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Review Article

ELECTROCEUTICALS: AN ALTERNATE BLESSING TO MANKIND

SRINIVASAN A[1], AMUDHA R[2], CRESENTA SHAKILA MOTHA L[3], ALAMELU R[2]*, NALINI R[2]

[1]Department of ECE, SRC, SASTRA University, Kumbakonam, Thanjavur, Tamil Nadu, India. [2]School of Management, SASTRA University, Thanjavur, Tamil Nadu, India. [3]Department of Training & Placement, SASTRA University, Thanjavur, Tamil Nadu, India.
Email: alamelu@mba.sastra.edu

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ABSTRACT

The objective of the present study is to understand the use of electricity in treating ailments to mankind where they need not swallow the pills or inject intravenously rather have the device implanted which would monitor the nerve impulses, detect if any problems exist, and then supply electricity to the organs affected to make them function properly. This study is based on the case approach to identify the usefulness of electrical appliances for mankind. Each individual is unique and, therefore, electroceutical devices should also have the patient-specific element for smarter use of the implant. This newly emerging field of electroceuticals needs to be understood keeping in mind the body's electrical grid and the language of nerve impulses to treat varied diseases and disorders affecting the mankind. The study pinpointed that electroceuticals is supplements to traditional treatment. Although much usefulness is found toward using electrical impulses to treat the organ, the devices need to be designed with relatively small wires and batteries for easier implantation. Each individual is unique and, therefore, electroceutical devices should also have the patient-specific element for smarter use of the implant.

Keywords: Electroceuticals, Ailments, Electrical appliances, Patient-specific treatment.

INTRODUCTION

Electroceuticals consists of medical-related devices that utilize electrical impulses to affect change, thereby modifying bodily functioning as an alternate to drug-base remediation. In variation to pacemakers and other stimulators of muscles/tissues, electroceuticals which is of recent origin make use of refined control strategies and work to the extent of simple stimulation-response mechanisms which enhances the modulation of physiological function regulating loops. Electroceutical examples include cardiac contraction modulation as a form of treatment for failure of heart, gastric contractility treatment as in diabetes, and inflection of vagus nerve which has also been a treatment for epilepsy and many other diseases caused by inflammation. Research in electroceutical which is in its foundational level provides a gigantic opportunity for advanced very-large-scale integration technology as it contributes to the upgradation and development of new devices and treatments. Whatever may be the profit-making devices, emergent microsystems for therapeutic applications need to take place in a heavily controlled environment which insists on decisive proof of the devices to ensure safety and efficiency. Costing, schedules, and clinical trials and strategies should be well planned and implemented to yield positive result [1].

Conventional medicine has always caused dependence on chemical-based pharmaceuticals. Many drugs have been manufactured to modify the molecular pathways in the body to enable achievable benefits for the individual as well for the pharma industries. Regardless of these benefits, drug dependency has resulted in various side effects from mild affliction to severe effect causing threat to life whereas some medicines have really not cured the conditions for what it was meant. In the recent past years, researchers have come up with an alternative practice to treatment without drugs using electroceuticals which help treat all sorts of medical conditions.

Bioelectronic devices such as pacemakers and defibrillators were the first such developed and implanted devices in the human body and are electroceutical devices which stimulate nerves and tissues. Following these implants, many other implants in the spine, ears, and eyes have been developed. The invent of wireless chip by Ada Poon and John Ho in 2014 from Stanford University is enabled to stimulate the nerves to relieve pain and many other diseases. This chip is implanted deep in the body and powered by externally operated batteries using electromagnetic radiation.

The concept of electroceuticals was first found in 2002 by Neurosurgeon Kevin Tracey in his experiment with a specific drug to limit the damage caused by the swelling of the brain in stroke victims which is a dangerous response by the body's immune system to the individual's injury. Although the drug's application was successful, shutting down the immune response not only in the brain but also in the rest of the body, his team went on to discover that the drug was affecting the vagus nerve. This is a pair of nerves running between the brain and the stomach which affected the body's production of immune systems mediators called cytokines that were causing the inflammation. Tracey, the President of Feinstein Institute, then realized that instead of drugs being used to stimulate the vagus nerve, the nerve itself could be manipulated. In 2012, the experiment identified that an individual with acute rheumatoid arthritis was implanted with electronic nerve stimulator to the vagus nerve and 8 weeks later, the patient was cured and resumed to work. This piece of investigation by Tracey has made many researchers around the globe to ponder on this new field of medicine, with the aim of treating many ailing conditions such as asthma, diabetes, hypertension, arthritis, pain, and possibly even cancer and as well to control neuropsychiatric ailments such as in Parkinson's and Seizure disorder [2].

TECHNOLOGICAL ADVANCEMENT

Electroceuticals which is a new advent in the technological era uses electronic pulses to treat ailments without the body being exposed to surgery-related risks or deadly side effects. With Apple and Samsung, the digital giants announcing the new e-health concept with its widespread range of apps and devices used to follow anything from calories burnt to fertility cycles. These devices which were initially passive monitors have now been developed to accommodate therapeutic interventions yielding better results in the arena of health and health care. ElectroCore, a US based company, has developed a handheld electric razor-like device which when placed against the

neck stimulates the vagus nerve and helps in the treatment of migraine headaches instead of medicines. The electronic impulses emitted help in the process of controlling the substance called glutamate which is linked with migraine headaches. The University of California had carried out a clinical trial with 30 patients and 43% were relieved of the pain using the device with no toxic effects [3].

