INVESTIGATION OF THE BEHAVIOR OF ELECTRIC CURRENT IN HUMAN CELLS UNDER THE IMPACT OF PULSATING MAGNETIC FIELD

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Abstract— Our body works by means of electrical conduction and we are able to move by this conduction. Some neurological diseases can arise due to the troubles experienced in electrical conduction. One of those diseases is Cerebral Palsy (CP). This disease is the result of irregularities in the electrical activity of the human body and weaknesses in the cerebellum. When this poor electrical conduction and irregularity ceases to exist, the symptoms of the disease begin to fade. The electrical shock therapy applied for the treatment of the disease works but is a short-term treatment and does not give long-term results.
It was aimed to increase the electric current on the cells without a physical effect and was worked to obtain an induction on the cells by the pulsating magnetic field. Through induction, it is aimed to increase the current on the cells via a pulsating magnetic field. During our controlled experiments, low electrical currents were applied to the HeLa cells in culture. Cell cultures were also exposed to the pulsating magnetic field and the effect of the magnetic field on the cells' electric current was investigated. The current over the induced cells is increased and electrical activity irregularity is eliminated. Under the constant potential difference, the frequency of the magnetic field applied to the coil is systematically changed and the optimal frequency value is found.
As a result of the experiments, applying different frequencies to the cells with constant potential difference enabled us to work on a wide spectrum of magnetic field. It has been observed that at an optimal frequency, the electric current is increased. The values found may be used as pioneering work in order to overcome electrical conduction problems in organs such as the brain, the cerebellum and the spinal cord.

Index Terms— Pulsating magnetic field, Electrical Conduction, Cellular conduction, HeLa

INTRODUCTION

Disorders of electrical conduction and diseases are very common both in our country and in the world and millions of children and people are suffering from these diseases. The most common of these diseases is known as Cerebral Palsy and is one of hand arm coordination and postural disorders and physical disability.1

1.1 ELECTRICAL CONDUCTION IN HUMAN BODY

All the actions and movements in the human body are electrical. Electrical conduction is continuous and continues throughout its lifetime. The intensity of electrical transmission varies, but does not necessarily end in sleep or in everyday life.8 Electrical conductions is the act of thinking and acting on brain activities, our movement of our heart from the movement of our lungs to all physical functions.6 All movements we make are transmitted through our brains as electrical signals. And our muscles, our organs respond to electrical signals by acting. When our muscles go into action, electrical charge is released and these openings activate the electron carrier cell elements to provide ATP production. 2

Unless there is an accident or disease condition, this electrical transmission works perfectly and our vital activities continue on this. The great advantage of working with our body by electrical conduction is that it can function in a multifunctional way. Electrical signals can go more than once at the same time and our bodies work in harmony. 2

1.2 WHAT IS CEREBRAL PALSY?

In other words, brain is also known as a philosopher. Damage due to an unknown condition due to prenatal, posterior or posterior cerebral or cerebrospinal fluid, and the slowing of electrical conduction is irregular or destructive. Without certainty, it is estimated that the brain is left without oxygen. one
Cerebral Palsy is a condition that prevents posture and physical movements. Patients are supported by treatment methods and rehabilitation techniques to reduce their effects, while not being a known definitive treatment. one
There are three engine types.
Spastic:
70% -80% is an obstacle. Muscles are hardened and tight. The motor cortex develops as a result of injury.
Dyskinetic:
It's a 6% hurdle. Invincible movements are characterized as a result. It is caused by the bruising that occurs in the basal ganglion.
Atastic:
It's a 6% hurdle. The shaky movements are characterized as a result. It affects the position of the

person (proprioception) and the balance. It is caused by the damage of the cerebellum.
The brain works with electrical signals and biochemical reactions, and in the event of impairment of the brain electrical system, epilepsy may occur with Cerebral Palsy. 1

