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Case Report

Improvement of Tetraplegia and Respiratory Symptoms with Complex Korean Medicine Treatment After Traumatic Cervical Spinal Cord Injury: A Case Report

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ABSTRACT

This study reports the effectiveness of traditional Korean medicine in treating tetraplegia and respiratory symptoms (including dyspnea) after traumatic cervical spinal cord injury surgery. The patient was treated with complex Korean medical treatment including electroacupuncture, pharmacopuncture, and herbal medicine. The manual muscle test (expanded Medical Research Council system) was used to measure the patient's muscle strength. The Korean version of the modified Barthel index and the functional independent measure were used to evaluate the patient's independence in performing daily activities. Following 2 hospitalizations and treatments, the patient's muscle strength improved > 4+ score for all joints, and the Korean version of the modified Barthel index and functional independent measure scores increased from 26 to 79 and 56 to 95, respectively. Symptoms of dyspnea, coughing, and sputum gradually improved and finally disappeared during hospitalization. This study suggests complex Korean medicine treatment may be effective in the rehabilitation of post-surgical cervical spinal cord injury patients.

Introduction

Most spinal cord injuries (SCI) are caused by trauma resulting from traffic accidents and falls, and frequently occur in people < 40 years [1]. Cervical SCI constitute a large proportion of all SCI, commonly affecting C5, C6, and C4 in descending order. SCI mainly impairs motor and sensory function, but in severe cervical SCI cases insufficient respiratory function could occur due to paralysis in the respiratory muscles, decreased lung capacity, and reduced capacity to cough. If the spinal cord is compressed due to the posterior displacement of bone fragments or an intervertebral disc, surgery with an anterior approach can remove the compression caused by the injury [2].

Few cervical SCI cases treated with Korean medicine have been published. Song reported a case of improvement in tetraplegia and neurogenic bladder following Korean medicine treatment for cervical SCI [3], and Choi reported improvement in a patient's muscle strength, gait status, and reduced level of pain [4]. However, respiratory symptoms occurring after cervical SCI have rarely been reported. More research into different Korean medicine treatments, their efficacy, and prognosis for patients with cervical SCI is needed.

In this study, we report a case of tetraplegia and respiratory symptom following surgery for SCI, and show improvement in the conditions with complex Korean medicine treatment.

Case Report

The patient was informed of the collection and use of personal information necessary for the study, and informed consent was obtained. This was a retrospective study based on medical records, and was approved by the Institutional Review Board of the Wonkwang University Korean Medicine Hospital (no.: WKUIOMH-2020-04).

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The patient was a 73-year-old male, admitted to the Wonkwang University Hospital after he slipped in the bathroom on August 18th, 2019. He was diagnosed with C3/4 SCI and cervical spinal stenosis by cervical (C)-spine X-ray and C-spine magnetic resonance imaging (MRI) investigations. The C-spine MRI revealed a diffuse high T2 signal at C4 body level of the spinal cord suggesting acute contusion, and moderate central spinal stenosis at C3/4/5/6 due to disc bulging and bilateral uncovertebral joint hypertrophy (Fig. 1). The patient underwent right anterior cervical discectomy and fusion surgery for C3/4/5 on August 19th, 2019 (Fig. 2). Postoperatively, he was treated with analgesic medication, O2 inhalation and antibiotic injections.

On August 30th, 2019, he was admitted to the Wonkwang University Korean Medicine Hospital and was hospitalized until November 13th, 2019. After discharge, he experienced worsening of tetraplegia and general weakness. He was hospitalized again from January 17th to February 28th, 2020.

He had a history of hypertension and diabetes diagnosed 10 years ago. He continued to take medications prescribed by the Wonkwang University Hospital during his hospitalization at the Korean Medicine Hospital.

Clinical findings and diagnostic focus

The manual muscle test, the functional independent measure (FIM), and the Korean version of the modified Barthel index (K-MBI) were used to evaluate the patient's progress. The manual muscle test measures muscle strength (Grades 0-5) according to the expanded Medical Research Council system (Table 1) [5].

