

Antispastic Effect of Electroacupuncture and Moxibustion in Stroke Patients

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Abstract: Spasticity is a frequently observed motor impairment that develops after stroke. The objective of this study was to evaluate the efficacy of electroacupuncture (EA) and moxibustion (Mox) on spasticity due to stroke. The subjects consisted of 35 stroke patients with elbow spasticity whose mean duration of stroke was 2.97 months. Fifteen patients were randomized to the EA group, ten to Mox, and ten to control. Every other day, 30 minutes of electrical stimulation with a frequency of 50 Hz was given through four needles on the *Ch'ü-Ch'ih-San-Li* (LI-11–LI-10) and *Wai-Kuan-Ho-Ku* (TB-5–LI-4) points of the paretic side. Direct Mox was applied to *Ch'ü-Ch'ih* (LI-11), *San-Li* (LI-10), *Wai-Kuan* (TB-5) and *Ho-Ku* (LI-4) points three times a day every other day. The control group was given only the routine acupuncture therapy for stroke and range of motion (ROM) exercise, which were also applied to the EA and Mox groups. The efficacy of treatment was measured before, immediately, 1 hour, 3 hours, 1 day, 5 days, 10 days and 15 days after the start of treatment using a modified Ashworth scale (MAS). In the EA group, spasticity was significantly reduced immediately, 1 hour and 3 hours after treatment ($p < 0.05$). Reductions were significant on the 5th day and thereafter ($p < 0.05$). In the Mox group, there was no significant change in the MAS scores after the first treatment. In the Mox and control group, there was no significant change in MAS scores. This study suggests that EA can temporarily reduce spasticity due to stroke, and if applied repeatedly it can maintain reduced spasticity.

Keywords: Electroacupuncture; Spasticity; Stroke; Moxibustion.

Introduction

Spasticity is a form of muscular hypertonicity associated with increased deep reflexes (Young and Delwaide, 1981) and is a common sequela of central nervous system disorders, including

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stroke, due to lesions that affect descending tracts in the brain and spinal cord that normally inhibit spinal reflex pathways (Gelber *et al.*, 2001). Spasticity is also a common complication in patients with stroke (Bakheit *et al.*, 2000). This abnormal excessive muscle tone can cause many problems, including pain, loss of free movement of a limb, and interference with the ability to walk and perform daily activities, such as bathing or dressing (Meythaler *et al.*, 1996). It also may cause the limb to become "fixed" or frozen in an uncomfortable position.

So far, spasticity management has been accomplished through selective use of various therapeutic interventions, which include physical therapy, pharmacologic agents (Kim *et al.*, 1988; Armstrong *et al.*, 1997; Brenneisen *et al.*, 1996), nerve blocks (Jeon *et al.*, 1996; Grazko *et al.*, 1995; Stuart *et al.*, 1996), surgical operation (Kim and Kim, 1993; Chung *et al.*, 1996) and electrical stimulation (Baik *et al.*, 1996; Paek *et al.*, 1997; Han *et al.*, 1994; Yu, 1993). In Oriental medicine, acupuncture (Paek *et al.*, 1997; Yu *et al.*, 1995) and electroacupuncture (Yu, 1993) have been used to treat spasticity and many studies have shown effectiveness in treating spasticity through clinical trials. However, there are still arguments as to how long they can reduce spasticity and whether they can maintain reduced spasticity.

This study was designed to evaluate whether electroacupuncture (EA) and moxibustion (Mox) can reduce spasticity due to stroke in terms of their cumulative effect.

Subjects and Methods

Patients

The prospectively recruited patient population consisted of 35 stroke patients with elbow spasticity who were more than 5 weeks out from the onset of stroke. Patients were recruited in a consecutive manner among those who were admitted to an Oriental medical hospital, Kyung Hee University Medical Center, for rehabilitation therapy for stroke and whose admission was within 2 days. Stroke was diagnosed by neurological findings and CT scan or MRI of the brain. After informed consent, patients were randomized to one of three study groups: the EA group, the Mox group and the control group.

Fifteen patients were randomized to the EA group, ten to Mox, and ten to control. Sixteen of the patients were men and 19 were women, evenly distributed amongst the groups. The mean age of the patients was 62 years (range 40 to 76 years) and mean duration of stroke was 2.97 months (range 1.3 to 6.3 months). There were no significant differences in ages and durations among groups. The characteristics of the subjects are shown in Table 1.

Treatments

All patients of the three groups received the same routine acupuncture therapy for stroke and range of motion (ROM) exercises once a day, which had been ongoing since admission. Acupuncture therapy was given at acupoint *Pai-Hui* (Go-20), *Shuei-Ko* (Go-26), *Cheng-Chiang* (Co-24), *Ch'ü-Ch'ih* (LI-11), *San-Li* (LI-10), *Wai-Kuan* (TB-5), *Ho-Ku* (LI-4), *Tsu-*

San-Li (St-36), *Hsüan-Chung* (GB-39), and *T'ai-Ch'ung* (LI-3) on both paretic and non-paretic side. Disposable, 26-gauge stainless steel needles (Dongbang Acupuncture Inc., Korea) were used in this study and were kept in place for 30 minutes each time.

