Foot Vibration to Improve Foot Sensitivity and Ankle Brachial Index and Relief Pain Sensation in Type 2 Diabetes Mellitus Patients

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ABSTRACT

Exercise is one way to achieve good glycemic control and complication prevention. These study analysed effect of foot vibration to pain, foot sensitivity and ankle brachial index (ABI) improvement on type 2 diabetes mellitus (DM) patients. These study used pre-experiment one group pre and post test design with 20 samples, collected by using consecutive sampling. Intervention was provide foot vibration for 8 weeks at public health center of Abiansemal II Badung, Bali. The result showed mean of foot pain (right: 4.35, left: 3.85), foot sensitivity (right: 2.85, left: 3.05) and ABI (right: 0.82, left: 0.85) before intervention. Neuropathy and ABI improved after intervention with mean of foot pain (right: 3.35, left: 2.70, p=0.001), foot sensitivity (right: 1.50, left: 1.35, p=0.001) and ABI (right: 0.82, left: 0.85, p=0.001). For the result concluded that foot vibration was effective to improve neuropathy n ABI on type 2 DM patients.

Keywords: Foot vibration; type 2 DM; neuropathy.
1. INTRODUCTION

Handling DM is focused on self-management. DM management starts with applying a healthy lifestyle (medical nutrition therapy and physical activity) along with pharmacological interventions [1]. This management requires patient independence to implement it. Target achievement of glycemic control is still low. The report from the National Health and Nutrition Examination Survey (NHANES) shows that only 50% of adult DM patients in America who reach HbA1C below 7.0 and The Healthcare Effectiveness Data and Information Set (HEDIS) report that 40% of DM patients with private insurance and 30% of DM patients with government insurance reach HbA1C below 7.0 [2]. The results of health fundamental research show that 6.9% over the age of 15 experience hyperglycemic [3].

Poor glycemic control can cause complications. One chronic complication is peripheral neuropathy. The prevalence of neuropathy in young type 1 DM patients is 7% and Type 2 young is 22% [4]. The incidence of neuropathy pain in type 2 DM patients was 26.4% [5]. Patients of type 2 DM who experienced neuropathy as much as 48.1% [6]. Another complication is a vascular disorder characterized by a decrease in the ankle brachial index (ABI). Low ABI is related to the duration of DM [7]. Low ABI in DM patients is related with atherosclerosis [8].

Exercise is one way to achieve the target of glycemic control and prevent complications. Exercise can increase mitochondrial density, insulin sensitivity and cardiac output [9]. Non-weight bearing exercise can improve glycemic control in type 2 DM patients with neuropathy [10]. Mild exercise is recommended to reduce the risk of injury to patients. In addition from active exercise there are also passive exercise such as body vibration. Whole body vibration can increase blood flow and decrease body fat in type 2 DM patients [11]. Whole body vibration can improve body balance in DM type 2 patients [12]. Body vibration can reduce leg pain in type 2 DM patients with neuropathy [13]. Giving Vibration can also reduce systolic blood pressure, HbA1C and blood glucose decrease 6.3% [14].

From another study was found that after six months of aerobic exercise can improve ABI. Improvements in ABI correlate with decreases in HbA1C and blood pressure in both systolic and diastolic [15]. High and moderate physical activities can improve ABI 6.15 times compared to those who are poor activities for people who are at risk of suffering from vascular disorders [16]. Body vibration can reduce leg systolic pressure in menopausal women [17].

2. MATERIALS AND METHODS

The method of this research is pre-experiment with one group pre and post-test design. This study aims to determine the effect of foot vibration on improving neuropathy and ABI in type 2 DM patients. Samples were 20 people selected by consecutive sampling. The treatment in this study is vibration training on both feet using a Chi-machine (The Sun Ancon Chi Machine™), 10 minutes, 3 times a week in the first 2 weeks, 15 minutes, 3 times a week at 6 weeks with oscillation 144 cycles per minute. The research conducted at the Badung Abiansemal II Health Center Bali.

3. RESULTS AND DISCUSSION

Characteristics based on gender are mostly female, 11 people (55%) than men, 9 people (45%). The youngest sample age was 47 years and the oldest was 80 years old with an average age of 59.90. Diabetic neuropathy is measured by pain and foot sensitivity. The results showed that there was a change in neuropathy score.

Pain and foot sensitivity scores in respondents experienced an improvement in the right foot with a difference in pain score of 1.00 (22.99%) and sensitivity of 1.55 (54.39%). There was improvement in left neuropathy with a difference in pain score of 1.15 (29.87%) and sensibility 1.35 (44.26%). Foot vibration has a significant effect on the improvement of neuropathy in type 2 DM patients with p = 0.001.

Ankle brachial index is measured on both leg. The results of the study of ABI values before and after treatment.

There was an improvement in ABI on both legs with an average difference of 0.07 (8.53%) on the right foot and 0.05 (5.88%) on the left foot. Foot vibration has a significant effect on the improvement of ABI in type 2 DM patients with p = 0.001.

The success of managing type 2 DM is evaluated from various parameters, e.i blood pressure, blood glucose, HbA1C, body weight and blood cholesterol. Complications are also a parameter
of the successful management of type 2 DM including neuropathy and ABI. The results of this study indicate that the average neuropathy score in the sample before treatment was the average right foot pain score of 3.85 and left foot 4.35. The average sensitivity of the right leg is 2.85 and the left foot is 3.05. This shows that the sample has peripheral neuropathy. Pain and sensibility scores refer to the severity of the neuropathy.