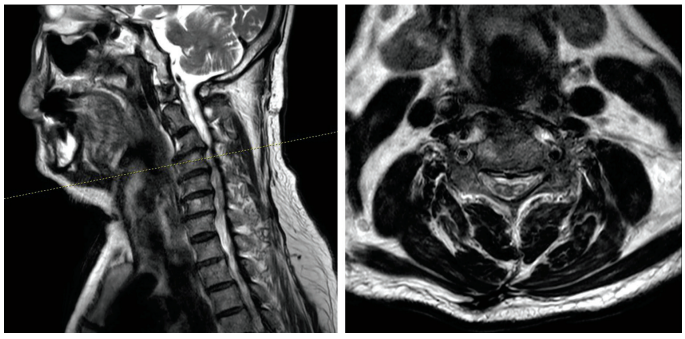

Fig 1. Patient's cervical spine magnetic resonance imaging(T2) (Sagittal, Axial at C4 body level) on August 18, 2019.

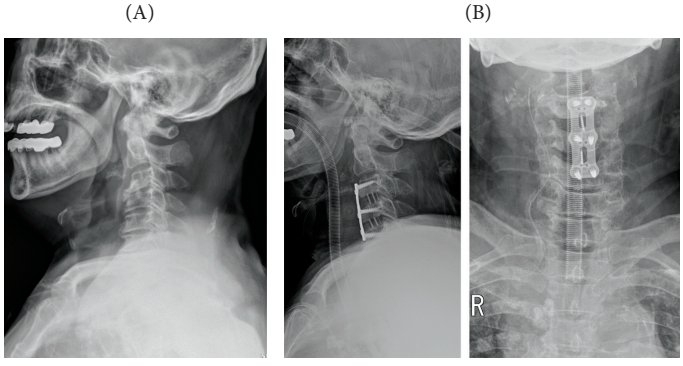

Fig 2. Patient's cervical spine X-ray (A) lateral view on August 18, 2019 (B) anteriorposterior, lateral view after surgery (August 19, 2019).

The K-MBI evaluates independence in performing daily activities using 5 grades, depending on the degree of assistance [6]. The FIM evaluates the degree of impairment in physical and cognitive function, and comprises of 18 items (scores 1-7) based on dependence [7].

On August 30th, 2019, the muscle strengths of the upper extremities were shoulder flexion (3−/3−), elbow flexion (2+/2+), and elbow extension (2/2). The K-MBI and the FIM scores were 29 and 56, respectively. According to the American Spinal Injury Association Impairment Scale, this patient was given a Grade D classification as sensory function was preserved at all neurological levels, and motor function was ≥ 3 in most of the key muscles [2]. Gasping occurred when the patient lay in a supine position for > 1 minute, and coughing occurred approximately 3-4 times/day with white sputum. Sputum formation and the globus pharyngeus sensation were reported postoperatively. Radiculopathy, bowel and bladder control problems were not present. The patient's neurological examination results were pupil reflex (3+/3+), Babinski's sign (−/−), Hoffmann sign (+/+), ankle clonus (−/−), and deep tendon reflexes of C5 (+/++), C6 (+/++), C7 (++/++), L4 (++/++), and S1 (++/++).

Therapeutic interventions

Single-use acupuncture needles (stainless steel 0.30 × 30 mm, Woojin acupuncture Inc., Boryeong, Korea) were inserted to a depth of about 10 mm at acupoints LI4, TE5, LI11, GB34, ST36, GB39, and LR3 once per day. Electrostimulation was performed bilaterally at TE5-LI11 or GB34-GB39 by an electric stimulator (STN-110, Stratek, Anyang, Korea). Electroacupuncture stimulation was performed for 15 minutes with 120 Hz continuous wave, and the current intensity was increased according to the patient's level of tolerance. Acupuncture treatment was performed by a specialist in acupuncture and moxibustion medicine (> 20 years of clinical experience) and residents with clinical experience (> 1 year).

Hominis placenta pharmacopuncture (C1-JH, Jaseng, Namyangju,

Table 1. Expanded Medical Research Council Scale for the Manual Muscle Test.

