

Cutaneous stimulation improves function of a chronic patient with cerebellar damage

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The prognosis of cerebellar hemorrhage with brain stem compression is known to be poor, and patients who can usually survive are severely disabled with limited benefit from conventional rehabilitation. An innovative cutaneous stimulation was administered to a chronic patient (2 years after the incidence) who has severe ataxia, gait imbalance and limb spasticity caused by cerebellar hemorrhage. After 8 months of intervention, patient's function as evaluated by two functional measures has improved by 40%. In addition, the patient's ataxia and hypotonia have improved significantly in which he has regained the abilities to grasp objects, sit upright, control his equilibrium, and monitor an electric wheelchair. The present case study demonstrated a significant improvement of a chronic severely disabled patient who received the intervention 2 years after the accident, suggesting that the cutaneous stimulation may be a possible effective neurologic intervention.

Introduction

Developing an effective intervention program to enhance the recovery of neurologic patients has been an endeavor chosen by many researchers. Although several studies reported positive results of various rehabilitation programs (Ottenbacher and Jannell, 1993; Kwakkel *et al.*, 1997; Volpe *et al.* 2000; Kelly *et al.* 2001), the treatment effect is usually small or highly specific to the trained skills (Wagenaar and Meyer, 1991a, b; Langhorne *et al.*, 1996; Kwakkel *et al.*, 1997). As a result, many researchers agree that there are lack of convincing evidence on the therapeutic value of neurological interventions (Gladman *et al.*, 1996).

To help establish effective interventions for neurological patients, we evaluated the effectiveness of a cutaneous stimulation intervention that was developed in China since the 18th century through a chronic, severely disabled patient who had cerebellar hemorrhage and brain stem compression. Whilst the prognosis is poor for these patients (Macdonell *et al.*, 1987; Kase *et al.*, 1993; Turgut *et al.*, 1996), there is no known effective rehabilitation program (Ott *et al.*, 1974; Triarhou, 1997; Bellenir, 1999). In addition, the intervention was implemented to this patient 32 months after the onset of the accident. Therefore, any observed

improvement would unlikely be due to spontaneous recovery.

Medical history of the patient

Patient CH, a 13-year-old-boy, suffered from sudden cerebellar hemorrhage that compressed onto the brain stem on 29 April 1998. On arrival at the hospital, the patient was in coma with Glasgow Coma Scale (GCS) of 3. The computed tomography scans taken on admission showed an extensive cerebellar hematoma with extension into the ventricles. After an emergency operation to evacuate a blood clot and excise a cerebellar arterio-venous malformation of 2 cm in diameter, the patient was admitted into the intensive care unit. When the patient was transferred to a convalescence hospital in June 1998, he was still comatose (GCS = 6), had spastic tetraplegia with limited voluntary limbs movement, and required tracheotomy.

The magnetic resonance imaging scan performed in May 2001 showed that the posterior fossa was predominantly occupied by cerebral-spinal fluid as a result of marked loss of cerebellar tissue. The remaining cerebellum was represented by the central cerebellar white matter and the adjacent atrophic cerebellar hemispheres. Apart from the anterior rim forming the roof of the fourth ventricle, the cerebellar vermis was totally lost. Moderate hydrocephalus with dilatation of the lateral and third ventricles was also noted (Fig. 1).