These results are in accordance with neuropathic studies found that the prevalence of neuropathy in young type 1 DM patients is 7% and Type 2 young age is 22% [4]. The incidence of neuropathic pain in type 2 DM patients was 26.4% [5]. Founded in type 2 DM patients who experienced neuropathy as much as 48.1% [6].

Symptoms of neuropathy measured are pain and decreased sensitivity of the left and right legs. This is in accordance with the results of research on neuropathy found that the most common symptoms of neuropathy were foot pain (15.7%), tingling (12.6%), decreased foot sensation (11.5) and not strong walking (10.5 %) [6].

The occurrence of neuropathy is triggered by a disorder of carbohydrate metabolism. The hyperglycemic state causes the activation of the polyol pathway. Other factors are oxidative stress, micro vascular changes and activation of microglia cells [18]. Neuropathy results from degeneration of the thermal nerve [19].

This study also found that the average right foot ABI was 0.82 and left foot was 0.85. These results indicate that ABI samples are in the low range. This is consistent with [20] that ABI of 0.70-0.90 includes mild leg vein occlusion. The results of other studies showed that normal ABI was 66%, ABI was 16% low and ABI was high 8% [7]. Furthermore it was found that the low ABI was influenced by gender, duration of DM, body mass index, and hypertension. ABI describes the quality of vascularization. Poor ABI is related with high HbA1C, high body mass index and smoking history [21].

Neuropathy and ABI after vibration of the foot for 8 weeks showed a significant improvement. The average right foot pain score was 3.35 and left foot was 2.70. The average sensitivity of the right and left legs is the same, namely 1.50. The average ABI of the right and left legs is the same, which is 0.89. Difference in mean pain score 1.15 and sensibility 1.35 (p = 0.001). There was also an improvement in ABI on both feet with an average difference of 0.07 (p = 0.001) on the right foot and 0.05 (p = 0.001) on the left foot.

This shows that the sensation of pain felt by the sample decreases and there is an improvement in the sensitivity of both feet. Vascularization repair is indicated by an increase in ABI, due to a decrease in the systolic pressure of both legs. During the treatment there will be vibrations in the legs which have an impact on the quality of blood circulation in the legs.

Body vibration causes transmission of energy throughout the body even if it is vibrated only by the hands or feet [22]. Whole body vibration is a therapy for the modalities of several diseases. At the time of vibration there will be a vertical

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transmission of vibrations throughout the body, namely the entire bone, stimulating sensory perceptions of the body and muscles. This will cause a tonic vibration reflex [23].

Vibration affected to the muscles and tendons, which is the alternation and shortening of the muscles alternately during vibration. The neurophysiological effect of vibration stimulates motorneuron impulses via monosynaptic and polysynaptic [22]. Vibration causes increased ATP turnover in cells which results in high energy consumption [22].

The metabolic effects of patients with type 2 diabetes are very much including blood glucose. Vibration causes an increasing in muscle contraction, stimulates osteocytes to secrete osteocalcin. Osteocalcin causes an increasing of Beta cell period, insulin secretion and increases insulin sensitivity. Vibration also causes an increase in energy expenditure, this causes an increase in insulin production and lowers blood glucose [23].

Whole body vibrations in type 2 DM patients can effect to blood flow. After 12 weeks of training there was an increase in leg blood flow, a significant decrease in body weight, arm circumference and body fat [11]. Body vibration training 3 times a week for 12 weeks with a vibration frequency of 14-14Hz and amplitude of 4 mm can increase balance on respondents [12].

There was a 22% decrease in HbA1C in mice with type 2 diabetes, after being given body vibration training with a frequency of 30 Hz, 3 mm, 20 minutes, 5 times a week for 6 weeks [24]. 6.3% decrease in fasting blood glucose in type 2 DM patients after vibration training with a frequency of 30 Hz, 2 mm for 9 weeks and 35 Hz, 2 mm for 3 weeks (all 12 weeks) [14]. Vibration therapy provided at the first week with a frequency of 30 Hz, 2 mm 5 times 30 seconds with a 1 minute pause. The second and third weeks 5 times 45 seconds with a 1 minute pause. Then the next three weeks are given 5 times 1 minute with 1 minute pause (total treatment for 6 weeks). Can reduce pain, increase local and general muscle strength, balance and move flexibility in type 2 DM patients with peripheral neuropathy [25].

A case study of the using vibration therapy in patients with diabetes mellitus with neuropathy. Vibration training is given for 4 weeks with a frequency of 30 Hz, 3 minutes, 5 times a week. After the exercise, there was a decrease in pain in both legs, the duration of pain was shortened and the appearance of pain returned longer, and there was an increase in the balance of patients [13].

The limitation of this study is that researchers cannot control several confounding factors including psychosocial factors such as stress. The researchers also did not carry out strict supervision of the sample diet. Samples go on a diet as recommended by health workers from the health center and take regular medication as recommended. Some of these confounding factors can affect pain, sensitivity and ABI during the study.

4. CONCLUSION

This study only examined a small sample (20 samples). There was an improvement in diabetic neuropathy and ABI after treatment in the form of foot vibration for 6 weeks. Repair on the right foot with a difference in pain score 1.00 (22.99%) and sensitivity 1.55 (54.39%). Improvement of left foot neuropathy with a difference in pain score 1.15 (29.87%) and sensibility 1.35 (44.26%). Improvements to the ABI with a difference of 0.07 (8.53%) on the right foot and 0.05 (5.88%) on the left leg Foot vibration significantly affected the improvement of neuropathy and ABI in type 2 DM patients with p = 0.001.

CONSENT

It is not applicable.
ETHICAL APPROVAL

Ethical clearance by Polytechnic, Ministry of Health, Denpasar Bali.

COMPETING INTERESTS

Authors have declared that no competing interests exist

REFERENCES


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