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INFLUENCE OF ELECTROMAGNETIC RADIATION PRODUCED BY MOBILE PHONE ON VISCOSITY OF HUMAN BLOOD

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Abstract: The paper is concerned with electromagnetic field effects of cell phone on viscosity of human blood belonging to blood groups A, B, AB & O. The blood samples were collected from healthy persons and stored in EDTA as anticoagulant. The samples were irradiated with cell phone up to 1 hour with the interval of 15 min. It is interesting note that viscosity of blood increases with the exposure time for groups A,B and AB and decreases for O group. There is a significant change in viscosity of blood, when compared with that of normal blood.
Keywords: Human blood, Electromagnetic field, Radio frequency, Mobile phone, Viscosity.

1. Introduction

Electromagnetic hazards are being considered one of the most dangerous types of pollution [1] due to the electromagnetic fields which affects the functions of cells of the human body [2]. The potential health risks of radiofrequency electromagnetic fields emitted by mobile phones are currently of considerable public interest [3]. The main sources of electromagnetic field are electromagnetic devices as mobile phones, wireless and electrical devices.

Mobile phones transmit and receive Radio Frequency (RF) signals to communicate. The RF signals from mobile phones fall within the microwave part of the electromagnetic spectrum. The global system for mobile communication GSM is the dominant mobile communications system in many countries around the world, operating at 900 MHz and 1800 MHz (850 and 1900 MHz in the USA) [4].

Blood is a complex fluid whose flow properties are significantly affected by the arrangement, orientation, and deformability of red blood cells. Blood viscosity is a measure of the resistance of blood to flow, which is being deformed by either shear stress or extensional stress [5]. Blood is a liquid that consists of plasma and cells. The viscosity of blood thus depends on the viscosity of the plasma, in combination with the hematocrit [6].

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Many studies reported that radiation from mobile phones absorbed by the human body turns into heat. This biological effect leads to the continuation of the existence of many damage risks caused to human and their vital organs [1]. These findings have confirmed the report of the Australian Radiation Protection in 2005, where 70% of the waves emitted by cell phone is absorbed in the user's head which leads to increase the speed of nerve impulses; blood pressure; heart rate that exposure to electromagnetic waves leads to an imbalance in the circulatory system; increase in blood flow; disruption in blood pressure [7,8]; and decrease in the hemoglobin content [9]. EMF of cell phone induces changes in neuronal activity and effects rCBF in human[10]. Viscosity of blood and plasma of rats increases and osmotic fragility decreases after exposure to electromagnetic radiation produced by mobile phone[1,6] and may alter mechanical and rheological properties of blood[11]. The radiofrequency of cell phone prolongs the QT interval of ECG in human beings and it interferes with voltage criteria of ECG records in male patients with myocardial ischemia [12].

Aim of the present investigation is to evaluate the effect of electromagnetic radiation generated by mobile phone on viscosity of human blood.

2. Materials and Methods

Blood samples of groups A, B, AB & O of volume 5 ml each were collected from 20 healthy male volunteers aged 18 to 50 years and were stored in EDTA as anticoagulant. Each sample was divided into 2 parts. First part was control sample. Second part was test sample, which was again divided into 4 parts. The test samples were exposed to EM field produced from mobile phone (Nokia X2) for an hour with an interval of 15 min. The first test sample was exposed for 15 min. Similarly, second, third and fourth samples were exposed for 30 min, 45 min and 60 min respectively.

The viscometer constructed in the laboratory is a glass capillary tube of length of about 30 cm with inner radius of 0.075 cm. The capillary tube is marked with two preset points A and B and the distance between them is 10 cm. A blood column is of about 2 to 8 cm in length. Sample of blood is sucked into capillary tube. The timer records time of the sample which travels a fixed distance say 10 cm in vertically held capillary tube.

In the present study, the time of travel (t) was recorded for different lengths of the blood column (L) and velocity (v) was calculated. A plot was drawn between L^{-1} on X-axis and v on Y-axis. The plot is straight line with negative slope and an intercept (V_0) on Y-axis. Coefficient of viscosity of the samples was calculated from the intercept and using the equation,

$$\eta=(R^2\rho g)/8V_0$$

where η: Coefficient of viscosity; R: Radius of capillary tube; ρ: Density of blood; g: Acceleration due to gravity; V_0: Y – intercept.

3. Results and Discussion

From the biological point of view, blood viscosity is the thickness and stickiness of blood. It is a direct measure of the ability of blood to flow through the vessels. It is also a key screening test that measures how much friction the blood causes against the vessels; how hard the heart has to work to pump blood; and how much oxygen is delivered to organs and tissues.

Table 1 presents data on coefficient of viscosity of human blood of groups A, B, AB and O of normal and also exposed to EM radiation produced by mobile phone upto 1 hour with an interval of 15 min. The table also shows percentage change in viscosity, when blood samples are exposed to mobile phone radiation for 1 hour duration. Here, exposure time of zero min means normal (unexposed) blood.

