Dystonia. Reflexions on movement
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Download date: 08 Dec 2018
Electroacupuncture in movement disorders after peripheral trauma. A soleus H-reflex study

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Six patients with a dystonic or segmental myoclonic movement disorder of probable peripheral origin repeatedly showed a beneficial, albeit temporary, response to electroacupuncture. To elucidate whether segmental sensorimotor pathways are involved in the abnormal movements, and whether electroacupuncture influences these segmental pathways, soleus H-reflex tests were performed before and immediately after acupuncture. Soleus H-reflex tests before acupuncture showed normal H/M ratio, increased late facilitation of the recovery curve and diminished vibratory inhibition. After acupuncture, concurrent with a beneficial response of the movement disorder, late facilitation and vibratory inhibition normalized. We suggest that abnormal afferent input is involved in the generation of abnormal movements in these patients. Electroacupuncture, by its afferent stimulation, probably alters the modulation of afferent input, allowing polysynaptic spinal and supraspinal pathways involved in motor control to resume normal function.
Introduction

Acupuncture is recognized to have beneficial effects in a number of disorders (Culliton 1997). In pain syndromes the beneficial effect is likely to be mediated by release of endorphins in the central nervous system (Culliton 1997). Which mechanisms are involved in other medical conditions in which acupuncture has therapeutic value remains uncertain. In the past we noticed that electroacupuncture was effective in some patients with segmental myoclonus after laminectomy for radiculopathy or after abdominal surgery (Jankovic and Pardo 1986; Horstink and Wong-Chung 1990). The same beneficial effect was seen in some patients with focal dystonia after peripheral trauma. To elucidate the influence of electroacupuncture upon pathophysiological mechanisms involved in motor control of the leg, six patients with a movement disorder of the leg of probable peripheral origin were studied with soleus H-reflex tests. All six patients repeatedly had shown a dramatic albeit temporary beneficial response to acupuncture whereas other therapies had failed. Soleus H-reflex tests were performed immediately before and after acupuncture (Delwaide 1984; Schieppati 1987; Koelman et al. 1995a).

Methods

Patients

All six patients (table 1) participating in the present study attended the center for movement disorders at the department of Neurology of the University Medical Center at Nijmegen. In none of the patients ancillary investigations such as electromyography, sensory evoked potentials, imaging of the brain, caudal roots and spinal cord, and examination of the spinal fluid, revealed additional abnormalities. In all patients other treatments such as psychotherapy, physiotherapy, and different kinds of medication including benzodiazepines, anticholinergics, antidepressants and muscle relaxants, had been tried in the past without success.

All patients had a clinical examination just before the neurophysiological testing (J.K.), after which electroacupuncture was administered (R. W-C). After electroacupuncture a second clinical examination followed and thereafter neurophysiological tests were
repeated. The whole procedure was performed on the same day.

Case reports

Patient 1 is a 57-year-old woman, who developed at the age of 46, an irregular myoclonus in the right leg on standing and sitting following a period of backache after uterus surgery. Walking was relatively undisturbed. In supine position the right leg was held flexed in the knee, straightening of the leg induced tremulous activity. At the age of 31 she also had myoclonus, when giving birth to a stillborn child, which diminished gradually in the weeks thereafter. Electroacupuncture had an immediate beneficial effect lasting for one week.

Patient 2 is a 49-year-old woman, who developed at the age of 46 irregular myoclonic movements in the right leg after a hysterectomy. Minor complaints were already present since giving birth and curettage at the age of 35. On the right side, rotational movements in the hip with flexion and extension movements in the knee gradually worsened, resulting in a peculiar gait disorder, and swinging flexion and extension movements in the elbow developed. She became wheelchair bound because walking and sitting were impossible without assistance. These late, secondary abnormalities of movement were thought to be psychogenic. After electroacupuncture the movements resolved completely for ten days.

