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Review

Does acupuncture help patients with spasticity? A narrative review

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ABSTRACT

Spasticity is a motor disorder encountered after upper motor neuron lesions. It adversely affects quality of life in most patients and causes long-term burden of care and has significant financial implications. The effect of conventional therapies for spasticity including physical therapy, surgery, and pharmacotherapy are not always satisfying because of the short-term effects or side effects in some patients. Acupuncture is a part of traditional medicine originating from China. It has been used to resolve functional recovery problems after central nervous system injury for many years in Asian countries and is increasingly popular in western countries. Some researches suggest that acupuncture has therapeutic potential to help improve limb movement function and decrease the severity of spasticity. This review synthesizes studies involving stroke, brain injury, spinal cord injury, cerebral palsy, and multiple sclerosis to give an overall picture of the effect and potential mechanisms of acupuncture on spasticity occurring after upper motor neuron lesions. Moderate-quality evidence suggests that electro-acupuncture combined with conventional routine care (pharmacological/rehabilitation) could reduce spasticity and improve motor function and activities in daily living after stroke. However, there is not enough evidence to conclude that acupuncture (including electroacupuncture) could reduce spasticity with other central nervous system diseases.

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1. Introduction

Spasticity is common in central nervous system (CNS) lesions such as stroke, brain injury, spinal cord injury (SCI), cerebral palsy (CP), and multiple sclerosis (MS) [1]. Prevalence estimates of spasticity with diseases vary greatly. For stroke survivors, 4% (1–4 weeks poststroke) to 42.6% (1–3 months poststroke) were found affected by spasticity [2]. For those with disorders of consciousness after brain injury, 59% to 70% showed severe spasticity during the first year after the injury [3]. For patients with chronic disease, the proportion increased to 89%, and more than 60% presented severe spasticity [4]. Spasticity is experienced by 65% to 78% of individuals with chronic SCI (>1 year after injury) [5], 70% to 80% of those with cerebral palsy [6] and 60% to 90% of those with MS [7].

Spasticity causes long-term burden of care and significant financial implications. The direct cost is almost 4 times higher for stroke patients with than without spasticity [8]. For MS patients, the level and cost of care substantially increases with the spasticity severity, especially in terms of home care, hospital admissions and hospital beds [9,10].

Spasticity may have positive effects; for example, it may allow for weak limb weight bearing for transfers [11]. However, it restricts motor functions and adversely affects quality of life (QoL) for many patients [12]. Hyperexcitability of muscle stretch reflexes, the characteristic feature of spasticity, results in an imbalance of forces between agonist and antagonist muscles, which leads to abnormal postural and motor control [13]. Spasticity can cause restricted joint range of movement, loss of dexterity, and abnormal limb posture, which adversely affects mobility, transfers, and activities of daily living (ADL) [14,15] as well as carer burden and QoL, including pain, pressure ulcers and difficulty in bowel and bladder care [16,17].

Conventional therapies for spasticity include physical therapy, surgery, and pharmacotherapy [14,18,19]. Most clinical guidelines prioritize non-pharmacological interventions, such as stretching and splinting [20–22]. For moderate or severe spasticity, oral medications (such as baclofen) or invasive therapies (such as botulinum injection and chemical neurolysis) should be considered. Individuals with severe generalized spasticity and no response to conservative options usually take intrathecal baclofen [23]. The use of oral anti-spasticity medications could be limited

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because their effect is often short-term for many patients and can contribute to systemic side effects including muscle weakness, drowsiness, and cognitive impairment [24,25]. Surgical intervention is considered for severe spasticity after the failure of pharmacological and/or non-pharmacological management [26], and the effect of surgery varies with the location and severity of spasticity [18]. Despite many treatments for spasticity management, limitations and uncertainty in clinical practice lead to more than half of spastic stroke survivors experiencing moderate to severe disabilities [27]. To achieve better control of spasticity with less adverse events, new therapies are needed.

Acupuncture is a part of traditional medicine originating in China. Acupuncture is a relatively simple, inexpensive, and safe treatment modality and has been used to resolve functional recovery problems after CNS injury for many years in Asian countries. It has become increasingly popular in western countries in recent decades [1,28–31]. Some research suggests that acupuncture has therapeutic potential for helping improve limb movement function and decreasing the severity of spasticity. This article reviews existing research into the effect of acupuncture on spasticity after upper motor neuron (UMN) lesions and provides suggestions for the clinical application of acupuncture and future research in this field.

