Rehabilitation Practice and Science

Volume 33
Issue 2 *Taiwan Journal of Physical Medicine and Rehabilitation (TJPMR)*

Article 5

12-31-2005

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Recommended Citation

Su, Hung-Tzu; Chen, Tien-Wen; Weng, Ming-Cheng; Lee, Chia-Ling; and Huang, Mao-Hsiung (2005) "Does Shortwave Diathermy Reduce the Intractable Spasticity of Patients with Spinal Cord Injury?," *Rehabilitation Practice and Science*: Vol. 33: Iss. 2, Article 5.
DOI: https://doi.org/10.6315/2005.33(2)05
Available at: https://rps.researchcommons.org/journal/vol33/iss2/5

Does Shortwave Diathermy Reduce the Intractable Spasticity of Patients with Spinal Cord Injury?

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Spasticity is a hallmark of an upper motor neuron disorder and represents the most important impairments for individuals who care for patients with central nervous system disease. It may have an adverse effect on rehabilitation training. Shortwave diathermy is a modality that produces deep heat. It is usually used to relieve pain and stiffness, promote wound healing and relieve deep muscle spasm.

In the present case, we show a 52-year-old male patient with spinal cord injury who has severe spastic hypertonia. He is disabling in motor and daily living. We have tried in vain with various physical therapy and medications. He has been receiving the shortwave therapy since April 2003. After treatment, the spasticity has been reduced. His motor recovery and functional performance have greatly improvement followed. We suggest that shortwave diathermy might become an adjunctive method for treating spasticity. Although shortwave diathermy reduced the spasticity of this patient, further study with more subjects is needed to establish its effect. (Tw J Phys Med Rehabil 2005; 33(2): 97 - 102)

Key words: spasticity, shortwave, spinal cord injury

INTRODUCTION

Shortwave diathermy (SWD) is a non-ionizing radiation in the radio frequency portion of the electromagnetic (EM) spectrum. “Diathermy”, derived from Greek, means “through heat”. The shortwave frequency ranges from 10 Hz to 100 MHz. Its wavelength is between that of microwave and medium radio wavelength. The common therapeutic shortwave diathermy uses the frequency 27.12 MHz with wavelength of 11.062 m. Shortwave diathermy is used to deliver heat and energy to deeply situated tissue to relieve pain, decrease stiffness, promote wound healing, and relieve deep muscle spasm.[1,2]

Spasticity is one of the manifestations in upper motor neuron disease. The spasticity affects the motor performanace of patients in the rehabilitation settings, and may induce secondary complications. Management of spasticity includes positioning, antispastic exercise, and medications.[3] However, shortwave diathermy used to reduce spasticity has not been frequently reported on.

In this article, we present that SWD reduces the spasticity on a patient with spinal cord injury (SCI).

CASE REPORT

Submitted date: 11 October 2004. Revised date: 21 December 2004. Accepted date: 27 December 2004.

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A 52-year-old male, a fruit seller, fell down accidentally on June 27, 1999. The accident resulted in the C3-4, C4-5 intervertebral disc protrusion with cord compression. He received C3-6 laminectomy and internal fixation on July 15, 1999. A sequela of C4 tetraplegia with ASIA graded D was noted since 1999, though regular rehabilitative treatment was given.

He suffered from marked spasticity, pain, and numbness over all four limbs and the trunk. He was confined to bed and wheelchair completely, making the rehabilitation for mobility or locomotion nearly impossible. In addition, he experienced clonus frequently, and his joints became stiff and contracted. He suffered from poor sleep quality and daily life disturbance with little motor improvement. The Modified Ashworth Scale (MAS) grading for both legs was between 3 and 4, and the Visual Analog Scale (VAS) for pain evaluation reached between 7 and 8. The Barthel Index showed severe dependence (30 points).

We had tried in vain to relieve his spasticity and improve life quality with medications and physical therapy. The medications included Baclofen (45 mg/day), Tizanidine (12 mg/day), Diazepam (2 mg/day), and Gabapentin (900 mg/day). In addition, several physiotherapeutic methods for reducing the spasticity had been applied: Cryotherapy was applied for extended periods, but the spasticity became more severe after removing the ice. Superficial heat increased the spasticity and clonus, and sometimes induced autonomic dysreflexia (AD). Electrical stimulation (ES) relieved spasticity for only 10 minutes each time. Tapping could relieve spasticity for a while, however, bullae occurred easily due to high skin tension and poor texture. Manipulation, stretching, and passive range of motion exercises could only temporarily relieve his symptoms.

