Effect of electroacupuncture on brachial plexus post-traumatic neuralgia: A case report

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Abstract

Background. Brachial plexus injury is a serious peripheral nerve injury that severely disables upper limbs and affects patients’ daily life and work. Acupuncture and Electroacupuncture have traditionally been used to treat neuropathic pain. However, there is still lacking evidence as regard to their effects on pain following traumatic nerve and plexus lesions. Neurotmesis after brachial plexus injury also causes movement disorders of the denervated muscles and loss of sensory function in the skin.

Case report. We report a case of a brachial plexus injury due to humeral fracture, predominantly involving the lower trunk and the medial cord, treated with electroacupuncture. Results. We documented a positive significant response, based on clinical examination, pain scores and neurophysiologic findings.

Conclusions. Repeated Electroacupuncture can relieve neuropathic pain due to brachial plexus injury. However, additional studies are needed to verify the efficacy and effectiveness of this approach.

Key words: Acupuncture, Brachial neuralgia, Complementary Therapies

In face of increasing number of studies about the benefits of acupuncture on pain syndromes, some authors found that stimulation of acupoints was associated with brain activation, suggesting that neural activity could be modulated by this approach (4, 5). Acupuncture has proven to be beneficial on nerve-related functional impairments after an injury in the peripheral nervous system (6, 7). In patients with peripheral neuropathy, Schroder and colleagues found that acupuncture was associated with improvement of nerve function based on conduction measurements and subjective symptoms (8).

Brachial plexus avulsion induces immediate or delayed pain that is described as crushing, squeezing, or burning, and is primarily treated through surgery. Previous works have revealed the analgesic effects and mechanism of EA mainly on low-back pain and inflammatory pain (9, 10), but the response of brachial plexus neuropathic pain to EA has been poorly investigated.

We report the case of pain after post-traumatic brachial plexus injury, successfully treated with EA.

Case report

A 51-year-old woman who reported left humeral fracture with severe brachial plexus injury involving predominantly the lower trunk/medial cord, was referred to our Pain clinic after several failed therapies in the previous months. Since the patient manifested sides effects to opioids (oxycodone 20 mg bid), and early intolerance to gabapentin (300 mg daily) and amitriptyline (25 mg daily), she was proposed for EA.

Before treatment, symptoms included severe pain with NRS 9/10 (Numeric Rating Score from 0 with no pain to 10 with the worst pain ever felt) and persistent tingling at the left hand 8/10.

Neurological clinical examination performed ten months after the injury showed the persistence of mild muscle weakness involving biceps brachii (Force= 4.5 MRC, Medical Research Council scale), brachioradialis (F= 4 MRC scale) and intrinsic hand muscles (F= 4 MRC scale), finger flexors and extensors (F= 4 MRC scale). Biceps and supinator stretch

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reflexes were absent, and triceps was reduced. Sensory changes involved the medial aspect of the arm, forearm and hand including fourth and fifth digits. The nerve conduction studies showed the absence of sensory potential evoked from ulnar nerve (fifth digit) and the median nerve (third digit), together with an amplitude reduction of compound muscle action potential (CMAP) registered from abductor pollicis (median nerve) (Fig. e 1).

Acupuncture was started 13 months after injury, employing a protocol based on TCM’s law and generally adopted for peripheral neuropathy, together to the Mussat Theory, according to which a linear approach on the energetic unit (i.e. Tsué Yin – Shao Yang; Liver and pericardial meridians) can be implemented. Thus, some points of meridians involved were selected and electrically stimulated.

Neiuguan (Pericardial Meridian – PC6) and Ximen (Pericardial Meridian – PC4), located on the median nerve above the wrist 2 and 5 cun respectively, were selected for EA because they represent activation of central regions related to inhibitory descending pathways involvement of somatic and visceral response.

At the Laogong (Pericardial Meridian – PC8) the positive electrode was placed in order to promote the energy drainage (Fig. 2).

