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REVIEW/MISE AU POINT

Repetitive peripheral magnetic stimulation to reduce pain or improve sensorimotor impairments: A literature review on parameters of application and afferents recruitment



Stimulations magnétiques répétitives périphériques pour réduire la douleur ou améliorer les désordres sensorimoteurs : une revue de la littérature sur les paramètres d'application et le recrutement des afférences

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Repetitive peripheral magnetic stimulation;
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Neurological disorders;
Musculoskeletal pain

Summary

Introduction. – Repetitive peripheral magnetic stimulation (rPMS over spinal root, nerve or muscle belly) is a promising technology in physiopathology research. As compared to electrical stimulation, rPMS is deemed to activate deep conductive structures and produce strong muscle contractions and massive proprioceptive afferents with minimal cutaneous recruitment. RPMS may thus act differently on neural plasticity involved in pain reduction and motor recovery in musculoskeletal or neurological conditions. However, literature is very scant and still controversial concerning afferents recruited by rPMS, thus no consensus is reached yet for its clinical use.

Study aim. – This review dealt with stimulation parameters reported in any scientific research that applied rPMS as an intervention to improve somatosensory or motor disorders with a view of proposing recommendations for future applications. Also, controversy on afferents recruitment was discussed.

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MOTS CLÉS

Stimulation magnétique périphérique répétitive ; Paramètres de stimulation ; Afférences proprioceptives ; Problèmes neurologiques ; Douleur musculosquelettique

Results. – The literature search resulted in 24 studies. Literature is scant on the topic but our review presents the rationale and the experimental data that may underlie the selection of parameters in future studies using rPMS as an intervention. Although controversy remains, the review presents that the specific recruitment of sensory afferents by magnetic stimulation may offer advantages and disadvantages depending on the pathology.

Conclusions. – The review proposed recommendations to improve rPMS application in clinical research. However, the development of guidelines still requires methodological and clinical studies enrolling larger samples and with randomized sham-controlled designs.

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Résumé

Introduction. – La stimulation magnétique périphérique répétitive (rPMS de racine spinale, nerf ou muscle) est une technologie prometteuse en recherche clinique. Comparée à la stimulation électrique, la rPMS produirait de fortes contractions musculaires avec recrutement massif des afférences proprioceptives et recrutement minimal des fibres cutanées. La rPMS pourrait ainsi agir différemment sur la plasticité neuronale à l'origine de la baisse de douleur et de la récupération motrice après lésion ou maladie affectant le système musculosquelettique ou nerveux. La littérature est cependant limitée et toujours controversée quant aux afférences recrutées. Aucune recommandation n'existe quant à l'utilisation de la rPMS en recherche clinique.

But de l'article. – La revue s'est intéressée aux paramètres de stimulation rapportés dans toutes les études scientifiques utilisant la rPMS pour améliorer les troubles somatosensoriels et moteurs et propose des recommandations pour applications futures. Aussi, la controverse concernant les afférences recrutées a été discutée.

Résultats. – La recherche littéraire a permis d'obtenir 24 articles. Malgré un manque d'évidences scientifiques, les données expérimentales et le rationnel présentés dans la revue pourraient aider à la sélection de paramètres appropriés dans les études futures, utilisant la rPMS comme une intervention. Quoique certaines controverses persistent, la spécificité de recrutement des afférences par la stimulation magnétique semble offrir des avantages et inconvénients, dépendant de la pathologie.

Conclusions. – La revue propose des recommandations pour améliorer l'application de la rPMS en recherche clinique. Cependant, le développement de guides de pratique requiert plus d'études méthodologiques et cliniques sur un plus grand nombre de participants et présentant un plan d'analyse randomisé contrôlé avec placebo.

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Introduction

Non-invasive peripheral stimulation refers to the use of an external device that can produce muscle contractions and sensory afferents via the depolarisation of conductive structures within the peripheral nervous system. For example, transcutaneous electrical stimulation (TES) and peripheral magnetic stimulation (PMS) create voltage differences and ion flows, thus activating conductive structures beneath the stimulated region [5]. Repetitive trains of TES and PMS stimuli are used in clinical research, with varying parameters, for reducing pain or promoting sensorimotor recovery [7,12,15,62,63,65]. The mechanisms potentially involved include local changes of muscle and nerve function, synaptic strengthening in the ventral horn of spinal cord [13], and also remote changes in frontoparietal activation between sensory and motor cortices and in corticospinal and intracortical motor excitability regulation [13,33,61,68]. These mechanisms of action were discussed in our last review, especially for the after-effects of PMS (named repetitive peripheral magnetic stimulation,

rPMS), a novel easy-to-administer approach in neurological conditions affecting sensorimotor control [7] and in pain conditions affecting the musculoskeletal system [55,65]. Conversely to TES, rPMS is considered a painless method deemed to preferentially recruit proprioceptive afferents with minimal activation of cutaneous fibers [67,68]. However, rPMS popularity and applicability are limited owing to missing evidence and recommendations on parameters of application, conversely to TES whose guidelines are already published [15,62]. Furthermore, the preferential recruitment of cutaneous vs. proprioceptive afferents by rPMS over nerves and muscles and whether this preferential activation is beneficial in pathological conditions are still controversial topics [38,77,78]. The present work included all papers using rPMS as an intervention to improve somatosensory or motor disorders with limitations of musculoskeletal function. The primary objective was to review some selected parameters to refine rPMS application in future protocols. The work also discusses which afferents are preferentially recruited by rPMS and whether this basic knowledge has a potential clinical impact.

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