BLESSINGS TO MANKIND

Electroceuticals has found a tremendous application in combating varied medical conditions. Tinnitus which is a medical condition commonly known as ringing ears has been successfully treated with electroceuticals. The device comprises a smart, limited to a small area and targeted application of therapeutic electrical stimuli to the body. Professor of Bioelectronics Wouter Serdijn, from TU Delft in the Netherlands, has highlighted that the challenge in electroceuticals is to develop devices in small and smart which would be complimentary to the existing pharmaceutical. The core aim of the electroceutical device is that it is localized and with not much of side effects as seen in drug-prone cure of a condition. These devices are quite large with outsized batteries and wires and a high degree of trial and error in their treatment modalities. Hence, it arises with the need to develop implants which are flexible [4].

The use of electricity in treating ailments has been advantageous to mankind where they need not swallow the pills or inject intravenously rather have the device implanted which would monitor the nerve impulses, detect if any problems exist, and then supply electricity to the organs affected to make them function properly. Recently, the US National Institutes of Health has announced a quarter-billion dollar project to fasten the innovative developments in electroceuticals. Moreover, the giant of the Pharma Industries GlaxoSmithKline has declared a US$1 million prize for research into the electroceutical technology to fight against diseases ranging from diabetes and rheumatoid arthritis to cancer. For centuries, it is known that living organisms which are made of cells respond quickly to electrical impulses. Way back in 1780, Luigi Galvani, an Italian physician, found that when a small electric voltage applied to the frog's leg, muscle made a twitch though the frog was dead. It is a known observation that every organ of our body is action potential when electric signals flow to and from along the nerves network resulting in some kind of impulse.

Researchers are involved in a more subtle approach exploring and discovering novel ways of tackling more and more subtle disorders. Attempts are made to precisely apply electrical impulses to the miscreant cells which are likely to reduce the side effects and associated risks caused due to consumption of drugs. An early success in this technique has come from EnteroMedics, based in Minnesota, which has published the results of a study where 100 obese patients were fixed with an electroceutical implant that stimulated the vagus nerve, which affects both hunger and satiety – A feeling of full stomach after a large and sumptuous meal. It was found that nearly half lost at least 20% of the excess weight which was double the success rate achieved by patients in a comparison group. There was drastic improvement in blood pressure and heart rate. It has also been reported that the US Food and Drug Administration has approved electroceutical device for use in treating obesity [5].

Electroceuticals has also been used to stimulate the brain which is interconnected with neuron and its stimulation has led to the discovery of treating Parkinson's disease in the early 1980's by the French neurosurgeon Alim-Louis Benabid. As a part of the trial exercise, Benabid made lesions to occur in the thalamus of the brain on a routine basis with the aim of relieving pain and symptoms in the patients with Parkinson's which is a neurodegenerative disorder. Electrical frequencies at varied intensities were applied to the tissues, and to his surprise, he observed that at at100 Hz frequency, the tremors were suppressed. Thus, we see that stimulation of the brain deeply has now become a standard therapeutic intervention for Parkinson's and for and resistant depression.

Plazier in his study of clients with fibromyalgia examined that pain was relieved in ten of his subjects by controlling the limbic system with a group of functionally related neural structures that contribute to the emotions and motivations of the individual. He observed that when mild electrical impulses stimulated the system, the average pain was almost halved from 6.6 to 3.9 (out of 10) which he measured using pain scores on a commonly used pain scale. It has been estimated that 3-6% of the populations in the universe have been subjected to electro stimulation treatment for fibromyalgia.

Electro stimulation as a therapy has been found to be effective in the treatment of non-compliant clients with chest pain. This chest pain is known as angina. In a study by Siegfried Eckert, a cardiologist at the Heart and Diabetes Center of North Rhine-Westphalia in Bad Oeynhausen, Germany, treated 144 people by implanting in their spinal cord a stimulation device. The result of this treatment was that 89% of the cases expressed reduced angina symptoms nearly after 8 years of follow-up and treatment [6].

The attempts in using electroceuticals have gone beyond pacemakers and many other stimulating devices with the aim of controlling the action potentials in individual neurons. From the above studies, we come to an understanding that stimulation of the nerves result in regular heartbeat, paced breathing rates, and lowered blood pressure. Electrical stimulation of the spleen results in altered activity of the T-cells which are the immune cells which impedes the progression and production of inflammatory substances, such in the case of tumor necrosis factor that accumulate in joints in rheumatoid arthritis. It could also act on the nerves in the skin that can arrest infection. The biggest challenge of electroceuticals is having a detailed understanding of the electric signals that run to and from each organ when electrical impulses are applied. This has led the US National Institutes of Health in launching their effort to map the body's electrical wiring and develop implants at an expenditure of $248 million throughout the lifetime of the program [7].

CONCLUSION

Thus, we find that electroceutic devices are supplements to traditional treatment. Although many usefulness is found toward using electrical impulses to treat the organ, the devices need to be designed with relatively small wires and batteries for easier implantation. Each individual is unique and, therefore, electroceutical devices should also have the patient-specific element for smarter use of the implant. This newly emerging field of electroceuticals needs to be understood keeping in mind the body's electrical grid and the language of nerve impulses to treat varied diseases and disorders affecting the mankind.

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