Taichong (Liver Meridian – LR3), Xiguan (Liver Meridian – LR7), Hegu (Large Intestine Meridian - LI4), Zusanli (Stomach Meridian – ST36) and Sanyinjiao (Spleen-Pancreatic Meridian – SP6), were bilaterally inserted as analgesics’ acupoints for general pain syndrome and Xué Bì syndrome. This condition refers the syndrome characterized by obstruction of qi and blood in the meridians due to invasion of external pathogens.

After skin disinfection, sterilized disposable needles (diameter 0.25 mm, length 25 mm) were inserted 1–4 mm deep into the predefined acupoints. The electric stimulation (ES) was used only on the affected arm, set at low frequency (8-10 Hz) with increasing intensity, until the perception of a slight shock. According to the “tonification” technique of TCM, negative electrodes were connected to PC4 and PC6, while positive electrode was connected to Laogong (Pericardial Meridian – PC8). We left all needles in place for 45 minutes after their insertion.

We delivered acupuncture treatment once per week for six weeks, followed by a four-week acupuncture-free time, and then another six sessions of EA, again once a week. The primary endpoints were changes in NRS and EMG findings.

The day after the first two sessions of treatment the patient reported an increase in pain and hand tingling, lasted one day and spontaneously regressed. No further significant effects were reported by the patient at the end of the next four sessions. Twenty-eights days after the first 6-weeks treatment the patient reported a gradual but significant improvement in terms of pain (4/10) and tingling (3/10). At that time we initiated the further weekly treatment, again six sessions. After the fourth session the patient reported a 3/10 NRS and 2/10 tingling intensity at the hand (Table 1).

Furthermore she reported a slight recovery of cold and heat sensitivity. This physical well-being lasted up to the control at 6 months, without assuming any analgesic drug.

Sensory nerve conduction examination, performed one month after the last acupuncture session, confirmed the absence of sensory potential evoked from median nerve (third digit). Interestingly, a sensory action potential was evoked by ulnar nerve (fifth finger), even if with reduced amplitude. Motor nerve conduction studies showed a CMAP amplitude reduction registered from abductor pollicis (median nerve) and abductor digitii minimi (ulnar nerve), which were reduced of 70% and 30%, respectively, when compared to the contralateral hand. In the second EMG, the neurographic examination involved more motor nerves than the first and fewer artifacts were visible on the sensory nerves than in the first exam. There were no involvement of the conduction velocities, while the appearance of the SAP (sensory nervous action potential) evoked by the ulnar nerve (stretch V finger-wrist) was detected (Fig. 1b).

**Discussion**

In this case report, we have detailed the favorable outcomes of EA in mitigating post-traumatic brachial plexus neuralgia, spanning a total of 12 weekly sessions.

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Table 1. Numeric Rating Scale (NRS) 0/10 and hand tingling (HT) 0/10 during the 1st and 2nd treatment. Absolute number showed before starting the session from the first session to the control visit 28 days after the end of treatment
Fig. 1. (A) - Neurophysiologic findings before treatment. In evidence the absence of sensory evoked potential of the ulnar nerve (fifth digit) and median nerve (third digit), together with CMAP amplitude reduction registered at the level of the abductor pollicis (median nerve) of the left and right (B) - Neurophysiologic findings after treatment. In evidence the absence of sensory potential evoked from median nerve (third digit), while a reduced sensory potential was evoked from ulnar nerve (fifth digit); and CMAP amplitude reduction registered from abductor pollicis (median nerve) and abductor digit minimi (ulnar nerve), which was reduced of 70% and 30%, respectively, when compared to the contralateral hand.
The observed clinical improvements encompassed a notable reduction in pain scores and decreased tingling intensity. Additionally, sustained benefits were evident in neurophysiologic findings assessed one month after the conclusion of acupuncture treatment.

