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Effect of Shock Wave Therapy on Spasticity: A Single-Institution Experience

Şok Dalga Tedavisinin Spastisite Üzerine Etkisi: Bir Merkezin Tecrübesi

Özlem ALTINDAĞ, Savaş GÜRSOY

Gaziantep University, Research Hospital, Department of Physical Medicine and Rehabilitation, Gaziantep, Turkey

Introduction

Spasticity can cause development of contractures, leading to extra physical disability.

Spasticity mostly occurs in disorders of the central nervous system, such as spinal cord injury, cerebral palsy, or hemiplegia.

The caregivers of spastic patients have to face problems, such as maintaining hygiene and dressing. Otherwise, the ability to stand or walk usually relies on degree of the spasticity.

Although, the mechanisms of extracorporeal shock wave therapy (ESWT) on spasticity are still unknown, there are a few studies on this topic in the medical literature. In this study, we described a significant reduction in hypertonia in the plantar flexors after shock wave therapy in patients with spasticity. Fifteen patients (5 males and 4 females) with spasticity were included in the study. The mean age of our patients was 25.6 years. Three patients had hemiplegia, 2 patients had cerebral palsy, and 4 patients had spinal cord injury. Spasticity was upward of than grade II, by modified Ashworth scale (MAS), in all patients. Spasticity was evaluated by MAS from 0 to 4 (0: no spasticity to 4: severe spasticity) on muscles 4 hours after exercises. In each subject, clinical measures were evaluated before and 2 weeks after the ESWT. Rehabilitation sessions varied in length from 30 to 60 minutes. Ankle-foot orthoses were given to all patients; inhibitor hand splint were used in patients with hemiplegia. ESWT was planned for reduction of spasticity, improving compliance with an exercise program. Reduction in physical activities in patients with spasticity leads to low endurance, deconditioning increased heart rates and energy costs. ESWT was applied in the first week of physiotherapy sessions every other day, 3 sessions in total. Rehabilitation programs continued after ESWT. Shock wave therapy instrument BTL® -5000 Power was used for ESWT. The pressure pulses were focused on the spastic side of upper and lower muscles. Shots (2000) were given in the belly of the muscles, and the intensity was 0.1 mJ/mm^2 (2 bars).

Results

The mean age of the patients was 25.6 years at the time of treatment. The mean values of clinical features at baseline and after treatment are seen in Table 1. The mean values of MAS were 3.27±0.5 at baseline and 1.90±0.3 at 2 weeks after the treatment. There were significant differences between baseline and 2 weeks later in respect to MAS ($p<0.001$) (Table 2).

Discussion

Extracorporeal shock wave therapy is an effect with sound pressure waves that focus and concentrate on a specific zone (1).

The curative effect of ESWT is based on micro-circulation in tissues, also consisting of mechanically stimulating the intrinsic movements of the smallest terminal vessels: an elementary characteristic of micro-angiodynamics, allowing blood flow through the vascular bed for regulation (2).

Another effect of the shock wave seems to be a disturbance of axonal contents, filtering of the cell membrane, and a resulting increase in permeability, causing depolarization-factors that effect mechano-sensibility (3).

A number of studies have investigated the effect of the shock waves, which can induce non-enzymatic and enzymatic nitric oxide (NO) synthesis (4). NO is related in neuromuscular junc-

Address for Correspondence / Yazışma Adresi: Özlem Altındağ, MD, Gaziantep University, Research Hospital, Department of Physical Medicine and Rehabilitation, Gaziantep, Turkey Phone: +90 342 360 60 60-76222 E-mail: ozaltindag@yahoo.com

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Table 1. Clinical features and modified Ashworth spasticity baseline intervention and follow-up (2 weeks after treatment) in patients with spasticity

Patients	At Baseline	At 2nd week
Case 1 (Cerebral Palsy, 12 age)	GMFS: 3 MAS: 3	GMFS: 2 MAS: 2
Case 2 (Cerebral Palsy, 14 age)	GMFS: 4 MAS: 3	GMFS: 2 MAS: 1
Case 3 (Stroke, 65 age)	Brunnstrom Level (Upper ext: 3, Hand: 2, Lower ext: 4) MAS: 3	Brunnstrom Level (Upper ext: 4, Hand: 2, Lower ext: 5) MAS: 2
Case 4 (Stroke, 72 age)	Brunnstrom Level (Upper ext: 4, Hand: 3, Lower ext: 6) MAS: 2	Brunnstrom Level: (Upper ext: 3, Hand: 2, Lower ext: 5) MAS: 3
Case 5 (Stroke, 63 age)	Brunnstrom Level (Upper ext: 3, Hand: 2, Lower ext: 4) MAS: 4	Brunnstrom Level (Upper ext: 3, Hand: 2, Lower ext: 4) MAS: 4
Case 6 (Spinal Cord Injury, 24 age)	ASIA Impairment Scale: B MAS: 3	ASIA Impairment Scale: B MAS: 2
Case 7 (Spinal Cord Injury, 32 age)	ASIA Impairment Scale: C MAS: 3	ASIA Impairment Scale: C MAS: 2
Case 8 (Spinal Cord Injury, 24 age)	ASIA Impairment Scale: B MAS: 3	ASIA Impairment Scale: B MAS: 2
Case 9 (Spinal Cord Injury, 24 age)	ASIA Impairment Scale: C MAS: 4	ASIA Impairment Scale: C MAS: 2

GMFS: gross motor function classification system; MAS: modified ashworth scale; ASIA: American Spinal Injury Association

Table 2. Comparison of MAS values at baseline and first intervention

	Baseline	Two weeks after	p
The mean value of MAS	3.27±0.5	1.90±0.3	0.001

tion formation in the peripheral nervous system and in important physiological functions of the central nervous system, including neuro-plasticity.

Hyperemia is one of the main effects of shockwave therapy in the body. It provides better energy supply and distortion of axonal contents and filtering of the cell membrane, leading to depolarization that causes a decrease of pathological interactions between actin and myosin in spastic muscles (5). We showed that ESWT in patients with spasticity resulted in a significant reduction in muscle tone. These data proved that ESWT can be an efficient method, in addition to exercises, in spasticity. ESWT could be a useful approach for contributing to exercise therapy and facilitating functional activity in spastic patients. ESWT may shed light on the treatment of spasticity as a safe and noninvasive method. We proposed a possible use of shock wave treatment for patients with spasticity due to central nervous system disorders.

Further studies in a greater number of patients on reduced spasticity, the most effective treatment protocol for ESWT, and the persistence of the effect are warranted.

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