

Electrostimulation

Electrostimulation is the use of electrical charge to treat muscle pain and spasms, but also in the treatment of psychiatric diseases and in lifesaving situations.

Reports of the therapeutic use of electrostimulation originate as early as 400 BC from contact with torpedo fish, which can produce electric shocks between 100 and 150 volts, where it was noted that electric shocks from them were able to reduce and control pain in painful parts of the body. As the understanding in electrical shock and pain increased, notably in mid-1700, with the development of the Leyden jar, and in 1965, with the introduction of the gate control theory of pain, in 1967 scientists Wall and Sweets found clinical evidence who improved the success of electrical nerve stimulation in relief of chronic pain.

Nowadays, with the therapeutic success of electrostimulation, it started to be used in rehabilitative therapies, notably in rehabilitating injured or diseased muscle and other soft-tissue conditions.

Theory

The major therapeutic uses derive from muscle contraction or sensory stimulation or a combination of both.

The nerve and muscles are both excitable, which is dependent on permeability of the cell membrane. This happens since it regulates the interchange of substances from inside and outside the cells.

This cell permeability is voltage-sensitive, which will produce an unequal distribution of charged ions on either side of the cell membrane. Consequently, there will be a difference of electrical charge between the interior and exterior sides of the cell. When the action potential occurs, sodium channels open, allowing sodium ions to enter the cell membrane. This process, where it is generated a positive charge within the cell, is called depolarization. After this process, repolarization occurs, where nearby sodium channels close and potassium channels open, hence allowing potassium ions to leave the cell. The impulse within the cell as it balances the concentrations of charged between the exterior and interior through active transport.

Therapeutic Uses

As referenced previously, electrostimulation has several therapeutic uses, ranging from treatment of muscle pain and spasms to treatment of psychiatric diseases.

- **Temporary cardiac stimulation:** Temporary cardiac stimulation involves electric cardiac stimulation to treat a tachyarrhythmia or bradyarrhythmia until it is solved or until the long-term therapy can be applied. It involves the introduction of a stimulating electrode (by catheterization) into the ventricle. The main function of this is the reestablishment of circulatory integrity which is affected by irregular heart rates.
- **Permanent cardiac stimulation:** This type of therapy involves the use of stimulators, such as pacemakers, with fixed frequencies to stimulate heart beating. Is mostly used when there is signs that the heart is not beating fast enough or might be a problem with the heart's natural pacemaker.
- **Heart defibrillation:** Is a type of treatment for life-threatening situations, such as ventricle fibrillation. The defibrillator delivers a therapeutic dose of electric charge, allowing the heart's pacemaker to reestablish the normal cardiac rate.
- **Electroshock therapy:** This involves the use of electrostimulation to induce convulsions on the patient in order to treat psychiatric diseases, such as severe depression or cases of mania and catatonia. Is done by attaching tongue-electrodes on the patient's damp temples and has a duration of 15 seconds.
- **Hyperthermia:** This therapy involves subjecting body tissue to slightly higher temperatures to damage and kill tumour therapies. As tumour cells have a disorganized and compact vascular structure, they will have difficulties to dissipate heat. Hence, this heating will cause denaturation and coagulation of cellular proteins, rapidly killing cells within the tumour. Is considered to be a supporting treatment to conventional treatment and is only successful to certain cancer types. Moderate hyperthermia therapy usually takes 1 hour, where the patient is subjected to 45 °C, and can be applied to the tumour itself (local hyperthermia), to an entire limb or organ (regional hyperthermia) or to the whole body (whole-body hyperthermia).
- **High frequency therapy:** Is a method of heating tissue by using high frequency electromagnetic for muscle relaxation and wash away of metabolic products. This can be used in three forms:

Short-wave diathermy: Involves the use of two condenser placed on either side of the body part to be treated or induction coils that are molded to the body part. These will generate heat as the high frequency waves pass through them. The frequencies applied are usually around 27.12 MHz and is used to treat deep muscles and joints that are covered by a heavy soft-tissue mass, such as the hip, or to treat deep inflammatory diseases, such as the pelvic inflammatory disease.

Ultrashort-wave diathermy: Uses the same therapeutic principal as short-wave therapy, with the exception of the frequency assigned to the body part, which is 433.92 MHz. Is used to treat acute and subacute inflammatory processes in internal organs, osteomyelitis, suppurative inflammations in soft tissue, such as paronychia and furuncles, and inflammatory diseases of the peripheral nervous system, joints, and lymph nodes.

Microwave diathermy: Involves the use of radar waves, which have a higher frequency than electromagnetic waves (around 2450 MHz). Although is considered the easiest type of diathermy therapy used, it has a relatively poor depth of penetration. Is mostly used to treat superficial tumours as a supporting therapy to radiotherapy and chemotherapy, but around 1994 was also used in physical medicine and sports, with positive results.

Surgery diathermy: As opposed to previous diathermy therapies, surgery diathermy involves the use of high

frequency A.C. electrical current as either a tool to cut through body tissue, or to cauterize blood vessels to stop bleeding, although some defend that the latter should only be used with D.C. current.

- **Urostimulator:** An urostimulator is used when a patient is facing disorders of urinary bladder function, commonly after spinal-cord injuries. In this, the stimulator is placed in the upper buttock area, and will transmit mild electric impulses to the sacral nerve, which has an influence in the urinary bladder muscles.
- **Electrostimulation of intestine:** This therapy is usually short-term, especially for managing of ileus states, also known as bowel obstruction. For this, stimulating electrodes are introduced via stomach into small intestine or rectally into large intestine.
- **Electrostimulation of peripheral nerves:** This type of therapy is used in partially paralyzed patients and requires the use of transcutaneous electric stimulators around the problematic zones. This will be able to reduce pain caused by diabetic nerve neuropathy.

Risks

Most therapeutic uses of electrostimulation don't result in adverse effects to the patient, when it is used in controlled doses. However, those therapies that involve production of heat, such as diathermy and hyperthermia, might have risks. Diathermy might result in burns and body blisters to the treated body part, while hyperthermia, with similar negative effects, can also cause diarrhea, nausea and vomiting, more predominantly in whole body hyperthermia.

Electroshocks, which is an aggressive treatment, may cause memory loss and in some cases resulted in brain damage. Moreover, seizures could be aggravated if the patient suffers from epilepsy or other neurological disorders. Finally, electrostimulation might result in skin lesions and irritability if the patient has less sensitivity to the administrated electric current, and also skin bruises, as it can rupture blood vessels and capillaries under the skin.

Links

Related articles

External links

Bibliography

http://en.wikipedia.org/wiki/Diathermy#Diathermy_Risks
<http://en.wikipedia.org/wiki/Electroshock>
http://www.cidpusa.org/electrical_stimulation_therapy.htm
<http://www.uptodate.com/contents/temporary-cardiac-pacing>
<http://en.wikipedia.org/wiki/Hyperthermia>
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