$) that

was accompanied by a significant fall in glutathione (GSH) ($p<0.01$) in the liver. The serum levels of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were significantly increased ($p<0.05$). histopathologically the liver section of the EMF group showed intense degeneration in hepatocytes with cytoplasmic eosiniphilic structure, pyknotic nuclei and fibrosis[12].

ANATOMY AND PHYSIOLOGY OF RAT KIDNEY

The kidney of albino rat is bean-shaped, smooth, reddish-brown colour it is covered by a thin connective tissues capsule that is adherent to sub capsular connective tissues containing occasional fibroblast. The rat kidneys lay alongside the vertebral column in the abdominal cavity, and the right kidney is situated more cranially than the left one.the mean weight of the right kidney was 1.1g while, the left kidney is 0.9g. the mean length, width and thickness of right kidney is 1.28 cm, 0.88 cm, 0.81cm respectively. The kidney consist of two regions, the outer cortex and the inner medulla. The basic unit of the rat kidney is the nephron. Each nephron can be sub divided into number of distinct part in the cortex and medulla. The nephron forming renal corpuscle, the first part of nephron consist from glomerulus and Bowman's capsule, the proximal convoluted tubules, loop of Henle which consist of ascending and then the descending limb of loop of henle and distal convoluted tubules. The collecting tubules are not part of the nephron.

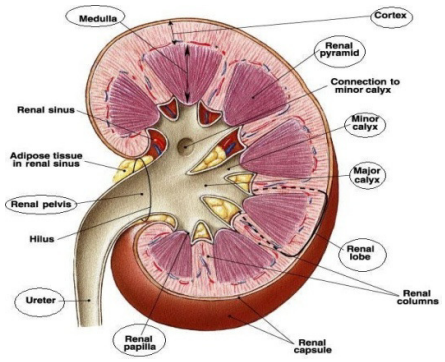

Figure: Anatomy of Rat Kidney

HISTOLOGICAL OF RAT KIDNEY

The rat kidney were reddish-brown in colour and were covered by a thin connective tissues capsule that was adherent to sub capsular connective tissue. Each kidney is of connective tissues which may contain a distinct layer of smooth muscle in its deepest portion. Also reported that each kidney is enclosed by a fibro connective tissue capsule. The histological section of each kidney showed. That the kidney of albino rat consist of two regions, the outer cortex and the inner medulla. The cortex and medulla are arranged into more pyramidal shape called renal pyramids. The apex of the each pyramid is called renal papilla. The basic uniot of the rat kidney is the nephron. Each nephron can be sub divided into number of distinct parts in the cortex and medulla. The nephron composed of renal corpuscle and the first part of nephron consist from glomerulus and Bowman's capsule, the proximal convoluted tubules, loop of Henle which arranged into ascending and descending limb and then the distal convoluted tubules. The cortex consist from renal corpuscles, proximal convoluted tubule and distal convoluted tubules. The renal corpuscles is a rounded or irregular structure which forms the glomerule that enveloped by Bowman's capsules. The Bowman's capsule is formed of two thin cellular layer, the outer parietal layer and inner visceral layer. The parietal layer consist of a flat single layer of squamous epithelium enclosing a narrow space, or the urinary space is continuous with the lumen of proximal convoluted tubule. The visceral layer is surrounding the glomerular capillaries. The visceral space of renal corpuscle communicates with arteries of glomerula. The renal corpuscles is a spherical structure formed of glomerulus which is enclosed bu bowman's capsule. The proximal convoluted tubule and distal convoluted are the initial and terminal parts of the nephron. The proximal convoluted tubule arises from the arterial epithelium of bowman's capsule of the urinary space of the renal corpuscle. The proximal tubule exibit a small, uneven human and a single layer of cuboidal cell with the eosinophilic granular cytoplasm. A brush border lines cells. The research disagree with who reported that the proximal convoluted tubules are lined with columnar epithelial but in agreement with that proximal tubule is more narrow than the distal convoluted tubule. The distal convoluted tubule were the second tubules of the cortex differs from the proximal tubules in that the cells lining were of cuboidal type with rounded and large nuclei possess no brush border. The distal convoluted tubules tend to be rather shorter than the proximal convoluted tubules and are fever in number in the regions cortex. Part of the

