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# Acupuncture Division: Application of contemporary medical acupuncture as a neuromodulation technique in pain management

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The goal of this article is to outline the basic implementation and understanding of the pain and neuromodulation achieved by the application of ElectroAcupuncture (EA) - Peripheral Stimulation Technique integrated into comprehensive pain management.

- 1) We will define pain as outlined by the International Association for the Study of Pain (IASP).
- 2) We will categorize pain and describe dimensions of chronic pain.
- 3) We will touch on the current theory of pain (R. Melzack - Neuromatrix).
- 4) We will describe Contemporary Medical Acupuncture and basic neurophysiological understanding of acupuncture-induced effects.
- 5) We will summarize the neuromodulatory effects of EA and its utilization in multidisciplinary pain management.

## **IASP Definition of Pain**

*"Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage."*

This definition indicates that pain is not only a sensory experience but also an emotional experience. People who experience pain are going to feel emotional consequences of this experience.

Currently, we understand that the perception of pain is a complex interaction that involves sensory, emotional and behavioural factors. All pain involves processing by the highest levels of the central nervous system, including brain function.

Pain is the most common symptom that brings people to the doctor. Most of the time, the conditions are reversible and will get better; however, pain may persist after the original cause has disappeared and, as a result, chronic pain develops.

## **Pain is divided into two types: Acute and Chronic pain.**

Acute pain motivates the person to guard against further injury and, if the pain is sufficiently severe, to seek treatment. The pain and the associated tissue damage, or dysfunction, are the primary problems. Treatment resolves the underlying pathology or dysfunction and hence the pain.

In Acute pain, normal activation of normal nociceptors,

which are specialized nerve endings in peripheral system, are processed and carry normal information to the brain.

Chronic pain occurs as a consequence of persistent injuries or develops when alterations in functioning of the dorsal horns or the spinal cord persist after the initial injury has healed. Chronic pain is the result of complex changes in the pain regulatory system as a whole. Different patterns of disruption in this system are probably associated with different pain conditions.

Chronic pain is defined as pain that persists six months after the injury and beyond the usual recovery time of a comparable injury. This is a costly condition, in terms of human suffering and in healthcare costs. For instance, according to recent statistics, 3.9 million adults in Canada (17% of the population) suffer from chronic pain.

There are 4 main effects on the individual who has chronic pain, and these include the effect on the physical functioning, psychological changes, social and societal consequences.

With respect to the effect on physical functioning, the ability to perform normal daily activities of daily living, such as dressing one's self or sleeping comfortably, may be significantly impaired by chronic pain.

The psychological effects of these impairments manifested as depression, anxiety, anger, loss of self-esteem, all contribute to the suffering that a person with chronic pain experiences.

Social consequences add to the suffering. A person may feel isolated. Relationships with family and friends and intimacy, including sexual activity, will change (most often for the worse).

From a societal point of view, chronic pain disables more people and contributes more to healthcare costs than cancer and heart disease combined.

The treatment of chronic pain is different than many other conditions and diseases. Rarely can a person with chronic pain be cured. More often the treatment is goal oriented and is centered on quality of life improvement and coping skills.

Chronic pain is a multidimensional experience; consequently, multidisciplinary pain management teams are needed to help these patients. A typical team may include an: anesthesiologist, physiotherapist, chiropractor, social worker, psychologist, psychiatrist, acupuncturist, manual therapist, occupational therapist, nurse skilled in therapeutic touch, counselor and dietician.

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The first thing that is needed in pain management is categorization (as best we can) of pain into one of two categories:

### **Nociceptive Pain and/or Neuropathic Pain**

Nociceptive pain results from mechanical, thermal or chemical trauma to tissue or excitation of receptors that are scattered throughout the body. It is usually described as dull, throbbing, sometimes sharp and it is opioid responsive.

Neuropathic pain results from damage to the peripheral or central nervous system. The damage can come from trauma or from disease. This type of pain is described as burning, tingling, shooting, electric-like or lightning-like. This sort of pain is often not very sensitive to opioids.

