Why Electromedicine?

Harnessing the electrochemical basis of biological processes, electromedicine offers a wide range of applications in the pain arena.

By Daniel L. Kirsch, PhD, DAAPM, FAIS

As we begin this new millennium, we rely on various forms of technology to diagnose our patients through an ever-increasing armamentarium of new devices. New therapeutic technologies for a variety of disorders also offer a remarkable and unprecedented track record in both safety and efficacy.

A fresh look at physiology is needed to better understand and intervene in the primary medical complaint of pain. Western universities are still teaching that life is based on a chemical model. Given the explosive growth in electrical technologies and our ever increasing understanding of physics, it is more realistic in the 21st century to view biological processes on an electrochemical basis rather than on a chemical basis alone.

Modern thinking on the subject far transcends the use of force in electromedical interventions. Scientific electromedicine has only evolved recently, over the past 50 years. This is due, in part, to advances in electrical technology and our understanding of biophysics as a distinct discipline from biochemistry. The most recent advancements involve only microcurrent levels of stimulation, often sufficiently minute as to not even be felt by the patient being treated.

Integrating Biochemistry and Biophysics

Robert O. Becker, MD, an orthopedist/researcher at the State University of New York, spent more than 30 years attempting to determine how trillions of cells with hundreds of subtypes can function harmoniously in life.[1] He found that a primitive direct current data transmission and control system exists in biological systems for the regulation of growth and healing. He calls this the fourth nervous system. His studies of extraneuronal analog electrical morphogenetic fields have established the importance of bioelectricity for all life processes. Becker has laid the groundwork for the medical professions to start to evolve towards a more reasonable integrated view of biology incorporating our understanding of both biochemistry and biophysics.

Björn Nordenström, MD, Emeritus Professor of Radiology at Karolinska Institute in Stockholm who also served as Chairman of the Nobel Assembly, has proposed a new and distinct model of bioelectrical control systems he calls biologically closed electric circuits (BCEC).[2,3] Nordenström's theory is that the mechanical blood circulation system is closely integrated anatomically and physiologically with a bioelectrical system. The principle is analogous to closed circuits in electronic technology.

The earliest concept of such field effects can be traced back to ancient China. Traditional oriental medicine is based on the controlling power of ch'i or ki energy; a concept that predates electricity but may be considered analogous today.[4] East Indians use the term prana to represent a similar observed phenomenon. Homeopathy is based on the energetic residual of the chemical after it has been so diluted that chemists question its continued existence. Western allopathic medicine is limited to a mechanistic approach to physiology and accordingly stands alone in its reliance on synthetic chemical treatments and invasive procedures. While no system has come close to the overall contributions made by Western medicine, the reported results in electromedical pain management to date are reason enough to re-explore the underlying mechanisms of traditional therapies towards modernizing them and automating technologies to function harmoniously in concert with clinical protocols.

In Western civilization, the first documented use of electricity to manage pain was by the physician Scribonius Largus in 46AD. He claimed that just about everything from headaches to gout (head to toe) could be controlled by standing on a wet beach near an electric eel. Not surprisingly, attempts at producing pharmaceutical preparations from dead eels proved ineffective. In 1791, Luigi Galvani discovered that electrical impulses could cause muscle contraction. By 1800, Carlo Matteucci showed that injured tissue generates an electric current. The discovery of alternating current by Faraday in 1830 opened the door to the development of man-made devices as sources of electricity. Over 10,000 medical practitioners in the United States alone made use of electrotherapeutic modalities until publication of the 1910 Flexner report which stated that there was no scientific basis for electromedicine at that time. Dr. Flexner's report was originally prepared by the American Medical Association and sponsored by the Carnegie Endowment for the Advancement of Teaching.[5]

Since then, arguably the greatest development in the field of electromedicine was when Becker electrically induced limb regeneration in frogs and rats as a model to study bioelectrical forces as a controlling morphogenetic field.[6] Regeneration represents a return to embryonic control systems and cellular activities within a localized area. It can therefore be considered a more accessible and more observable form of morphogenesis. The complexity of instructions required to designate all of the details to recreate a finished extremity is impossible to transmit by biochemical processes alone.[7]

Evolution of Electromedicine

Transcutaneous electrical nerve stimulation (TENS) came on the scene in the 1970s following Melzack and Wall's introduction of the Gate Control Theory of pain in 1965 in which counter stimulation could effectively close the gate to peripheral pain messages attempting to ascend spinal pathways to the brain.[8] TENS stimulation is typically applied at a level of 60 or more milliamperes of current. Nearly 40 years later, microcurrent electrical therapy (MET) now attempts to alter or eliminate the pain message by inducing normalization of neural function, as well as healing at the pain site, as opposed to serving as a counter-irritation analgesic.[9]

Following closely behind TENS was the introduction, in the 1980s, of electromagnetic bone healing devices that are utilized to heal non-union fractures. For the first time this allows physicians to heal non-union fractures that previously necessitated amputation.