2. Literature search and selection

Research regarding the effect of acupuncture on spasticity (including electroacupuncture) was searched from the earliest date available until May 2018 in the following electronic databases: Cochrane Library, MEDLINE via PubMed, EMBASE, China National Knowledge Infrastructure, VIP Database for Chinese Technical Periodical and Wanfang Data. Search terms included [“acupuncture” or “electroacupuncture”] and [“stroke” or “brain injury” or “spinal cord injury” or “SCI” or “cerebral palsy” or “CP” or “multiple sclerosis” or “MS”] and [“spasticity” or “spasm”]. There was a language restriction for Chinese and English but no restrictions on publication date or study design. We also manually searched the references of selected articles.

The EBM pyramid was used to determine the level of evidence because the study design of the retrieved articles varied considerably. According to the pyramid, systematic reviews (including meta-analysis) and randomized controlled trials (RCTs) were given priority review. Research with other designs was included if there was a lack of systematic reviews and RCTs. Finally, we included 5 systematic reviews, 3 RCTs, 1 crossover study and 2 case reports (Fig. 1).

3. Effect of acupuncture on spasticity for specific diseases/injuries

3.1. Stroke

So far, the greatest amount of research on the effectiveness of acupuncture for spasticity deals with stroke. Khan et al. [1] evaluated evidence from systematic reviews of clinical trials for the effect of non-pharmacological interventions on spasticity. Three of 22 systematic reviews evaluated acupuncture (including electroacupuncture) [32–34]. The Assessment of Multiple Systematic Reviews (AMSTAR) was used to assess the methodological quality of the reviews, and the score for the 3 studies was high [32,33] and moderate [34]. The Grade of Recommendation, Assessment, Development, and Evaluation (GRADE) tool was used to assess the quality of evidence for acupuncture. The research suggested moderate-quality evidence that electroacupuncture combined with conventional routine care (pharmacological/rehabilitation) could reduce spasticity, improve motor function and ADL in individuals with stroke [4].

The review by Cai et al. [32] included 22 RCTs involving 1425 participants; 13 of the studies reported the modified Ashworth Scale (MAS) score, which was synthesized for analysis. As compared with routine care, electroacupuncture combined with routine care significantly decreased the MAS score for upper and lower limbs. Of note, electroacupuncture was not beneficial if treatment duration was less than 30 min or for patients with longer than 180 days in the poststroke period in the subgroup analysis.

