CASE REPORT

Effects of Whole-Body Vibration on a Diabetic Type 2 patient with Peripheral Neuropathy

Amin Kordi Yoosefinejad [1], Azadeh Shadmehr [2], Ghloamreza Olyaei [3], Saeed Talebian [4], Hossein Bagheri [5], Mohammad Reza Mohajeri -Tehrani [6]

1.PhD student of Physical Therapy, Physical Therapy Department, Rehabilitation Faculty, Tehran University of Medical Sciences (TUMS), Pich-e- Shemiran, Tehran, IR. Iran

2.Associate Professor, Physical Therapy Department, Rehabilitation Faculty, Tehran University of Medical Sciences (TUMS), Pich-e- Shemiran, Tehran, IR. Iran

3.Professor, Physical Therapy Department, Rehabilitation Faculty, Tehran University of Medical Sciences (TUMS), Pich-e- Shemiran, Tehran, IR. Iran

4.Associate Professor, Physical Therapy Department, Rehabilitation Faculty, Tehran University of Medical Sciences (TUMS), Pich-e- Shemiran, Tehran, IR. Iran

5.Professor, Physical Therapy Department, Rehabilitation Faculty, Tehran University of Medical Sciences (TUMS), Pich-e- Shemiran, Tehran, IR. Iran

6.Assistant Professor, Internal medicine, Endocrinology and Metabolic Research Institute ,5th floor, Shariati Hospital ,Karegar st.,Tehran ,IR. Iran

ABSTRACT

The **aim** of this study was to describe a case of type 2 diabetic patient with peripheral neuropathy treated with 6-week Whole-Body Vibration program training. A 52-year old woman who complained from night sleep disturbance due to feet pain and tingling and also fear of falling during daily walking. She tried medications without any significant effect. After six weeks training with Whole-Body Vibration, the pain level, muscle strength, balance and flexibility improved. Also, neuropathy score decreased significantly. These finding demonstrate that Whole-Body Vibration is an effective complimentary treatment in type 2 diabetic patients with peripheral neuropathy.

Key words: Whole-Body Vibration, Diabetes, Muscle strength, Neuropathy, Michigan Diabetic Neuropathy Score.

CORRESPONDING AUTHOR

Azadeh Shadmer

Email: shadmehr@tums.ac.ir

INTRODUCTION

Type 2 diabetes mellitus (DM) is a prevalent metabolic disease all around the world that affects 1.3% to 14.5 % of Iranian population.[1,2] As the disease progresses over time, neuropathy becomes a common complication. Up to 36% of individuals with non-dependent diabetes mellitus are affected by this condition.[3] While some studies reported a more prevalence among people with type 2 diabetes, others suggest that symptoms are more severe in this population.[4] Muscle strength and balance can be impaired in

patients with DM. Diabetic patients had a 17 and 14% reduction of strength of ankle flexors and ankle extensors, respectively.[5] Somatosensory and visual systems are often affected in the presence of DM. Signs and symptoms of peripheral nerve damage may occur in up to 25% of patients with DM after 10 years. The fact that several sensory systems are simultaneously affected in DM makes balance problems and the risk of falling. Yet, proprioceptive deficits of foot and ankle are considered to be the primary sources of balance impairment in DM.[6] In addition to gait and balance impairments, diabetic patients are known to suffer from high risk of injurious falls. Fall-related injuries are supposed to trigger a vicious cycle because of their potential detrimental effects on physical activity levels of the patients.[7]

Pain is a common symptom of diabetic neuropathy occurs often symmetrically in the feet and ankles. Peripheral nerves are composed of small and large diameter nerve fibers. Symptoms associated with the large fiber dysfunction are: weakness, tingling, numbness and balance deficit, while those associated with small fiber damage include pin and temperature sensation loss, pain and autonomic dysfunction. Small fiber involvement initially predominates in early stages of neuropathy.[8]

Aerobic exercise is considered as the main strategy to treat type 2 diabetic patients.[9] Besides endurance training, segmental strength training of the major muscle groups is used in the management of diabetic type 2 patients.[10] However, majority of diabetic patients suffer from several problems as obesity, articular complications in addition to adverse effects of diabetes. Whole-Body Vibration training can be a good substitution.

WBV is a new somato-sensory stimulation (SSS) type of exercise that has been emerged in sport training and rehabilitation during the last decade.[11,12] Long term WBV increases muscular strength and balance.[12-17] Recently, a case report showed that WBV has an effect on pain level of a diabetic patient with neuropathy.[1]

The purpose of this study was to describe a case of diabetic type 2 patient with peripheral neuropathy suffered from muscular weakness and sleep disturbances and also fear of falling during walking who treated by a six-week WBV training program.

