J. Phys. Ther. Sci.
25: 725–728, 2013

Effects of Electro-Acupuncture Therapy on Post-Stroke Depression in Patients with Different Degrees of Motor Function Impairments: a Pilot Study

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Abstract. [Purpose] The present study examined whether electro-acupuncture therapy reduces post-stroke depression (PSD) and whether motor function impairments interact with the effects of the therapy. [Subjects] Twenty-eight PSD patients were assessed and assigned to either a good or poor motor function group depending on their motor grade. [Methods] The Beck Depression Inventory (BDI), Hamilton Depression Rating Scale (HDRS) and Manual Muscle Test (MMT) were administered at the screening and initial phases of the study, and at the 4th, 8th, 12th and 16th week of the daily electro-acupuncture treatment. [Results] The electro-acupuncture treatment reduced PSD (as assessed by BDI and HDRS) of the patients. In particular, the depression of the good motor function group was significantly more reduced than that of the poor motor function group. The degree of motor function impairment did not change throughout the study in either group. [Conclusion] The results of the present study demonstrate that electro-acupuncture therapy can improve PSD, and that the treatment effect varies depending on the degree of motor function impairment.
Key words: Post-stroke depression, Electro-acupuncture, Motor function impairment

(This article was submitted Jan. 9, 2013, and was accepted Feb. 15, 2013)

INTRODUCTION

Stroke patients suffer from deterioration of physical ability, but in many cases emotional problems such as depression also accompany the physical symptoms. Post-stroke depression (PSD) has been estimated to occur in 33% of patients in the acute stage and in 34% over the long term after stroke[1)]. PSD has a negative impact on rehabilitation processes, but the underlying mechanism of PSD is not completely understood[2–4)].

Several epidemiological studies have shown that PSD is associated with increased disability, and poor functional and cognitive outcomes of stroke survivors[5, 6)]. This association is observed not only in disabled stroke patients but also in those who seem to be functionally independent in their activities of daily living[7)]. Thus, it is important to reduce PSD to improve stroke outcomes and quality of life of stroke patients. Although there is evidence that pharmacological treatments (e.g. tricyclic antidepressants and selective serotonin-reuptake inhibitors) have some beneficial effects on PSD, they may also have some side-effects (e.g. cardiovascular or gastrointestinal side-effects, sexual dysfunction and sleep disturbance)[1)]. In addition, it is hard to achieve a complete remission of PSD through drug treatments[1)]. Thus, to reduce or prevent PSD of stroke patients, combinations of pharmacological and non-pharmacological therapies are recommended[1)].

Many studies have turned to acupuncture as a non-pharmacological treatment for PSD[8–12)]. However, the effects of acupuncture on PSD have not been consistent, and as a result, it is not yet clear that acupuncture is an effective treatment for PSD[13–15)]. One of the reasons for the inconsistent findings may be that the patient samples may have been different in different studies. For example, some studies may have used patients with poor motor function, whereas other studies may have used patients with relatively good motor function. There is evidence that PSD is associated with increased disability in stroke patients[5, 6)], suggesting that acupuncture may have different effects on PSD, depending on the degree of motor impairments of stroke patients.

The purpose of the present study was twofold. First, we investigated whether acupuncture is an effective treatment for PSD. Second, we examined whether the effect of acupuncture differs according to the degree of motor function impairments of the stroke patients. Thus, we divided stroke patients into two groups according to a manual motor test,

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i.e., good vs. poor motor function groups, gave daily electro-acupuncture treatment for 16 weeks, and measured the severity of PSD at several time points during the treatment period.

SUBJECTS AND METHODS

Participants were recruited from the stroke clinic of the Wonkwang University Gwangju Medical Center. Twenty-eight patients with PSD were originally selected. At the screening, participants signed an informed consent form approved by the Wonkwang University Gwangju Medical Center and were given the Korean version of Beck Depression Inventory II (BDI)[16] and Hamilton Depression Rating Scale (HDRS)[17], both of which are the most widely used instruments for measuring the severity of depression in Korea. The higher the total score each patient receives in the test, the more severe the depressive mood. The Manual Muscle Test (MMT)[18] of stroke patients was conducted by experienced neurologists on the same day as the depression scale assessments. We conducted MMT of the shoulder, elbow, wrist, hip, knee and ankle joints on the paretic side and calculated average scores from them. The subjects were assigned to either a good or a poor motor function group according to their MMT results. A previous study divided stroke patients into good (MMT, 4–5) and poor (MMT, 0–3) motor function groups[19]. In our study, stroke patients were divided into good (average MMT 2.5 or above) and poor (average MMT under 2.5) motor function groups by a mid-point of 6 schematic grades (from 0 to 5). The mid-point between grade 3 and 2 is a critical point, because the grades of 0, 1 and 2 are tested in a gravity-minimized position and all other grades are tested in an anti-gravity position[20]. These depression scale assessments were repeated every four weeks to find out the time course of the treatment effects.

