

# Therapeutic application of electric current

**Electric current** is a flow of charged (positively or negatively) particles between a conductive medium. Good conductive mediums are the ones who have free charged particles (electrons or ions), because that characteristic allows a electric current to pass through them. The human body is an example of a good conductive medium (due to the high percentage of water and the presence of  $\text{Cl}^-$  and  $\text{Na}^+$  ions).

**Therapeutic application of electric current** isn't still nowadays generally accepted, because many people are sceptical when it comes to use electric energy as a medical treatment (though there are clinical evidences that electrical nerve stimulation provided successful relief of chronic pain, for example).

## History

One of the oldest therapeutic applications of electric current is electrotherapy and it has a unique history, because it wasn't discovered in a laboratory or clinic. Electrotherapy originates as early as 400 BC from contact with the torpedo fish, which could produce electric shocks between 100 and 150 volts. People would catch the fish alive and place it on a painful area of the body, the torpedo fish produced a series of electric shocks that reduced and controlled pain.

During the eighteenth century, the development of the battery provided the capacity of store electricity. As a result, physicians had more control over where, when, and how much current could be applied for therapeutic use. In the latter half of the nineteenth century most physicians in America possessed at least one electrical stimulator. However, as with any new medical technology, electrotherapy was not immediately accepted. This skepticism resulted in a decline of interest in electrotherapy toward the end of the century.

In 1965 electrotherapy regained its popularity when the **gate control theory** of pain was introduced. This theory proposed that an increase in large nerve fiber activity can potentially *close the gate* to information going to the brain from small pain fibers. When the gate is closed, the transmission of pain signals to the brain is blocked.

In 1967 clinical evidence came, reporting that electrical nerve stimulation provided *successful relief of chronic pain*. This therapeutic effectiveness in pain relief has led to other applications of electrotherapy by rehabilitative clinicians, including treating injured or diseased muscle and other soft-tissue conditions.

## Types of therapeutic applications

### Iontophoresis

Iontophoresis is the technique that uses electric current to deliver a medicine or other chemicals through the skin. This technique implies the usage of a phoresor which has two electrodes. One electrode is the drug-delivery electrode intended for the medicine or other chemical, and the other is used as a dispersive electrode charged opposite to the substance ion. When the electrodes contain solutions of ions, negatively charged anions are repelled from the cathode (electrode negatively charged) into the body and positively charged cations are repelled into the targeted body area from the anode (electrode positively charged).

### TENS

Transcutaneous Electrical Nerve Stimulation (TENS) is the therapeutic technique that uses the electric current produced by a device to stimulate nerves. There are numerous clinical evidences stating this technique's effectiveness when it comes to pain relief (for conditions such as low back pain, myofascial and arthritic pain, neurogenic pain, and postsurgical pain). This technique can be explained by the **gate control theory** (above mentioned).

### Electrical Muscle Stimulation

Electric Muscle Stimulation (EMS) is the technique where the electric current is used to cause the contraction of one single muscle or a group of muscles. This technique is used in rehabilitation processes, trying to fight muscle atrophy. Contracting the muscle via electrical stimulation helps strengthen the affected muscle. Adding to this, the electric current also stimulates the blood circulation.

### Functional Electrical Stimulation

Functional Electrical Stimulation is a technique very similar to EMS, but with this technique the electric current is set to stimulate nerves and not muscles. This is used to try to active nerves innervating extremities affected by paralysis (this paralysis can be caused by spinal cord injuries, head injuries, strokes or other neurological disorders).

### Interferential Current Therapy

Interferential Current Therapy is used as a pain relief, soft tissue healing and the reduction of swelling. This therapy uses low frequency electrical charges and when this electric reaches the affected tissue (by electrodes), endorphins are released as a response. The currents further relieve pain by inhibiting the nervous system, resulting in muscle relaxation.

## **Electro-acupuncture**

Electro-acupuncture is a specialization of another technique, acupuncture. This techniques uses the acupuncture needles to transmit the electric current to the part of the body affected by pain. The electric stimulation is provided by the electrodes that are attached to the skin after the needles. Electro-acupuncture is used to treat conditions like abdominal, kidney and occipital nerve pain.

## **High Voltage Pulsed Galvanic Stimulation**

High Voltage Pulsed Galvanic Stimulation (also known as HVPGS) is a method of applying high voltage, but overall low amperage, direct current to relieve pain, stimulate blood flow, and promote wound healing. This technique is usually used for injuries that are associated with bleeding and/or swelling. This technique differs from the others because it uses other type of electric current, galvanic current.

## **Microcurrent Stimulation**

Microcurrent Stimulation (MS) is a really specialized electrical therapy because it uses electric current extremely tiny (electricity measured in micro amperes). It is believed that in healthy tissues there is a flow of electric current along our body. When the balance of that electric current is damaged, pains appear in a certain area of the body. A microcurrent can be used over the damaged area to relief the pain, by realigning the flow and thus aiding in the tissue repair.

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