distal convoluted tubules in contact with glomerular root has rather modified appearance than the rest of these tubules; this region is identified as the macula densa. Who registered that the distal convoluted tubule is fever in number and may be recognized by the pale cuboidal epithelial cells, and with who claimed that the distal convoluted tubules have a smooth internal surface, and lack of brush border. The medulla of each kidney is formed from collecting tubules, thick and thin part of the loops of henle and the 118 thin linb had a distinct rounded lumen. It could be clearly distinguished from the other parts of the nephron on the bases of its low lining epithelial squamouse cells and the cytoplasm was homogeneous eosiophilic. The thinner wall of this limb resembles the capillaries or small venules in their lumina. The thick descending portion in medulla is similar to the proximal convoluted tubules in cortex, while the thick ascending portion of medulla is similar to distal convoluted tubules in the cortex. The ascending limb of loop og henle appears large in size then that of the descending limb and is enclosing a wider lumen. Henles loop consisting of thick descending limb, which is very similar in structure to the proximal convoluted tubule, a thin descending limb, a thin ascending limb, and a thick ascending limb which is very similar in structure to the distal convoluted tubules. The collecting tubules are not part of the nephron. These tubules are lined by cuboidal epithelium with rounded nuclei and basophilic cytoplasm. This result agreed with the epithelial sells of the collecting tubules are pale and very form cuboidal to columnar close to the papilla. Cell boundaries are normally clear when compared with the cells of the proximal and distal convoluted tubules in progress toward the renal papilla. The terminal portion of these tubules is lined by columnar or pseudostratified epithelium and is called papillary duct. The renal pelvis appeared as a dilated cavity at the proximal end of ureter lodged in of sinus.

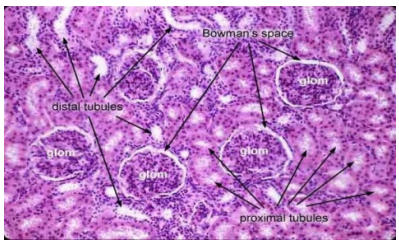

Figure: Rat Kidney of Transverse Section

PHYSIOLOGY OF RAT KIDNEY

The rat is one of the most widely used research animal particularly the urinary physiology. The rat is also useful in assessment of toxicology insult to the urinary system. They are initially used for experimental purposes since the half of the 19th century. Several strains have been developed for studying genetic diseases, neuroanatomy, nutritional disorders, diabetes, hypertension, and other. The rat also is the most important animal used as a model for biological experimental in research laboratories worldwide. Generally the urinary system of mammals consists of the paired kidneys, renal pelvises ureters, urinary bladder, and urethra. The kidney are highly vascularised, compound tubular glands that function to maintain the composition of body fluids at a constant level and to removal excretory wastes. The kidneys also regulate the fluide and electrolyte balance of the body and are the site of production hormones as rennin and erythropoietin. Rennin participates in the regulation of blood pressure and erythropoietin is a growth factor glycoprotein that stimulates the production of erythrocytes. According to the kidney of mammalian species has typical bean shaped appearance characteristic of the unipolar mammalian kidney. The nephron is the functional unit ofthe kidney; each nephron consists of the corpuscle, proximal convoluted tubules, loop of Henle, distal convoluted tubule and collecting tubules. The aim of this work is beneficial in pathological and physiological research[13].

FUNCTIONS OF KIDNEYS

1. Maintenance of homeostasis: The kidneys are largely responsible for the regulation of water, electrolyte and acid-base balance in the body.
2. Excretion of metabolic waste product: The end product of protein and nuclei acid metabolism are eliminated from the body. These include urea, creatinine, creatine, uric acid, sulphate and phosphate.
3. Retention of substances vital to body: The kidney reabsorb and retain several substances of biochemical importance in the body e.g. glucose, amino acid etc.
4. Hormonal functions: The kidney also function as endocrine organs by producing hormones. Erythropoietin, a peptide hormones, stimulates haemoglobin synthesis and formation of erythrocytes.

1.25 Dihydroxycholecalciferol the biochemically cative form of vitamin D is finally produced in the kidney. It regulates calcium absorption from the gut.renin a proteolytic enzymes liberated by kidney, stimulates the formation of angiotensin II which is turn, leads to aldosterone production. Angiotensin II and aldosterone are the hormones involved in the regulation of electrolyte balance[14].

STEREOLOGICAL ANALYSIS

1. Mean kidney volume.
2. Mean cortex and medulla volume.
3. Mean proximal and distal tubule volumes.
4. Total number of glomeruli[15].

15 albino rats were used throughout this study and received appropriate animal care, the animal were divided into 2 group (A&B). Thic first group (A) served as control where it composed of 5 rat and the second group (B) composed of 10 rats and served as mobile phone group. The rat of 2nd group were put in cage on were free in motion in their cage, the cage containing opened mobile phone and called intermittently (1h/d for 4 week). During the study, all the animal including the control group were feed on laboratory diet and water. At the end of the study period, the animal were sacrificed under anaesthesia and their kidney was dissected into small strips.
The specimens were immediately fixed in 4% formalin solution for 24 h and embedded in paraffin. Then tissues were sectioned and examined for histopathological changes using light microscope.