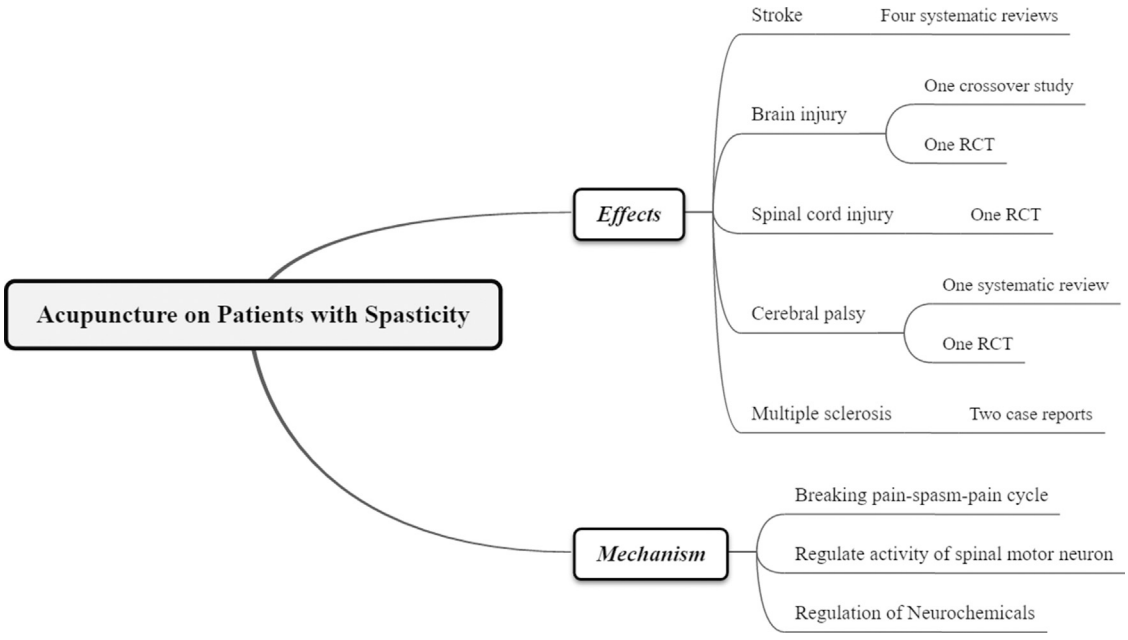

Fig. 1. Outline of the review and literature selection.

Lim et al. [33] compared the effects of acupuncture or electroacupuncture with usual care or placebo acupuncture. Five RCTs were included in the systematic review. Acupuncture or electroacupuncture could significantly decrease poststroke spasticity, especially in muscles of the wrist, knee, and elbow. Subgroup analyses showed that electroacupuncture might be more effective than acupuncture. However, in the meta-analysis of Park et al. [34], acupuncture had no effect on improving MAS score or H-reflex/M-response [H/M] ratio at the end of treatment (3-8 weeks) as compared with controls. However, it did have a significant instant effect on decreasing H/M ratio after the first acupuncture treatment. All 8 trials were of inadequate methodologic quality.

Li [35] summarized the acupuncture treatment protocols of 33 RCTs and found the most-used acupoints for upper-limb spasticity were Quchi (LI11), Hegu (LI4), Shousanli (LI10), Waiguan (SJ5), Jianyu (LI15) and Jiquan (HT1); the most-used acupoints for lower limb spasticity were Sanyinjiao (SP6), Zusanli (ST36), Xuehai (SP10), Yanglingquan (GB34), Yinlingquan (SP9), Jiexi (ST41), Taichong (LR3), Taixi (KI3), Liangqiu (ST34), Fenglong (ST40), Xuanzhong (GB39) and Zhaohai (KI6); and the most-used acupoints for outside extremity spasticity were Baihui (DU20) and Fengchi (GB20). According to the theory "treatment for flaccidity aims at the yangming meridian", the large-intestine meridian of the hand yangming and stomach meridian of the foot yangming were the most-used meridians. Acupuncture therapy was performed 1 to 2 times/day, 5 to 7 days/week for 2 to 8 weeks. Most studies required retaining the needle for 20 to 40 min for body acupuncture and 2 hr for scalp needles after deqi sensations.

3.2. Brain injury

One review examined studies of spasticity management in disorders of consciousness after brain injury [28] and only 1 article focused on acupuncture treatment for spasticity [36]. Matsumoto et al. [36] investigated the effect of acupuncture on the excitability of spinal motor neurons in 11 patients with chronic disorders of consciousness due to traumatic brain injury. The activity of spinal motor neurons was measured by event-related electromyography (F wave, M wave, and F/M ratio). As compared with controls, after the acupuncture session, the F/M ratio was significantly decreased within 10 min after needle insertion as well as removal. The decrease in overactivity of the spinal motor neurons of the abductor pollicis brevis muscle would lead to a decrease in spastic muscle hypertonia. However, no objective measurement of spasticity (such as the MAS) was conducted. Zhao et al. [37] evaluated the efficacy and safety of transcutaneous electrical acupoint stimulation (TEAS) to treat muscle spasticity after brain injury; as compared with 2-Hz or sham TEAS, 100-Hz acupoint TEAS decreased wrist spasticity after 2-week treatment and the effect lasted for 1 month after treatment.

3.3. Spinal cord injury (SCI)

Although some systematic reviews investigated the effect of acupuncture on various dysfunctions after SCI (motor dysfunction, sensory dysfunction, bladder or bowel dysfunction) [31,38,39], none focused on the effect of acupuncture on spasticity. As well, the number of RCTs in this field is insufficient. An early study (Chen et al., 1995) [40] included 67 SCI patients with lower extremity spasticity and randomly assigned them to electroacupuncture or control treatment. Electroacupuncture patients received 1- to 2-Hz EA for 30 min/day, 6 times/week for 2 months, whereas controls received conventional physical therapy. After 2 months' treatment, electroacupuncture could decrease lower extremity spasticity in SCI patients and was more effective than conventional therapy.