For the EA group, electrical stimulation (GFP-91, Siemui Co, Japan) was applied every other day for 15 days (eight treatment sessions in total). A frequency of 50 Hz was given to four needles on the *Ch'ü-Ch'ih-San-Li* (LI-11–LI-10) and *Wai-Kuan–Ho-Ku* (TB-5–LI-4) points of the paretic side, which were kept in place for 30 minutes each time. The amplitude was adjusted to be strong enough for patients to feel stimulation but not to elicit visible muscle contractions.

For the Mox group, direct Mox was applied to *Ch'ü-Ch'ih* (LI-11), *San-Li* (LI-10), *Wai-Kuan* (TB-5) and *Ho-Ku* (LI-4) points three times a day every other day. The moxa (Dongbang Acupuncture Inc., Korea) used was in a cone shape of 1.4 cm diameter and 1.5 cm height.

The control group was given only the routine acupuncture therapy for stroke and ROM exercises as described above.

For all patients, treatment with nerve blocks or surgical operation for spasticity was not allowed during this study. However, in patients who had been administered antispasticity drugs such as baclofen before the study, previous dosage was allowed to continue during this study.

Table 1. Characteristics of Subjects

	Subject Group		
	EA (n = 15)	Mox (n = 10)	Control (n = 10)
Age (Years, Mean ± SD)	58.2 ± 10.8	63.9 ± 9.2	65.1 ± 7.9
Male Sex (n)	7	5	4
Duration of Stroke (Months, Mean ± SD)	3.7 ± 3.7	2.5 ± 1.8	2.7 ± 1.4
Stroke Type			
Hemorrhage (n)	6	4	3
Infarction (n)	9	6	7
Side of Rigidity			
Right (n)	8	5	4
Left (n)	7	5	6
Brain Lesion			
Cortex (n)	2	3	3
Subcortex (n)	10	6	7
Brainstem (n)	3	1	0

EA: Electroacupuncture group, Mox: moxibustion group.

Assessments

The efficacy of treatment was evaluated with the modified Ashworth scale (MAS) (Table 2) (Ashworth, 1964; Bohannon and Mellisa, 1987). All assessments were performed by the same investigator to reduce inter-rater error. In the experimental groups (EA and Mox groups), to assess the effect of one-time treatment with EA or Mox, patients were assessed before, immediately, 1 hour, 3 hours and 1 day after the first treatment. To assess the cumulative effect of repeated EA and Mox treatment, patients were assessed at 5, 10 and 15 days after treatment began. The measurements were obtained at least 24 hours after the most recent treatment to exclude any short-term effects. In the control group, the MAS was measured at the corresponding time to the experimental groups: at the beginning of observation, 1st day, 5th day and 15th days.

Table 2. Modified Ashworth Scale (MAS)

Grade	Description
0	No increase in muscle tone.
1	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end.
2	Slight increase in muscle tone, manifested by a catch followed by minimal resistance throughout the remainder (less than half) of the ROM.
3	More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved.
4	Considerable increase in muscle tone, passive movement difficult.
5	Affected part(s) rigid in flexion or extension.

Statistical Analysis

The results were expressed as mean \pm SD. Statistical analysis was performed using SPSS version 7.5. We compared MAS measured before treatment with those after treatment using the Wilcoxon signed ranks test. We also analyzed the relationship between MAS and treatment duration using Spearman's rho correlation coefficient. Significance of these statistical analyses was set at $p < 0.05$.

Results

Changes of MAS After the First Treatment

In the EA group, spasticity was significantly reduced immediately, 1 hour and 3 hours after treatment over pre-treatment level ($p < 0.05$) (Table 3).

In the Mox group, the changes in MAS scores after the first treatment were not statistically significant (Table 3).

Table 3. Changes in MAS After the First Treatment

Group	Before Treatment	After Treatment			
		Immediately	1 hour	3 hours	24 hours
EA	3.3 ± 1.04	1.9 ± 1.33*	2.3 ± 1.18*	2.9 ± 0.99*	3.1 ± 1.10
Mox	3.2 ± 1.23	2.9 ± 1.20	2.9 ± 1.20	3.0 ± 1.25	3.2 ± 1.14

Values are mean ± SD. EA: Electroacupuncture group, Mox: moxibustion group. *p < 0.05 compared with before treatment by Wilcoxon signed ranks test.

Changes of MAS According to Treatment Period

In the EA group, significant reduction of spasticity was achieved on the 5th day after treatment compared with before treatment (p < 0.05), and maintained for the following observations (Table 4).

In the Mox and control group, there were no significant changes among each MAS score measured during treatment period (Table 4).