RESULT: Histological examination of the kidney from control group kidney showed normal appearance of glomeruli tubules and intestinal tissues,. However, the kidney of sections from exposed group revealed extravasation[16].
Increasing use of mobile phone in daily life with increasing adverse effects of electromagnetic radiation, emitted from mobile on same physiological processes, cause many concerns about their effects on human health. Therefore, this work was designed to study the effect of exposure to mobile phone emit 900MHz EMR on the kidney of male albino rats. 30 male adult rats were randomly divided into 4 group (10 each) as follow: control group (rats without exposure to EMR), exposure group (exposure to 900MHz EMR for 1h/d for 60 d) and withdrawal group (exposure to 900MHz electromagnetic wave for 1h/d for 60d then left fro 30 d without exposure). EMR emitted from mobile phone led to a significant increase in malondialdehyde level and significant decrease total antioxidant capacity (TAC) level in kidneys tissues. The sera activity of urea and creatinine were significantly increased ($p<0.05$). these alterations were corrected by withdrawal. In conclusion, electromagnetic field emitting from mobile phone might produce impairments in some biochemicals changes and oxidative stress in renal tissues of albino rats. These alterations were corrected by withdrawal[17].
To research the harmful effects of prenatal exposure of 900 MHz electromagnetic field on kidneys of 4 week old male rats and determine protective effects of melatonin and omega-3. Materials and methods: 21 wister albino rats were randomly placed into 7 groups as follows; control, sham, melatonin, omega-3, EMF+Melatonin, EMF+ Omega-3. After mating 3 group [EMF, EMF+MELATONIN, AND EMF+OMEGA3] were exposed to EMF. In the 4th week subsequent to parturition, 6 rats were randomly chosen from each group. Mean volume of kidneys, renal cortices, total number of glomeruli and basic histological structure of kidney were evaluated by stereological and light microscopical method.

RESULT: stereological result determine the mean volume of kidneys and cortices were significantly increased in EMF exposed group compared to the control group. Additionally, the total number of glomeruli was significantly higher in EMF unexposed group compared to control group. Melatonin and Omega-3 prevented adverse effects of EMF on kidneys[18].
Investigated the effects on kidney tissues of 900MHz EMF applied during the prenatal period. Pregnant rats were exposed to 900MHz EMF, 1h/d, on days 13-21 of pregnancy no procedure was performed on control group pregnant rats or on mothers or newborns after birth. On postnatal day 21, kidney tissues of male rats pupm from both groups were examined by light and electron microscopy. Malondialdehyde(MAD), superoxide dismutase(SOD), catalase(CAT) and glutathione levels also were investigate. Light microscopy revealed some degenerative changes in the tubule epithelium, small cystic formation in the primitive tubule and large cysts in the cortico medullary or medullary region in the experimental group. Electron micro-

scopy revealed a loss of peritubular capillaries and parietal layer epithelial cells in the experimental group and decrease SOD and CAT levels. EMF applied during the parental period can cause pathological changes in kidney tissues in 21 days old male rats owing to oxidative stress and decreased antioxidant levels[19].

24 adult male wistar albino rats were divided into control, EMR, EMR+folic acid and folic acid group, each containing 6 rats. The EMR and EMR+folic acid group were exposed to EMR for 60 min a day over a period of 21 day, while no EMR device which exposure was applied to control and folic acid groups. The sources of EMR was an EMR device which emits a digital signal producing 900MHz frequency radiation. The generator connected to a one monopole antenna was used in this study. Following the experimental period, a physical dissector Cavalieri method combination was applied to the section. The mean volume of cortex, medulla, proximal and distal tubule increased significantly in EMR group compared to control group. 900MHzEMR leads to kidney damage folic acid may exhibit a protective effect against the adverse effect of EMR exposure in terms of the total number of glomeruli[20].

ANATOMY AND PHYSIOLOGY OF RAT LUNGS

Lungs are the respiratory organ in respiratory system. Rat has pair of lungs, a pair of bronchi and a trachea. The inspiration starts from the nasal cavities by the palate. The pharynx is divided into naso-pharynx and oro-pharynx. Nasopharynx is present above the palate and the oro-pharynx behind the buccal cavity.

The edge of the soft palate functions as a valve to prevent food from passing into the naso-pharynx and then into the nasal cavities during swallowing. Glottis is the opening from the pharynx into the larynx, or voice box. The glottis is closed during swallowing with a gate-like epiglottis, to prevent the passage of food into the lower respiratory passages. Lungs are located on each side of the heart. The wall of the thoracic cavity is lined by the membrane called parietal pleura. These pleura from both lungs meet in the midline to form a mediastinal septum. Lungs are covered by the membrane called visceral pleura. Only lobe is present in the left lung and four lobes in the right lung. The four lobes are cranial lobe, medial lobe, caudal lobe and accessory lobe.

