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Full Length Research Article

Effect of Proprioceptive Neuromuscular Facilitation Exercises on Blood Pressure and Ankle Brachial Indexin Type 2 Diabetic Patients with Newly Diagnosed Mild Hypertension

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ABSTRACT

Background: Proprioceptive Neuromuscular Facilitation (PNF) is a form of treatment which may decrease complications of Type 2 Diabetes Mellitus (T2DM).This study aims to reveal the effect of some techniques of PNF exercises on blood pressure (BP) and ankle brachial index (ABI) in T2DM patients with newly diagnosed mild hypertension. Methods: This interventional study was performed on 50 patients aged between 40 and 60 years with controlled T2DM and newly diagnosed mild hypertension (systolic BP (SBP) between 140 and 159 mmHg and/or diastolic BP (DBP) between 90 and 99 mmHg).Patients were followed up for 3 months. Results: Both SBP and DBP showed significant decrease and ABI showed significant increase after 1, 2 and 3 months as compared to before PNF. There were 48 (96%) patients who had SBP > 140mmHg before PNF and only 9 (18%) patients after 3 months. There were 35 (70%) patients who had DBP > 90mmHg before PNF and no patient after 3 months. There were 22 (44%) patients who had ABI <0.9 before PNF, 6 (12%) patients after 1 month, 1 (2%) patients after 2 months and no patients after 3 months. Conclusion: PNF exercises may have a great role in controlling blood pressure and improving ABI in T2DM patients with newly diagnosed mild hypertension.

Introduction

Diabetes mellitus (DM) is one of the most common worldwide disease, affecting about 415 million persons all over the world, where the majority have type 2 diabetes mellitus (T2DM). This is expected to rise to 642 millions by 2040(1). DM is a metabolic disease which is caused by a defect in insulin secretion, insulin action, or both leading to hyperglycemia. Chronic hyperglycemia is causing long-term complications to the eye, kidney, nerve, heart, and blood vessel(2). Proprioceptive Neuromuscular Facilitation (PNF) is a form of treatment developed by Herman Kabat in the 1950's(3). PNF is aiming to improve strength, coordination and control of motion, maintaining a proper balance of motion and stabilization and increasing endurance by proprioceptor stimulation(4-6).PNF is based on neuromuscular mechanisms (facilitation, inhibition, muscular resistance, irradiation, successive induction, and reflexes)(7).

Peripheral artery disease (PAD) of lower limbs impacts> 200 million persons all over the world. People with PAD have a 2-3 fold increase of cardiovascular (CV) events and all-cause mortality compared to people without PAD(8). The ankle brachial index (ABI) is a reliable, sensitive, and highly specific noninvasive test and can be used to diagnose and assess the severity of PAD (9).

There is lack of awareness among most patients about the importance of sports, even though the scientific research periodically confirms the benefits of exercise in reducing the complications of DM. Hence, this study aims to reveal the effect of some techniques of PNF exercises on blood pressure (BP) and ABI in T2DM patients with newly diagnosed mild hypertension.

Subjects and Methods

After approval from institutional ethics and research committee, this interventional study was performed on 50 patients aged between 40 and 60 years with controlled T2DM and newly diagnosed mild hypertension (systolic BP (SBP) between 140 and 159 mmHg and/or diastolic BP (DBP) between 90 and 99 mmHg) from October 2017 to July 2019 in Kafrel Sheikh University hospital. Full explanation of the

procedures, possible side effects and complications were discussed. An informed written consent was obtained from the patient. There were adequate provisions to maintain privacy of participants and confidentiality of data like the patient had his secret code and private file and research results were only used for scientific purposes. Exclusion criteria were moderate or severe hypertension (before or during the study),patients on antihypertensive medications, smoking, patients on insulin, patients with severe complications (e.g. diabetic nephropathy, retinopathy), other comorbidities (e.g. cardiac, renal, hepatic).

PNF patterns

The patients underwent 3 sets of exercises one hour each day for 3 days/week for 3 months. Each set of exercise had 5 repetitions of PNF patterns (10).

The PNF patterns were diagonal 1 (D1) and diagonal 2 (D2) patterns. Both patterns are subdivided into:

A) Moving into Flexion: the toes start flexed, and endsextended. Ankle and foot start plantar flexed; everted and ends dorsiflexed inverted. Tibia starts externally rotated and ends internally rotated. Knee starts extended, and ends flexed. The hip starts extended, abducted, internally rotated and ends flexed, adducted, externally rotated.
B) Moving into Extension: The start and end are reversed to "D1 Moving into Flexion".

BP measurements

All cases were measured by a trained doctor who had clinical data collection experience. After 5 minutes' rest in the supine position, the both palpatory and auscultatory methods were used to record BP with the appropriate size of right arm by validated standard sphygmomanometers. Three readings have been taken for each SBP and DBP, and the average BPs have been used.

ABI technique

Participants stayed 5 minutes before measurement of ABI in the supine position. BP cuffs were properly placed over brachial artery and above malleolus. The cuffs were rapidly inflated in each arm to 20 mm Hg above the audible SBP and deflated at 2 mm/s. We have measured SBP twice, first in the following order and in reverse order with a 5 MHz Hand-Held Doppler probe: in the right brachial artery, dorsalis pedis and posterior tibial arteries and in reverse in the left side. The SBP was recorded as the pressure at which the first SBP was felt.For each leg, we calculated the ABI by averaging two arterial pressures. In most cases, we used the brachial arterial pressure for the ABI measurement on average of all four brachial arterial pressures. Participants with an ABI less than 0.90 were classified as peripheral arterial disorders.

