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Partial Recovery of Sensitivity in Patients with Spinal Cord Injury and Dimuition of Visual Clouding and Floaters with the Use of Analog Electrostimulation

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Abstract:- Spinal cord injuries are disabling and irreversible events. Numerous are the researches developed in order to promote the reduction of the harmful effects and the spinal cord regeneration. However, this still remains a challenge to science and medicine. The present work consists of a case study whose main objective is to verify the effect of controlled magnetoelectrotherapy on nervous tissue regeneration at the central level and the possible recovery of some degree of function of the patient with paraglegia or tetraplegia due to spinal cord injury. Possible benefits that could be obtained through the application of high voltage pulsed currents would be: the use of new nerve pathways, intact; the formation of pores in the glial scar and in the neural membranes that surround the site of the lesion, and through them the ions could move ; and the transmission of substances from the cells, including those of the protoplasmic astrocytes to stem cells present in the medulla. The magnets would assist in changing the direction of the moving ions, potentiating the applied electrical pulses.

Keywords:- *Magnetoelectrothermotherapy; Injury; Marrow; Recovery.*

I. INTRODUCTION

Spinal cord injury is and always has been one of the main challenges of medicine and rehabilitation technology. Disability caused by complete injuries is severe and currently irreversible, resulting in significant limitations to the individual.

Spinal cord injury is caused by extrinsic and intrinsic factors. According to HOERLEIN et al, 1990, extrinsic factors include hit-and-runs, falls, kicks and stomping, bites and firearms. Intrinsic causes include intervertebral disc protrusion, vertebral malformation, pathological fractures due to osteopenia, osteomyelitis, and extramedullary compressive masses such as abscesses and neoplasms (Hoerlein, 1971; Colter and Rucker, 1988; Shores et al. 1990; Summers et al., 1995).

Numerous researches are being carried out with the aim of regenerating the injured spinal cord. For gait recovery, electrical stimuli have already been directly applied to the human spinal cord, distally to or over the site of the injury. Currently, epidural stimulation, in which a controllable electrostimulator is implanted in the back of the spinal cord, along with an intense rehabilitation exercise program, has developed movement for people with spinal cord injury.

The present work aims to verify whether combined electric currents, combined with magnets, promote some level of functional recovery, which would suggest neural plasticity and/or nerve regeneration.

II. SPINAL CORD INJURY

The affected body segments are according to the level of the injury, and the severity is dependent on the extent of the damage to the affected site in the spinal cord. The higher the level of spinal cord injury, the greater the amount of body area affected.

Symptoms depend on the degree of injury. The recovery time between acute injuries and those caused by slow compression is different, so the type of trauma is an important factor in assessing damage (Scharamm et al., 1979, Carlson et al., 2000). A slow gradual compression tends to have a better prognosis than an acute compression (Braund et al., 1990a; Summers et al., 1995), because in chronic compressions, due to the stiffness of the vertebrae, the medulla tends to distribute the increased pressure throughout its length and not only in the adjacent segments. This increase in pressure can determine a dysfunction and, generally, the blood flow and oxygen level are maintained (Kraus, 2000).

Oligodendrocytes and the myelin sheath destroyed by lipid peroxidation leave *-**363-replenished.

Li et al., 1996 states that the death of neurons and oligodendrocytes after trauma interferes with conductivity and induces myelin degeneration. As a consequence, a reduction in the possibility of remyelination will occur. It is hypothesized that after spinal cord injury the injured axons would cease to produce electrical stimulation, indispensable for the survival of oligodendrocytes. In addition, over time fibrous astrocytes synthesize gliosis-forming protein or glial scarring, which further hinders regeneration.

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III. CASE REPORT

Tingling and burning from the second session.

Sensation of itching in the left leg in the second session, and pulling when imagining movement. Involuntary movements occurred in the first week.

In the second week there was tactile sensitivity in the testicles and increased libido. There was improvement in trunk control. Absence of voluntary movements. Feeling of imminence of voluntary movement when imagining movements.

Since the second week, the patient used, in two sessions, passive movement of the legs with an electric bicycle, and fitting in the ankles.

A. Hypothesis and Justification

A pilot test will be conducted with two individuals with paraplegia due to spinal cord injury.

The benefit that could be obtained through the application of galvanic microcurrents would be the transmission of substances from protoplasmic astrocyte cells to stem cells present in the medulla, which could cause differentiation into neurons and other glial cells.

In the literature, the possibility of pulsed electrical stimulation of high voltage favoring the synthesis of substances has already been affirmed. According to JK, Jeon et all (2015) high voltage pulsed current stimulation – HVPCS – with a visible contraction intensity was effective in promoting wound healing by increasing expression of TGF-β1 and synthesis of type I collagen.

The electrical stimuli of the FES - or similar protocol - have the ability to depolarize nerves in the spinal cord. The electrical neuronal activity serves as a positive "signal" for the regenerating activity of the myelin sheath, promoted by oligodentrocytes. Theoretically, they would again produce the sheath, which would be deposited between the pores in the glial scar produced by electroporation.e magnetic electrodes will be used in order to deflect moving electrical charges. In this way, ions can penetrate and exit through the ports produced by electroporation, promoting the flow of loads and reducing their concentration in the injured axonal zone.