Rat Respiratory system- Trachea

The trachea is a long tube supported with cartilaginous rings to prevent collapse as the organism inhales. Trachea branches into a right and left bronchus and each bronchi lead to the lungs where they further branch into bronchioles. Trachea is the windpipe which connects the larynx to the lings and allows for the passage of air during respiration.

Rat Respiratory System- Alveoli

The lungs have numerous microscopic functional called alveoli. These structure are involved in pulmonary respiration. Alveoli from many small sacs, giving them a large surface area. The walls are very thin and they are surrounded by capillary beds. All of this makes them well-adapted for the exchange of gas between the blood and the lungs.Air from outside passes through external nostrils to pharynx, than to larynx, then to trachea and finally to bronchi. Lungs are made up of large number of minute structure called alveoli in which external respiratory take place. Thoracic cage surrounds the lungs and heart and it contains long, curved bones called ribs. Diaphragm located below the lungs divided the trunk into an upper thorax and a lower abdomen. The ribs and the diaphragm play a major role in the breathing movement inspiration and expiration[21].

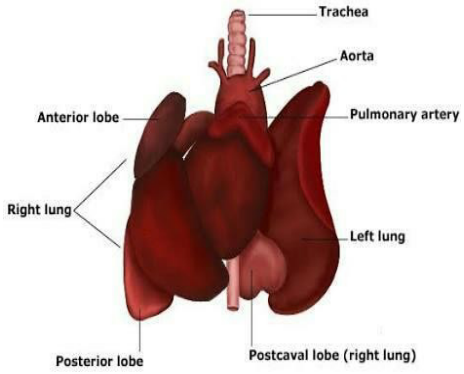

Figure: Anatomy of Rat Lungs

FUNCTIONS OF LUNGS

The lungs primary role is to bring in air from the atmosphere and pass life giving oxygen into the blood stream from here, it can be circulated to the rest of the body.

Lungs have no musculature of their own, and so the mechanics of breathing are reliant upon the miscles of the diaphragm (to which it is attached), the intercostals muscles (between ribs) and the muscles of the abdomen and neck.

Regulation of blood pressure: the lungs play a role in the rennin angiotensin system. Angiotensin I is converted to angiotensin II within the lungs.

pH balance: carbon dioxide can cause the body to become acidic. If a rise in acidity is detected, the lungs increase the rate of ventilation to expel more of the unwanted gas.

Filtering; small blood clots are filtered by the lungs; they can also remove small air embolism (bubbles) if they occur.
Protective: the lungs AL can act as a shock absorber for the heart in certain types of collision.

Protection from infection: certain membrane within the lungs secrete immunoglobulin A which protects the lungs from some infections.

Mucociliary clearance: the mucus that lines the respiratory passages traps dust particles and bacteria. Cilia (tiny hair like projection) move the offending items upwards to a position where they can be swallowed and destroyed by the digestive system.

Blood reservoir: the lungs can be very much blood they contain at any moment in time. On average, around 9% of the total blood is within the lungs, and this level can be modified up to around 18% if necessary. This function can be life saving if hemorrhage should occur blood can be moved from the lungs to the rest of the body[22].

Oxidative damage was seen by investigation lipid peroxidation, melondialdehyde, nitric oxide and glutathione level which are indicators of tissues toxicity. A total of 30 male wistar albino rats were used in the study. Rats were randomly divided into 3 groups, control group, sham group (device off) and 900MHz pulsed modulated RF radiation group. The RF rats exposed to 900 MHz pulse modulated RF radiation at a specific absorption rats level of 1.20 w/kg 20 min/day for 3 week.

Malondialdehyde and nitric oxide were increased in lungs of exposed group composed to the SHAM and control group. Conversely GSH level were significantly lower in exposed rats tissues. No significant difference was observed between SHAM and control groups. Therefore it is proved pulse modulated RF radiation causes oxidative injury in lungs[23].

CONCLUSION AND FUTURE WORK

In this paper we reviewed and summarized some of the crucial research done to study the biological effect of cell phone radiation. The work was motivated by the fact that the public is concern about the danger of using cell phone. We categorized the existing work into three categories based on the effect pointed out by researchers. These effects are positive effects, negative effect and no effect. Some research studies have indicated some positive health effect due to the exposure to the EMF radiation, such as improve bone healing and reduce toxic effect of chemotherapy. Although, we have many evidence about the negative effect of the cell phone radiation on human heath, but we still in need for more research work to confirm the evidence we have.

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