LIB-Stimulation (Long Impulse, Bidirectional) Improves Reinnervation in Patients With Long Term Denervation

T. Mokrusch

Hedon-Klinik Lingen
University of Erlangen-Nürnberg
Hedon-Allee 1 D-49811 Lingen (Germany)
Mokrusch@geset.de

Abstract

LIB-Stimulation has proved its efficacy before in a reasonable number of patients with complete and irreversible denervation following destruction of brachial and/or lumbosacral plexus. Tetanic contraction force can be increased in these patients by up to 400%. In patients, a maximum of 30% of normal values of voluntary contraction force was reached, in rabbits up to 100% and even more than normal. In the animal experiment, reinnervation was not inhibited, but even supported, and the present study was looking for effects in man.

Design/Methods

A series of 19 patients with high-grade pareses following plexus lesions were investigated. In group I (n=12), patients were treated with LIB-stimulation (30-70 ms impulse width, 6-16 Hz, 20-50 mA, bidirectional balanced rectangular shape of impulse) twice daily, with a total stimulation time of 5-6 minutes/muscle group. Group II (n=7) did not receive any electrotherapy. Each patient received physiotherapy, observation time was 6 months. Contraction force was measured using a hand-held myometer, the amount of reinnervation was estimated by measuring nerve conduction velocity (NCV) and polyphasic muscle action potentials.

Results

Contraction force and NCV increased to a higher amount in each of the patients with electrotherapy. Additionally, the results of motor scales, rating scales of the activities of daily living and a well-being scale indicated a better improvement in the electrotherapy-group.

Conclusions:

According to the present data in a small number of patients, this type of electrotherapy may not only help to prevent disuse atrophy on a long term basis to allow full benefit in the event that some nerve regeneration does eventually occur, but it also may improve regeneration and reinnervation, resp. Further studies have to be done to check these preliminary results.

1. Introduction

Background

In previous studies of our group (Ref. 1-3), electrical stimulation with balanced bidirectional rectangular impulses of high intensity and long pulse duration (LIB-stimulation) has proved to be effective in maintaining and restoring muscle contraction force in fast muscles of rabbit. Additionally, the morphological sequelae of denervation atrophy was stopped and muscle bulk was restored.

LIB-Stimulation has also proved its efficacy before in a reasonable number of patients with complete and irreversible states of denervation following destruction of brachial and/or lumbosacral plexus. Tetanic contraction force was increased in these patients by up to 400% and reached - at maximum - 30% of normal values of voluntary contraction force (in rabbits up to 100% and more!).

It has been discussed, whether electrical stimulation could or could not disturb collateral or terminal sprouting during reinnervation. As in own previous animal experiments, reinnervation was not inhibited, but even supported, the present study was designed to look for effects in man. The question was whether LIB-electrotherapy would disturb reinnervation mechanisms or whether it could have even a positive
influence on the clinical course of reinnervation

1.1. Previous Work

Design/Methods

Patients/Denervation

A series of 19 patients (11 male, 8 female, 41±15 years) with high-grade pareses (average MRC-grade 2.5, 1.5-4.0) following traumatic brachial plexus lesions were investigated. The average time course of denervation was 5 months. No previous electrotherapy had taken place, each of the patients received a 30-minute physiotherapy at least four times weekly.

Electrical stimulation/therapy

In group I (n=12), patients were treated with LIB-stimulation (30-70 ms impulse width, 6-16 Hz, 20-50 mA, bidirectional balanced rectangular shape of impulse) twice daily, with a total stimulation time of 5-6 minutes/muscle group. Patients in group II (n=7) did not receive any electrotherapy. Each patient received physiotherapy, observation time was 6 months.

Evaluation

Contraction force was measured using a hand-held myometer, the amount of reinnervation was estimated by measuring nerve conduction velocity (NCV) of the forearm median nerve and polyphasic muscle action potentials.

Activities of daily living (ADL) were measured by the Barthel-Index (BI) and the Functional Independence Measure (FIM). Additionally, a well-being scale (Befindlichkeitsskala nach von Zerssen, Bf-S) was used to estimate the patient’s life quality.

Results

Physiological measurements:

Contraction forces of several muscles tested increased to a higher amount in each of the patients with electrotherapy (overall significance: p≤.04, see Fig. 2).

The forearm NCV of the median nerve increased by 6.5±4.0 m/s in the electrotherapy group and by 4.1±4.3 m/s in the control group (p≤.01). Similar results were obtained measuring the distal motor latency (not shown).

Polyphasic muscle action potentials:

The average amount of polyphasic MAPs in the investigated muscles was 24±8 % in the electrotherapy group and 25±8 % in the control group. No statistically significant difference was found.

Fig. 1: LIB-Impulse form

Fig. 2: Increase of muscle contraction force (kp)
Rehabilitation measurements

The rating scales of the activities of daily living both the BI and the FIM improved better in the electrotherapy-group (p≤.02). The same result was obtained considering the well-being scale (Fig. 3).

Fig. 3: ADL- and well-being results (gen. %)

2. Summary and Conclusions

According to the present data in a small number of patients, this type of electrotherapy shows some clear benefits for regeneration in patients with denervation following peripheral nerve lesions. It may not only help to prevent denervation atrophy (to allow full benefit in the event that some nerve regeneration does eventually occur), it is also able to increase the intensity of regeneration and probably the amount of reinnervation. Further studies have to be done.

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References