3.4. Cerebral palsy (CP)

Liao et al. [41] systematically reviewed 8 RCTs involving 570 participants (<18 years old). Three studies reported the MAS score and the review found that acupuncture was effective in decreasing spasticity in CP. Dabbous et al. [42] investigated the effectiveness of laser acupuncture (LA) for spastic CP in children. A total of 40 children with spastic hemiplegic CP (1–4 years old) were randomly divided into control and LA groups. Both groups received physical therapy for 3 months, whereas the LA group received laser acupuncture at GB 34, LI 4, LI 12 and LR 3 (low-level laser 650 nm, 50 mW power, 30 sec/acupoint, energy density 1.8 J/cm^2). LA involved 2 sessions per week for 3 successive months. After the intervention, LA children showed a significant decrease in muscle tone (wrist flexors and plantar flexors) as compared with controls; however, the groups did not differ in range of motion.

3.5. Multiple sclerosis (MS)

Although some case reports [43,44] supported acupuncture for MS spasticity, the number of high-quality studies is strikingly small. Karpatkin et al. [29] analyzed 15 studies of acupuncture for MS; only 2 examined the effect of acupuncture on MS spasticity and lacked statistical analysis. Hao et al. [43] examined the effect of scalp acupuncture in a 65-year-old male with MS for 20 years. The motor area, sensory area, balance area, hearing and dizziness area, and tremor area were stimulated once a week for 10 weeks, then once a month for 6 sessions. The patient showed remarkable improvement after the 16 treatments. Miller [44] investigated the effect of acupuncture on spasticity in 4 women with MS. Spasticity was measured by using the MAS and MAS score was reported to be improved in 1 patient.

4. Mechanism of acupuncture on spasticity

4.1. Breaking pain-spasm-pain cycle

The mechanism of the effect of acupuncture on spasticity is still unclear. It is widely accepted that acupuncture can reduce pain. Acupuncture therapy could break the pain-spasm-pain cycle and relax muscles by controlling pain [45]. The threshold of pain receptor is increased after acupuncture because the CNS releases opioid peptides after location stimulation [46,47]. However, the mechanism cannot explain all cases because spasticity is not always painful and the link between spasticity and pain is not clearly established.

4.2. Regulating activity of spinal motor neurons

After a UMN lesion (brain or spinal cord), spinal motor neurons have increased excitability because of loss of inhibitory supraspinal control. The increased gamma-motor neuron activity, decreased inhibition by specific interneurons, and altered common interneuron activity increase alpha-motor neuron activity [13]. Acupuncture therapy may regulate the activity of spinal motor neurons by decreasing the hyperexcitability of γ and α motor neurons and/or increasing the inhibition of interneurons. Fink et al. [48] and Lee et al. [49] found that after the first acupuncture treatment, H/M ratios decreased immediately as compared with controls. The improvement in H/M ratio may be associated with decreased excitability of α motor neurons. Yu et al. [50] found that acupuncture on the antagonistic muscle of the spastic muscle could prolong the mean H-reflex recovery time, which may be caused by the increased inhibition of interneurons.

4.3. Regulation of neurochemicals

Feng [51] found that electroacupuncture could significantly decrease metabotropic glutamate receptor subtype 1 (mG1uR1) mRNA expression in the CNS of rats with stroke. Yang et al. [52] found that acupuncture on affected limbs and the Governing Vessel could increase GABA level and decrease levels of excitatory neurotransmitters in the brain and spinal cord of rats with stroke. The increased GABA level, which could enhance GABA-mediated pre-synaptic inhibition, and the decreased expression of excitatory neurotransmitters and their receptors may have a role in the anti-spasticity effect of acupuncture. Qi et al. [53] found that acupuncture may relieve muscle spasms and reduce muscular tension by inhibiting the release of inflammatory cells after brain injury in rats with spastic CP.