Table 1 – Data on Coefficient of viscosity of normal and irradiated (with mobile phone) human blood of groups A, B, AB and O

Blood Group	Coefficient of Viscosity (η) for Exposure time of					
	0 min	15 min	30 min	45 min	60 min	% Change for 60 min
A	0.045	0.047	0.051	0.054	0.056	23.6
B	0.046	0.050	0.053	0.054	0.057	22.3
AB	0.045	0.050	0.061	0.060	0.061	35.7
O	0.052	0.046	0.049	0.046	0.041	-19.9

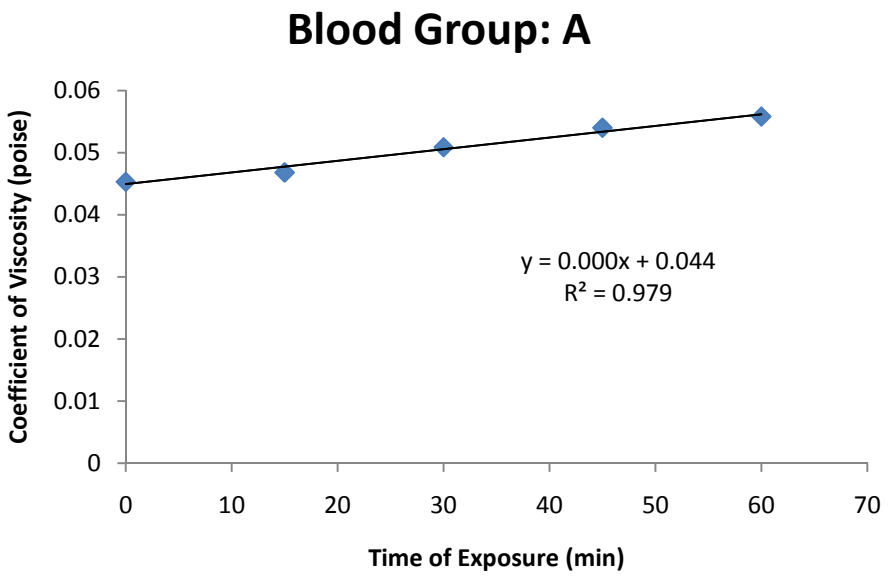

Fig. 1. A plot between viscosity and exposure time for human blood of group A

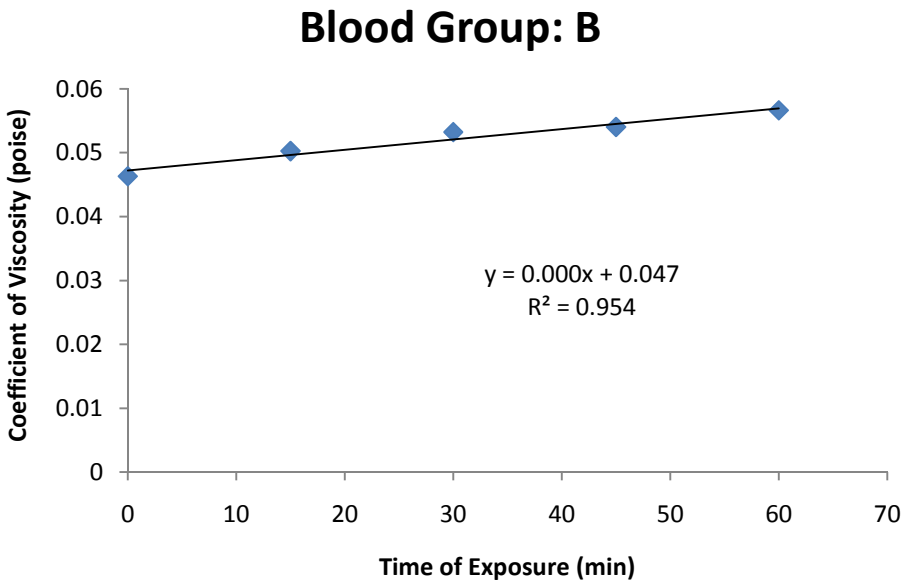

Fig. 2. A plot between viscosity and exposure time for human blood of group B

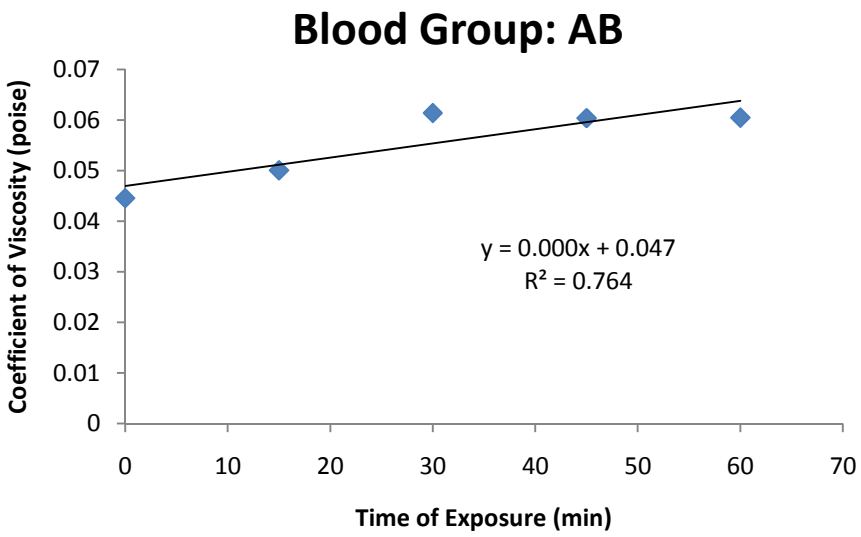

Fig. 3. A plot between viscosity and exposure time for human blood of group AB

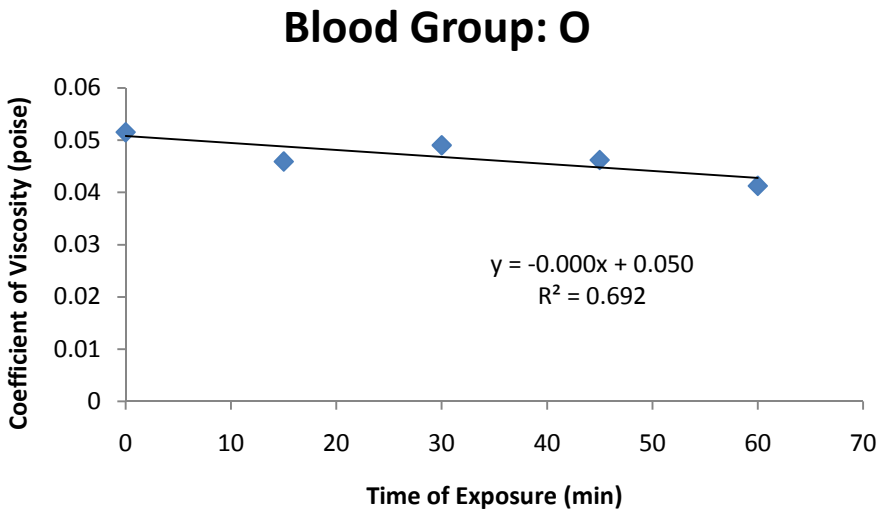

Fig. 4. A plot between viscosity and exposure time for human blood of group O

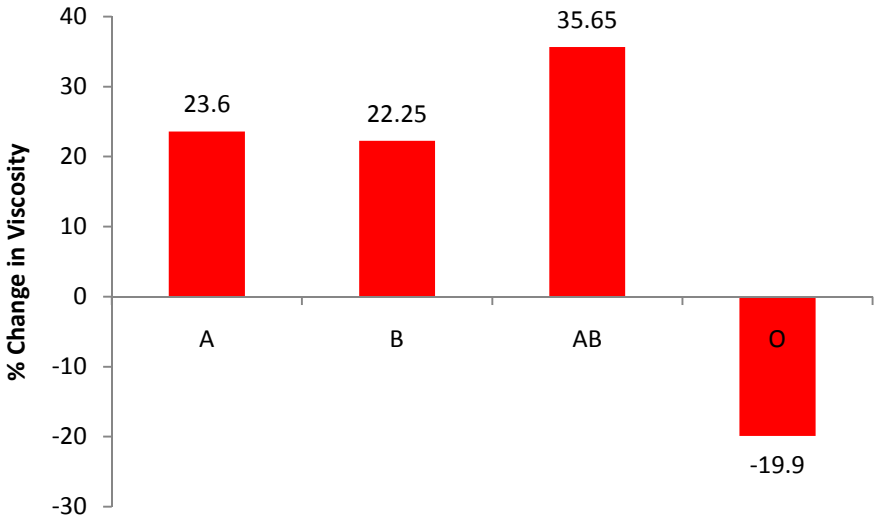

Fig. 5. A comparison on % change in viscosity of exposed human blood of different blood groups

It is evident a significant effect in blood viscosity due to the exposure to mobile phone radiation. The viscosity increases linearly with the increase in exposure time in the case of blood groups A, B and AB (Fig. 1 – 3). The increase in viscosity may perhaps be due to the aggregation of erythrocytes and can be attributed to the presence of antigens (A & B) in the erythrocyte membrane. It is interesting to note that rheological behavior of blood of group O is different to other blood groups. In this case, viscosity decreases with the increase in exposure time (Fig. 4). It may be fact that erythrocyte membrane of exposed blood of O group, having no antigen A or B, becomes more fragile and hemolysis takes place. Further, the percent increase in viscosity of blood of group AB, exposed to mobile phone radiation for 1 hour, is more than that of blood of A and B groups. However, viscosity of irradiated blood of groups A, B and AB is more and less for O group than that of normal (unexposed) blood (Fig. 5).

The present study suggests that the effect of EM radiation, produced by mobile phone, is blood group dependent and sensitive to the antigens (A and B) present in erythrocyte membrane.

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