Patient 3 is a 54-year-old man, who developed at the age of 45 tremulous myoclonus with a frequency of 4 to 5 Hz in the right leg, shortly after surgery for a lumbar disc protrusion causing radicular pain. The right foot was held adducted in the ankle. Movements persisted in sleep. Neurological examination revealed hypaesthesia of the lateral side of the right leg. The diagnosis of postradicular segmental spinal myoclonus was tentatively made. After three sessions of electroacupuncture abnormal movements and pain resolved completely. The benefit of acupuncture lasted about a month, but strain shortened the effect.

Patient 4 is a 39-year-old woman, who developed at the age of 35 flexion and extension movements in the right knee two days after bladder surgery for stress incontinence. Immediately after operation she had experienced violent pains in the right leg and walking had been queer. Sometimes similar movements occurred in the left knee. The right more often than the left foot was cold and pale. When standing on the right foot, there were shaking flexion and extension movements of the knee. A tentative diagnosis of segmental spinal myoclonus after traumatic lumbosacral plexus...
injury was made. After two sessions of electroacupuncture walking was normal for some hours. Eventually benefit of acupuncture lasted for one week, but strain shortened the effect.

Patient 5 is a 31-year-old woman who developed at the age of 29 dystonic posturing of the left foot with periods of weary feelings, blue discoloration and coldness of the left foot. On examination the foot was inverted but could be redressed passively with ease. She walked on the outer side of the left foot. Dystonic posturing was suspected to be part of a complex regional pain syndrome. After successive electroacupuncture sessions, foot position normalized within one month and autonomic features gradually disappeared completely.

Patient 6 is a 42 year-old woman, who developed at the age of 30, a dystonic movement disorder predominantly in the lower extremities, provoked by exercise and walking, after a caesarean section. It consisted of inversion and plantar flexion of the feet. To a small extent dystonic movements were also present in both arms but more pronounced in the right one. Family history was unrevealing. Although dystonia musculorum deformans was considered the predominance of pain and the fixed postures were more suggestive of peripherally induced dystonia. Electroacupuncture had an immediate beneficial effect that lasted for one month. With electroacupuncture once a month she remained almost symptom free.

Electroacupuncture

Electroacupuncture was applied according to traditional Chinese rules and consisted of scalp acupuncture of the so-called contralateral zones of Chorea and Tremores, which lie over the premotor cortex. This was combined with acupuncture of the ipsilateral paravertebral acupuncture points between the ninth thoracic and second lumbar vertebrae, which points are thought to influence the lower extremities (Shunfa 1981; O'Connor and Bensky 1981; Zeitler 1985; Yau 1984). Scalp and paravertebral acupuncture points were stimulated electrically with a multiple electroacupunctoscope WQ 10C2 (Beying, China). Frequency modulation of the electrical stimulation ranged from 20 to 80 Hz. Stimulus intensity of electrical stimulation was adjusted by the patient up to pain threshold. Additional acupuncture points could be selected for individual patients, if necessary. Therapy sessions lasted 45 to 60 minutes.
Soleus H-reflex tests

Recording and stimulation techniques for the soleus H-reflex have been described previously (Hugon 1973; Bour et al. 1991; Koelman et al. 1995a). During all tests subjects were seated in a reclining chair in a standardized position. Soleus H-reflexes were elicited only in the absence of triceps surae EMG activity, which was noted on the oscilloscope at the beginning and end of each reflex study. In addition, EMG activity was monitored aurally during the investigation. The H-reflex was discarded, if there was any soleus activity prior to tibial nerve stimulation. Soleus H-reflex responses were elicited by 1 ms square constant current pulses to the posterior tibial nerve in the popliteal fossa. Responses were amplified with a band-pass filter of -3 dB at 2 Hz and 10 kHz, filter roll off was 6 dB/octave, and digitally stored with a sample frequency of 10 kHz in a mini-computer (PDP 11/73). The time interval between successive trials during the examination was at least 30 seconds. For the construction of an H-reflex recruitment curve as a function of stimulus intensity, intensity increment of successive stimuli was chosen small at low intensity levels, while it was gradually enlarged at higher intensity. Each recruitment curve consisted of 12 or more H-reflex responses at different intensities. Simultaneously with the H-reflex recruitment curve, a recruitment curve of direct soleus M potentials was constructed also as a function of intensity. Peak-peak (PP) values of the maximal H-reflex response and maximal M-potential were used for the H/M ratio (Ongerboer de Visser et al. 1989).

