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HIGH MAGNITUDE CURRENT SERVES AS A MEDICINE IN MEDICAL FIELD

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ABSTRACT

This paper proposes how a current of high magnitude can provide aid in the medical field for treatment. Conventionally electrical signals in the form of current, find application in the biomedical field in diagnostic or therapeutic instruments. The high magnitude current ranging from about 6A to 20A is practically administered in medical emergencies such as atrial fibrillation by using synchronized electrical cardio version or in case of ventricular fibrillation by wielding an electric defibrillator. Also high amperage current is deployed in diathermy surgeries and electro cauterization. In the following study emphasis is given on application of such methodologies that meticulously use high current values to meet the medical exigencies of man, and add to advancement in the field of medicine for the humanity.

Keywords: Defibrillator, Diathermy Surgery, Cardio Version

I. INTRODUCTION

The advancement in the field of electrical technology has lead to great inventions. After 1970, a steady growth has been reported in the field of biomedical instrumentation and engineering. The electro-physical investigation in this field has assisted certain observations related to cardio-vascular system. The cardio-vascular system of study concerns with the activity of heart and the rhythmatic blood flow all over the body. The interrelation between cardiac activity, blood flow and electro physical responses of cell are found to be interlinked. This biopotential generated in cells can be considered to be a major breakthrough in this field. The process of using electrical signals and electric energy in medical treatment is termed as **"Electrotherapy"**. Electrotherapy can be applied to a variety of treatments. It involves the use of current to speed healing or other therapeutic purposes. With the technological evolution, use of high magnitude current and its benefits related to biomedical field are under research. This paper gives an insight on the favourable use of this current and its practical applications in biomedical instrumentation.

II. ELECTRO-CARDIO VERSION

Electro cardio version is used to attend to a heart disorder which is known as atrial fibrillation. "Fibrillation" can be described as the non sequential or irregular beat of the heart. Also this can be referred to as a rhythm disarray of the heart. Atrial fibrillation is a heart state which occurs due to irregular shrinking of the muscles of the atria which causes the heart to beat erratically. If this is left unattended it can worsen and further mount to become a

major reason for heart strokes or heart attacks. Cardio version is a medical practice by which abnormally speedy heart rate or cardiac arrhythmia is rehabilitated to customary heart rate using electricity. The standard operating procedure for electro cardio version involves the application of a high dose of electric current. This high magnitude current brings back the erratic heart rate to the habitual sequence. The current is applied synchronously by providing it to the heart at a specific moment in the cardiac cycle. Each heartbeat is initiated in the upper right chamber which is also known as atria of the heart and it contains specific "pacemaker" cells. Every time these cells send a structured electrical signal all the way through the heart that results in a synchronized, recurring heartbeat. In patients with atrial fibrillation the atria fibrillate (or quiver) because of disorganized electrical wave fronts that flow all the way through both atria. This leads to less proficient blood pumping and an asymmetrical or speedy heartbeat. This low voltage and high current electricity penetrates the body through the metal pads that are placed on a specific manner on the chest. And then the electric shocks are given in a synchronous manner to stabilize the heart rate.

III. DEFIBRILLATION

Defibrillation is also one of the most widely used pactices used to treat fibrillation. The cardiac arrest is a failure of the heart, where in the heart stops pumping blood to the body because of the uncharacteristic beat of the heart. When this happens the patient loses consciousness and faces breathlessness, and the chances of death increases substantially.but in such a situaton the patient can be brought back to consciousness in a small span of time by using a defibrillator. The defibrillator is a device that gives shocks at a high current to normalize the rhythm of the heart and results in depolarization of the heart muscles and tunes the standard transference of electrical impulses of the heart. It is also similar to the cardio version process but the difference is that, in cardio version the shocks given follow a synchronous pattern whereas in defibrillation the shocks are unsynchronous and do not have any predefined cycle. Defibrillators were first demonstrated in 1899 by Jean-Louis Prévost and Frédéric Batelli.

The breakthrough in the field of defibrillators was the discovery of portable defibrillators which was pioneered in the 1960s in Belfast by professor Frank Pantridge. There are various types of defibrillators available as follows:

1. Advanced life support units(ALS)
2. Automated external defibrillators
3. Implantatble cardioverter defibrillators(ICD's)
4. Wearable defibrillators

- **ALS**

ALS defibrillators used in medical healthcare centres allow doctors to observe the victim's heart pulse and physically intervene if a shock is needed. These are provided with AED.