1.3 EFFECTS OF MAGNETIC FIELDS ON THE HUMAN BODY

"According to the principles of biomagnetism, the human body is magnetic because of all the elements. Magnetism like sun, air and water is an indispensable part of people. The signals of the magnetic field used by human beings to communicate with each other are in harmony with each other and with the magnetic field of the world. But this harmony sometimes deteriorates for various reasons. Nowadays, a new type of pollution is born by the introduction of electromagnetic devices in our lives. For this reason, in this work, studies on the magnetic field and their possible effects on human health are emphasized. "3
"The reasons for fatigue, muscle soreness, headache and dizziness that lasted for weeks and were seen in astronauts sent to the sky could not be understood in the first years. It has been determined that these findings are due to the lack of the magnetic field of the world. According to the principles of biomagnetism, all living things have weak or strong magnetic properties due to all materials. Because of each space, there is a low magnetic field at high altitude in all voids inside and outside all living things. The human body is actually an electromagnetic machine in which every cell has its own electric circuit. The magnetic field in the human body is responsible for the movement of bioelectric charges. According to the Biot - Savar Theory, moving electric charges form the magnetic field. There is absolutely magnetic field in any region of bioelectricity. Therefore, the organs such as heart, muscle, nerve and brain have a certain magnetic field. The signals of the magnetic field used by human beings to communicate with each other are in harmony with each other. These signals are in harmony with the Earth's magnetic field. The compatibility between the inner magnetic field of a person and the magnetic field created by the earth can be deteriorated for various reasons. One of the reasons for this is the size of the magnetic field of the place where the person lives. Earth's crust has a natural magnetism. All fields contain three variables; frequency, spinin direction, spinin size or power. When these three variables match the human body, the body supports its own energy. This magnetic interaction makes it possible to exchange substances in cell membranes. Thus, it is possible to maintain the function of the cell in a proper course and vigor by taking water, nutrients, oxygen and necessary minerals by removing the cells, waste materials and toxins from within the factory. In an experiment on Sara patients, the effects of the disease state were established by the contamination of the bioelectric activity of the brain, thus the snaps, in the case of changing the magnetic field of the subjects from outside."3
HeLa cultures were used in our experiments because we could not work with human body and living tissues.

1.4 EFFECTS OF FREQUENCY ON MAGNETIC FIELD

In the neighborhood, there are electromagnetic fields inside the buildings, on the street, at home, in short, everywhere. Generally, electromagnetic field sources; energy transmission and distribution lines, high voltage lines, energy cables, transformer stations (transformers). 9

The magnetic field appears when electric charges are displaced, that is, when an electric current is circulated. When the lamp is lit, there is also a magnetic field originating from the electric field as well as the passage of the current from the supply line to the lamp. 10 The magnetic field, magnetic flux density unit T (T) is used as the international unit. It is often referred to as microtext (T). Gauss (G) unit is also used as the magnetic field measurement unit. The higher the current, the higher the magnetic field, which is the final result. Just as in the field of electricity, the magnitude of the magnetic field decreases rapidly with distance. On the other hand, the obstructing objects such as the magnetic field and the electric field are virtually unimpeded. Electromagnetic fields (EMA) occur when electric and magnetic fields come together. Here, the electric wave and the magnetic wave are displaced together at the speed of light. The distinctive features of electromagnetic fields are the frequencies and wavelengths. "Frequency" is the number of vibrations (oscillations) of a wave in a second and measured by Hertz (Hz). The wave length is the distance of the waveguide during a vibration. As the frequency increases, the wave length becomes shorter and the energy spread in the field increases. 9

1.5 PULSED MAGNETIC FIELDS

Pulsed magnetic fields used for therapeutic purposes are known methods and studies. The most important situation in such methods is the use of magnetic fields in the frequency and intervals towards the correct diseases. 7 These magnetic fields, which are applied at very low frequencies, have been used in studies such as wound healing and rehabilitation. To create a pulsed magnetic field, it is necessary to use a square wave generator. Square waves provide a sharp change in the magnetic field, and a pulsed magnetic field is formed at this point. 4

In the procedures developed so far, the magnetic field intensity was kept at 0.1 - 1.2 mT and this range was preferred because it is harmless. Despite the use of magnetic field effects for therapeutic purposes, the relationship between both magnetic field and frequency values has not been investigated. In our experiments, the constant potential difference applied to the bobbin was applied only at different frequencies and the results were evaluated. 5

1.6 EXPERIMENTAL PROCESS AND MECHANISMS

Throughout the experiment period, the method determined according to literature review was applied. The experiment was started with the installation phase of the method. The coil, which will be a magnetic field source, is fixed vertically. The HeLa cells in the T75 Flask were taken to the petri dish and prepared for placement in the experimental setup. The height of the center of the coil was measured as 10.1 cm, and the HeLa cells were fixed at a height of 10.1 cm. The reason for fixing the coil to the exact center is that the magnetic field in the coils reaches the highest value in the center of the magnetic field and the magnetic field lines parallel to each other in this region. The square wave transducer, prepared on a perforated copper plate, is connected to an electronic circuit board. The signal generator is connected to the electronic circuit by setting the frequency of 1 Hz to 7.5V. The waveform from the signal generator is set to square.

In the data collection phase, firstly the kinds of data to be used in data analysis were determined. The data of the magnetic field sensor was recorded in mT unit so that the generated magnetic field can be measured. The power supply is adjusted so that the current passing through the heli cells will be about 58 volts, which is about 0.1 A, and the computer is set to receive all data in 1/10 second by the computer, saving the sensor data. Only the frequency effect is observed by giving constant potential difference at different frequencies. Although all the frequency values were scanned, it was decided that the range of 0.5 - 2.0 Hz values were found to provide the most suitable current increase.

