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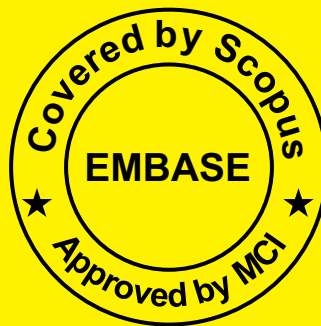
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Effect of Buerger Exercises on Improving Peripheral Circulation of the Lower Extremities among Patients with Type 2 Diabetes Mellitus at Selected University Hospital–Egypt

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ABSTRACT

Diabetes Mellitus (DM) is a metabolic disorder characterized by increased glucose level in the blood, resulting from defect in the insulin secretion, insulin action, or both. In advanced stage of disease; peripheral circulation of lower extremities is impaired which increases the risk for developing peripheral arterial diseases (PAD). Buerger Exercises is a simple intervention for improving the peripheral circulation of patients with diabetes mellitus. The aim of the current study was to assess the effect of Buerger Exercises on improving the peripheral circulation among patients with type 2 DM as assessed by Ankle Brachial Index (ABI) scale. Quasi experimental design was used. A non-probability purposive sample consists of sixty male and female adult patients with type 2 DM were selected. The study findings revealed that the post intervention mean ABI scores of both legs (Rt leg =1.097, Lt leg =1.086) were significantly higher than pre-intervention scores (Rt leg =.885, Lt leg =.937) ($p=0.001$). The use of Buerger Exercises is effective in improving the perfusion of lower extremities. Therefore, it is recommended that Buerger Exercises can be used to improve the peripheral circulation of lower extremities among patients with type 2 diabetes mellitus.

Keywords: Peripheral circulation, Buerger exercises, type 2 Diabetes mellitus

Introduction

Diabetes Mellitus (DM) is becoming one of the increasing health problems' concern worldwide. Half of patients with DM were undiagnosed and about 4 out of 5 patients live in low and middle income countries. According to the World Health Organization (WHO)¹; Diabetes is a pandemic disease affecting more than 415 million adults worldwide. This number is expected to surge to 642 million by 2040, diabetes will become the seventh leading cause of death worldwide with diabetes deaths expected to rise by 50% during the next 10 years².

According to the International Diabetes Federation (IDF), Egypt is one of the top 10 countries in the number

of people with diabetes between 20 and 79 years of age, with 8.5 million of and around 4.5 million undiagnosed. Consequences of the compromised vascular system in DM are among the most devastating complications. Both macro and micro-vascular diseases are believed to contribute to the consequences of peripheral vascular disease(PVD)³.

The risk of PVD is increased in patients with DM, it occurs earlier and is often more severe and diffuse, leading to ischemic ulcers, gangrene and possible amputation, it is also a marker for generalized atherosclerosis and impaired peripheral circulation of lower extremities⁴. The use of ankle-brachial index (ABI) provides a measure of blood flow to lower extremities. This could help in early detection, initiate early therapy and reduce the risk of limb ischemia and amputation. It is recommended that patients with DM should be screened annually for impaired peripheral circulation³.

There are many modalities to improve the lower extremities' perfusion such, Buerger exercises which

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considered one of the low cost and simple physical interventions to stimulate the development of collateral circulation in lower extremities⁵. The exercises were proposed in 1924 by Leo Buerger⁶ and modified by Arthur Allen in 1931.

The mechanism of Buerger exercises depend on the use of gravitational changes in positions that are applied to the smooth musculature of vessels and to the vascular bed of lower extremities. Gravity helps alternately to empty and fill the blood vessels, which can eventually increase transportation of blood through it. Buerger exercises drained engorged vessels by using postural changes. However in spite of its simplicity, the application of these exercises to patients with diabetes is very rare, and the clinical significance of peripheral circulation improvement is still limited due to the lack of measuring tools⁷.

Nurses should focus on the prevention of impaired peripheral circulation among patients with DM by early recognition and detection of those at risk. An awareness of diagnostic and treatment strategies will enable nurses to educate patients. This will help to improve both concordance with treatment and disease outcome⁸. Therefore, the aim of the current study was to evaluate the effect of Buerger exercises on improving the peripheral circulation of the lower extremities among patients with type 2 DM.