- **AED**

The most universally used defibrillators are the Automated External Defibrillators better known as AED's. The AED's are refined, safe, dependable, programmed devices that deliver electric shocks of high current value to patients of cardiac arrest. The AED's analyse the patient's heart pace and determines the requirement for a

shock. The AED's have two sticky pads which serve as the electrodes and are placed on the right and left of the chest to provide uniform conduction

- **ICD**

Each electrical signal usually starts in a group of cells called the sinus node. The signal starts from the top of the heart then moves to the bottom. An ICD utilizes high current electrical pulses or shocks to take care of life threatening cardiac arrests that arise in the ventricles, the bottom chambers. An ICD has wires with that connect to heart chambers. The ICD will examine the heart beat. If the device detects an unbalanced rhythm in the ventricles, it will apply low-energy electrical pulses to re-establish the regular rhythm. If the low-energy pulses don't bring back the regular heart rhythm, the ICD will change to sending high-energy pulses for defibrillation.. The high-energy pulses appear for a short period of time, just fraction of seconds, but they can be agonizing. Arrhythmias can also be treated with a pacemaker. An ICD is parallel to a pacemaker, but has some dissimilarity. Pacemakers provide low-energy electrical pulses. They are habitually employed to treat less hazardous heart conditions, such as those that take place in the upper chambers of the heart. Some of the ICDs can operate as both pacemakers and defibrillators.

IV. DIATHERMY

The expression diathermy is derived from greek words 'dia'and 'therma' meaning ''heating trough'', thus it means electrically induced heat. It utilizes high-frequency electromagnetic current. In 1891, an American engineer and inventor Nikola Tesla discovered that heat occurred from irradiation of tissue with high-frequency alternating current and pointed out its possible medical applications. So diathermy uses an electric current to generate heat inside a tissue. It has a deep reach of about 2 inches from the skin's surface. The heat is not applied directly to the body in this process but the high current by the machine allows the body to produce heat from inside the tissue. Blood flow is promoted with the increasing heat. It also assists in the advancement of flexibility in rigid joints and connective tissues.

There are three types of diathermy:

1. Short wave (range 1–100 MHz)
2. Microwave (typically 915 MHz or 2.45 GHz)
3. Ultrasonic

- Short wave diathermy equipment uses two condenser plates that are placed on both sides of the body. One more method of appliance is by induction coils that are flexible and can be placed on the body part to be treated. The high-frequency waves pass through the body tissues between the coils and then they are transformed into heat. These high frequency waves require a high magnitude of current to function. It may be applied in continous enrgy pulses.
- Microwave diathermy uses radar waves, which has higher frequency and shorter wavelength than radio waves. The therapeutic effects of microwave therapy are correlated to the exchange of energy into heat and its circulation throughout the body tissues. This mode of diathermy is considered to be the easiest to use, but the microwaves have comparatively poor depth of penetration. Microwave diathermy uses microwaves

to generate heat in the body. It can warm deep tissues without heating the skin. Since it can't penetrate deep muscles, it is appropriate for areas that are nearer to the skin.

- Ultrasonic uses sound waves to take care of deep tissues. Heat is produced by vibration of the tissue. This encourages blood flow into the area.

V. ELECTROSURGERY

This process involves using a high frequency current. This high frequency high magnitude current is applied to the body tissues as a means to cut or remove a tissue. It depends on the generation of heat dissipated by a tissue when electric current flows through it. This is accomplished by converting the electrical energy into heat.It is also called surgical diathermy. The tissue can be considered as an electric resistor. Its advantageous over the conventional method because of its ability to make precise cuts and minimize blood loss. Electrical current is formed by the movement of electrons, voltage is the force that causes this movement. The two types of current have different flow of electrons, in direct current (DC), electrons flow in the same direction, whereas in alternating current (AC), current changes direction after each cycle. The cycle is the time that is needed to pass through one positive or one negative alternation of the current. Electrosurgical units (ESU) employed in operating rooms convert the electrical frequencies from 50 to 60 Hz, to much higher frequencies, 500,000 to 3,000,000 Hz . This is vital to minimize nerve and muscle stimulation, which occurs at electrical currents below 10,000 Hz .

Diathermy may be:

Monopolar

In this type of surgery the current goes through the patient to complete the cycle.

Bipolar

In this type of surgery the current only passes through the tissue between the two electrodes of the instrument.

Electrosurgery is a little different than electrocautery. The latter uses heat conduction from a probe heated to a glowing temperature by a direct current. This may be accomplished by direct current from dry-cells in a penlight-type device. Electrosurgery, by contrast, uses alternating current to directly heat the tissue itself.

Electrosurgery is of the following types:

- Electrodesiccation
- Electrofulguration
- Electrocoagulation
- Electrosection

VI. CONCLUSION

This paper reflects how the high magnitude current can attend to the different types of medical issues. The objective is that it intends to promote the technological development in expanding the applications of high magnitude electrical signals to attain beneficial and coherent outcomes in the medical field. My research in this

field is further under process along with consultation from the experts. My study in the future will focus on using this technique on a wider basis by minimizing the hazards and risks related to high magnitude current by putting forward cogent measures.

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