One of the most promising advances in electromedicine today is cranial electrotherapy stimulation (CES).[10] This therapy usually uses less than one milliampere of current directed through the brain for the treatment of anxiety, insomnia and depression; all of which are ubiquitous in pain patients. Researchers at several major universities in America and elsewhere along with the Veterans Medical Centers are establishing the analgesic effects of CES for chronic intractable pain such as in spinal cord injuries.11 Dr. Ronald Melzack's group has now centered their thinking on a pain neuromatrix in the brain that develop pain messages autonomously, even in the absence of incoming noxious input from the body.[12] This can account for phantom limb pain and many other types of chronic pain.[13] The latest cranial electrotherapy stimulation research is showing dramatic improvement in pain throughout the body from such difficult management problems as fibromyalgia, spinal cord injuries, and chronic regional pain syndrome from current applied across the brain.[11,14-16]

So from slow beginnings in the latter half of the 20th century, we now have hundreds of FDA approved electrical devices. Some stimulate muscle contraction so that people with paralyzed muscles can maintain muscle tone in unused limbs thus preventing atrophy. Other disabled people use them in learning to walk again, or in developing new skills in using their arms or hands, for example.

Other electrical stimulators are now widely implanted in the body, such as the cardiac pacemaker, electrical stimulators in various parts of the brain to prevent such things as fine tremor of the hands or whole body seizures, and now for depression.[17,18] Dorsal column stimulators implanted along the spinal cord interdict pain from various etiologies.

We have had electroacupuncture since the early 1970s when it was introduced from China via Hong Kong. Most contemporary acupuncturists use some form of electromedical treatment delivered to the acupuncture points because it is safer, faster, more effective, and provides longer lasting results. Many acupuncturists prefer electrical modalities to needles for these reasons and that it avoids the fear of needles some people experience.[19]

Discussion

One might ask: "Why do we not try the most inexpensive and conservative treatments first, instead of last?" When such treatment is based on sound electromagnetic principles, most physicians are surprised to discover that the results are often more immediate and spectacular than they can imagine. In fact, electromedicine is fast becoming recognized as one of the primary safe, efficacious, and certainly most cost effective treatments of

General Overview of Benefits to a Practice[20]

- Very low incidence of adverse effects.
- Relatively easy to learn.
- Can be administered by paramedical personnel or by patients at home.
- Expands the practitioner's clinical capability.
- Enhances the total efficacy of clinical efforts.
- A proven effective alternative therapy in cases refractive to conventional methods.
- Eliminates, or reduces, the need for addictive medications in chronic pain and stress syndromes and allows the limited use of necessary drugs where polypharmacy effects are not well tolerated.
- May be applied on a scheduled basis or as needed.
- Some technologies produce cumulative and long-term effects as healing ensues.
- Highly cost effective. Electromedical products are durable, and may be used for years.

choice in the 21st century. Its greatest benefit is in maintaining functional homeostasis.

Yet, a lack of updated education in health care professionals is the main stumbling block to widespread acceptance of the modern theories and practice of electromedicine.

Ironically, the other problem is the wide variety of technologies available. At present, there are hundreds of different models of transcutaneous electrical nerve stimulation (TENS) devices in the marketplace and an increasing number of other electrical devices applied through the skin or implanted. Most health care practitioners who desire to utilize such technology have received little or no training in electrobiology or electrical technology. Hence, when it comes to making an educated decision on what type of instrument to choose for a practice or a particular patient, practitioners are often overwhelmed when meeting an electromedical sales representative. Purchase decisions are frequently made based on lack of knowledge, misinformation, unsubstantiated claims such as testimonials not backed by solid research, or price. If a device is effective in only 2% of the population, treatment of 1,000 patients can result in 20 testimonials. The plural of anecdote is not data. Accordingly, healthcare professionals should rely only on evidence-based technologies supported by double-blind research.

Looking Forward

This Electromedical Department of *Practical Pain Management* will help unravel the confusion surrounding this rapidly expanding field. We will bring only the best, most qualified authors and proven technologies to these pages. We hope it helps your patients and your practice as well. The first article that will appear in the next issue will be about the research (there have been two university-based double-blind studies conducted to date) and practical protocols for treating fibromyalgia syndrome. ■

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