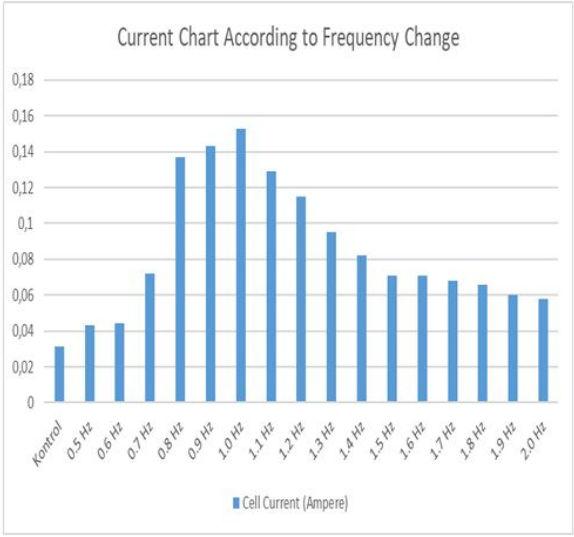
Although the data in all the experiments performed were taken for 10 seconds after taking data in 1/10 second, the experiments were repeated 5 times and the averages were taken and the sensitivity and accuracy were increased. One advantage of increasing the number of experiments is that we have to reduce the rate at which a very variable and sensitive quantile such as a magnetic field is affected from external factors.

II. RESULTS

	Cell Current (Ampere)	Magnetic Field Applied to the Cell (mT)
Control	0,031	0,284
0.5 Hz	0,043	0,901
0.6 Hz	0,044	0,905
0.7 Hz	0,072	0,911
0.8 Hz	0,137	0,901
0.9 Hz	0,143	0,905
1.0 Hz	0,153	0,900
1.1 Hz	0,129	0,900
1.2 Hz	0,115	0,900
1.3 Hz	0,095	0,897
1.4 Hz	0,082	0,898
1.5 Hz	0,071	0,898
1.6 Hz	0,071	0,890
1.7 Hz	0,068	0,896
1.8 Hz	0,066	0,897
1.9 Hz	0,060	0,901
2.0 Hz	0,058	0,901

The values seen in the table are average values, and the experiments were repeated 5 times and the averages were taken even though the data in all experiments were taken for 1/10 second and data were taken for 10 seconds. Each average contains about 500 values. We tried to find the right results by reducing the error probability to a minimum.

As the table indicates, the control group has a very low magnetic field and current values, but after the application of the magnetic field and frequency has started, the values have increased sharply and the results have begun to show up.



CONCLUSION AND DISCUSSION

The results of our experience can be summarized as follows.

1. The frequency does not affect the magnetic field, but directly affects the current flowing through the HeLa cells.

2. The current value on the HeLa cells increases up to the frequency value of 1.0 Hz, while the value of the current is decreased even if larger values of 1.0 Hz frequency are sent.
3. Even though the value of the magnetic field does not change during transmission in the cells, the frequency has an important effect. We have shown that frequency is a more important factor for us to obtain the constant magnetic field at different frequencies.
4. Magnetic fields with frequency at each value will not work and may have harmful results. Only the magnetic fields at certain frequency values increase the intensity of the current on the HeLa cells, indicating that the frequency is important in regulating and increasing the irregular or low currents on the cells and that the frequency value of 1.0 Hz gives maximum efficiency.

In our project, we applied magnetic fields to cells at different frequencies, approximately constant magnetic field. Our magnetic field averaged 0.900 mT. We reached this magnetic field value at different frequencies and experimented with this in a controlled way. We have seen that the only variable is the frequency, which is the frequency that is effective on the cells. In magnetic field treatments, it is important how much the characteristics are transmitted rather than the magnitude of the magnetic field. We also examine the frequency value to see how the frequency is affected. As it can be seen in the graphs, the frequency value reaches the maximum at 1.0 Hz and it ensures maximum efficiency here. In such magnetic field treatments, it will be much more efficient to keep the magnetic field constant and send magnetic fields at different frequency values instead of changing the magnetic field.

RECOMMENDATIONS

When experimental results are obtained, we measure the values of the magnetic field with sensitivity of 10-3 mT. This showed us how variable the magnetic field is. For this reason, especially when operating with magnetic fields at very low currents and frequencies, the environment must be as far away from other magnetic field sources as possible. Despite our laboratory conditions being underdogs, even our phones and WiFi internet did not attract even the slightest movements changed the values of the field of medicine. Because of this reason, we have tried and tested all the electronic equipments while keeping the experimental equipment out of the building (clock, telephone, computer etc.). But try to reproduce more precisely within a large faraday cage can provide a more precise work.
We had to work with body cells in HeLa culture because we were ethically restricted to work with true nerve cells. The effects of frequency and magnetic field can be examined by experimenting and studying the same experiment with nerve cells.

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