Vibration of the Achilles tendon with a frequency of 100 Hz and an undamped amplitude of 1 mm was applied by a vibrator (Brüell and Kjær 4809, Denmark). The cumulative vibratory index (CVI) was used as a quantitative measure for the vibratory effects on the H-reflex (Ongerboer de Visser et al. 1989). This CVI is defined as the ratio between the area under the recruitment curves obtained during and without vibration at the stimulus intensity level yielding the maximal H-reflex response was used only (Bour et al. 1991).

H-reflex recovery curves were constructed by application of paired pulses of equal intensity. The stimulus intensity level where the H-reflex reached half its maximum value was used (Bour et al. 1991). Time-intervals between conditioning and test stimulus were 100, 200, 250, 300, 400 and 500 ms and at 1, 3, 10 and 30 seconds. Early facilitation and inhibition were not examined. The recovery curves were plotted as the ratio in percentage between the area values of the test and the conditioning H-reflex response.
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against time-interval between the two stimuli. Two characteristic values were used for statistical analysis (Bour et al. 1991; Koelman et al. 1995a). Firstly, the local maximum of the test H-reflex occurring in the late facilitatory phase (LF) at a stimulus time-interval ranging from 50 to 350 ms. Secondly, the local minimum of the test H-reflex found in the late inhibitory phase (LI) of the recovery curve at a stimulus time-interval ranging from 350 to 1000 ms.

Soleus H-reflex tests in the patients were performed on both sides, immediately before and after electroacupuncture therapy. Recording electrodes over the soleus muscle were kept in place during electroacupuncture.

Controls
The neurophysiological test results found in the patient group were compared with those found in a control group of 48 healthy subjects aged 20-70 years (mean 38 years). The latter results have been published earlier (Koelman et al. 1993).

Statistical methods
Soleus H-reflex test results obtained in the electroacupuncture responsive patients were compared with those seen in the control subjects using unpaired two tailed two sample Student's t tests. Soleus H-reflex test results obtained in the patients before and after electroacupuncture where compared using paired t tests. P values smaller than 0.05 were considered significant.

Results

Clinical features
In five patients the movement disorder was possibly related to abdominal or lumbar spine surgery (table 1). In two patients (nos. 5 and 6) the movement disorder resembled dystonia, and in three patients (nos. 1, 3 and 4) it resembled segmental spinal myoclonus. One patient (no. 2) was thought to suffer from segmental myoclonus, complicated by suspected psychogenic dyskinesia later on. In three patients (nos. 1,3 and 4) pain was a prominent feature at the onset of the involuntary movements. Two patients (nos. 4 and 5) showed autonomic features, such as discoloration and coldness.

At the time of the investigation patients nos. 1 through 4 had irregular abnormal
leg movements. In patient no. 5 the left foot was inverted but could easily be redressed passively, walking was on the outer side of the foot. In patient no. 6 only after exercise some dystonic activity was present in the right leg. During electroacupuncture abnormal movements resolved in patients nos. 1 through 4. In patient no. 5 inversion of the left foot clearly improved, but the foot position remained slightly inverted. In patient no. 6 dystonic activity could not be elicited by exercise anymore.

Table 1. Patients features.

<table>
<thead>
<tr>
<th>Patient</th>
<th>age at onset (years)</th>
<th>duration (years)</th>
<th>related causative factor</th>
<th>clinical diagnosis</th>
<th>acupuncture duration (years)</th>
<th>duration effect of acupuncture (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF</td>
<td>57 (31)46</td>
<td>11</td>
<td>abdominal surgery/</td>
<td>segmental myoclonus</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>postradicular</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2F</td>
<td>49 (35)46</td>
<td>3</td>
<td>abdominal surgery</td>
<td>segmental myoclonus</td>
<td>2.5</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>secondary psychogenic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dystonias</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3M</td>
<td>54 45</td>
<td>9</td>
<td>lumbar surgery/</td>
<td>segmental myoclonus</td>
<td>8</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>postradicular</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4F</td>
<td>39 35</td>
<td>4</td>
<td>abdominal surgery</td>
<td>segmental myoclonus</td>
<td>3.5</td>
<td>1</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5F</td>
<td>31 29</td>
<td>2</td>
<td>complex regional pain</td>
<td>dystonia</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>syndrome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6F</td>
<td>42 30</td>
<td>12</td>
<td>abdominal surgery</td>
<td>dystonia</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