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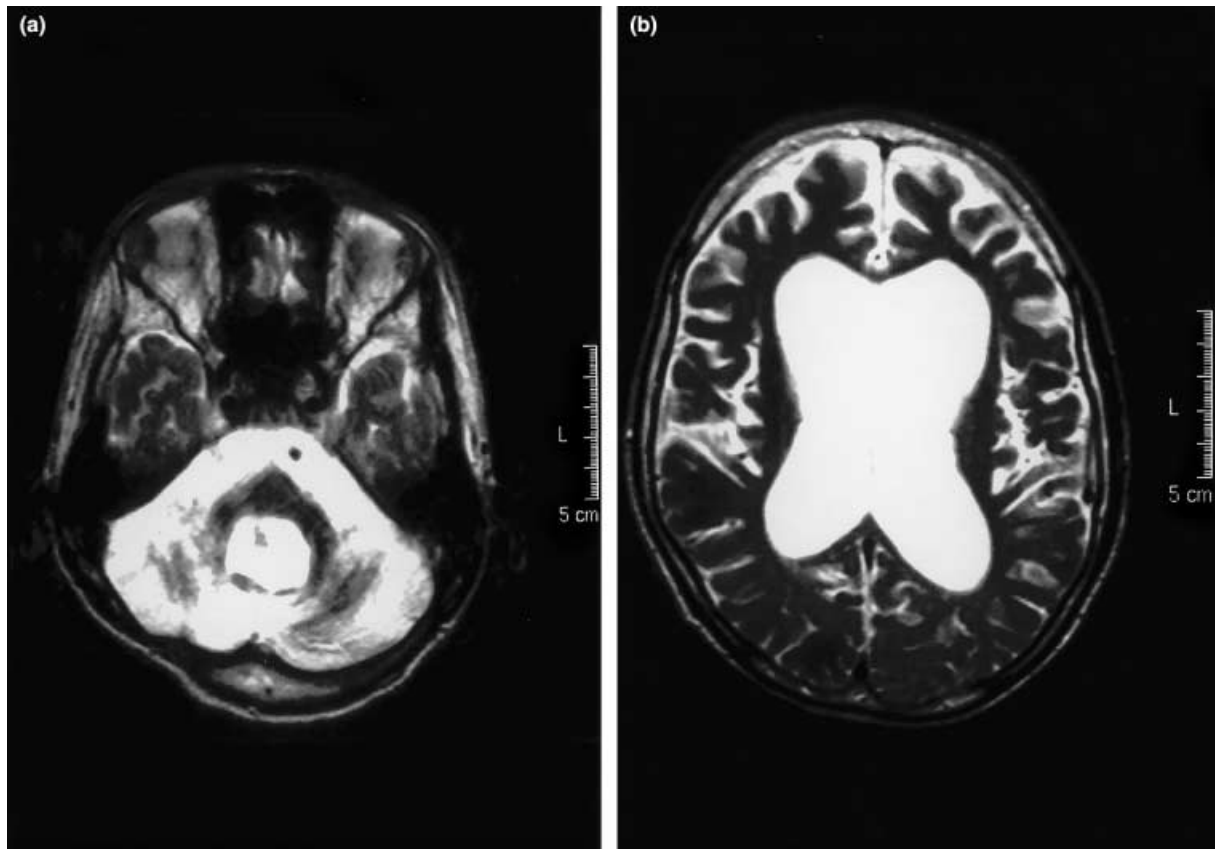


Figure 1 Magnetic resonance imaging T2-weighted horizontal images of patient CH showed (a) a marked loss of cerebellar tissue, and a total loss of the right cerebellar vermis; (b) moderate hydrocephalus with dilatation of the lateral and third ventricles.

Intervention method

Cutaneous stimulation is one of the intervention approaches in traditional Chinese medicine that has a history of over 1000 years, and the specific method used in the current study was first described by Dr Sun Huiqing in 1919. By observing some older methods of cutaneous stimulation, such as beating epileptic patients with willow twigs and scraping the skin of stroke patients, Dr Sun understood that the essence of the cutaneous stimulation therapies in the Chinese traditional medicine was to cause temporary cutaneous pain without damage to the skin or organs. To minimize the impact on the skin and yet provide stimulation, a special tool called the dermatoneural medical hammer was designed by the first author based upon the description by Dr Sun. The tool is a 13-inch-long medical hammer with a fitted head where seven dull needles (48°, 5 mm long, 1 mm in diameter) are tied together. Given the specific design of the tool, this stimulation can provide a stinging sensation without making any damage to the skin.

A session of the intervention is about 15 min, and was conducted by a trained therapist five times per week. The manipulation of the tool is called 'spring stab' in which the wrist moves swiftly up and down quickly onto the skin. The stimulation was applied onto the two sides (about half an inch) along the spine from the lumbar to the thoracic regions, along the midline on the front of the body, and the dorsal and posterior parts of the head. Other target areas included the lateral sides of the neck. Each stimulation site was tapped three times, with the interval of 2 cm between each tap. As these stimulation areas were primarily developed from deduction approach through the clinical observation and experience of Dr Sun, the underlying nature of its therapeutic effect remains unknown. However, two hypotheses have been put forward to explain the effect. It has been suggested that the treatment effect is related to the stimulation of sympathetic nervous system that is distributed along the spines, abdomen and upper body (Bai, 1989). Tapping the skin in high frequency is believed to generate some bioelectric signals that can restore the energy of the brain.

Another hypothesis, based upon the meridians (channels) system in traditional Chinese medicine, suggests that its therapeutic effect is related to restore the energy of the Ren (along the midline of the front body) and Du (along the spine) channels.

Baseline measure

CH began the intervention in December 2000. He has received conventional rehabilitation prior to this intervention, including occupational therapy once per week and physiotherapy daily.

Overall function

CH was totally dependent on the others for his self-care, and was bedridden most of the time. His overall function as measured by the Functional Independence Measure (FIM, Granger and Hamilton, 1996) was 34/126, and by the Functional Status Rating System (FSRS, Forer, 1996) was 60.5/120 (Table 1). This measure suggested that the conventional rehabilitation had very limited effect to improve the function of this patient. Although he was physically disabled, his cognitive function was relatively intact. He was orientated, able to follow commands, and remember the past and present events.

