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Studying Chromosomal Changes in the Genetic Material of People Exposed to Electromagnetic Radiation

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Abstract: This study aimed to study the chromosomal changes of the peripheral blood lymphocytes of people living near the communication towers in the Diwaniyah city. Where samples were collected from 40 people (males) ranging in age from 20-35 years from different regions, and they were divided according to the distance from the tower into 3 groups in addition to the control group, which consisted of 10 healthy people of the same sex and average age who live in areas far from the towers. Chromosomes were prepared from peripheral blood lymphocytes, and then chromosomal changes were calculated Where the results of the study showed that there are abnormalities in the chromosomes of people who are 30-60 meters away from the tower (the third group) compared to the control group and the rest of the groups, where it reached 1.8 and formed a significant difference at the level (p<0.01).Slight chromosomal changes were also observed in the second and fourth groups, amounting to 1.2 and 0.8, but they did not constitute statistically significant differences compared to the control group. Among the types of abnormalities observed in the chromosomes of the study samples: chromatid fractures, chromatid deletions, chromosomal fragments, and no numerical changes were seen in the studied aggregates.

Keywords: chromosomal changes, genetic material, electromagnetic radiation

1. INTRODUCTION

In recent years, the environment has witnessed a new group of pollutants that threaten all living organisms, and the emergence of these pollutants coincided with the technological developments that the world witnessed in various fields. Among these developments, we find only wired and wireless communication devices, the mobile phone has become one of the indispensable daily necessities of life, and since each technology has its pros and cons, scientific research has focused on the damage caused by mobile phones and communication towers from diseases that affect the human body as a result of erecting these towers on the roofs of buildings and urban neighborhoods without observing the minimum conditions of protection, which necessitates the development of a legal system in order to regulate this issue and reduce the environmental electromagnetic damage (Mohammed, 2003)The damage from these rays is based on different types of effects, such as damage to the eyes, neck and shoulders, to the effects of different stress, to damage to the skin, because these towers can emit one or more types of electromagnetic radiation.Citizens' fears have increased due to the spread of many diseases caused by exposure to dangerous radiation, such as cancer, birth defects, and some diseases affecting the brain or other parts of the body, which made the

establishment of a communications tower a threat to the population. According to what was reported by the specialists who indicated its dangers in the long term, not the direct one, which warns of a danger that includes all residents who are in close proximity or direct contact with the tower, which causes electromagnetic pollution that leads to many serious diseases and a number of problems for heart patients. It affects the work of the organs regulating its beats, and it also negatively affects the general ability of individuals, as it causes lethargy, and a constant feeling of fatigue, exhaustion, tension, and insomnia. Its long-term effect on children is believed to cause breast cancer and affect female fertility and fetal growth. Birth defects may occur, and it can also cause nervous system diseases such as Alzheimer's. Due to the lack of genetic studies in this field, a cellular genetic study of peripheral blood cells was conducted to investigate chromosomal aberrations of people living near communication towers.

2. LITERATURE REVIEW

Radiation is a broad term that includes electromagnetic radiation (photons) and particles free of charge such as neutrons and charged particles, whether positive, such as protons and alpha particles, or negative, such as beta particles, negative ions, and radiation in general can be harmful.There are two types of electromagnetic radiation, which are non-ionizing electromagnetic radiation, such as radio waves with a wavelength of about 3 km, infrared, visible light, and ultraviolet radiation. Microwaves and these rays are characterized by their low energies, as well as their frequencies. The other type of radiation is high-energy waves, as well as their frequency, because they ionize the particles that penetrate them, causing serious dangers to humans and animals alike, such as (Al-(Al-Omran et.al, 2009).ionizing electromagnetic radiation, gamma rays, and x-rays

Electromagnetic radiation affects lymphocytes, and since these cells have a real nucleus, they suffer from cell division.
The effect of these radiations contributes to the sabotage of the behavior of these divisions, so the cell becomes dividing at a rate higher than the normal rate as a result of the destruction of the genetic material (DNA), which appears clearly during cell division or it works to increase the rate of cell division from the normal rate, which leads to the emergence of several diseases, and the most important of these diseases is leukemia (leukemia), which is one of the most dangerous diseases, in addition to other damages that affect the functions of the brain and nervous system (Khalaf Allah, 2010). Because of the coupling of the electric field and the magnetic field of the rays, and then the absorption of energy by the cells, a rise in temperature occurs, and then the cells of the organism ionize. As a result of the recent development of communication networks and their spread in most regions It became obvious that people would receive even a small amount of these electromagnetic radiations that are transmitted by mobile towers installed above buildings in the middle of residential areas.

Radiation Protection and Permissible Doses
Roentgen discovered X-rays in 1985, and these rays were used after their discovery for radiographic purposes. It was noted that these radiations had harmful effects. Multiple cases such as skin burns and other cases of hair loss were recorded in areas of the body that were exposed to radiation for a long time. The first regulations for radiation protection (ICRP) were issued in 1928, and in 1934 an upper limit for radiation exposure called at that time (Tolerance Dose) was set at 0.2 Roentgen per day (Khalil, 1994).