In April 2003, the patient complained about low back pain and stronger spasticity than before. The X-ray revealed spondylosis over L2 to L5 and disc degeneration disease over L3-4 and L4-5. We tried the SWD (Cosmogamma® SW 500) for managing lower back pain and muscle spasm. The parameters used first were 250 W, continuous type, coplanar, capacitive technique, and disc application over the paraspinal area of the lumbar spine for 15 minutes. Unfortunately, a burn injury occurred. However, the spasticity and the pain intensity over the lower trunk decreased after the first treatment. After the burn injury healed, we started to try treatment with 100 W for 1 week. The spasticity decreased significantly (MAS from 3-4 to 2). Trunk control and rotation ability also improved. The VAS scale decreased to around 4-5. He could even perform transfer and bed mobility with minimal assistance and activity of daily living (ADL) with partial dependence.

After receiving SWD for 6 months, the patient could ambulate with a walker under supervision. The range of motion of joints also increased. The pain intensity decreased. He could also do ADL with partial independence. We used the Barthel index to evaluate the ADL ability of this patient. A great improvement in transfer and walking was found. Regardless, he was still at the level of severe dependence (Barthel index: 50 points). His activity and

Table 1. The Barthel Index of ADL at various time periods

Date	2003/02/05	2003/10/03	2003/12/25
Feeding	5	5	10
Grooming	0	5	5
Bowel	5	5	5
Bladder	5	5	5
Transfer	5	10	10
Toilet	5	5	5
Dressing	5	5	5
Bathing	0	0	0
Walking	0	10	10
Stairs	0	0	5
Total	30	50	60

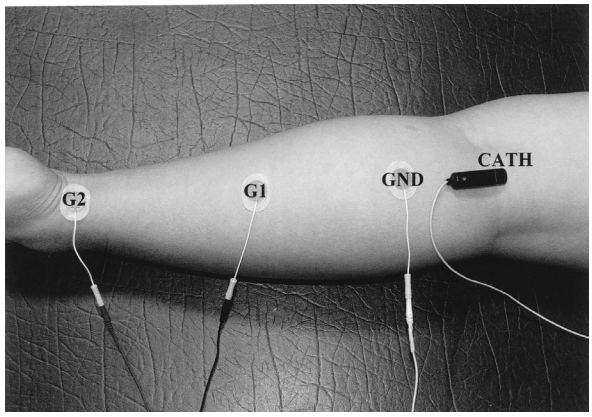

Figure 1.

functional performance were improved (Table 1), and the frequency of AD and clonus decreased. The medication for reducing spasticity was minimized to Baclofen (30 mg) only. We also tried pulsed shortwave diathermy (PSWD, pulse reception rate: 100 Hz, pulse duration: 400 μs, peak pulse power: 200 W, mean power: 8 W) in October 2003. More significant decrease of spasticity was found compared with the previous treatment.

We used nerve electrophysiological study (EPS) and MAS to examine and follow up the change of spasticity. The ratio of the highest amplitudes of H-reflex and M-response (H_{max}/M_{max} ratio) was the indicator of EPS in evaluating spasticity. The H_{max}/M_{max} ratio and MAS score reduced as time went by. The patient had great improvement in motor and functional performance.

DISCUSSION

Many individuals with upper motor neuron disease develop spasticity in the limbs. The spasticity is defined by hyperactivity of the stretch reflex, manifested as a velocity-dependent increase in tonic and phasic stretch reflex.[4,5] The spinal neural mechanisms include both post- and presynaptic mechanisms involving motorneuron pool excitability.[6] The presynaptic inhibition of Ia excitory effects may also contribute to the spasticity.[7] In rehabilitation settings, severe spasticity often interferes the motor function recovery and the improvement of functional outcome.

SWD and PSWD are applied clinically to soft tissue healing, resolution of hematomas, back and neck pain and muscle spasm relieving.[1] SWD is mainly used to treat musculoskeletal disease. A previous study demonstrated the protein denaturing effects of shortwave irradiation damaging nerves or nerve roots similar to neurotomy or rhizotomy.[3] In the present case, we found the therapeutic effect of SWD improving the motor and functional performance in a patient with intractable spasticity due to SCI.

We found the effects of SWD on lowering spasticity accidentally. The patient suffered from marked spasticity, stiffness, chronic musculoskeletal pain and joint contracture due to SCI. At first, we tried short-wave diathermy merely to relieve pain. After treatment for a period of time, the spasticity over the whole body, including upper extremities, decreased surprisingly. The motor recovery and functional performance also improved. The Barthel index showed greater improvement at transfer and ambulation.

The precautions for using heat include acute trauma, inflammation, impaired circulation, bleeding diatheses, edema, large scars, impaired sensation, malignancy, metal implants and cognitive deficits.[1,2] This patient had internal fixation for C3-4 and C4-5 intervertebral disc protrusion, and paresthesia due to SCI. He was relatively contraindicated to SWD. The application of SWD was not considered until April 2003. Because the low back pain had aggravated the spasticity, we used SWD for pain relief. Due to paresthesia, we chose low intensity and PSWD to avoid burn injury.