It is important to realize that chronic pain has many different sites of propagation, integration and perception. As R. Melzack proposed, we understand now that the brain and spinal cord are active systems that filter, select and modulate input. Dorsal horns are sites of great dynamic activity where inhibition, excitation and modulation occur. The brain also has a neural network, the body self-neuromatrix, which integrates multiple inputs to produce an output pattern that evokes pain.

The body neuromatrix comprises a widely distributed neural network that includes parallel somatosensory, limbic, thalamo-cortical components that serve the sensory-discriminative, affective-motivational and evaluative-cognitive dimension of the pain experience.

The synaptic architecture of the neuromatrix is determined by the genetic and sensory influences.

So, in view of designing an appropriate treatment approach for the individual who has chronic pain, one needs to combine pharmacological and physical therapies, as well as a behavioural approach, with clear understanding of the individual psycho-emotional, physical, behavioural background and the pathophysiology of the condition the patient has.

### **Contemporary Medical Acupuncture (CMA)**

Medical acupuncture refers to acupuncture that has been successfully incorporated into medical or allied health practices in Western countries. It combines traditional clinical information with biomedical sciences. Originally, acupuncture was part of traditional Chinese Medicine, a medical system with more than 2,000 years of documented existence that includes the use of herbal remedies, dietary therapy, massage, relaxation and special exercises as therapeutic interventions.

Contemporary Medical Acupuncture (CMA) is a precise peripheral nerve stimulation technique, in which fine solid needles are inserted into neuro-reactive anatomical loci and stimulated manually or with electricity for the therapeutic purpose of modulating abnormal activity of the nervous system and/or of its associated effectors, the endocrine, exocrine and immune systems.

When integrated with Western-based Medicine, CMA is a very practical discipline, with a wide range of clinical applications, from pain management problems to

functional disturbances.

Many patients already use acupuncture, and many more could potentially benefit from the use of this safe, and versatile, therapeutic discipline. With a better knowledge and gained skills, health care providers who have acupuncture in their scope of practice will be able to provide appropriate advice to their patients, and will be able to evaluate the quality of acupuncture treatments.

CMA is an eclectic approach that combines information from traditional acupuncture and modern biomedical knowledge, practiced by Western-trained health-care practitioners (e.g. physicians, physiotherapists and chiropractors). The simultaneous use of both systems allows practitioners to better organize clinical information to generate safer and more efficient treatments for their patients, either using acupuncture as a sole therapy or, more commonly, as an adjunct to other therapeutic interventions.

### **Acupuncture Treatment Goals**

The goal of acupuncture treatment is not to cure, but to provide clinical improvement as measured by a patient's function and sense of well-being. Acupuncture focuses on a holistic, energy-based approach to the patient, rather than a disease-oriented diagnostic and treatment model. Acupuncture is thought to have a general homeostatic effect, facilitating the activity of the body's natural healing mechanisms, thus returning the body to its normal functional state.

### **Scientific Basis of Acupuncture**

Considerable evidence supports the claim that opioid peptides are released during acupuncture and that the analgesic effects of acupuncture are at least partially explained by their actions. Stimulation by acupuncture also may activate the hypothalamus and the pituitary gland, resulting in a broad spectrum of systemic effects. Alteration in the secretion of neurotransmitters and neurohormones, and changes in the regulation of blood flow, both centrally and peripherally, has been documented. There is also evidence that there are alterations in immune functions produced by acupuncture.

Neurophysiological mechanisms involved in the therapeutic response triggered by acupuncture needle stimulation on neuroreactive sites belong to 3 functional categories: Local, segmental and suprasegmental reflexes. Local reflexes include somato-autonomic reflex.

*Segmental reflexes* could be somatosomatic (nociceptive and motor modulation) and/or somato-autonomic (vasomotor or visceral modulation).

*Suprasegmental reflexes* are triggered by signals reaching the central nervous system above the medulla oblongata. They are mainly autonomic and neurohumoral in nature.