Motor ability

Severe ataxia with jerky movement of four limbs was noticeable. His motor control ability, as measured by the Finger–Nose Test, was impaired, which he failed to perform by both hands (Fig. 2). He was also unable to pick up an object placed in front of him by either hand. Vestibular ataxia with unsteadiness of gait was observed that CH was not able to sit up on a chair without restriction. Hypotonia and spasticity in the four limbs was also noticed. Specifically, his

left wrist arched inwardly for approximately 60° and was unable to lay flat. Both of his ankles bent inwardly for about 60°. Some muscle contraction of upper limbs, but not the lower limbs, was possible. Dysarthria was also observed and his speech was unintelligible.

Quality of life

CH rarely left the nursing home because of his motor problem. In addition, CH's daily activity was very limited because he was unable to walk or control an electric wheelchair. Failing to swallow fluid and being choked during oral feeding, CH was totally dependent on the feeding tube. He was somewhat low in energy and not very motivated. He scored 4 of 10 in the Quality of Life Index (Spitzer, 1996) representing a relatively low level of living quality.

Treatment effect

CH has received the cutaneous stimulation for 8 months till August, 2001. He was evaluated monthly, and the summary of the assessment results were as follows:

Overall function

After 8-month of intervention, his overall function raised to 60 and 77.5 on the FIM and the FSRS, respectively (Table 1). The results represented a functional improvement of 20–40% from the baseline. The areas improved most significantly included mobility, communication, psychosocial cognition and self-care, and his cognitive function remained relatively the same.

Motor ability

Improvement on the ataxia was observed with reduced jerky movement of four limbs. After 3 months of

Table 1 The functional measures of patient CH before and after 8 months of the cutaneous stimulation therapy

Measures	Baseline	After 8 months of intervention	Percentage of improvement
The Functional Independence Measure			
(a) Self-care	6/42	13/42	54
(b) Sphincter control	2/14	6/14	67
(c) Mobility	3/21	8/21	63
(d) Locomotion	3/14	5/14	40
(e) Communication	8/14	10/14	20
(f) Social cognition	12/21	18/21	33
Total	34/126	60/126	43
The Functional Status Rating System			
(a) Self-care	10.5/36	15/36	30
(b) Mobility	5.5/20	9.5/20	42
(c) Communication	16/28	19.5/28	18
(d) Psychosocial adjustment	11/16	15.5/16	29
(e) Cognitive function	17.5/20	18/20	3
Total	60.5/120	77.5/120	22