5. Discussion

Acupuncture seems to be a potential therapeutic intervention for spasticity. There may be moderate-quality evidence that electroacupuncture combined with conventional routine care (pharmacological/rehabilitation) could reduce spasticity in stroke patients. However, the effectiveness of this therapy remains unclear in other CNS diseases with spasticity [1,28–31]. Despite the available range of acupuncture (including electroacupuncture) for spasticity, high-quality evidence for many diseases is lacking. Methodological limitations and low reporting quality of the existing studies limit the level of evidence for the following reasons.

First, the insufficient number of RCTs prohibited a meaningful systematic analysis to assess whether acupuncture therapy is effective in decreasing the severity of spasticity or not. In the past years, studies of the effect of acupuncture on spasticity were mainly limited to stroke. For brain injury, SCI, CP and MS, although some studies assessed the effect of acupuncture on rehabilitation of other functions (motor function, sensory loss, pain, etc.) [28–31], few studies of acupuncture (especially high-quality studies such as RCTs) specifically focused on spasticity. For studies of the effect of acupuncture on poststroke spasticity, with the available information, subgroup analyses comparing patients with different causes of stroke, stroke lesion, time to start treatment, and spasticity severity at baseline were not possible [34].

Second, the limited methodological quality of the present clinical trials prevents from drawing a solid conclusion. Smith et al. [54] found a higher proportion of positive results for poor-quality than high-quality studies. Cai et al. [32] found that only 40.9% of included studies used proper randomization methods and none reported adequate allocation concealment, which might lead to overestimation of the effects [55]. Insufficient blinding may also result in exaggeration of the estimated efficacy [56]. Admittedly, blinding of therapists who perform acupuncture would be difficult. Sham acupuncture can be used to blind patients and other care providers to reduce the potential placebo effect. One study compared Chinese medical acupuncture with minimal acupuncture (a form of sham acupuncture, needles are inserted to a shallower depth and not at true acupuncture points) [57]. The research found that minimal acupuncture could significantly improve the psychological subscore of the Multiple Sclerosis Impact Scale. At the same time, the attempt to reduce assessment bias of trials is needed in future research. All outcomes should be assessed by outcome assessors who are blinded to the allocation. Cai et al. [32] also found that sensitivity analysis with low risk of bias in outcome assessors reduced heterogeneity to 0%.

Third, the high heterogeneity among studies limits the generalizability of the results. Besides study quality, disease-related individual differences and varied treatment regimens can both result in heterogeneity. For example, for studies of the effect of acupuncture on poststroke spasticity, the stroke type, lesion location, duration before starting acupuncture after the onset of stroke, and spasticity severity of stroke survivors could affect the therapeutic effect and restrict the range of applications to the population. In addition, because most participants were Chinese, generalizing results to other populations is questionable [32]. Different acupuncture treatment protocols including timing, type, duration, acupoints, and intensity can also lead to clinical heterogeneity.

Finally, poor reporting quality is likely to decrease the credibility and application of the results. Cai et al. [32] compared the key items reported in the included studies with those recommended by the STandards for Reporting Intervention in Clinical Trials of Acupuncture (STRICTA) guidelines [58]. Only the style of acupuncture, needle stimulation, number of treatment sessions and frequency and duration of treatment were reported for all included trials. Most of the included studies reported the acupoint selection, details of needling and other interventions and gave a precise description of control methods. Park et al. [34] found that none of the included trials reported the acupuncturists' background. We also found that most studies did not report the long-lasting effects of acupuncture, and adverse effects were barely mentioned.

In the future, efforts should be made to increase methodological quality during the whole research, including the research design, implementation, and report. Particularly, researchers should:

- use appropriate methods to generate the allocation sequence in sufficient detail;
- use proper methods to conceal the allocation sequence in sufficient detail;
- use placebo or sham acupuncture as the control for blinded participants;
- ensure the outcome assessors are blinded to allocation sequence;
- use standard validated spasticity outcome measurements and publish the results in a usable form to facilitate meta-analysis;
- set long-term follow-up;
- report intervention details according to STRICTA guidelines;
- assess the immediate and long-lasting effects;
- critically assess adverse events [58,59].

Disclosure of interest

The authors declare that they have no competing interest.

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