F = female, M = male

Neurophysiological features

The results of the soleus H-reflex tests are presented in table 2. In patients H/M ratio in the symptomatic leg before acupuncture (mean 47%, SD 27%) was similar to H/M ratio in controls (mean 48%, SD 18%) and did not alter after acupuncture (mean 46%, SD 27%). In the non-symptomatic or clinical less affected leg the mean H/M ratio before acupuncture (mean 32%, SD 24%) and after acupuncture (mean 43%, SD 18%) did not differ significantly from H/M ratio in controls, either. Soleus H-
reflex inhibition during vibration (CVI) in the symptomatic leg was less before electroacupuncture (mean 36%, SD 26%) compared to controls (mean 19%, SD 16%, p = 0.03) and returned to normal after electroacupuncture (mean 20%, SD 13%). On the other side CVI before (mean 25%, SD 22%) and after acupuncture (mean 27%, SD 18%) did not differ significantly from CVI in controls. Late facilitation of the recovery curve (LF) in patients was enhanced in the symptomatic leg before acupuncture (mean 180%, SD 100%, p = 0.02) compared to the one in controls (mean 42%, SD 20%) and returned to normal after acupuncture (mean 62%, SD 44%). In the other leg LF before acupuncture (mean 86%, SD 52%) and after acupuncture (mean 50%, SD 39%) were similar to LF in controls. However, within

Table 2. Results of soleus H-reflex tests in individual patients before and after acupuncture and in controls.

<table>
<thead>
<tr>
<th>Patients</th>
<th>Controls (n=48) mean (SD)</th>
<th>H/M ratio (%)</th>
<th>Cumulative vibratory inhibition (%)</th>
<th>Late facilitation of recovery curve (%)</th>
<th>Late inhibition of recovery curve (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>48 (18)</td>
<td>19 (16)</td>
<td>42 (20)</td>
<td>17 (11)</td>
<td></td>
</tr>
<tr>
<td>Side</td>
<td>before - after</td>
<td>before - after</td>
<td>before – after</td>
<td>before - after</td>
<td></td>
</tr>
<tr>
<td>patient 1</td>
<td>R</td>
<td>19 - 19</td>
<td>85 - 18</td>
<td>312 - 78</td>
<td>81 - 41</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>23 - 35</td>
<td>68 - 47</td>
<td>98 - 86</td>
<td>40 - 29</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>17 - 55</td>
<td>29 - 43</td>
<td>173 - 112</td>
<td>76 - 38</td>
</tr>
<tr>
<td>patient 3</td>
<td>R</td>
<td>38 - 25</td>
<td>37 - 34</td>
<td>256 - 31</td>
<td>22 - 9</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>9 - 14</td>
<td>19 - 32</td>
<td>56 - 25</td>
<td>20 - 19</td>
</tr>
<tr>
<td>patient 4</td>
<td>R</td>
<td>31 - 53</td>
<td>15 - 4</td>
<td>230 - 35</td>
<td>16 - 3</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>20 - 37</td>
<td>12 - 30</td>
<td>92 - 39</td>
<td>26 - 5</td>
</tr>
<tr>
<td>patient 5</td>
<td>R</td>
<td>72 - 60</td>
<td>11 - 3</td>
<td>16 - 21</td>
<td>5 - 6</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>82 - 79</td>
<td>15 - 39</td>
<td>55 - 38</td>
<td>30 - 18</td>
</tr>
<tr>
<td>patient 6</td>
<td>R</td>
<td>82 - 74</td>
<td>27 - 17</td>
<td>120 - 46</td>
<td>67 - 6</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>49 - 58</td>
<td>9 - 9</td>
<td>81 - 19</td>
<td>29 - 13</td>
</tr>
</tbody>
</table>