Hypotheses:

H1: There is a statistical significant difference between the pre and post interventional mean scores of ankle brachial index (ABI) of the study participants after five days.

H2: There is a statistical significant difference between the pre and post interventional mean scores of ankle brachial index (ABI) of the study participants after fifteen days.

Method

Selection and Description of Participants: A non-probability purposive sample consists of sixty male and female adult patients who met the inclusion and exclusion criteria were selected for the study from the medical departments of a selected university hospital in Cairo, Egypt.

Inclusion and Exclusion Criteria: Patients diagnosed with type 2 DM according to WHO criteria¹, with regular treatment, had ABI score of 0.7 up to .99 were eligible to be included in the study. Patients who had; previous re-vascularization, hyperglycemia above 300 mg/dl, uncontrolled hypertension (BP \geq 160/100 mmHg, Extreme obesity (BMI \geq 37.5 kg/m², and sever edema according to level (sever edema (4): up to the groin) and severity (+4), active foot ulcer, gangrene and history of amputation, were excluded.

Data Collection Tools:

Peripheral Circulation Assessment Tool (PCAT): Tool was developed by the researcher guided by extensive literature review. It consists of three parts:

Part 1: Demographic Data: age, gender, education.

Part 2: Medical History and General Health Status: duration of diabetes, blood sugar, blood pressure, weight, height & body mass index (BMI).

Part 3: Assessment of ABI Value: The ankle-brachial index (ABI) is the ratio of the blood pressure at the ankle to the blood pressure in the upper arm (brachium).

Ankle Brachial Index = Highest ankle pressure / Highest brachial arm pressure

Interpretations of ABI:

- Normal ABI ranges from 1.0 — 1.4
- Values above 1.4 suggest a non-compressible calcified vessel.
- Value below 0.9 is considered diagnostic of peripheral arterial disease (PAD) and less than 0.5 suggests severe PAD, according to the American Heart Association (AHA) guidelines⁹.

Tool Validity and Reliability: Tool validity was assured and was also tested for internal consistency by test-retest reliability. Cronbach's alpha was 0.99.

Procedure: Patients who met the inclusion criteria for the study were approached by the researcher; individualized interview session was conducted to collect data related to the demographic and medical data. Ankle Brachial Index (ABI) of the lower extremities of the study participants were assessed and recorded. Buerger exercises as a study intervention (independent variable) was administered on the same day and continued 2-3

times for 15 days for each patient. Post assessment of ABI was done on the fifth and 15th day using the same scale. Buerger Exercises were performed and taught for each participant in the following position sequence:

- Elevation of lower extremities to a 45 to 90 degree and keep in position until the skin blanches (appears dead white);
- Put lower extremities below the level of the rest of the body until redness appear; Flexion, extension, and circumduction of the ankles are done during this phase of dependency.
- Finally, the lower extremities are placed flat on the bed (horizontal) for a few minutes.

The length of time for each position varies with the patient's tolerance and the speed within which color change occurs. Usually the exercises were prescribed for about 12 -15 minutes. The final overall effect was determined by comparing ABI pre and post-test scores of the participants.

Statistical Analysis: Data were coded and analyzed using SPSS, version 20. Shapiro-wilk Normality test was done. Descriptive statistics including frequency distribution, mean, and standard deviations, as well as inferential statistics such as Wilcoxon test were used to examine the relationships between variables. A p-value less than 0.05 were considered statistically significant.

Results

Table 1: Frequency and Percentage Distribution of Demographic Characteristics of the Study Participants (n = 60)

Demographic Characteristics	Frequency & Percentage	
	No.	%
Age (in years):		
30 to > 40	7	11.6
40 to > 50	22	36.7
50 and more	31	51.7
Mean ± SD	51.98 ± 10.43	
Sex:		
Male	23	38.3
Female	37	61.7
Education:		
Illiterate	24	40
Can read and write	13	21.6

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Primary & Preparatory	10	16.7
Secondary	10	16.7
University	3	5

Table (1) shows that majority of participants were females, and aged 50 years old and above, with a mean of (51.98 ± 10.43). Near half of participants were illiterate.

Table 2: Frequency and Percentage Distribution of the Medical History and General Health Status of the Study Participants (n = 60).