During the last three decades, the addition of electrical stimulation to the needles has enhanced the analgesic effects of acupuncture treatments. Research has shown that there are at least two clearly defined systems involved in this phenomenon.

- 1) An endorphin-dependent system involving low-frequency, high-intensity electrical stimulation of the acupuncture needles. It is slow in onset, generalized throughout the body and cumulative on subsequent stimulation.
- 2) A monoamine-dependent system involving high-frequency, low-intensity electrical stimulation of the acupuncture needles. It is rapid in onset, segmental in location and not cumulative.

The possible mechanisms for many of the other effects elicited by acupuncture are still not entirely clear, however, promising new research utilizing functional magnetic resonance imaging (fMRI) during needling may soon shed more light on this fascinating subject. The results from the latest studies documented that stimulation of GB37 acupoints (vision-related disease treatment) showed nearly the same result as the direct visual stimulation by an increased signal fMRI.

This might support the hypothesis that acupuncture as a peripheral nerve stimulation technique delivers information to the corresponding cortical area or areas thereby activating higher centers of the brain to induce alteration in hormonal, autonomic nervous system and neurochemical activities.

In addition to the physiological responses elicited by acupuncture, it is well established that acupuncture points are associated with important neurovascular structures or with the motor points of the muscles.

#### **When is Acupuncture Most Useful?**

The most successful applications of acupuncture in the United States and Canada are for pain problems, particularly acute and chronic musculoskeletal pain. Pain problems responsive to acupuncture include: acute sprains and strains, pain from nerve entrapment, repetitive strain disorders (e.g. carpal tunnel syndrome, tennis elbow, plantar fasciitis, Achilles tendonitis), myofascial pain patterns (e.g. tempero-mandibular joint pain, muscle tension headaches, shoulder pain, neck and back pain), arthralgias (particularly osteoarthritic in nature), degenerative disc disease with or without radicular pain, pain following surgical intervention (both musculoskeletal and visceral), post herpetic neuralgia, peripheral neuropathic pain and miscellaneous headaches.

#### **Electroacupuncture induces neuromodulation.**

##### **What is neuromodulation?**

Neuromodulation is the procedure that has the ability to alter nervous system function. Among different strategies and procedures used for neuromodulation is the utilization of electrical stimulation. EA involves passing a pulsed current through the body tissue in neuroreactive sites via acupuncture needles.

Electrical stimulation includes at least 3 basic parameters: frequency, intensity and pulse duration. Low frequencies are those below 10 Hz and they preferentially produce motor stimulation. High frequencies are greater than 70 Hz and produce sensory stimulation. Medium frequencies are between 10 - 70 Hz

Pulse duration ranges from 10-250 msec. In the ALTENS (Acupuncture-Like Transcutaneous Electrical Nerve Stimulation) machines (Codetron) it may reach 1000 msec. Action of low, medium and high frequency has different preferential action and achieves different responses in neuromodulation.

According to Drs. L. Terenius and J. S. Han, three opioid peptides are present in wide areas of the central nervous system and they are virtually represented through the body system network and are engaged in pain transmission and modulation.

Strong afferent stimulation by EA and TENS is known to cause endorphin release and to provide pain relief in certain clinical cases of patients who have chronic pain. The best pain relief is achieved in patients who have neuropathic or neuralgic type of pain and have subnormal endogenous opioid endorphenergic tonus. Erikson documented that 87% of patients treated daily for one week with acupuncture of low frequency produced an increase in fraction one of endorphins. For the best analgesic response, one needs to implement somatic stimulation with induction of muscular activity in order to activate A-delta and type 2 and 3 muscle afferents.

We now recognize a multitude of opioid receptors, which have functional sub-specialization. The three main subclasses are MU, Delta, and Kappa receptors and they appear to be potential mediators of anti-nociceptive effects and are, therefore, involved in pain modulation.

