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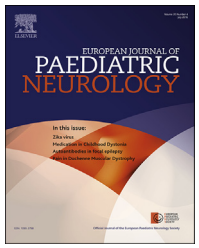

Original article

Magnetic stimulation of the upper trapezius muscles in patients with migraine – A pilot study

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ABSTRACT

Background: Repetitive peripheral magnetic stimulation (rPMS) has been applied to musculoskeletal pain conditions. Since recent data show that migraine and tension-type headache (TTH) might be closely related to peripheral muscular pain in the neck and shoulder region (supporting the concept of the trigemino-cervical complex (TCC)), this pilot study explores the acceptance of rPMS to the upper trapezius muscles in migraine (partly in combination with TTH).

Methods: We used rPMS to stimulate active myofascial trigger points (aTrPs) of the upper trapezius muscles in 20 young adults suffering from migraine. Acceptance was assessed by a standardized questionnaire, whereas self-rated effectiveness was evaluated by headache calendars and the Migraine Disability Assessment (MIDAS). Algometry was performed to explore the local effect of rPMS on the muscles.

Results: Acceptance of rPMS was shown in all subjects without any adverse events, and rPMS had a statistically significant impact on almost every parameter of the headache

Abbreviations: DMKG, German Migraine and Headache Society; MIDAS, Migraine Disability Assessment; PPT, Pressure Pain Threshold; rPMS, Repetitive Peripheral Magnetic Stimulation; sTMS, Single-pulse Transcranial Magnetic Stimulation; TCC, Trigemino-Cervical Complex; TES, Transcutaneous Electric Stimulation; aTrP, Active Myofascial Trigger Point; TTH, Tension-type Headache; VAS, Visual Analogue Scale.

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calendar and MIDAS. Among others, the number of migraine attacks ($p < 0.001$) and migraine intensity ($p = 0.001$) significantly decreased regarding pre- and post-stimulation assessments. Accordingly, 100.0% of subjects would repeat the stimulation, while 90.0% would recommend rPMS as a treatment option for migraine.

Conclusions: rPMS might represent a promising tool to alleviate migraine symptoms within the context of myofascial pain. This might be due to stimulation-dependent modulation of the peripheral sensory effect within the TCC in migraine. However, sham-controlled studies with larger and more homogeneous cohorts are needed to prove a potential beneficial effect.

Ethics Committee Registration Numbers: 356-14 and 447/14

1. Introduction

Migraine has been ranked the sixth most disabling disorder worldwide since 1990.[1] In this context, recurrent headaches represent one of the most common complaints in adolescents and young adults. Both migraine and tension-type headache (TTH) belong to the complex of primary headaches, and they already show a high but still increasing prevalence among children and adolescents.[2,3] Compared to TTH and unspecific headaches, the prevalence of migraine is relatively low in children (7.5%, 6-months prevalence), but it is experienced as the most disabling and most recurrent type of headache.[4] Furthermore, additional pain symptoms (e.g., back pain) are significantly more common in children suffering from migraine.[4] In this context, several studies indicate that at least certain subtypes of headaches seem to be strongly connected to neck and shoulder pain.[5–10] Approximately twice as many adolescents with recurrent headache reported muscular pain in these regions when compared to healthy subjects in a recent investigation among German students, and muscular pain was shown to be more common in subjects suffering from migraine than in those suffering from TTH.[8]

A widely accepted hypothesis regarding the underlying pathologic mechanism is the concept of the trigemino-cervical complex (TCC).[11–13] This concept represents the idea of a partial convergence in sensory nociceptive afferent input from the upper cervical radices (and from the meninges) in the caudal trigeminal nuclei within the brainstem.[11,12] In line with this hypothesis, migraine-related pain could be partially attributed to nociceptive myofascial inputs that increase cortical neuronal excitability.[6] Accordingly, Fernandez et al. (2010) reported significantly lower pressure pain thresholds (PPTs) at the upper trapezius muscles in subjects suffering from migraine and chronic TTH, compared to controls.[9] This suggests that peripheral muscle hyperalgesia might trigger central pain perception via cervical-to-trigeminal linking and vice versa. Hence, targeted treatment of the neck and shoulder region might relieve muscle pain, and therefore might also be beneficial in treating migraine itself. In this context, different invasive and non-invasive neuromodulation approaches were described by Diener et al. (2015), although they failed to show beneficial results overall.[14] Thus, new therapy options are urgently needed, since migraine treatments are often unsatisfactory due to a lack of effective and well-tolerated acute and preventive therapies.[14]

However, targeting the upper trapezius muscles in subjects suffering from pain to alleviate symptoms is not a completely new idea. In this context, local therapy of active myofascial trigger points (aTrPs) using anesthetic infiltration has already proven to significantly decrease migraine-related pain. Interestingly, it was shown that the change in pain thresholds of the aTrPs is linearly correlated with migraine reduction, thus supporting the hypothesis of a cervical-to-trigeminal nociceptive link.[6] Moreover, transcutaneous electric stimulation (TES) represents another option for treating the upper trapezius muscles. However, TES has been shown to cause stimulation-related pain by stimulating less deeply and by inducing less muscle torque compared to repetitive peripheral magnetic stimulation (rPMS).[15] Additionally, rPMS has shown longer-lasting effects on myofascial pain compared to TES.[16] Since rPMS is comparatively painless, non-invasive, deeply penetrating, easy to handle, and not characterized by frequent or severe side-effects,[15] it might provide substantial advantages over TES.

Furthermore, rPMS has proven to significantly alleviate muscular pain within the upper back[16–18] and lower back,[19] and to be beneficial in treating symptoms related to lumbar spondylosis and peripheral nerve injury, respectively.[20,21] However, it has not yet been used to modulate migraine or migraine-related muscle pain. Since recent literature suggests that there is a strong relationship between migraine and neck and shoulder pain,[7–9] we hypothesize that rPMS could principally represent a useful peripheral neuromodulation approach for migraine. Therefore, this pilot study aims to investigate, as a first step, the acceptance of rPMS to the upper trapezius muscles in young adults suffering from migraine.

2. Materials and methods

2.1. Ethics

The study was approved by our local ethics committee (registration numbers LMU and TU Munich: 356-14 and

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