Table 4. Changes in MAS According to Treatment Period

Group	Before Treatment	Treatment Period			
		1 Day	5 Days	10 Days	15 Days
EA	3.3 ± 1.04	3.1 ± 1.10	2.7 ± 0.98*	2.3 ± 0.81*	2.1 ± 0.80*
Mox	3.2 ± 1.23	3.2 ± 1.14	3.0 ± 1.15	3.1 ± 1.20	3.1 ± 1.29
Control	3.5 ± 0.71	3.4 ± 0.70	3.4 ± 0.84	3.4 ± 0.84	3.2 ± 0.79

Values are mean ± SD. EA: Electroacupuncture group, Mox: moxibustion group. *p < 0.05 compared with before treatment by Wilcoxon signed ranks test.

Correlation Between MAS and Treatment Period

In the EA group, there was an inverse correlation between MAS and treatment duration (Spearman's rho -0.439, p < 0.01).

Discussion

In Oriental medicine, acupuncture (Paek *et al.*, 1997; Yu *et al.*, 1995) and EA (Yu, 1993) have been used to treat spasticity. So far, there have been several reports showing the effectiveness of acupuncture or EA on spasticity. Yu (1993) reported that EA applied on the surface at two pairs of acupoints with short term application (30 minutes) of high-frequency EA (100 Hz) produced an immediate antispastic effect in patients with spinal spasticity while low-frequency EA (2 Hz) showed no effect, and that this antispastic effect continued with the application of high-frequency EA (2 times/day, 30 minutes/time) over 3 months. Han *et al.* (1994) reported that high-frequency (100 Hz) stimulation with the transcutaneous

electrical nerve stimulator (TENS) produced ameliorating effects on muscle spasticity in 32 patients with spinal spasticity, which lasted for only 10 minutes after one stimulation but became consolidated after consecutive daily treatments for 3 months, while low-frequency (2 Hz) stimulation had no effectiveness. Yu *et al.* (1995) reported that the mean H-reflex recovery time of the paretic limbs in stroke patients was significantly shorter than that of normal controls and became significantly prolonged after acupuncture compared with that before acupuncture, which meant that acupuncture decreased the stimulation of spinal motor neurons and led to lower muscle spasticity. Baik *et al.* (1996) reported that when they applied low-frequency EA (4 Hz, 15 minutes/time) on pairs of acupoints on lower extremities in 21 patients with spasticity, including six with traumatic brain injury, seven with spinal cord injury and eight stroke subjects, spasticity reduction was shown for 24 hours or more in spinal cord injured subjects and 3 hours or more in traumatically brain injured and stroke subjects. Paek *et al.* (1997) reported that reduced spasticity was observed in both a TENS (100 Hz) application group and an acupuncture application group, both of which were stroke patients with spasticity.

As for the frequency of electrical stimulation, it can be divided into three categories according to the ranges of frequency: low (< 10 Hz), middle (10–100 Hz) and high (> 100 Hz) (Filshie and White, 2001). Yu (1993) and Han *et al.* (1994) reported that low-frequency (2 Hz) stimulation showed no antispastic effect unlike high-frequency stimulation. This result might be related to differences in neurotransmitters released following different frequencies of electrical stimulation. It has been shown in studies of acupuncture analgesia that endogenous opioid peptides were released in response to low frequency electrical stimulation, while serotonin and dynorphin were released with high frequency electrical stimulation (Filshie and White, 2001). In this study using mid-frequency stimulation (50 Hz), we found that EA temporarily reduced spasticity due to stroke, and when it was applied repeatedly, reduction of spasticity was maintained until the 5th day after treatment began. Our result was similar to previous reports with high-frequency stimulation.

The mechanism of the effect of EA on spasticity has not been fully understood. It has been said that EA reduced increased spinal motor neuron excitability (Kendall, 1989). Yu (1993) inferred that high-frequency EA enhanced the production of dynorphin in cerebrospinal fluid (CSF) and then decreased the excitability of the motor neurons in the anterior horns through the kappa opiate receptors, thus ameliorating muscle spasticity of spinal origin. Han *et al.* (1994) reported that the antispastic effects induced by high-frequency electrical stimulation could be partially reversed by a high dose of naloxone, which they suggested that the antispastic effect elicited by peripheral electrical stimulation was mediated, at least in part, by an endogenous opioid ligand interacting with the kappa opiate receptors in the central nervous system.

Mox therapy did not show effectiveness in reducing spasticity after stroke in this study, even though it has been used to treat motor impairments after stroke from ancient times in Oriental medicine. However, to determine the effect of Mox on spasticity, further studies with different treatment durations and different amounts of Mox per treatment will be needed.

In conclusion, we suggest that EA can temporarily reduce spasticity due to stroke, and can maintain reduced spasticity when applied repeatedly. Further investigation is needed to show the mechanism of the effect of EA on spasticity due to stroke.

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