Low frequency EA increases cerebrospinal fluid (CSF) concentration of  $\beta$ -endorphins and increases the binding of MU receptors, which leads to pain relief and improvement in mood. Repeating therapies have a cumulative effect. Medium frequency EA increases CSF concentration of MET-Enkephalin, as well as Dynorphin, and increases binding to delta receptors. High frequency EA increases spinal cord Dynorphin levels and increases binding to Kappa receptors as well as increases levels of serotonin.

Frequencies higher than 100Hz exceeds the refractory rate of muscle fibers and rates about 200 Hz exceed that of nerve fibers refractory rate, although these very high frequencies are not without physiological effect.

Frequencies are often combined in order to release as wide a variety of neurotransmitters as possible and to reduce the chance of accommodating nerve signals. For example, low frequency is interspersed with periods at higher frequencies alternating at 3 to 6 second intervals. The traditional term for this was Dense Dispersed Waves. Other apparatus offers a sweep of frequencies between 1-99Hz.

Among common indications for EA is pain of nociceptive origin, as for example musculoskeletal pain, myofascial pain due to trigger points, osteoarthritis, chronic back pain, and fibromyalgia. Other indications include neuropathic or neurogenic pain, as in trigeminal neuralgia, post-herpetic neuralgia and post surgical back pain and other conditions as nausea, drug addiction, post-stroke conditions, depression, and skin disease.

In my twenty-year clinical practice of acupuncture in chronic pain management, more than 70% of patients seen

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in the Acupuncture/Pain Clinic presented with associated myofascial pain syndrome and active trigger points.

In many patients, myofascial pain may not receive the appropriate attention and this may contribute to the perpetration of the dysfunction and chronic pain. Myofascial trigger points are among the most common, yet poorly recognized and inadequately managed causes of musculoskeletal pain seen in daily medical practice. Deactivation of TP by EA is rewarding in view of neuromodulatory effect achieved, not only eliminating TP but also achieving better functioning peripheral and central nervous system.

Physiotherapists have an important role in the multidisciplinary team, specifically their ability to effectively treat myofascial pain by incorporation of knowledge and skill of CMA. In an integrated health-care model, medication, surgical procedures, or other interventions, should be integrated with therapies such as electro-acupuncture, which stimulates the natural homeostatic mechanisms of the body. We also need to provide humane caring treatment based on the best available evidence. There is still a lack of well-designed studies of acupuncture but a number of different clinical trials are already under way.

Meanwhile, a CMA is an effective and valuable approach when incorporated into a multimodal integrated health-care model.

An increasing number of doctors and other health-care providers are learning about acupuncture and are incorporating this safe and effective modality into their treatment plans. Rational use of acupuncture is cost-effective, helping to prevent some of the iatrogenic side effects of certain drugs and invasive procedures used in pain management.

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Since 1998, over 300 course graduates have already experienced the benefits of a new innovative approach to the teaching of contemporary acupuncture at McMaster University. The McMaster Contemporary Medical Acupuncture accelerated training program (300 CME hours) is based on the principles of problem solving approach and self directed learning, and the contact time is full of well structured workshops devoted to practice the manual skills involved in the learning of this discipline, such as surface anatomy palpation and needling insertion. Dr. Angelica Fargas-Babjak and Dr. Alejandro Elorriaga are the leaders of the McMaster novel program, already in its fifth year of existence, which has already attracted people from countries as diverse as Brazil, USA, Switzerland, Spain, Mexico, Egypt, Saudi Arabia, Norway, and Austria. International students have agreed that thanks to this contemporary approach it is no longer necessary to accept acupuncture as a separate intervention, because it is just another technique that can be combined with any other in the course of the regular practice of medicine and allied disciplines. The McMaster Contemporary Medical Acupuncture Program is pioneering the teaching of

acupuncture (which other teaching institutions from all over the world are adopting). The course is only open to physicians, chiropractors, osteopaths, and physical therapists. For more information, go to <http://www.acupuncturecourses.com>, or call Valerie Cannon at 905-521-2100 Ext 75175.

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