

A Study on Effects of Electromagnetic Radiation Produced by Mobile Phone on Size and Shape of Red Blood Cells of Human Blood Using Laser Diffraction Technique

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Abstract: The effect of electromagnetic field of mobile phone on size and shape of red blood cells belonging to blood groups A, B, AB & O is studied using laser diffraction technique. Blood samples were collected from healthy persons and stored in heparin as anticoagulant. The samples were irradiated with mobile phone for 1 hour. The study reveals that the size of exposed erythrocyte increases slightly in A and B blood groups, significantly in blood groups of AB and O, when compared with that of normal. The increase in size of red cells of exposed blood may perhaps be due to the hyper tonicity of the medium, because an influx of water occurs; the cells swell; and the integrity of their membrane is disrupted.

Keywords: size and shape, red blood cells, mobile phone, laser diffraction technique.

1. Introduction

The use of mobile phones in the present society is inevitable, while there are concerns about the effects of the mobile phone radiation on human health with excessive growth of using mobile phones. Most experts do not deny the dangers of mobile phones and related equipment due to the nature and effects of electromagnetic fields on biological systems at different wavelengths.

World Health Organization (WHO), in 1996, has started an international project that called electromagnetic fields project (EMF project) [1]. It has collected evidences relevant to the effects of electromagnetic waves on human health. So far, no strong evidence has been found for the health effects of mobile phone [2 – 4]. However, sometimes cancer symptoms and tumors signs were suspected because of the long time (a few decades) and continuous use of mobile phone. But researchers could not clearly reject or confirm the role of mobile radiation on tumors or cancer [5].

Blood is the only tissue that flows throughout human body. Red blood cell carries oxygen and removes carbon dioxide from human body, transporting it to the lungs. The size and shape of red blood cells are of clinical importance. For example, the size of red blood cell differs from one individual to another but is distributed about a mean and hence the average size has to be determined [6]. The size and shape of blood cells are determined usually by microscope. But this method is tedious. In view of this, a simple and rapid method is developed for determining the average size and shape of blood cells by laser diffraction method which was found to be free from the practical difficulties of the past techniques like optical and eriometer methods with the results in agreement with laser diffraction method. The variations in morphological parameters give clues to many disease conditions and guide additional diagnostic information [7].

Aim of the present investigation is to evaluate the effect of electromagnetic fields radiation on size and shape of red blood cell of human blood using mobile phone of Global System for Mobile Communication (GSM).

2. Materials and Methods

Blood samples of groups A, B, AB & O of volume 2 ml each were collected from healthy male volunteers aged 25 to 50 years and were stored in heparin as anticoagulant. Each sample was divided into 2 parts. First part was control sample. Second part was test sample. The test samples were exposed to EM field produced from mobile phone (Nokia X2) for an hour with 10 cm distance between blood sample and mobile phone.

The size of red blood cell of normal and mobile radiation exposed samples was measured using the technique of laser diffraction, developed at Biophysics Research Laboratory, Nizam College, Osmania University, Hyderabad.

Fig.1 shows experimental setup for the determination of size of human RBC using the technique of laser diffraction. The sample was prepared by smearing a drop of fresh blood uniformly on microscope slide and then introduced in between the laser and the screen with the smeared surface facing the screen, which gives the diffraction pattern. The laser diffraction patterns were photographed using a digital camera and typical diffract grams are presented (Fig.2.). The radius (r) of the first order diffraction ring was measured for different values of D , the distance between the sample and the screen. A plot between radius of the diffraction ring r and D was drawn, the slope of which gives the tangent of the angle of diffraction. The average size of the RBC is calculated using the relation

$$d = 1.22 \lambda D / r \text{ (for the first order dark ring)}$$

Where λ = wave length of the He – Ne laser beam (6328 \AA)

D = distance between the sample and the screen

r = radius of the first order dark ring of diffraction

Also, specimens were examined under trinocular microscope and micrographs were taken using digital camera with attachment (Fig.2.).



Fig.1.Experimental setup



Fig.2. A typical laser diffraction pattern of human Erythrocytes

3. Results and Discussion

Table 1 gives data on size of RBC of normal and exposed blood of groups A, B, AB and O. Also, percent change in size is presented. The increase in size is 2.42% to 3.55% in A and B blood groups, which is not significant. But, a significant increase in size is evident in blood groups of AB and O.

Table1 - Data on average size of human erythrocytes before and after use of cell phone.

Blood Group	Average size of RBC (µm)		% Change in size for 60 min
	Before Exposure	After Exposure	
A	8.25	8.45	2.42
B	8.45	8.75	3.55
AB	8.25	8.8	6.66
O	8.42	9.36	11.16

The average size of RBC is one of the important parameters in differentiating abnormal from the normal cells. For example, in the case of pernicious anemia, the mean size of RBC is greater than the normal and there is larger than normal variation between the cells. Red cells of small size, less than 6 µm, are seen most frequently with abnormalities in hemoglobin production such as iron deficiency and *thalassemia*. Red cell of large size, greater than 8 µm, is seen normally in young infants but is abnormal later. The large size red cells macrocytes usually have mature cytoplasm with adequate hemoglobin and are differentiated from reticulocytes, which are also large but immature. The excessive variation in size, called *anisocytosis* seen with most anemias, prominent in *sideroblastic anemia*.

The measurement of size of the RBC by using a microscope, besides being tedious cannot be extended to a large number of samples. Hence, in the present investigation a simple and sophisticated method using laser diffraction has been employed for the study of size and shape of different blood cells.

The study reveals that the size of exposed erythrocyte increases slightly in A and B blood groups, significantly in blood groups of AB and O, when compared with that of normal (Fig. 3.).The increase in size of red cells of exposed blood may perhaps be due to the hyper tonicity of

the medium, because an influx of water occurs; the cells swell; and the integrity of their membrane is disrupted.

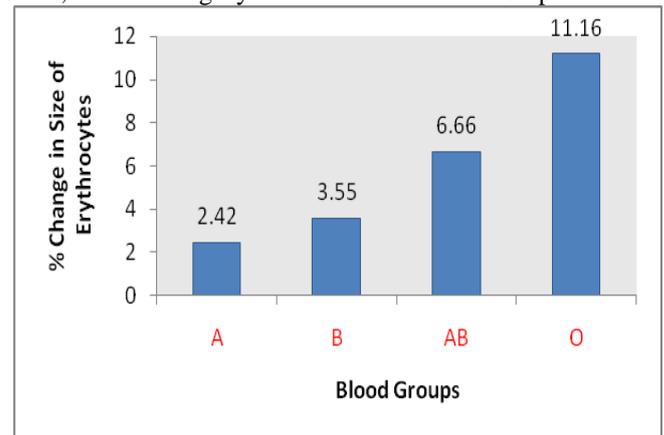


Fig.3. Percent change in size of RBC of irradiated human blood with EM field produced by mobile phone.

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