In 1955, the International Commission on Radiological Protection (ICRP) first referred to the existence of organs in the body that are highly sensitive to radiation called critical organs. Where the blood-forming organs (Bone Marrow), genitals and eye lens are critical organs, the maximum dose was set at 0.3 rem per week, while the maximum dose for the skin was set at 0.6 rem per week. The upper limits of radiation dose set by the ICRP are for people working in the field of radiation. As for the rest of the individuals, the upper limit of the permissible radiation dose is a tenth of this amount. In 1957, the organization (ICRP) determined the permissible radiation dose during a certain period of time and recommended that this dose should not exceed 500 rem on a period of 30 years. (Al-Dulaimi, 2004).

Children under 18 years of age prefer not to be exposed to radiation because their cells grow rapidly and there are a large number of cells that multiply by division and there is a greater chance for radiation to destroy these cells. In the same year 1957 (ICRP) set the upper limit for radiation doses for the genitals of individuals who are not working in the field of radiation, not to exceed (5 rem) during the first thirty years of life. This dose does not include radiological doses resulting from medical tests, which should be less valuable from a practical point of view. [ASU, 2002]

3. METHODS AND MATERIALS

Collection of Blood Samples

Information was collected from the groups that underwent a study of chromosomal changes of peripheral blood lymphocytes using the questionnaire method, the details of which are described in the appendix. Blood was drawn from a sample consisting of 40 males from different regions belonging to Al-Diwaniyah province, and their ages ranged from 20-35 years, and the sample was divided into 4 groups as follows:

1- The first group: the control group, and it consisted of 10 people living in areas far from the towers, at a distance of not less than 1000 meters. meter.

2- The second group: It consisted of selecting 10 people who live in the areas surrounding the tower, with a distance of less than 30 meters.

3- The third group: It consisted of selecting 10 people who live in the areas surrounding the tower, at a distance of 30-60 meters.

4- The fourth group: It consisted of selecting 10 people who live in the areas surrounding the tower, at a distance between 60-90 meters. 2 ml of blood was drawn from the subjects in a test tube containing an anticoagulant and the tubes were transferred to the laboratory for the purpose of culture.

Blood culturing

The blood culture process was conducted in the research laboratory of the Department of Life Sciences at Al-Qadisiyah University under sterile conditions, by adding (6) drops of blood to each tube containing (5) milliliters of the previously prepared culture medium, then adding (0.3) milliliters of (0.3) milliliters of (PHA).The tube is closed tightly, the contents are mixed well, and incubated at a temperature (37 C°) in an inclined position for a period of (72) hours, taking into account that the tubes are gently shaken at least twice every (24) hours during the incubation period.

Cell preparation:

The method (Gokalp and Kaymak, 2002) was used as follows:

1. (0.1) ml of colesimide was added to each culture tube (23) minutes before the end of the incubation period. The tubes were shaken well and quietly and returned to the incubator to complete the incubation period of (72) hours at a temperature of (37°C).
2. At the end of the incubation period, the cells were separated by centrifugation at a speed of (1500) rpm/min for a period of (10) minutes.
3. The clear was removed using a Pasteur pipette and the pellet containing the cells was left with a little culture medium at the bottom of the tube.
4. The precipitate was mixed well, then a potassium chloride solution was added to it at a concentration of (0.075) molar warm water at a temperature of (37 °C). The addition was gradual with continuous stirring, and the shaking continued with mixing and addition until the addition reached (10) ml per tube.
5. The tubes were incubated at (37°C) for (25) minutes.
6. The cells were separated from the mixture by centrifugation at a speed of (1500) rpm for a period of (10) minutes.
7. The clear liquid was removed and the precipitate was shaken well, then 5 milliliters of the prepared fixative was added to each tube, and the addition was gradual with continuous shaking.
8. The cells were separated from the mixture by centrifugation at a speed of (1500) rpm for a period of (10) minutes.
9. Step No. (8) was repeated, then the clear liquid was removed, leaving a little of it at the bottom of the tube, where it is in the form of a hazy suspension.

Preparation of microscopic slides

1- The fuzzy cell suspension was dripped onto the glass slide prepared in advance. The drop was from a height of (30-50) cm on the glass slide, where (4-6) drops per slide were dripped.
2- The slide was dried by placing it tilted for half an hour at room temperature.
3- The dry slides were stained with Kamsa dye by covering the slide with the dye for (2-3) minutes, then washed with warm Sorensen's solution. After that, the slide was left to dry and then tested with a light microscope for the purpose of testing the chromosomes.

Chromosomal Aberrations tests

The microscopic tests was conducted using an optical microscope using an oil lens (X 100) and an ophthalmic lens (X 40). The number of changes in (100) cells in the metaphase of cell division was calculated, and the rate was extracted (Gokalp and Kaymak, 2002).

statistical analysis

For data analysis, the ready-made statistical program (SPSS) was used. Significant differences between the treatments were tested using Duncan's test and under the probability level (0.01).