Clinically (most) involved leg in bold. *p < 0.05 compared to controls
the patient group improvement of LF after acupuncture was significant ($p = 0.025$). Late inhibition of the recovery curve (LI) in the symptomatic leg before (mean 43%, SD 26%) and after acupuncture (mean 23%, SD 23%) were similar to the one seen in controls (mean 17%, SD 11%). In the asymptomatic or less affected leg mean LI before (33%, SD 24%) and after acupuncture (18%, SD 13%) were also similar to LI in controls, but within the patient group improvement of LI in that leg almost reached significance ($p = 0.055$).

**Discussion**

The movement disorders of the six patients in the present study showed a beneficial response after acupuncture, concurrent with normalization of spinal inhibitory mechanisms as revealed by the soleus H-reflex tests.

The soleus H-reflex is evoked by stimulation of myelinated muscle spindle afferents (Ia fibers) and appears at lower stimulus intensities and at longer intervals than a direct muscle potential evoked by stimulation of motor nerve fibers (Schieppati 1987). Different soleus H-reflex tests may be used for the study of spinal inhibitory mechanisms involved in motor control of the leg (Delwaide 1984; Koelman et al. 1995a; Floeter et al. 1998). The normal H/M ratio of the soleus H-reflex in the patients before electroacupuncture suggests normal motoneuron excitability (Schieppati 1987). The finding that the motoneuron excitability did not alter with electroacupuncture suggests that the effect of acupuncture is mediated by premotor inhibitory interneurons. Before electroacupuncture inhibition of the soleus H-reflex during vibration was less than after acupuncture. In healthy subjects vibration of the Achilles tendon strongly activates primary spindle endings and may suppress or even abolish the H-reflex response during the vibration (Ongeboer de Visser et al. 1989). This action is predominantly due to an autogenic axoaxonal presynaptic inhibition of Ia terminals through GABAergic interneurons, i.e., classic presynaptic inhibition and probably also to mechanisms intrinsic to presynaptic terminals, i.e., postactivation depression (De Gail et al. 1966; Gillies et al. 1969; Crone et al. 1989; Hultborn et al. 1996; Floeter et al. 1998). In patients with spasticity or dystonia inhibition of the H-reflex during vibration is also decreased (Delwaide 1973, 1984;
Ongerboer de Visser et al. 1989; Koelman et al. 1995a). In spasticity benzodiazepines may increase vibratory inhibition, which in spasticity has been reported also to occur with acupuncture (Delwaide 1983; Milanov 1991).

The H-reflex recovery curve comprises several phases (Schieppati 1987). A late facilitatory phase is present around a time interval of 200 msec between the conditioning and test stimulus and is proposed to be mediated by cutaneous afferents (Gassel 1970; Pierrot-Deseilligny et al. 1973). Facilitatory enhancement of the soleus H-reflex was present in patients before electroacupuncture.

Facilitatory enhancement, also present in dystonia and Parkinsonian rigidity, may reflect activity attributed to polysynaptic pathways running either in the spinal cord or in supraspinal long-loops (Zander Olsen and Diamantopoulos 1967; Sax et al. 1976; Panizza et al. 1990; Koelman et al. 1995a). The normalization of late facilitation after acupuncture concurrent with clinical improvement has also been reported in patients with dopa-responsive dystonia treated with levodopa indicating that alterations in the soleus H-reflex tests in these patients are associated with disturbed movement too (Koelman et al. 1995b).