Description of the Case

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The patient was a 52-year old female with a 10-year history of type 2 diabetes mellitus and a sensation of tingling and numbness in feet from a year ago that awoke her from night sleep with a sense of pain obliged her to change her position continually. Her Body Mass Index (BMI) was 26.1 and Waist to Hip ratio was 0.97. She had moderate degree of neuropathy according to Michigan Diabetic Neuropathy Score (MDNS). When her pain was described by using Visual Analog Scale (VAS), both feet pain was 6 of ten. After her pain was described, muscle strength was assessed by a dynamometer (MIE, medical research ltd., England) locally from Tibialis Anterior and Quadriceps Femoris muscles and also generally by a Back-Leg-Chest dynamometer (BASELINE, USA). Balance was evaluated by Unilateral Stance Test (UST) and Timed Up and Go Test (TUGT). UST is a commonly-used measure of balance capabilities, and a significant predictor of falls [18]and peripheral neuropathy.[19]With the arms folded across the chest, the subject stood on the dominant leg and lifted the other limb approximately 5 centimeters from the medial malleolus of the stance leg. Three experimental trials of UST were recorded and then the average of three was calculated. TUGT is a valid test for mobility and dynamic balance.[20] The participant asked to rise from a chair, walk three meters to a point on the floor at her usual comfortable safe pace, turn around the point and return to her initial seated position. TUGT was scored as the mean time of three subsequent trials. Lower and upper limb flexibility were assessed using back scratch and chair sit-and-reach test. The back scratch test consists in reaching behind the head with one hand and behind the back with the other hand towards the middle finger of hands. The score expressed as the distance (in cm) between the middle fingers. During the chair sit-and-reach test the subject sat on the front edge of a chair and extended her dominant leg straight in front of hip, with ankle in dorsiflexion and heel resting on the floor and reached as far as possible toward the toes. The result of test expressed as the distance (in cm) between the fingers and foot. In both tests the scores were negative when the subject was unable to touch the foot or middle finger and positive when overlap with foot or middle finger was possible.[21] After recording the initial data, the subject exposed to a WBV program which followed overload principle. At the first week the WBV applied at the frequency of 30 Hz, amplitude of 2mm and five thirty-second bouts with one minute elapsed between

bouts. For the following two weeks, frequency and amplitude kept the same but exposure duration changed to five 45-second bouts with one-minute interval between bouts and for the last three weeks, subject exposed to five one-minute bouts with one minute interval between bouts. Subject stood barefooted with an even distribution of weight over both feet on the plate with 30 degrees of knee flexion. She was told to contract the muscles of the lower limbs during exposure to vibration and bear weight more on their forefoot to dampen the vibration.[22] She was not allowed to touch the handle of vibrating plate. Data were collected three times; before exposure to WBV, at the end of 3rd week and at the end of 6th week. Data are summarized in Table 1.

After 6 weeks of WBV training, the patient's pain in her both feet reduced from 6 to one of ten in VAS and she reported to have a good sleep during night time without being awaken due to feet pain and Paraesthesia. The most interesting finding of our study is the alteration of MDNS score from 13 at baseline to 2 after WBV training. Also, BMI reduced from 26.1 initially to 25.3 and waist to hip ratio declined from 0.97 to 0.89 post training. When the study was about to completed, the patient asked if she could continue the training with WBV or she could purchase her own vibration plate. The patient is very happy with the response and satisfied with her daily activities.

Conclusion

This study demonstrated that WBV training reduces pain and improves muscle strength locally and generally and balance parameters and flexibility in a diabetic type 2 patient with peripheral neuropathy. The interesting finding was that although peripheral neuropathy is believed to be progressive and irreversible[3,23,24], MDNS score reduced significantly in our patient. Although, research on this topic is still in its infancy, the incorporation of WBV to other therapeutic treatment options may be promising. In this case report study, possible placebo and learning effects cannot be completely excluded. Our report is intended to further a discussion about the possible mechanisms of WBV effects on diabetic patients. WBV warrants further investigation over the course of longer, prospective study; in addition long term follow up is required to understand any possible side effects with application of WBV.

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ANNEX

Table 1. Summary of strength, balance and flexibility parameters collected before, at the third and at the end of six-week WBV training program. As can be seen, approximately all data had an incremental slope.

variable	*before WBV*	*third week*	*sixth week*
Tibialis Anterior Strength (kg)	3.3	8.7	12.8
Quadriceps Strength (kg)	5.9	13.6	16.8
General Strength (kg)	83.3	133	130
Unilateral Stance Time (seconds)	2.2	4.2	4
Timed Up & Go Test (seconds)	8.79	7.4	7.7
Back Scratch Test (cm)	+1	+5	+5
Chair Sit-and-Reach Test (cm)	0	+5	+9

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