Thousands of individuals confront the challenges posed by nerve injuries each year, facing life-altering consequences and debilitating disabilities. Despite the severity of such injuries, treatment options remain limited.

Several studies have delved into the potential influence of EA on nerve regeneration and functional recovery, offering insights into its multifaceted impact. However, open questions persist, particularly concerning the duration and intensity of electrical stimulation (ES) and their effects on nerve recovery (11, 12). For instance, Geremia et al. have highlighted the effectiveness of 20 Hz stimulation on dorsal root ganglia for less than one hour, possibly attributed to downregulation of TRK receptors on sensory neurons (13). Conversely, Mobarakeh et al. found that brief ES periods did not significantly affect axon outgrowth (14).

Debates continue to revolve around the optimal time frame for ES in nerve regeneration, with indications that early ES might confer greater benefits. Tang et al. achieved commendable nerve regeneration outcomes by maintaining ES intensity below 6 mA on injured ulnar nerves alongside acupuncture needles (12).

Brachial plexus injury is a serious peripheral nerve injury that severely disables upper limbs and affects patients’ daily life and work. Neuropathies after brachial plexus injury also cause movement disorders of the denervated muscles and results in loss of sensory function in the skin. In addition to these problems, the mechanosensitivity of nerves may increase (gain of somatosensory function), resulting in elevated painful response to different stimuli, thus leading to hyperalgesia and in more severe cases to allodynia (15).

Hui et al. explored the effect of EA on a rat model of brachial plexus neuralgia (16). They concluded that EA attenuated neuropathic pain and its analgesic effects were related to relieving the inflammatory response in the peripheral and central nervous systems. In rats EA has proven to be effective in the treatment of neuropathic pain after brachial plexus injury and importantly, associated with increased expression of β-endorphin in the arcuate nucleus (17). The excitability of neurons in these regions can be blocked by interruption of opioids and β-endorphins gateway or the injection of naloxone (18). Furthermore, Lee and coauthors documented a reduction in the expression of Substance P in the dorsal horn section of the spinal cord of a cancer pain animal model, and higher levels of β-endorphins (19).

The pain that occurs after brachial plexus injury is also related to a flaccidity syndrome, a disorder characterized by muscular flaccidity and weakness of the limbs, well described in traditional Chinese medicine (20, 21), which has been successfully treated with acupuncture (22, 23).

Notably, our nerve conduction studies confirmed a partial axonal damage involving especially median nerve together with ulnar nerve. While the sensory action potential evoked from median nerve (Third finger) was absent, after treatment we registered a reduced amplitude sensory action potential from ulnar nerve (stretch fifth finger-wrist). This data may support a possible role of ES in distal sensory nerve fibers regeneration.

ES may also enhance motor action potentials and fiber density, contributing to increased nerve functionality (24). However, it is essential to acknowledge the complexity of the underlying mechanisms, encompassing ion transfer, molecule secretion, and growth factor release.

The main limitation of our study is that EA has been performed with the same frequency and intensity of electric current. Thus, further investigations on the effects of EA with increasing Hz are required. Moreover, further EMGs in follow-up, confirming the sustained nerve recovery, were not available.

Conclusion

In conclusion, we performed an EA intervention, with low constant Hz, on a patient suffering of post-traumatic chronic neuropathic pain due to a brachial plexus injury. Our main findings showed a significant and lasting pain relief after two six-session made treatments. Low-frequency and low-intensity EA could be effective in nerve functional recovery based on EMG findings. However large trials with different electrical current modalities could clarify the role and mechanism of EA on peripheral nerve pain treatment.
Conflict of interest
All the authors have no conflicts of interest or financial ties to disclose.

Author’s contributions
DDP and GF designed and executed the study; CR and AP performed quality control of clinical data and data entry for statistical processing through the mesoresearch project; GF has proposed the review and drafted the manuscript; MR reviewed and corrected the manuscript and all the other Authors approved the final text.

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