The most common tool for evaluating spasticity is MAS. It is a subjective evaluation, and the result may change interraterly. Therefore, an objective evaluation with H-reflex was also performed. The soleus H-reflex, elicited by long lasting vibration of the Achilles tendon, is caused by presynaptic inhibition of Ia afferents.[5-7] Many studies used H_{max}/M_{max} ratio to quantify spasticity.[8-10] The value is between 1% and 3% in normal individuals and significantly higher in patients with spasticity.[11,12]

The spasticity of our patient was evaluated by both

Table 2. The spasticity of bilateral leg at various time periods

Date	2002/07/01		2003/09/19		2003/12/15		2004/01/05	
Spasticity	Right	Left	Right	Left	Right	Left	Right	Left
MAS	3	4	3	2	2	1+	1	1+
H_{max}/M_{max} ratio	2.27	4.17	1.23	0.88	1.42	0.04	0.48	0.68
H_{amp} (mV)	2.5	2.5	2.1	2.2	1.7	0.1	1.2	1.7
M_{amp} (mV)	1.1	0.6	1.7	2.5	1.2	2.5	2.5	2.5

MAS: Modified Ashworth Scale score; H_{amp}: H-reflex maximal amplitude; M_{amp}: M-wave maximal amplitude

MAS score and H_{max}/M_{max} ratio. The result showed that the MAS score and the H_{max}/M_{max} ratio decreased after the shortwave treatment, though the value did not reach the normal range (Table 2). However, the ADL ability and locomotion improved, and the severity of pain and the frequency of AD attacks also decreased.

In patients with SCI, there are some risk factors aggravating spasticity. If the physicians or caregivers can reduce the nociceptive and exteroreceptive stimuli, spasticity may be managed. The nociceptive stimuli, either acute or chronic, exacerbates spasticity and triggers AD.[13-15] At first, we used SWD to relieve lower back pain. The pain intensity decreased and reduced spasticity followed. It may have resulted from the pain source being removed. Besides, SWD also relieved muscle spasms over the trunk and limbs. The patient could perform more active rehabilitation programs (e.g. stretching or range of motion exercise) after stiffness diminished. SWD and stretching exercises caused muscle relaxation, relief of pain, and increase tissue flexibility.[16,17] The pain relief and increasing flexibility might be the reason for the reduced spasticity.

Emotional distress, like sadness or anxiety, is common in SCI patients with or without chronic pain.[18] The anxiety has been suggested to be associated with spasticity and triggering AD.[19,20] In the present case, the patient has sought many conventional and alternative therapies to manage spasticity, but in vain. The persistent pain has caused anxiousness and hopelessness. SWD provided a chance to improve motor and functional performance. The psychological satisfaction might be contributing to the management of spasticity.

CONCLUSION

SWD is still not the first choice for treatment of spasticity in rehabilitation. Although SWD reduces the spasticity on this patient, it might become a new adjunctive method for spasticity control. However, a further study with more subjects to establish its effect is warranted.

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短波是否能降低脊髓損傷後痙攣?

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痙攣(spasticity)，廣義來說是肌肉張力過強的現象，與肢體移動的速度有關(velocity-dependent)；上運動神經元(upper motor neuron)受傷的病人，容易伴隨著痙攣的問題產生，而痙攣問題又會影響動作功能的表現，甚至造成次發性的併發症。較爲普遍的短波治療儀器大部分使用 27.12MHz 這個頻率，臨床上短波用來止痛與消腫、促進組織癒合與神經生長以及軟化攣縮的組織。

本文報告一位 52 歲男性，於 1999 年 6 月 27 日因意外摔傷導致頸椎 3-4，4-5 節椎間盤突出，緊急施行手術，脊椎損傷定位爲 SCI (C4, ASIA:D)，長期接受復健追蹤治療。軀幹及四肢長年處於痙攣狀態(spasticity, MAS: 3-4) ，不僅造成日常生活及照護困擾，對於復健治療亦有窒礙難行之處。曾併用多種降低張力的藥物及復健治療方法，皆無顯著之改善。2003 年 4 月開始，嘗試以短波治療痙攣，患者張力明顯下降(MAS:3-4→2)，且患者能自行獨立操作日常生活技能，軀幹活動及轉位靈巧性亦大幅增加。因此短波也許能降低脊髓損傷患者痙攣的程度，但仍需更進一步的研究來驗證療效。（台灣復健醫誌 2005; 33(2): 97 - 102）

關鍵詞：痙攣(spasticity)，短波(shortwave)，脊髓損傷(spinal cord injury)

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