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ORIGINAL ARTICLE/ARTICLE ORIGINAL

Therapeutic effects of peripheral magnetic stimulation on traumatic brachial plexopathy: Clinical and neurophysiological study

Étude clinique et neurophysiologique des effets thérapeutiques de la stimulation magnétique périphérique en cas de plexopathie brachiale traumatique

E.M. Khedr[a,*], M.A. Ahmed[a], E.A.M. Alkady[b], M.G. Mostafa[c], H.G. Said[d]

[a] *Department of Neurology, Assiut University Hospital, Assiut, Egypt*
[b] *Department of Rheumatology and Rehabilitation, Assiut University Hospital, Assiut, Egypt*
[c] *Department of Anesthesia and Pain Relief, Assiut University Hospital, Assiut, Egypt*
[d] *Department of Orthopaedic, Assiut University Hospital, Assiut, Egypt*

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KEYWORDS
Therapeutic magnetic stimulation;
Brachial plexopathy;
Pain

Summary
Objective. — To evaluate the therapeutic effects of peripheral repetitive magnetic stimulation (rMS) on recovery of traumatic brachial plexopathy.
Patients and methods. — Thirty-four patients with traumatic brachial plexopathy were studied. Strength of different muscles of upper limbs was evaluated neurologically. Nerve conduction studies (NCS), upper limb F-waves and visual analogue scales (VAS) for shoulder pain were obtained for all patients. These were randomly assigned into two groups with a ratio of 2:1; each patient received conventional physical therapy modalities and active exercises as well as real or sham rMS applied over the superior trapezius muscle of the affected limb daily for 10 sessions. Patients were reassessed with the same parameters after the 5th and the 10th session, and 1 month after rMS treatment.
Results. — No significant between-group differences were recorded at baseline assessment. Significant improvement was observed (time X groups) after real rMS in comparison to the sham group ($P = 0.0001$ for muscle strength and 0.01 for VAS of shoulder pain). These improvements were still present at 1 month after the end of treatment. In accordance with the clinical improvement, a significant improvement was recorded in the neurophysiological parameters in the real vs the sham group.

* Corresponding author.
E-mail address: emankhedr99@yahoo.com (E.M. Khedr).

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Conclusions. — We demonstrate that peripheral rMS for 10 sessions may have positive therapeutic effects on motor recovery and pain relief in patients with traumatic brachial plexopathy. Therefore, it is a useful adjuvant in the therapy of these patients.

MOTS CLÉS
Stimulation magnétique thérapeutique ;
Plexopathie brachiale ;
Douleur

Résumé

But de l'étude. — Évaluer les effets de la stimulation magnétique répétitive (SMR) périphérique sur la récupération d'une plexopathie brachiale traumatique.

Patients et méthodes. — L'étude porte sur 34 patients atteints de plexopathie brachiale traumatique. La force de différents muscles des membres inférieurs a été mesurée cliniquement. Nous avons obtenu, chez tous les patients, une mesure des conductions nerveuses incluant celle des ondes F des membres supérieurs ainsi qu'une échelle visuelle analogique (EVA) des scapulalgies. Les patients ont été aléatoirement distribués en deux groupes selon une proportion 2:1; chaque patient a bénéficié d'une prise en charge physiothérapeutique conventionnelle incluant des exercices de mobilisation active et a suivi dix sessions au cours desquels une SMR réelle ou fantôme était appliquée sur le muscle trapèze du membre atteint. Les mêmes paramètres ont été évalués chez les patients après la cinquième et la dixième session et un mois après la SMR.

Résultats. — La ligne de base ne différait pas entre les deux groupes. Une amélioration significative fut observée après la SMR réelle par comparaison à la SMR fantôme ($p = 0{,}0001$ pour la force musculaire et 0,01 pour l'EVA). Cette amélioration était toujours manifeste un mois après le traitement. Parallèlement à l'amélioration clinique, une amélioration significative des paramètres neurophysiologiques fut observé après SMR réelle par opposition à la SMR fantôme.

Conclusions. — Dix sessions de SMR périphérique peuvent avoir un effet favorable sur la récupération motrice et l'atténuation de la douleur en cas de plexopathie brachiale traumatique. La SMR périphérique peut, dès lors, constituer une thérapie adjuvante utile chez ces patients.

Introduction

Brachial plexopathy is a common complication of traffic accidents. It is characterized by brachial neuralgia and upper limb weakness. One approach to treatment of the peripheral pain consists of repetitive electrical stimulation of peripheral nerve; however, deep structures are difficult to activate due to local discomfort at the site of stimulation. Single and repetitive pulse magnetic coil stimulation (rMS) can activate deeper neural structures without causing irritation and has been successfully applied to reduce musculoskeletal pain for several days [14]. The mechanism of action is unclear, although it may be similar to transcutaneous electrical nerve stimulation (TENS) with actions at both peripheral and/or central levels of the nervous system. For example, it has been proposed that TENS could cause slowing of conduction in both small and large afferent nerve fibers [19,23]. Kaelin-Lang et al. [6] concluded that TENS elicits focal increase of cortico-motorneuronal excitability outlasting the stimulation period and probably occurring at cortical sites.

Struppler et al. [21,22] found that rMS could reduce spasticity and improve perception of joint position in stroke patients. Heldmann et al. [5] found that prolonged peripheral rMS could modulate the response of primary and secondary somatosensory cortices to afferent input. Recent studies on healthy subjects demonstrated that somatosensory input produced by peripheral nerve stimulation or muscle stretch can produce a lasting increase in cortico-motorneuronal excitability of the stimulated body parts [15]. Thus, peripheral mixed nerve stimulation may evoke conjoint activity of somatosensory afferents and intrinsic motor cortical circuits. Such combination seems particularly effective in modulating motor output, as shown by the fact that median nerve stimulation paired with transcranial magnetic stimulation can lead to lasting changes in excitability of motor cortex [20].

The aim of this study was to evaluate the therapeutic effects of peripheral rMS on pain relief and motor recovery as an adjuvant therapy in patients with traumatic brachial plexopathy.

Patients and methods

Neurophysiological measurements

Ulnar and median nerve motor conduction velocities, distal latencies and compound muscle action potentials (CMAP) amplitudes were measured with standard surface stimulating and recording electrodes in both affected and unaffected arms. For the axillary and suprascapular nerves, the technique described by Gassel [4] was used for measuring motor nerve conduction time (latency) to the deltoid and suprascapular muscles, respectively, using a concentric needle as the recording electrode. A concentric needle electrode was placed in the middle of the biceps, deltoid, and supraspinatus muscles.

The brachial plexus was stimulated with bipolar surface electrodes at Erb's point (a few centimeters above the clavicle in the angle between the posterior border of the sternomastoid muscle and the clavicle at the level of the 6th cervical vertebra). Latency values obtained with anodal and cathodal stimulation were averaged to calculate the