Grade	Degree of strength
5	Normal strength
5-	Equivocal, barely detectable weakness
4+	Definite but slight weakness
4	Able to move the joint against combination of gravity and some resistance
4-	Capable of minimal resistance
3+	Capable of transient resistance but collapses abruptly
3	Able to move through full range against gravity without resistance to the movement
3-	Able to move against gravity but not through full range
2	Able to move with gravity eliminated
1	Flicker of movement
0	No movement

Korea) was performed 8 times during the first hospitalization, approximately once every 2 weeks to both SI10 and PC2. Disposable 29-gauge × 38 mm sterile needles (Sungshim Medical Co., Bucheon, Korea) were used to inject each acupoint with 0.5 mL of hominis placenta solution to a depth of 0.5-1 cm. The patient was prescribed Dokhwalgisaeng-tang-Gami (120 mL, 3 times/day, 1 hour after eating) to aid the recovery from SCI. Macmundong-tang soft extract (Hamsoa Pharmaceutical Co.) was prescribed to relieve the patient's cough, production of sputum, and globus pharyngeus sensation from September 10th, 2019 to September 25th, 2019. Since the patient's coughing and production of sputum were effectively reduced after taking Macmundong-tang, Liriope platyphylla, the main ingredient of Macmundong-tang, was added to the herbal medication treatment list on September 26th, 2019 (Table 2).

Moxibustion was performed 5 times/week on the patient's abdomen, and dry cupping was performed on the back-shu points once daily to promote blood circulation.

The patient was treated with foot-bath (FZ600A, Koreagat, Wanju, Korea) therapy 5 times/week for 20 minutes or with 30 minutes of lower-body sauna 3-4 times/week using a lower-body sauna device (UTH-SN2, GS Sauna, Gimhae, Korea) during the first admission. The patient was treated with physical and occupational therapy 6 times/week, in consultation with the Department of Rehabilitation Medicine.

Outcomes

The K-MBI score increased to 43 with improvements in ambulation on September 8th, 2019. On November 13th, 2019, the muscle strength of the elbow joints increased in flexion (4/4+) and extension (5−/5−). The K-MBI and the FIM scores increased to 71 and 78, respectively, and he was able to walk for 2 minutes without the use of a device for assistance.

Table 2. Prescription and Daily Dose of Dokhwalgisaeng-tang-Gami.

Composition (1st hospitalization*)	Dose (g)	Composition (2nd hospitalization†)	Dose (g)
Radix of Astragalus membranaceus	16	Ramulus of Loranthus parasiticus Merr.	16
Ramulus of Loranthus parasiticus Merr.	12	Radix of Aralia continentalis Kitagawa	12
Radix of Aralia continentalis Kitagawa	12	Cortex of Eucommia ulmoides Oliver	12
Cortex of Eucommia ulmoides Oliver	12	Fructus of Chaenomeles sinensis	12
Sclerotium of Poria cocos Wolf	12	Sclerotium of Poria cocos Wolf	12
Radix of Panax ginseng	12	Steamed radix of Rehmannia glutinosa	12
Rhizoma of Cnidium officinale Makino	12	Radix of Panax ginseng	12
Radix and rhizoma of Glycyrrhiza uralensis Fischer	8	Rhizoma of Cnidium officinale Makino	12
Ramulus of Cinnamomum cassia Presl	8	Radix of Achyranthes japonica Nakai	8
Fructus of Chaenomeles sinensis	8	Radix of Angelica gigas Nakai	8
Radix of Angelica gigas Nakai	8	Germinated Fructus of Hordeum vulgare Linna var. hexastichon Aschers	8
Steamed radix of Rehmannia glutinosa	8	Radix of Peucedanum japonicum Thunberg	8
Radix of Achyranthes japonica Nakai	8	Radix of Paeonia lactiflora Pallas	8
Germinated Fructus of Hordeum vulgare Linna var. hexastichon Aschers	8	Fructus of Crataegus pinnatifida Bunge	8
Radix of Peucedanum japonicum Thunberg	8	Massa Medicata Fermentata	8
Radix of Paeonia lactiflora Pallas	8	Radix and rhizoma of Glycyrrhiza uralensis Fischer	6
Fructus of Crataegus pinnatifida Bunge	8	Ramulus of Cinnamomum cassia Presl	6
Massa Medicata Fermentata	8	Radix of Gentiana macrophylla	6
Radix of Gentiana macrophylla	8	Radix and rhizoma of Asiasarum heterotropides	4
Fructus of Cornus officinalis Siebold et Zuccarini	8		
Tuber of Liriope platyphylla Wang et Tang	8		
Flos of Carthamus tinctorius Linne	6		

*1st hospitalization was from August 18th, 2019 to November 13th, 2019 (76 days).
†2nd hospitalization was from January 17th, 2020 to February 28th, 2020 (43 days).