High-voltage pulsed currents will be used to promote the formation of micropores – in a process called electroporation – in the cytoplasmic membrane of neurons near and adjacent to the lesion site.

Electroporation consists of the application of short high-voltage electrical pulses that increase the membrane transport potential, promoting a transient formation of aqueous pores ("aquaporins") in the lipid bilayer, allowing macromolecules to migrate through these pores. The effectiveness of transport depends on the electrical parameters (pulse frequency, waveform, electric field strength and others) and the physicochemical properties of the drugs (IORIO, 2007).

In the case of the research, mainly ions and electrons would be moved through the presumed pores formed; Through these they could enter and leave the axons, favoring the communication of the intracellular medium with the extracellular medium and thus reducing the mechanical barrier effect of the glial scar. The greater permeability resulting from the formation of pores can help in the reestablishment of synaptic connections – because they are caused by the electrical impulse determined by the entry and exit of ions. Such currents also promote the transfer of energy with few chemical reactions (due to the current being alternated and applied for fractions of seconds). The energy transmitted tends to increase ATP synthesis. Other possible effects would be the formation of cytoplasmic membrane elements by protoplasmic astrocytes with increased metabolism due to the treatments applied, in addition to the differentiation of stem cells into neurons and/or glial cells. As a consequence, functional recovery tends to occur.

An example that electrical stimulation can be beneficial to the recovery of spinal cord injury patients is epidural stimulation.

The Epidural Stimulation device consists of two components including a neurostimulator and a plate from a coated set of 16 electrodes. This device is implanted by surgery in the posterior lumbar structures of the spinal cord, where it will apply a direct electric current that will be supplied to the electrode. The compromised nerve signals originating from the brain will be amplified and redirected to the spinal cord tissue below the injury site, thus allowing the recovery of voluntary movements and the restoration of lost functions. Epidural stimulation can be offered to patients with total and partial injuries and can help them achieve significant improvements, something considered impossible for doctors in their country (https://epiduralstimulationnow.com/pt-br/tratamentos/, 2020).

"Epidural stimulation with task-specific training can reactivate previously silent spared neural circuits or promote plasticity. These interventions may be a viable clinical approach to functional recovery after severe paralysis (https://www.sbmfc.org.br/efeito-da-estimulacao-epidural-da-medula-espinhal-lombossacral-apos-paraplegia/, 2011).

According to Leme (2004), in addition to plasticity, specific mechanisms can be used in order to stimulate axonal regeneration.

B. Risks, Con – Indications and Adverse Effects

Contraindications include infected open wounds, systemic or internal infection at or near the site of spinal cord injury.

Adverse effects may occur, among which redness, sensation of shock and others not yet known.

C. Environment for the Procedure

The treatments will be carried out at the residence of the participant by the participant.

D. Goals

➢ *General*

- To verify the effect of electrotherapy equipment on the lost function in patients with complete spinal cord injury considered irreversible.

➢ *Specific*

- To verify the effect of Galvanic Microcurrent equipment on the production of movements lost due to spinal cord injury
- To verify the effect of Galvanic Microcurrent equipment on the production of movements lost due to spinal cord injury
- Verify the effect of pulsed currents of high voltage and low power on the production of movements lost due to spinal cord injury
- Verify the effect of high voltage and low power pulsed currents on the production of sensitivity lost due to spinal cord injury

IV. MATERIAL AND METHODS

Treatment: medium-high voltage microcurrents are applied for 20 minutes. Position of the electrodes on, above and below the lesion site of the lesion; alternating microcurrents, vom electrodes lateral to the lesion, for 20 minutes; and FES or similar protocol, for 20 minutes, in the motor neuron body region, when possible. The treatment should be carried out five times a week for two months. A thorough evaluation of sensorimotor functions should be performed before the start of treatment and another two months later. The physical therapist should prepare observations during the treatment, in a similar way to the medical record, to record the evolution of the experimental treatment.

The physiotherapist's evaluations will determine the degree of sensory and/or motor recovery.

➢ *Resources*

The resources will come from the researcher herself.

V. RESULTS AND DISCUSSION

There may have been activation of new nerve pathways for the transmission of sensory impulses through neural plasticity and/or nerve regeneration of injured pathways of the nervous systemntral, in the medulla.

It is suggested that the use of electrotherapy with the parameters adopted for the experimental treatment in clinical research of patients with diseases and acquired lesions of the retina and optic nerve, because the amount of stimuli necessary to promote and even the activation of new photoreceptors and neuronal pathways and even regeneration of the same may be quite similar for the occurrence of these effects in the sensory pathways of patients with complete irreversible spinal cord injury.

VI. CONCLUSION

There was recovery of mild tingling and tactile sensations in the testicular region after the application of the exclusive treatment of high voltage and low current equipment with non-invasive analog circuit.

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