In our patients onset of involuntary movements appeared to be related with surgery of the abdomen or spine, or with symptoms suggesting a complex regional pain syndrome. Involuntary movements after peripheral trauma are quite variable and may present as a predominantly tonic form of dystonia, tremor, spinal myoclonus, or muscular incoordination, and may occur in the absence of pain (Marsden et al. 1984; Jankovic and Pardo 1986; Schott 1986; Jankovic and van der Linden 1988; Schwartzman and Kerrigan 1990; Iliceto et al. 1990; Veldman et al. 1993; Jankovic 1994; Marsden 1994). The pathophysiological mechanisms involved in movement disorders after peripheral trauma remain uncertain. Noxious and non-noxious afferent stimulation may increase the excitability of polysynaptic spinal reflexes (Andersen et al. 1995; Ellrich and Treede 1998). In patients with segmental myoclonus abnormal functioning of dorsal horn interneurons suggests a spinal origin of excitability changes (Di Lazzaro et al. 1996). Both the presence of peripheral trauma and pain without damage to the central or peripheral motor system in combination with the less effective inhibition in polysynaptic spinal sensorimotor pathways suggest that abnormal modulation of sensory input plays a crucial role in the origin of movement disorders in our patients too. In pain syndromes heterotopic acupuncture stimulation, as applied in our patients, inhibits the original pain by modulating transmission of noxious signals in the dorsal
horn by the release of endogenous opioids. This effect is known as diffuse noxious inhibitory control (DNIC) (Culliton 1997; Wang et al. 1992; Bing et al. 1990). DNIC can also be activated by noxious stimuli such as non-acupoint acupuncture or noxious thermal stimulation and probably involve supraspinal structures (Bing et al. 1990; Bouhassira et al. 1993). Administration of the opioid antagonist naloxon diminishes the efficacy of electroacupuncture in the treatment of pain (Wang et al. 1992; Bing et al. 1990). In patients with spasticity or with dystonic syndromes improvement by (electro)acupuncture has also been reported (Milanov 1991; Story 1989; Han et al. 1994; Wu 1996). The antispastic effect also can be partially abolished by high doses of naloxon (Han et al 1994). These data suggest that the effect of acupuncture upon movement may be mediated by the release of endogenous opioids, resulting in a normal modulation of afferent input.

Although the mechanisms tested by the soleus H-reflex operate largely at the spinal level, they are influenced by descending activity from supraspinal structures (Koelman et al. 1999). As such, another explanation for the effects of electroacupuncture in our patients may also be appropriate. Altered sensory input induces central cortical and subcortical reorganization, by which it may generate abnormal movements (Recanzone et al. 1990; Merzenich and Jenkins 1993; Jankovic 1994; Marsden 1994). Such a central reorganization may explain the observation that peripherally induced movement disorders show a tendency to spread beyond the involved site where the injury is located (Jankovic 1994). In the adult cat, electrical stimulation of the large fiber afferents running in the median nerve, resembling an extended period of electroacupuncture, enlarges contralateral receptive cortical fields (Recanzone et al. 1990; Merzenich and Jenkins 1993; Byl et al. 1996; Hamdy et al. 1998; Stefan et al. 2000). These changes are not restricted to the skin field belonging to the median nerve, but may extend over neighbouring representations of that half of the body surface. Administration of naloxone after enlargement of receptive fields following an episode of peripheral nerve stimulation makes the receptive fields shrink (Recanzone et al. 1990; Merzenich and Jenkins 1993). The changes underlying novel cortical receptive fields are thought to be due to synaptic plasticity induced by long-term potentiation and long-term depression of thalamocortical or corticocortical projections (Buonomono and Merzenich 1998). The treatment effects of electroacupuncture upon movement in the presented patients, therefore may relate to rearrangement of cortical and subcortical receptive fields.

Noteworthy is, that, in the absence of their regular therapist, five of the presented
patients have been treated occasionally by another acupuncturist, who applied the same technique. All patients noted similar improvement. In all patients various other treatments, but not electroacupuncture were given, without any success. In this respect the beneficial response towards electroacupuncture in our patients is probably not a mere placebo effect, but rather related to a specific effect of electroacupuncture itself. Our data suggest that electroacupuncture alters modulation of afferent input allowing polysynaptic spinal and supraspinal pathways to resume normal function. This effect may be mediated by DNIC through the release of endogenous opioids, or through electroacupuncture induced alterations of cortical and subcortical receptive fields. The temporary effect of electroacupuncture suggests a dynamic process.

Acknowledgements

We would like to thank Dr. J.E.J. Duysens for his advise during the preparation of the study and Dr. M. Aramideh and D. H. Nieman for helpful comments on the manuscript.

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