On January 17th, 2020, when the patient was re-admitted, the muscle strength of the upper extremities was approximately 3+/4+. The K-MBI score was 51 and the FIM was 62, showing deterioration within the last 2 months. He could not walk without assistance (a walker) because there was some difficulty in balancing. After treatment, on February 28th, 2020, the muscle strength of the upper extremities increased to 4+/4+ (Table 3). The K-MBI and the FIM scores increased to 79 and 95, respectively (Tables 4 and 5), and he could walk without assistance for approximately 5 minutes (Table 6).

Although he had been treated at the Wonkwang University Hospital for dyspnea with O_2 inhalation and had decreased oxygen saturation in his blood, O_2 was no longer needed. The patient's oxygen saturation was 91%–92% on the first and second day, and then remained below 95%. The duration time for lying supine increased as the dyspnea improved. He could maintain a supine position without dyspnea for more than 20 minutes on October 15th, 2019. His coughing disappeared on October 8th, 2019, and the amount of sputum produced decreased to 50% on October 21st, 2019 before finally disappearing. Although the globus pharyngeus sensation persisted slightly even after discharge, there was no discomfort. Fig. 3 shows the patient's history and progress. There were no adverse events due to treatment or unanticipated events during hospitalization.

Table 3. Changes in the Patient's Motor Grade.

	2019.08.30.		2019.09.22.		2019.11.13.		2020.01.17.		2020.02.28.	
	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
Shoulder flexion, abduction	3-	3-	3	3	3-	3-	3+	4+	4+	4+
Elbow flexion	2+	2+	3-	3-	4	4+	3+	4+	4+	4+
Elbow extension	2	2	3+	3+	5-	5-	3+	4+	4+	4+
Wrist flexion, extension	3	3	4	4	5-	5-	3+	4+	4+	4+
Hand grip	4	4	4+	4+	5-	5-	4	4+	5-	5-
Hip flexion	4+	4	4+	4+	4+	4+	5-	5-	5-	5-
Hip extension	4	4	4+	4+	4+	4+	5-	5-	5-	5-
Knee flexion, extension	4	4	4+	4+	4+	4+	5-	5-	5-	5-
Ankle dorsiflexion, plantarflexion	4+	4	4+	4+	4+	4+	5-	5-	5-	5-
Great toe flexion, extension	4+	4+	4+	4+	4+	4+	5-	5-	5-	5-

Lt, left; Rt, right.

Table 4. Changes in the Korean Version of Modified Barthel Index Score.

	2019.08.30.	2019.09.08.	2019.11.13.	2020.01.17.	2020.02.28.
Personal hygiene	0	1	4	3	4
Bathing	0	0	3	3	3
Feeding	2	2	5	5	5
Toilet	0	2	5	2	10
Stair climbing	0	0	5	0	5
Dressing	0	2	2	2	8
Bowel control	10	10	8	10	10
Bladder control	10	10	10	10	10
Ambulation (or wheelchair)	1	8	12	8	12
Chair/bed transfers	3	8	12	8	12
Total	26	43	71	51	79

Table 5. Changes of the Functional Independence Measure Score.

Classification	Items	2019.08.30.	2019.11.13.	2020.01.17.	2020.02.28.
Self-care	A. Eating	2	4	3	4
	B. Grooming	1	3	3	4
	C. Bathing	1	2	3	4
	D. Dressing-upper body	2	3	2	5
	E. Dressing-lower body	2	3	2	5
	F. Toileting	1	5	2	7
Sphincter control	G. Bladder management	7	7	7	7
	H. Bowel management	7	7	7	7
Transfer	I. Bed, chair, wheelchair	2	5	3	5
	J. Toilet	2	3	2	5
	K. Tub, shower	2	3	2	5
Locomotion	L. Walk or wheelchair	2	4	3	6
	M. Stairs	1	2	1	4
Communication	N. Comprehension	6	6	5	6
	O. Expression	6	6	4	6
Social cognition	P. Social interaction	6	6	5	5
	Q. Problem solving	6	5	4	5
	R. Memory	3	4	4	5
Total score		59	78	62	95

Table 6. Changes in the Patient's Locomotion.