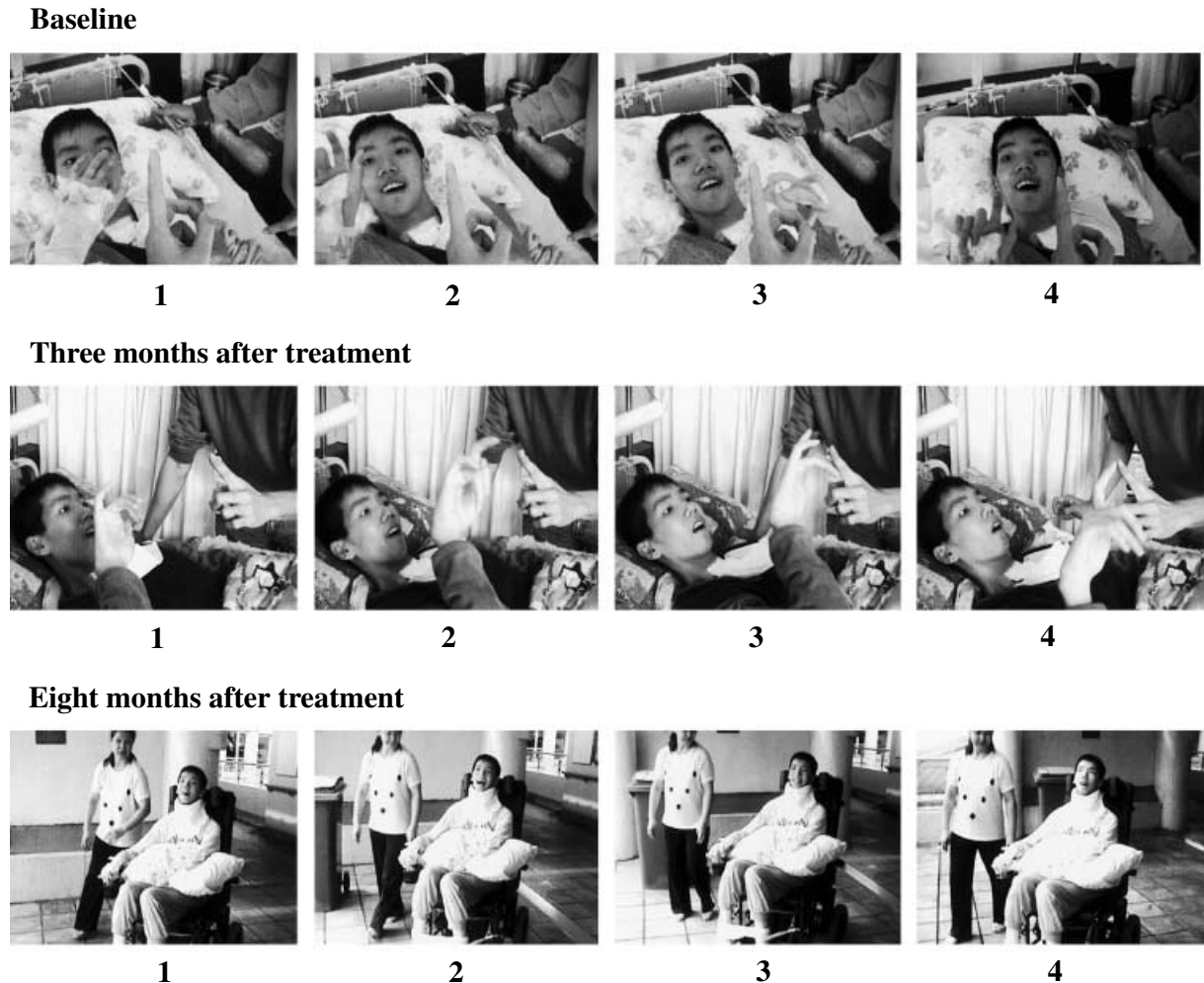


Figure 2 The improvement of patient's ataxia by cutaneous stimulation. The patient failed to perform the Finger–Nose test at the baseline level, and regain the ability to perform the test after 3 months of intervention. After 8 months, the involuntary jerky movement has reduced to the point that the patient was able to control an electric wheelchair.

treatment, CH was able to perform the tests assessing his motor control ability. Specifically, on the Finger–Nose Test, CH completed the task within 3 s for the right hand, and within 7 s for the left hand (Fig. 2). On the Grip Strength Test, CH yielded on 3.5 kg for the left hand and 3 kg for the right hand whilst on the Finger Tapping Test, CH performed three taps in 10 s for the right hand. His left hand still failed to perform the task. CH was also able to reach and grasp the object that was put on his chest within 60 s by his right hand. His muscle power was increased and contraction of the lower limbs began to be noticed. Hypotonia and spasticity of the four limbs improved indicated by the ability of CH was able to lay his left hand flat on the bed. Bending of his both ankles reduced to about 30°, and a new pair of shoes with smaller correction angles was made for fitting his legs. His speech became more

intelligible and the force of his tone became more natural.

CH's motor strength has continued after 8 months of intervention. He yielded 7 kg for the left hand and 6 kg for the right hand on the Grip Strength Test. On the Finger Tapping Test, he obtained six and four taps for the left and right hands, respectively. His motor function had improved to the extent that he was able to sit on a wheelchair without being tied up, and control the electric wheelchair independently (Fig. 2).

Quality of life

The most significant improvement of CH was his ability to control the electric wheelchair (with standby supervision) and his equilibrium to the extent that he could get into and out of a taxi with assistance. He was now more independent, and more home visits were made.

Although CH was still dependent on the feeding tube, he was able to swallow about 5–15 ml fluid and solid food daily. CH appeared more alert, cheerful and motivated, and became more co-operative during intervention. The measure on his quality of life yielded a score of 7 of 10, that is, about 40% improvement from the baseline.

Discussion

Whilst most studies on the effectiveness of rehabilitation programs are performed on acute neurological patients who are mildly to moderately impaired (Kwakkel *et al.*, 1997; Volpe *et al.*, 2000; Kelly *et al.*, 2001), the present study evaluated an intervention for a chronic severely disabled patient. To the contrary of a common belief that chronic patients benefit little from interventions, the present study demonstrated that the cutaneous stimulation intervention improved the function of a patient with cerebellar stroke who had been severely disabled for over 2 years.

Although this case study demonstrated some therapeutic effect of a cutaneous stimulation, this result is still limited by its single case study approach without control comparison. Whilst clinically it is unusual to observe spontaneous recovery of patients after 2 years of accident and the improvement found in this patient is conceivable to be related to the cutaneous stimulation, other possible unexpected effect (e.g. placebo effect) cannot be ruled out at this point. Therefore, this case study may not be conclusive enough to imply that the cutaneous intervention is an effective therapy for neurologic problems and these encouraging results warrants further studies.

This result raises an issue of the 'window of recovery'. It is well understood that functional recovery of neurological patients mostly occurs within the first year after the accident. However, the present study demonstrated a significant improvement of a patient who received the intervention 2 years after the accident. Thus, continuous recovery may be possible in neurologic patients if appropriate interventions are provided.

Acknowledgement

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