

ELECTRICAL STIMULATION IN AMYOTROPHIC LATERAL SCLEROSIS

Dooley D.M., Sharkey J., Keller W., and Kasprak M. (1978) Treatment of demyelinating and degenerative diseases by electro stimulation of the spinal cord. *Med. Prog. Technol.* 6, 1-14.

Abstract: Electrical stimulation was applied to the spinal cord of 75 patients who had demyelinating and degenerative diseases of the central nervous system, and 3 patients who had sustained spinal cord injuries. The electrical energy was delivered to the central nervous system by the percutaneous technique. The amount of electrical energy required to produce the perception of paresthesias was measured in 11 patients. The minimum power necessary was 76.89 μW , the maximum was 868 μW , and the average was 448.8 μW . The patients were evaluated by 4 examiners by means of routine neurologic examination, videotape movies, and measurement of urinary bladder function. Continued improvement in neurological status, which allowed the patient to live a better lifestyle, occurred in 30 of the 61 patients with multiple sclerosis, and 6 of the 10 patients with ataxia. The patient with transverse Myelitis, the patient with primary lateral sclerosis, and 1 patient with olivopontocerebellar atrophy; also noted similar enhancement of neurological function. The patients with amyotrophic lateral sclerosis and spinal cord injuries had no changes of significance. Thirty-two out of 44 patients who were ambulatory had significant improvement, whereas 10 of the 19 patients who were not ambulatory had improvement. There was no evidence that electrical stimulation of the spinal cord, when applied via dorsally placed percutaneous electrodes and when carried only to the perception of a paresthesias, has any adverse effect on neurological function. It is hypothesized that the electrical current alters neurotransmitters to enhance the transmission along nervous and neurochemical pathways. The exact mechanisms are unknown at the present time

Dooley D.M. and Nisonson I. (1981) Treatment of patients with degenerative diseases of the central nervous system by electrical stimulation of the spinal cord. *Appl. Neurophysiol.* 44, 71-76.

Abstract: Patients with dystonia, spinocerebellar and cerebellar ataxia and spasmodic torticollis have a reasonable chance of being significantly aided in their control of motor function and neurogenic bladder by electrical stimulation of the cervical or thoracic spinal cord. This mode of therapy has the advantages that it is not destructive of neurological tissue, effects can be varied by altering the intensity and rate of the stimulus and preliminary testing with externalization of the electrodes is predictive of the effects of chronic stimulation

Erb D.E., Mora R.J., and Bunge R.P. (1993) Reinnervation of adult rat gastrocnemius muscle by embryonic motoneurons transplanted into the axotomized tibial nerve. *Exp. Neurol.* 124, 372-376.

Abstract: In some cases of spinal cord injury and in certain motoneuron diseases, such as amyotrophic lateral sclerosis and spinal muscular atrophies, lower motoneurons are destroyed and muscle function cannot be restored except by reinnervation from alternate motoneuron sources. We have tested the feasibility of employing local transplantation of embryonic motoneurons to restore innervation to denervated somatic muscle as a first step in salvaging muscle function and enabling use of functional electric stimulation. Dissociated ventral spinal cord cells from Embryonic Days 14 and 15 rats were transplanted into the distal stump of axotomized tibial nerves of adult rats. Animals were killed 3-18 weeks after transplantation. After 3 weeks large multipolar cells, resembling alpha motoneurons, were observed within the transplant site surrounded by myelinated and unmyelinated axons and dendrites. Axons emanating from these transplanted motoneurons were identified within the nerve stump and within the previously denervated gastrocnemius muscle, forming neuromuscular junctions. Transplanted motoneurons survived up to 18 weeks and were labeled after intramuscular injection of fast blue. This study demonstrates that embryonic spinal motoneurons, transplanted into the distal adult peripheral nerve stump, are able to survive and reinnervate the denervated target muscle. We are now exploring the possibility of using this experimental approach to retard the atrophy of denervated skeletal muscle, thus providing a muscle capable of useful response to functional electrical stimulation

Handa I., Matsushita N., Ihashi K., Yagi R., Mochizuki R., Mochizuki H., Abe Y., Shiga Y., Hoshimiya N., Itoyama Y., and . (1995) A clinical trial of therapeutic electrical stimulation for amyotrophic lateral sclerosis. *Tohoku J. Exp. Med.* 175, 123-134.

Abstract: This paper describes the effects of therapeutic electrical stimulation (TES) on the wasting muscles in a patient with amyotrophic lateral sclerosis. The patient is a 47-year-old male, and he has a history of progressive muscle weakness and atrophy, affected more in the right side. Percutaneously indwelling intramuscular electrodes were implanted to the affected muscles in the right upper and lower extremities but no electrode in the corresponding left region. Within a month of TES therapy, a rapid improvement of extremity motion appeared in the TES treated side. Long-term application of TES more than 3 months increased the strength of the muscle which had been evidently weaker than the non- treated side. CT findings of both the upper and lower extremities with TES therapy showed an increase in the density and a reduction in the moth-eaten image. An increase in the thickness of the muscles was also observed in the TES treated side while deterioration was observed in the muscles on the non-treated side

Schriefer T.N., Hess C.W., Mills K.R., and Murray N.M. (1989) Central motor conduction studies in motor neurone disease using magnetic brain stimulation. *Electroencephalogr. Clin. Neurophysiol.* 74, 431-437.

Abstract: Central motor conduction (CMC) to abductor digiti minimi (ADM) was evaluated in 22 patients with motor neurone disease (MND) using magnetic stimulation of the motor cortex and electrical stimulation at the C7/T1 interspace. CMC was abnormal in 14 patients; prolonged CMC time and absence of response to brain stimulation were more frequent abnormalities than low amplitude responses without prolonged CMC time. The technique can reveal subclinical upper motor neurone involvement and document central motor pathway dysfunction in MND. The patterns of abnormality are not specific to MND; all may occur in other neurological disorders including multiple sclerosis