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The effects of electroacupuncture on analgesia and peripheral sensory thresholds in patients with burn scar pain



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ABSTRACT

The aim of this study is to observe if the effects of electro-acupuncture (EA) on analgesia and peripheral sensory thresholds are transposable from the model of heat pain in volunteers to the clinical setting of burn scar pain.

After severe burns, pathological burn scars (PPBS) may occur with excruciating pain that respond poorly to treatment and prevent patients from wearing their pressure garments, thereby leading to unesthetic and function-limiting scars. EA might be of greater benefit in terms of analgesia and functional recovery, should it interrupt this vicious circle by counteracting the peripheral hyperalgesia characterizing PPBS.

Therefore we enrolled 32 patients (22 males/10 females) aged of 46 ± 11 years with clinical signs of PPBS and of neuropathic pain despite treatment. The study protocol consisted in 3 weekly 30-min sessions of standardized EA with extra individual needles in accordance to Traditional Chinese Medicine, in addition of previous treatments. We assessed VAS for pain and quantitative sensory testing (QST) twice: one week before and one after protocol. QST measured electrical thresholds for non-nociceptive A-beta fibers, nociceptive A-delta and C fibers in 2 dermatomes, respectively from the PPBS and from the contralateral pain-free areas. Based on heat pain studies, EA consisted in sessions at the extremity points of the main meridian flowing through PPBS (0.300 s, 5 Hz, sub noxious intensity, 15 min) and at the bilateral paravertebral points corresponding to the same metameric level, 15 min. VAS reduction of 3 points or below 3 on a 10 points scale was considered clinically relevant. Paired t-test compared thresholds (mean [SD]) and Wilcoxon test compared VAS (median [IQR]) pre and after treatment, significant $p < 0.05$.

The reduction of VAS for pain reached statistical but not clinical relevance (6.8 [3] vs. 4.5 [3.6]). This was due to a large subgroup of 14 non-responders whose VAS did not change after treatment (6.6 [2.7] vs. 7.2 [3.8]). That subgroup exhibited significant differences in sensory thresholds when compared to the 18 responders (VAS from 7 [3] to 3 [1]).

First, responders' thresholds for A-delta and C fibers in the PPBS area were significantly lower than those in the pain-free area before treatment but corrected after acupuncture (from respectively 60 [30] and 63 [10]% to 91 [11] and 106 [36]%). That might account for a nociceptive hypersensitivity in the PPBS that corrected after treatment. On the contrary, in

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non-responders nociceptive thresholds were similar in both the PPBS and the pain-free areas before treatment and did not change after EA. However, absolute values for thresholds in the pain-free areas were significantly lower for non-responders than for responders. The fact that non-responders had significant pain scores while presenting with lowered nociceptive thresholds even in the pain-free areas might evoke the possibility of a generalized supra-spinal hyperalgesia. The fact that acupuncture did not correct the pain nor the nociceptive thresholds in this subgroup requires further investigation.

We also observed a statistically and clinically relevant reduction in VAS for pruritus for all patients – even those from the subgroup of non-responders to pain – that is worth to be mentioned and requires further studies to be confirmed.

This observational study is the first that confirms the effects of acupuncture on analgesia and nociceptive thresholds in the clinical setting of burn pain only for patients presenting with a burn-localized but not a generalized hyperalgesia.

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1. Introduction

We designed this study to observe the effects of a combination of manual (MA) and electro-acupuncture (EA) on the pain scores and on the sensory thresholds of the nociceptive pathways in patients presenting with pathological burn scars (PPBS).

Up to 77% of patients may develop PPBS [1]. Scar tissues become hypertrophic and inflammatory and produce both pain and pruritus that do not respond well to conventional treatments, thus preventing patients from wearing their pressure garments. However, these are the only effective ways to reduce hypertrophic scarring that eventually worsens the rehabilitation by the production of unsightly and function-limiting scars [2]. Nociceptive changes after PPBS share the same characteristics as the experimental models of heat pain – i.e. a peripheral but not a spinal or supra-spinal hyperalgesia [3].

Heat pain in healthy volunteers is a common model in the research field of central pain that has recently been used to demonstrate that EA reduces the pain scores and increases the nociceptive sensory thresholds [4].

The acupuncture presumes that there are two opposing and complementary forces that coexist in nature: Yin and Yang. These two forces interact to regulate the flow of “vital energy,” known as Qi. The Qi flows through a network of channels called meridians, which bring Qi from the internal organs to the skin surface. When a burn is located on the trajectory of a meridian, it produces disturbances in Qi, which lead to pain and pruritus. Along these meridians there are points that can be stimulated by acupuncture to correct the imbalance and reduce both pain and pruritus [5].

The use of functional magnetic resonance imaging (f-MRI) and quantitative sensory testing (QST) demonstrated what parameters of EA optimally interact with the lateral and medial nociceptive pathways and with all components of pain at the cortical level. However, these positive results have never been confirmed in the clinical practice so far.

Therefore, we tested the use of EA combined with MA (E/MA) in patients presenting with PPBS since any significant analgesic effect can improve not only their short but also their

long-term quality of life by enabling them to reuse their pressure garments.

2. Material and methods

After institutional ethics committee approval and after obtaining informed consent, we enrolled adult patients presenting with PPBS as assessed by the modified Vancouver scale [6] and with clinical neurological pain as assessed by the DNS4 [7]. Analgesic regimens consisted in oral opioids and in some cases in non-steroidal anti-inflammatory agents but no other medications for the treatment of neuropathic pain. Patients were instructed to remain on their pain regimen throughout the study period and no new analgesic medications were initiated. Exclusion criteria were contraindications to electrotherapy such as pacing or epilepsy. We excluded patients with factors that have been shown to favor the spinal and supra-spinal hyperalgesia, such as a pre-existing neurological problem (stroke, head injury), peripheral neuropathy or conditions that may lead to it (diabetes, uremia, alcohol abuse, etc.), or an history of previous burns, 3rd degree burns, TBSA > 25%, or a SIRS during hospitalization [8].

Our primary endpoint was a reduction in the pain score, assessed by the visual analog scale (VAS) where 0 is no pain and 10 is the highest level of pain imaginable by the patient. Clinical response was defined for a VAS of 3 or below 3 on the 10 points scale after treatment. The secondary endpoint was the comparison of sensory thresholds between responders and non-responders, in order to better understand the mechanism of interaction between E/MA and nociception.

The effects of MA and EA on sensory perception have recently been evaluated by QST [9]. QST systems are separable into devices that generate specific physical vibratory or thermal stimuli and those that deliver electrical impulses at specific frequencies. Their clinical utility, efficacy, and safety have been evaluated in general [10] and in specific conditions like oro-facial pain and headache [11]. These systems are often cumbersome and difficult to use at the bedside, though. Therefore, we adapted a method that used electrical QST to assess the postoperative neuroplasticity following spine surgery [12], as it is easy to perform in the clinical setting

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