Medical History & General Health Status	Frequency & Percentage	
	No.	%
Blood Pressure (mmHg):		
<i>Systolic</i>		
100 to less than 120	16	26.7
120 to 140	44	73.3
Mean ± SD	123.8 ± 13.4	
<i>Diastolic</i>		
60 to less than 75	34	56.7
75 to 90	26	43.3
Mean ± SD	73.3 ± 8.2	
Random Blood Sugar (mg/dl)	Min. (102)	Max. (250)
Mean ± SD	168.5 ± 35.9	
Duration of illness:		
1 to > 5 years	21	35
5 to > 10 years	20	33.3
More than 10 years	19	31.7
Mean ± SD	8.13 ± 5.20	
Body Mass Index (BMI):		
Normal (less than 23 kg/m ²)	6	10
Over weight (23 – 27.4 kg/m ²)	39	65
Obesity (27.5 – 37.4 kg/m ²)	15	25
Mean ± SD	27.1 ± 3.4	

Table (2) illustrates that about three quarters of participants had a systolic blood pressure ranged from 120 to 140 mmHg, while more than half had a diastolic blood pressure ranged from 60 to > 75 mmHg. Participants' random blood sugar ranged from 102 – 250 mg/dl. About one third of participants were diabetics since one to > five years, and one third were from five to > 10 years. More than half of participants were overweight.

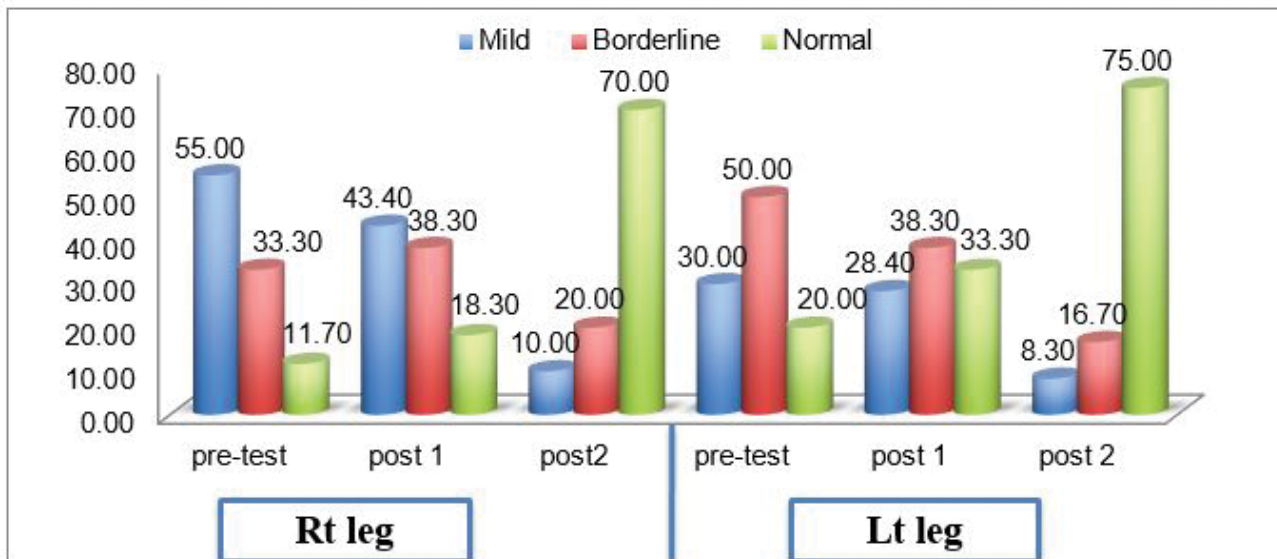


Figure 1: Percentage distribution of ankle brachial index (ABI) scores of the Rt & Lt legs among participants in the pre intervention, 1st & 2nd post-intervention (n = 60)

The Figure depicts the changes which happened between the ABI categories for both Rt and Lt legs. Before intervention; more than half of the participants had mild ABI value in the Rt leg and borderline in Lt leg while the minority had normal ABI, whereas after performing Buerger exercises for five days (post 1); Percentage of mild category decreased while the borderline and normal ones increased. In 2nd post intervention after 15 days; the majority of participants moved to the normal category for both legs. The shift of the participants from each category to another revealed the improvement of the lower extremities’ peripheral circulation after performing Buerger exercises.