The inclusion criteria of this study were as follows: a diagnosis as cerebral infarction based on CT or MRI; BDI score ≥ 14 and HDRS score ≥ 7; and no treatment history related to PSD in the past 3 months. Exclusion criteria were as follows: history of main depressive disorder, psychosis or mania; serious uncontrolled medical conditions; multiple or bilateral lesion; transient ischemic attack without progression to stroke; or communication problems, i.e. speech disorder, cognitive dysfunction. Based on the acupuncture literature, we selected the HT-7, LI-4, ST-36, SP-6 and LR-3 acupuncture points bilaterally and stimulated all the points at the same time with a 2 Hz electrical current continuously for 20 min. We treated all subjects with the same protocol every day for 16 weeks. All subjects were eligible for per trial analysis, based on finishing all scheduled follow-ups after initiation of the electro-acupuncture treatment.

Depression scores were analyzed with repeated-measures ANOVA with Group as between-subject and Time as within-subject factors. In order to compare degrees of improvement between the two groups, the t-test was conducted. Values of $p < 0.05$ were considered statistically significant in all comparisons.

RESULTS

Twenty-eight patients (16 females and 12 males, age range 47–78, mean age 64.89 ± 7.36 years) were recruited; and there were 14 subjects in each group. Table 1 shows the characteristics of the good and the poor motor function groups. The two groups did not differ in terms of age ($t = 0.065$, $p = 0.801$), gender ($\chi^2 = 0.445$, $p = 0.704$), medication ($\chi^2 = 0.710$, $p = 0.871$), or stoke characteristics ($\chi^2 = 1.363$, $p = 0.506$). The motor grade of all the participants did not change throughout the study, except for one patient whose score changed from grade 1 to 2.

Table 2 shows the BDI and HDRS scores of the two groups. The BDI and HDRS scores did not differ with respect to gender (data not shown, $p > 0.3$ for all) or between the two groups on the first day of the treatment ($t = -0.651$, $p = 0.521$ and $t = -1.688$, $p = 0.103$, respectively for BDI and HDRS), indicating that the two groups were homogeneous at the beginning of the study in terms of the severity of depression. Repeated-measures ANOVA revealed a sig-

Table 1. Characteristics of the good and the poor motor function group patients with post-stroke depression

Characteristics		Good motor function patients (n = 14)	Poor motor function patients (n = 14)
Demographic	Age	67.43 ± 7.08	62.36 ± 6.97
	Male, n (%)	7 (58.33)	5 (41.67)
Medication, n (%)	Cardiac disease	2	1
	Diabetes mellitus	3	4
	Hypertension	6	5
	Mixed	3	4
Stroke characteristics, n (%)	Right hemisphere	6	8
	Left hemisphere	7	6
	Brainstem/other	1	
	Days post-stroke	74.79 ± 10.35	77.00 ± 10.79
	Manual Motor Grade	4.43 ± 6.65	2.28 ± 0.49

Data are presented as mean ± SD. Mixed: combination of cardiac disease, diabetes mellitus and hypertension

nificant main effect of time (Wilks' Lambda = 0.284, $F_{4, 23}$ = 14.48, $p < 0.001$, and Wilks' Lambda = 0.342, $F_{4, 23}$ = 11.04, $p < 0.001$, respectively for BDI and HDRS), indicating that depression status generally improved during the treatment sessions, and there was no significant interaction effect of Time×Group (Wilks' Lambda = 0.759, $F_{4, 23} = 1.83$, $p = 0.158$, and Wilks' Lambda = 0.816, $F_{4, 23} = 1.29$, $p = 0.302$, respectively for BDI and HDRS). In both groups, the BDI and HDRS scores of the first day of the treatment were significantly higher than those of the other test days ($p < 0.01$ for all) except for the 4th week for BDI ($p = 0.057$). These findings indicate that the electro-acupuncture treatment started to have a treatment effect within the first four weeks of the treatment.

