EDITORIAL

Bioelectronic medicine: Will it bring revolution to the practice of medicine?

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"Bioelectronic medicine is a scientific discipline that brings together molecular biology, neurophysiology, neurotechnology and analytics to develop nerve-stimulating technologies to regulate the molecular targets underlying disease".

At the core of bioelectronics medicine is the electrical signal used by the nervous system to communicate information. Virtually every cell of the body is directly or indirectly controlled by these neural signals. Bioelectronic medicine will change the way we treat diseases, injuries and conditions such as rheumatoid arthritis, Crohn's disease, diabetes, paralysis, bleeding and even cancer.[1]

All major organs of the body are innervated, allowing the brain to both monitor and regulate organ function. Bioelectronic medicine leverages these neural pathways to regulate therapeutic targets and treat disease, nerve-stimulating or nerve-blocking devices, either implanted or held against the skin, have the potential to modulate specific nerve activity, elicit a specific change in organ function and restore health without side effects.[1]

Many of the processes of the human body are controlled by electrical signals firing between the nervous system and the body organs which may become distorted in many chronic diseases. Bioelectronic medicine's vision is to employ the latest advances in biology and technology to interpret this electrical conversation and to correct the irregular patterns found in disease states.[2]

The development of new materials and approaches is needed to enable enhanced tissue integration, interrogation and stimulation and other functionalities. New classes of molecular-scale bioelectronics interfaces can be constructed using either one-dimensional nanostructures, such as nanowires and nanotubes, or two-dimensional nanostructures, such as grapheme.[3]

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Systematic study of oxidative stress establishes the relationship between macromolecules and cancer biomarkers in saliva.[4]

Understanding the regulatory mechanisms and neural circuitry modulating immunity reveals possibilities to use targeted neuromodulation as a therapeutic approach for inflammatory and autoimmune disorders.[5]

Studies in animals revealed that different types of neuromodulation act by releasing different inhibitory and excitatory neurotransmitters in the central nervous system.[6]

Normally, our nervous systems send signals to our tissues and organs to supress inflammation, a phenomenon known as inflammatory reflex. This system sometimes goes berserk and result in diseases. Medications and alternate treatments are used to suppress these inflammations which sometimes do not respond, exacerbate or even cause mortality. Electrical stimulation to the right areas may stop inflammation.[7]

Activation of vagus nerve modulates leukocyte cytokine production and alleviates experimental shock and autoimmune disease, recent data have suggested that vagus nerve stimulation can improve symptoms in human rheumatoid arthritis.[8]

Development of a Microchannel Electrode Array (DCEA) capable of interfacing nerve fascicles as small as 50-300 micrometre.[9]

There appears to be the potential for an ultrasound-based neural interface system for advancing future bioelectronics-based therapies.[10]

The main claimed advantages of the new devices are integration of multiple steps in complex analytical procedures, diversity of application, sub-microliter consumption of reagents, sample and portability.[11]

This approach promises to deliver therapies superior to pharmaceuticals in terms of efficacy, safety and cost without significant side effects".

Bioelectronic medicine appears to open wide vistas for health care. We have yet to see the application processes and its impact on human health. Lot of work is being done in a number of areas like cloning, organ transplantation, stem cell research and whole body transplantation. A number of claims are being made about certain types of food that can cure diabetes, hypertension and many other illnesses.

Should we expect a revolution in medical practice coming our way?

References

1. What is Bioelectronic Medicine? [Online] [Cited 2016 August 08]. Available from URL: http://www.feinsteininstitute.org/programs-researchers/bioelectronic-medicine/
2. URL: http:www.gsk.com/en-gb/media/press-releases/2016/gsk-and-verily-to-establish-galvani. Date accessed: 19/08/16).
3. Cohen-Karni T, Langer R, Kohane DS. The smartest materials: the future of nanoelectronics in medicine. ACS Nano. 2012; 6: 6541-5.
4. Mishra S, Saadat D, Kwon O, Lee Y, Choi WS, Kim JH, et al. Recent advances in salivary cancer diagnostics enabled by biosensors and bioelectronics. Biosens Bioelectron. 2016; 81:181-97.
5. Pavlov VA, Tracey KJ. Neural circuitry and immunity.Immunol Res. 2015; 63: 38-57.
6. de Groat WC, Tai C. Impact of Bioelectronic Medicine on the Neural Regulation of Pelvic Visceral Function. Bioelectron Med. 2015; 25-36.
7. What is Bioelectronic Medicine? [Online] [Cited 2016 August 19]. Available from: URL: http://businessinsider.com/what-is-bioelectronic-medicine
8. Sundman E, Olofsson PS. Neural control of immune system. Adv Physiol Educ. 2014; 38:135-9.
9. Kim YT, Kanneganti A, Fatemi S, Nothnagle C, Wijesundara M, Romero-Ortega MI. A novel Microchannel Electrode Array: towards bioelectronics medical interfacing of small peripheral nerves. Conf Proc IEEE Eng Med Biol Soc. 2014; 2014:1981-4.
10. Seo D, Neely RM, Shen K, Singhal U, Alon E, Rabaey JM, et al. Wireless Recording in the Peripheral Nervous System with Ultrasonic Neural Dust. Neuron. 2016; 91: 529-39.
11. Kricka LJ. Microchips, microarrays, biochips and nanochips: personal laboratories for the 21st century. Clin Chim Acta. 2001; 307:219-23.