Table 3: Means, Standard Deviations and Wilcoxon test of Ankle Brachial Index (ABI) scores pre intervention and 1st post-intervention and 2nd post-intervention (n = 60)

	Pre intervention	1 st post-intervention	W(p) Pre Vs. 1 st Post	2 nd post-intervention	W(p) Pre Vs. 2 nd post	W(p) 1 st post Vs. 2 nd post
	Mean ± SD	Mean ± SD		Mean ± SD		
Rt leg	.885 ± .144	.928 ± .168	-1.866 (.062)	1.097 ± .180	-6.086 (.0001*)	-5.033 (.0001*)
Lt leg	.937 ± .143	.968 ± .184	-1.239 (.215)	1.086 ± .166	-5.057 (.0001*)	-3.704 (.0001*)

* significant > 0.05

There was a gradual increase of the ABI mean scores in terms of improvement of the peripheral circulation after exercises. There was no statistical difference found between the ABI mean scores of pre intervention and 1st post intervention. On the other hand, there was a high statistical difference found between the ABI mean scores of pre intervention and 2nd post intervention and also between 1st and 2nd post interventions.

Discussion

The present study results revealed that ABI mean scores before performing Buerger exercises in the right and left legs were .885 and .937 respectively, while the

mean scores after were 1.097 and 1.086, in the right and left legs respectively.

According to WHO index for blood pressure; the study findings regarding blood pressure showed that participants were in the pre-hypertension category which means that they are at increased risk for developing hypertension and subsequently impaired peripheral circulation especially that they are diabetics. This is congruent with Makin¹⁰ and Priya¹¹, who reported that the diabetic patients, with elevated blood pressure, long disease duration and obesity; are at a greater risk to develop impaired circulation of lower extremities.

Ankle brachial (ABI) mean scores after performing Buerger exercises for five days didn't show any significant difference between pre intervention mean scores so the 1st hypothesis was not supported. It might be due to the short period to produce effect from performing the exercises. Also as any exercise program; increasing the duration and compliance might help in producing the desired results. The current study results were concurrent with some studies^{12,13}, While it weren't matched with other studies^{8,11} as there was a significant difference after five days.

Regarding the results related to the 2nd post intervention which was assessed after 15 days, a significant difference and acceptable level of improvement of ABI mean scores was presented as there was an observable shift from each category to another. In a simple way, the participants improved from mild-moderate ABI to borderline and from borderline to normal as shown in fig (1). This mean that performing Buerger exercises for 15 days is more effective in improving peripheral circulation. So the 2nd hypothesis was supported and verified. These results were supported and concurrent with Sathya, Vijayabarathi & Mehani¹²⁻¹⁴ who reported a significant difference after using exercises for 15 days as recommended.

The resulted change might be due to the sufficient period that help in establishing new collaterals of the lower extremities and improve the peripheral circulation, and perfusion, which was presented as acceptable ABI values. These findings were supported by the AHA⁹ and ADF³ guidelines which emphasized the importance of performing exercises regularly than other invasive procedures to maintain lower extremities' perfusion.

Conclusion and Implications

The current study concluded that Buerger exercises are effective noninvasive intervention that helps in improving the peripheral circulation of lower extremities among patients with type 2 diabetes mellitus.

The study recommended the following:

- Replication of the study by using a large sample from different geographical areas, and different settings, and for long duration.
- A comparative study is recommended to evaluate the effectiveness of Buerger exercise with other

non-pharmacological measures for improving the level of lower extremity perfusion.

- Evidence based nursing practice should be encouraged for applying Buerger exercises to prevent PAD among diabetic patients.
- There is a need for further investigation of standardized procedures of Buerger exercises.
- More studies are needed on the prevention of diabetic foot using Buerger exercises.

Conflict of Interest: No conflict of interest among authors.

Source of Funding: It is a self-funding.

Ethical Consideration: A written initial approval was obtained from the ethics and research committee of the Faculty of Nursing - Cairo University. Written informed consent was obtained from each patient after explaining the nature & purpose of the study. Patients were informed that participation in the study was entirely voluntary and anonymity and confidentiality of the data were assured.

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