The results of the t-test showed that the BDI and HDRS scores of the good motor function group were significantly lower than those of the poor motor function group on the 12th and 16th week of the treatment ($t = -2.107$, $p < 0.05$ and $t = -2.499$, $p < 0.05$, respectively for BDI and HDRS scores on the 12th week; and $t = -2.410$, $p < 0.05$ and $t = -2.368$, $p < 0.05$, respectively for BDI and HDRS scores on the 16th week).

DISCUSSION

The main finding of this study is that the PSD (as assessed by BDI and HDRS) was reduced by daily electro-acupuncture treatment. Moreover, the treatment effect was more pronounced for the good motor function group than for the poor motor function group. It is noteworthy that the good motor function group continued to improve in terms of depression status until the end of the study, while the poor motor function group reached an asymptotic level by the 12th week. Because the motor grades did not change throughout the study, these effects cannot be explained by improvement in motor function.

These findings are consistent with previous studies[8–12] reporting improvement of PSD due to the electro-acupuncture treatment. However, as these previous studies did not provide detailed protocols and results in English, it is hard to make direct comparison between these previous results and those of the present study.

In the present study, PSD improved significantly more in the good motor function group than in the poor motor function group. Stroke is characterized by limited ambulation due to impairment of motor function. Because evidence suggests that exercise improves the depression of stroke patients[21–24], one might argue that more ambulation in the good motor function group as compared to the poor motor function group contributed to the improvement observed in depression. Since we did not have control groups that did not receive the treatment for ethical reasons, it is not possible to know if our patients would have improved without the treatment. Some studies have evaluated the effects of acupuncture on PSD against control groups that did not receive the treatment[8–12]. However, those studies did not control for motor function of the patients, and some studies failed to report significant effects of acupuncture on PSD[15]. Our results make it clear that the improvement in PSD was not a result of improvement of motor function, and suggest that the treatment effect varies depending on the degree of motor function impairment.

We also found the PSD was reduced in the 4th week after the start of the daily treatment. This finding suggests that the improvement in depression begins within four weeks after the start of daily electro-acupuncture treatments. If this finding can be replicated by more frequent measurements within the first four week period, it would have important implications regarding when the electro-acupuncture treatment starts to have an effect on PSD.

A limitation of this study was that it was an open study without a negative control group; therefore, our results should be viewed as preliminary. It is possible that PSD improvement was the result of a placebo effect or the passage of time. Another limitation was the small sample size. While we were able to demonstrate significant improvement in PSD after electro-acupuncture treatment, this effect needs to be verified with a larger sample.

In summary, the findings of the present study show that the PSD can be ameliorated by electro-acupuncture treatment and that the PSD improvement of stroke patients with good motor grade is greater than that of stroke patients with poor motor grade. Further studies are needed to investigate the neurological and psychological mechanisms underlying

Table 2. Changes in depression scores in the good and the poor motor function groups with post-stroke depression

Depression scale	Group	Measurements					
		At the screening	At the beginning	At the 4th week	At the 8th week	At the 12th week	At the 16th week
BDI	Good motor function group	16.50 ± 5.53	17.00 ± 5.42	14.50 ± 6.11	11.29 ± 6.52**	10.14 ± 4.85**, †	9.79 ± 4.85**, †
	Poor motor function group	17.86 ± 6.19	18.43 ± 6.17	17.14 ± 5.86	14.57 ± 6.10**	15.29 ± 7.74**	14.57 ± 5.63**
HDRS	Good motor function group	13.14 ± 3.66	13.79 ± 3.42	10.86 ± 3.92**	9.71 ± 5.15**	9.07 ± 3.95**, †	8.07 ± 3.69**, †
	Poor motor function group	15.14 ± 3.11	15.86 ± 3.06	14.29 ± 4.14**	12.14 ± 4.24**	13.29 ± 4.92**	12.71 ± 6.34**

Data are presented as mean ± SD. BDI: The Korean version of the Beck Depression Inventory II. HDRS: Hamilton Depression Rating Scale. ** $p < 0.01$, comparison with the beginning measurement, † $p<0.05$, comparison between the good and poor motor function groups

this antidepressant effect of electro-acupuncture treatment on PSD patients.

ACKNOWLEDGEMENTS

This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (MEST) (2010-0029468) and a grant of the Traditional Korean Medicine R&D Project, Ministry for Health & Welfare & Family Affairs, Republic of Korea (B110010). All authors contributed equally to this research as first authors.

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