Measurements

Demographic data (age, gender, weight, height and BMI) were recorded. Both BP (SBP and DBP) and ABI were recorded before PNF and after 1, 2 and 3 months.

Outcome measures

The primary outcome was the decrease in BP and the secondary outcome was the improvement of ABI.

Statistical analysis

The statistical software was SPSS v25 (IBM©, USA). Numerical variables were presented as mean and SD and were compared by paired student T. test. Categorical variables were presented as patients' number and percentage (%). P value < 0.05 was considered significant.

Results

The characteristics of the patients (age, gender, weight, height and BMI) are shown in [Table (1)]. As regards SBP, there were significant decrease after 1, 2 and 3 months as compared to before PNF [Table (2)].There were 48 (96%) patients who had SBP > 140mmHg before PNF, 35 (70%) patients after 1 month, 24 (48%) patients after 2 months and only 9 (18%) patients after 3 months.

As regards SBP, there was significant decrease after 1, 2 and 3 months as compared to before PNF [Table (3)]. There were 35 (70%) patients who had DBP >90mmHg before PNF, 15 (30%) patients after 1 month, 4 (8%) patients after 2 months and no patients after 3 months.

ABI showed significant increase (improvement)after 1, 2 and 3 months as compared to before PNF[Table (4)]. There were 22 (44%) patients who had ABI<0.9 before PNF, 6 (12%) patients after 1 month, 1 (2%) patients after 2 months and no patients after 3 months.

Table (1): Characteristics of the studied patients

N = 50		Mean ± SD	Range
Age (year)		58.1 ± 3.95	49-65
Height (cm)		166.9 ± 11.1	150-187
Weight (kg)		87.9 ± 12.2	66-105
BMI (kg/m^2)		31.8 ± 5.13	24.242.7
Duration of the disease (year)		8.1 ± 2.22	4-11
		N	%
Gender	**Male**	34	68
	Female	16	32

Table (2): Systolic blood pressure (SBP) in mmHg of the studied patients

N = 50	Before	After 1 mon	After 2 mon	After 3 mon
Mean ± SD	149.19 ± 5.88	144.04 ± 6.59	140.16 ± 6.96	135.10 ± 6.95
Range	136 – 159	131 – 156	125 – 153	120 – 151
P value		**<0.001***	**<0.001***	**<0.001***

** significant as P value < 0.05*

Table (3): Diastolic blood pressure (DBP) in mmHg of the studied patients

N = 50	Before	After 1 mon	After 2 mon	After 3 mon
Mean ± SD	92.26 ± 3.74	87.68 ± 4.46	84.36 ± 5.79	80.68 ± 6.17
Range	85 – 98	77 – 96	72 – 95	68 – 89
P value		**<0.001***	**<0.001***	**<0.001***

** significant as P value < 0.05*

Table (4): Ankle brachial index (ABI) of the studied patients

N = 50	Before	After 1 mon	After 2 mon	After 3 mon
Mean ± SD	0.95 ± 0.13	1.00 ± 0.10	1.04 ± 0.09	1.08 ± 0.07
Range	0.78 – 1.15	0.88 – 1.19	0.88 – 1.23	0.92 – 1.28
P value		**<0.001***	**<0.001***	**<0.001***

** significant as P value < 0.05*

Discussion

Epidemiological studies show overwhelming evidence that the effects of CV disease and mortality are inversely linked with physical activity which was evaluated by questionnaires or interviews or physical fitness measured on exercise testing(11). Proof of the beneficial effects of exercise on BP, glucose homeostasis, lipid profile, body composition, smoking, endothelial function was obtained from randomized controlled trials (RCTs) and observational studies(12).

Regular physical activity decreases the CV diseases, which was the result of a higher expression and phosphorylation of the endothelial isoform of NO synthatase at endothelial level, resulting in a more efficient radical scavenger mechanism, rejuvenated endothelium by circulating progenitor cells(13, 14).

Results of the present study are in line with the results of Fagard and Cornelissen (11)meta-analyses of 72RCTs involving dynamic aerobic endurance training or resistance training. in Ambulatory BP at rest and daytime decreased significantly 3/2.4 and 3.3/3.5 mmHg respectively. Resting BP was decreased significantly in the hypertensive patient than others (-6.9/-4.9 vs -1.9/-1.6). Endurance training decreases BP through a reduction in systemic vascular resistance, in which the sympathetic nervous system and the renin-angiotensin system appear to be involved, and favorably affects concomitant CV risk factors.

Siasos et al (15) stated that moderate intensity aerobic exercise (IRE) and moderate interval resistant exercise can favorably affect endothelial function. Flow-mediated dilation (FMD) in the brachial artery was used to measure the endothelial function. The femoral carotid pulse velocity (PWV) was used to the arterial rigidity index. Tests were conducted before and after each IRE session. In comparison to baseline, IRE significantly improved FMD and increased PWV.

Pereira(16) stated that healthy elderly women can perform PNF without CV complications; as it doesn't increase BP. In this study, 15elderly fit women with a mean age of72.40±6.82 years carried out 3 sets of 3 separate PNF techniques, each five replications, performing a single movement pattern. SBP and DBP were evaluated only before and during the last two repetitions of each technique. In our study, we followed the BP for 3 months.

Further studies are needed to assess the role of PNF in coronary artery disease, neuropathy and other complications of DM. Also, further studies with larger sample size are needed. RCTs are needed to compare between PNF alone, other antihypertensive drugs and combinations between PNF and drugs.

Conclusion

PNF exercises may have a great role in controlling blood pressure and improving ABI in T2DM patients with newly diagnosed mild hypertension.

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Conflict of Interest: Nil

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