	2019.08.30.	2019.09.08.	2019.10.14.	2019.10.28.	2019.11.13.	2020.01.17.	2020.02.28.
Locomotion	Wheelchair	Wheelchair & walker	Walker	Walker & walking stick	Walker & self-gait (2 minutes)	Walker	Walker & self-gait (5 minutes)

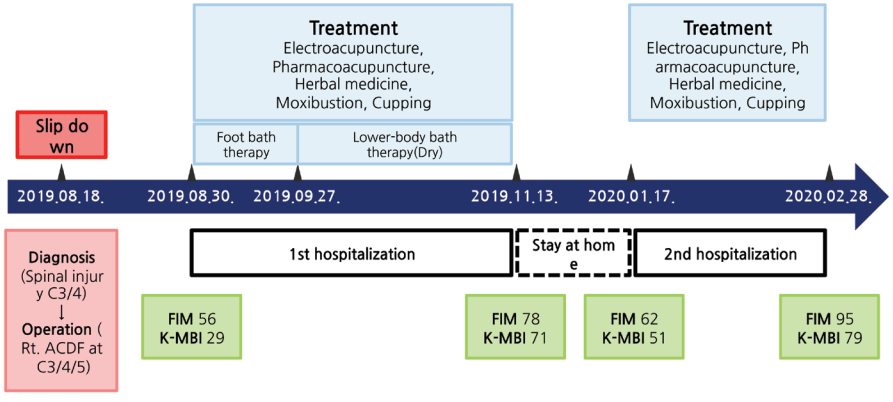

Fig. 3. Timeline of the patient's history and progress.

Discussion

The patient's motor weakness due to SCI was considered a wilting syndrome (痿證) in Korean medicine. Acupoints located at the paralyzed joints and muscles were selected for acupuncture treatment mainly to improve motor function [8]. Hominis placenta pharmacopuncture and electroacupuncture were combined with the treatment because they have been reported to aid recovery in motor function in SCI, and contribute to nerve regeneration [9].

It has been reported that Dokhwalgisaeng-tang has a protective action against spinal motor neuron damage [10]. Considering general weakness and tetraplegia, Astragalus membranaceus was prescribed as the main ingredient for its antioxidant and neuroprotective effects [11]. It is assumed that electroacupuncture, and Dokhwalgisaeng-tang with Astragalus membranaceus (the treatments mainly used in this case), played a major role in improving the patient's tetraplegia. Additionally, symptoms of coughing and production of sputum persisted without improvement, but decreased after administering Liriope platyphylla, an antitussive and expectorant [12]. The foot-bath, lower-body sauna, and moxibustion are thought to stimulate blood circulation and relieve fatigue [1].

A study on the prognosis of cervical SCI, showed the K-MBI increased by 28.19 and the FIM increased by 20.26 on average, in a group of patients without radiating pain [13]. The follow-up period was uncertain, and so it cannot be directly compared with this case. However, since the K-MBI and the FIM scores increased by 53 and 39, respectively, in this case, treatment results can be considered as meaningful. The patient showed a high level of satisfaction with his treatment and after discharge following the second hospitalization, he could return to daily activities.

This study has limitations as it reports a single case. Moreover, the patient not only underwent Korean medical treatment, but also received physical therapy and medicines prescribed by the previous hospital. Therefore, the patient's progress cannot be attributed only to Korean medicine treatment. Nevertheless, in this case, various Korean medical treatments such as electroacupuncture, pharmacopuncture, herbal medicine, foot-bath, and lower-body sauna were applied. Progress in muscle strength, independence in daily activities, respiratory symptoms, and neurological signs were observed for 6 months from the onset of the injury. Post-treatment, the patient's muscle strength and independence in performing daily activities improved significantly, suggesting the efficacy of Korean medicine treatment in rehabilitation of cervical SCI patients. Future studies should evaluate the prognosis and effects of Korean medical treatment for SCI.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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