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Editorial

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Recent topics on repetitive peripheral magnetic stimulation (rPMS) and transcutaneous electrical nerve stimulation (TENS) in clinical rehabilitation

Abstract

In recent rehabilitation, treatments include electrical stimulation and magnetic stimulation. They are transcranial magnetic stimulation (TMS), repetitive peripheral magnetic stimulation (rPMS), transcutaneous electrical nerve stimulation (TENS), and others. rPMS has been effective technique for non-invasive neuromodulation. Clinical effects of rPMS have been reported such as generalized sarcopenia and dysphagia, measurement of rectus femoris muscle (RF), strength of suprahyoid muscles and association of hand splint materials. TENS also shows clinical efficacy for decreasing peripheral and central neuropathic pain (PNP, CNP). Beneficial efficacy is found in diabetes and herpes zoster for PNP, and in stroke and spinal cord injury for CNP.

Keywords: transcranial magnetic stimulation, repetitive peripheral magnetic stimulation, transcutaneous electrical nerve stimulation, peripheral neuropathic pain, central neuropathic pain

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Abbreviations: TMS, transcranial magnetic stimulation; rPMS, repetitive peripheral magnetic stimulation; TENS, transcutaneous electrical nerve stimulation; PNP, peripheral neuropathic pain; CNP, central neuropathic pain

Editorial

In recent years, several therapeutic methods have attracted attention in medical rehabilitation fields, using electrical stimulation and magnetic stimulation. For patients with cerebral vascular accident (CVA), some treatments have been applied, such as constraint-induced movement therapy (CI), non-invasive brain stimulation (NBS), transcranial magnetic stimulation (TMS),[1] transcranial direct current stimulation (tDCS), transcranial alternating current simulation (tACS)[2] low intensity transcranial electrical stimulation (tES), functional electrical stimulation (FES), peripheral magnetic stimulation (PMS)[3] and transcutaneous electrical nerve stimulation (TENS).[4] Current topics and perspective of PMS and TENS with related matter will be described in this article.PMS has been a medical technique which can induce eddy currents. It penetrates peripheral nerves and muscle spindles, where magnetic field with time-varying pulse is applied using a coil for the trunk and extremities. It is evaluated for novel neuromodulation method that can cause the activation of mechanoreceptors of nerve fibers of group 1a, 1b, II during contraction and relaxation rhythm.[5] From neurological aspect, it also causes the activation of front-parietal network and sensorimotor cortex, which cover parietal and premotor areas. Further, repetitive PMS (rPMS) can modulate intracortical circuits and corticospinal excitability and stimulate motor performance in healthy people.[6,7] Especially, rPMS is evaluated a novel neurorehabilitation way for improving motor and sensory impaired functions in CVA patients[8,9] and decreasing the symptom of lower back pain.[10]

In clinical rehabilitation, rPM has been an effective technique for non-invasive neuromodulation. By induction of rPMS, magnetic field can pass through almost types of materials, and it reveals medical applications for neurorehabilitation. The latest study investigated whether rPMS can bring adequate movement and strengthen corticospinal excitability via hand splint.[3] The protocol included 14 healthy cases and application of direct (layer 0) and layer 1 or 2 of materials with the standard stiumuli. As a result, successful recording was induced for wrist movements and motor-evoked potentials. From this response, rPMS can cause enough electromagnetic induction for peripheral even when the case wears clothing and orthosis. Consequently, rPMS can be expected for potential application of neurorehabilitation.

As to clinical effect of rPMS for patients after stroke, randomised controlled trials (RCTs) were reviewed.[11] From 4 studies with 139 participants, significant improvement of spasticity in the elbow was found (-0.48 pts of mean difference, p=0.03). In order to obtain robust evidence of clinical efficacy, larger sample size trials will be required. In order to study rPMS effect for acute stroke patients, the degree of muscle atrophy was investigated. The protocol included 12 cases of acute stroke, and the measurement of rectus femoris muscle (RF) in the paretic extremity.[12] As a result, rPMS could prevent muscle atrophy more in patients with ages of 60s compared with more than 70 years.

As to sarcopenic dysphagia, the rehabilitation for both generalized sacopenia and dysphagia would be necessary. Then, both of resistance training and nutritional support are required.[13] Several kinds of treatments have been included, such as swallow resistance exercise, jaw-opening exercise, tongue-hold swallow exercise, neuromuscular electrical stimulation and rPMS. For the rehabilitation of patients with dysphagia, head lift exercise has been known. Applying rPMS was investigated for 24 cases for 2 weeks.[14] As a result, the intervention brought the increased strength of suprahyoid muscles compared to control group as the primary outcome. Secondary outcomes included tongue pressure, jaw-opening force, fatigue degree of laryngeal and hyoid muscles and opening level of upper esophageal sphincter (UES), which did not show significant differences.

When the treatment of rPMS is performed, the possible involvement of antagonist muscles would be checked. The experiment was conducted for several conditions, which are i) rest, ii) rPMS, iii) motor imagery, iv) rPMS + motor imagery.[15] The results showed no difference of motor-evoked potentials among them. These situations suggested that rPMS would not influence corticospinal excitability of the antagonist muscles, and would provide meaningful importance

of rPMS and motor imagery at spinal level. During rPMS treatment, hand splint materials made of thermoplastics are useful for supporting the forearms, hands and fingers. They are also beneficial for fixed position in the neurorehabilitation.[16] Consequently, rPMS has possibly induction of facilitation of corticospinal excitability using hand splint.[3] Treatment for peripheral stimulation includes magnetic and electrical methods. rPMS has more clinical potentials than peripheral electrical stimulation (PES). Both shows common stimulation of nerves and muscle spindles. However, the former shows magnetic permeability, where pulse can pass almost all materials on the skin or skull.[17] On the other hand, the latter needs the attachment directly on the skin. Consequently, rPMS would be non-invasive, painless and easy to treat.

As non-pharmacological approach for reducing pain, transcutaneous electrical nerve stimulation (TENS) has been recently used.[4] TENS is evaluated to show clinical efficacy for decreasing peripheral and central neuropathic pain (PNP, CNP) in the case of various clinical situations. From basic studies, TENS can alleviate pain by regulating neurotransmitters and the related receptors at the stimulated site and also upper levels. They may include brain, brainstem and spinal cord.[18] Further, TENS has benefit for patients with PNP (diabetes, herpes zoster or cancer)[19] and CNP (stroke, spinal cord injury or multiple sclerosis).

Both rPMS and TENS can elicit the movements of hand and legs. For comparative study, subjective sensation for both treatments were investigated for 12 healthy people.20,[21] The rPMS was applied using new stimulator Pathleader with 10 intensity levels, and TENS was provided using 1-mA increments. The results showed that rPMS showed less pain or discomfort compared with TENS. This experiment was performed using right dorsal forearm, and then the study in the larger joint will be expected.

In summary, the stimulation of peripheral nerve has been used for lots of patients, through electric or magnetic route. This application has been developed not only in the medical center but also in the home care, where several commercial -based apparatus can be found. This article would become hopefully a reference for development of rehabilitation in the future.

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Conflicts of interest

Author declares that there is no conflict of interest.

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