4. RESULTS

CA test for chromosomal aberrations

These aberrations included structural and numerical changes, chromatid breaks, chromosomal fragments, and the ring chromosome. Figure (1) shows that there are no significant differences between the percentage values of chromosomal aberrations for peripheral blood cells in the second and fourth groups. Its CA value was (1.2%) and (0.8%), respectively, and did not constitute any significant difference when compared to the control group, whose CA value

was (0.9%). As for the third group, it caused a significant increase in the value of (CA), reaching (1.8%), so that the difference was significant compared to the control at the probability level ($P < 0.01$), and no numerical changes were recorded in the three groups.

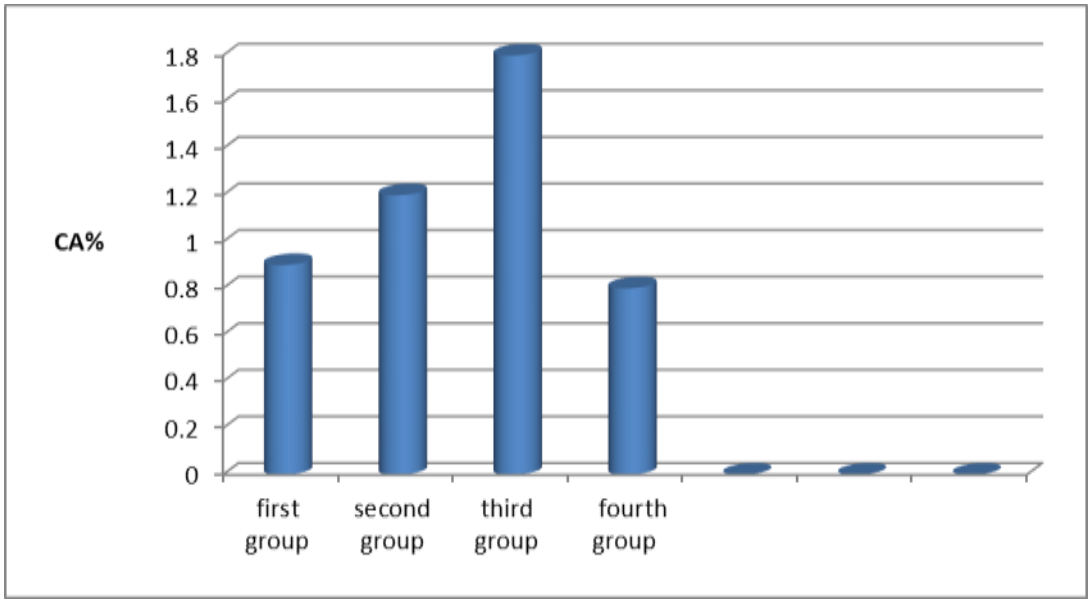

Figure (1) The effect of electromagnetic radiation on chromosomal changes in peripheral blood cells

Table (1): The average of chromosomal aberrations of peripheral blood cells in the studied groups

Chromosomal aberrations			**groups**
standard error	**average**		
0.20 ±	**0. 9 a**	**control**	first
0.50 ±	**1.2a**	**30 >m**	second
0.04 ±	**1.8 b**	**30- 60 m**	Third
0.09 ±	**0.8 a**	**60-90 m**	Fourth

Different English letters within one column mean that there are significant differences below Probability >0.01 when compared to control

Electromagnetic radiation affects lymphocytes, and since these cells have a true nucleus and continue with cell division, the effect of these radiations contributes to confusing divisions, so the cell becomes dividing at a rate higher than the normal average as a result of damage to the

genetic material. Which appear clear when cell division or that it works to increase the rate of cell division from the normal rate, which leads to the emergence of several diseases, and the most important of these diseases is leukemia (leukemia), which is one of the most dangerous diseases, As well as damage (UNSCEAR, 2006). Others affect the functions of the brain and nervous system Because of the coupling of the electric field and the magnetic field of the rays and then the absorption of energy by the cells, a rise in temperature occurs and then the cells of the organism are ionized, which leads to the formation of free radicals, which cause many damages to the DNA,As a result of the recent development of communication networks and their spread in most areas, it has become obvious that people receive even a small amount of these electromagnetic radiations that are transmitted by communication towers installed above buildings in the middle of residential areas. . (Lateff, 2011)

Chromosomal abnormalities occur due to a defect in the genetic material (DNA), which leads to the cutting of the double chain. The initial defect that occurs in DNA may be in the single or double chain, Transversal links may occur between DNA molecules with each other, and the bond between the five sugar and the phosphate group in the DNA i chain may be broken (Santin et.al, 2005). These errors can be distinguished by DNA repair systems and repaired. fix it or repair it incorrectly, as this leads to the emergence of chromosomal abnormalities or to the emergence of genetic mutations (Strachan and Read, 1999).Chronic exposure to electromagnetic radiation leads to confusion of the repair system and thus increases the rate of genetic mutations Also, the different inheritance patterns of genes lead to a different rate of occurrence of chromosomal abnormalities for people, that is, there are individuals more susceptible to chromosomal breaks or damage to the spindle apparatus responsible for chromosome segregation (Ramirez and Cuenca, 2001).

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