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Effect of resistance training on nerve function in type 2 diabetic patients asymptomatic to autonomic dysfunction

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Abstract
Background: Diabetic peripheral neuropathy (DPN) is a common complication and quality-of-life damaging factor in diabetic patients and May contributes to diminished exercise tolerance. Therefore autonomic testing offers a useful tool to identify patients with potential poor exercise performance. So studying of effect of resistance training will give a precise protocol for prevention of DPN in asymptomatic patients.
Aim and objectives: to study the effectiveness of resistance training on nerve conduction study, glycemic control and exercise tolerance.
Methodology: 18 type 2 Diabetic aged 35-60 were selected. NCV for tibial nerve, glucometer reading and 6MWT was done pre and post intervention program of 4 weeks resistance training.
Results: post intervention glucometer reading show that there significant variation (p=0.001), 6MWT show that there is significant variation (p=0.001) and NCV of tibial nerve show there is quite significant variation (p=0.0306).
Conclusion: with supervised resistance training there is significant improvement noted in exercise tolerance, glucose control and Nerve conduction velocity of tibial nerve.

Keywords: type 2 diabetic, resistance training, NCV, exercise intolerance, glycemic control

Introduction

Diabetic peripheral neuropathy (DPN) is a common complication and quality-of-life damaging factor in diabetic patients [1]. Distal symmetric polyneuropathy is the most common form of DPN, involving usually both small and large nerve fibers [2].

Autonomic dysfunction occur when there is damage to the nerves that manage every day body functions such as blood pressure, heart rate, sweating, bowel and bladder emptying, and digestion. Disorders of autonomic regulation are described in multiple and diverse diseases, both those that directly afflict the nervous system as well as those afflicting other organs, where they trigger or enhance pathological symptoms [1].

Diabetic polyneuropathy is underdiagnosed by both endocrinologist and non-endocrinologist [13]. The routine evaluation of DPN is based on patients' symptoms and physical examination which may include Semme Weinstein monofilament and the 128-hertz tuning fork. However simple screening methods are of limited value in early neuropathy, nerve conduction studies are the most sensitive and specific DPN detection method [14].

There are beneficial effects of a regular exercise on glycemic control, insulin sensitivity, lipid abnormalities, and hypertension in diabetic patients [2].

The resistance training works by causing microscopic damage or tears to the muscle cells, which in turn are quickly repaired by the body to help the muscles regenerate and grow stronger. The breakdown of the muscle fiber is called catabolism, and the repair and regrowth of the muscle tissue is called anabolism. Anabolic means to grow, and that's exactly what happens after you down muscle fibers with resistance training. In fact, many biological processes of growth in the body require some breakdown, or catabolism, prior to re-growth. For instance, bones must be broken down first before calcium and other growth factors repair the bone and make it stronger. With muscles, testosterone, insulin-like growth factors, growth hormone, protein, and other nutrients rush to the muscle after a resistance exercise session to help repair the muscles to make them stronger. Importantly, muscles heal and grow when you aren't working out, and so that's why it's necessary to leave time between workouts for recovery.

When performed regularly and in a systematic way resistance exercise promotes, among other benefits, increases in muscle strength and mass, increased bone mineral density and basal metabolic rate, helping to maintain body weight and improving quality of life [3].

Prescribed and supervised long-term exercise programs may influence neuromuscular parameters in diabetic patients, thereby inducing adaptive changes in the neuromuscular system in response to exercise training [4]. In this study, we sought to examine the effects of resistance training on nerve function, glycemic control and exercise tolerance in 2 diabetic patients. There are beneficial effects of a regular exercise on

glycemic control, insulin sensitivity, lipid abnormalities, and hypertension in diabetic patients [2].

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Methodology

Study design: experimental study.

Target population: patients with type 2 diabetes mellitus.

Sample population: patients with type 2 diabetes mellitus.

Sampling method: purposive sampling.

Sample size: 18

Inclusion: type 2 diabetes patients aged 35-60 with no sign or symptoms of DPN.

Exclusion criteria: type1 diabetic patients, severe cardiovascular disease, lower extremity arthritis or pain that limits exercise.

Materials required: pen, paper, weighing machine, resistance band, survey of autonomic symptoms scale, cones, timer, 6MWT worksheet, sphygmomanometer, pulseoximeter, glucometer, NCV machine.

Outcome: NCV, glucometer reading, 6MWT pre and post resistance training.

Procedure

Patients were selected according to inclusion and exclusion criteria and consent was taken after explaining the aim and procedure of study. Demographic data was noted along with the anthropometric measurements like height and weight and vital signs like heart rate, blood pressure and SpO_2.

1. for glucometer

Fasting (nothing by mouth ≥8 hours) blood glucose levels are noted. have the patient wash and dry hand well, new sterile unused lanchet is used to pierce and finger is gently squeezed to get a drop of blood and the reading on the glucometer is noted[9] pre and post training period of 4 wks.

2. for 6MWT

Warm up before the test should not be performed. Patient is seated for at least of 10 mins. Baseline heart rate, SpO_2 and dyspnea is scored according to Borg scale is recorded.

Two cones are placed at distance of 30m and patients is asked to walk on own pace for 6 mins period. Start the timer once patient starts walking laps are noted and compared with the reference value [10]

3. for NCV Placement

- Active electrode: over the medial foot, slightly anterior and inferior to the navicular tubercule at the most superior point of the arch of foot.
- Reference electrode: slightly distal to the 1st metarasophalangeal joint on medial surface of joint.
- Ground electrode: on dorsum of foot.
- Stimulation point (S1): the cathode was placed 8cm proximal to the active electrode and slightly posterior to the medial malleolus. The anode is proximal.
- Stimulation point (S2): the cathode was placed at the mid popliteal fossa or slightly medial or lateral to the mid line. The anode is proximal.
- Lat1(ms), lat2(ms): ration(ms^2), Amplitude(mv), rea(mu) are noted [11].

Intervention Protocol

Protocol consists of three phases: rest, resistance exercise session, and recovery. Initially, the volunteers remain seated for 10 min (rest stage). Then, they are submitted to a RE session in which they performed two sets of 20 repetitions at 50% of 1 RM on the following exercises: leg extension, leg press, leg curl, calf raise and squats. The rest interval between the sets and exercises is set to 2 min. Finally, individuals return to the seated position, remaining in recovery for 10 min[1]

Result

Table 1: represents age and gender distribution.

Count of age	Female	Male	Grand Total
35-44	6	2	8
45-54	4	4	8
55-64	1	1	2
Grand Total	11	7	18

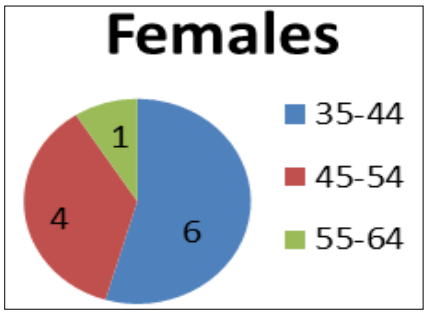

Fig 1a: represents age distribution for females

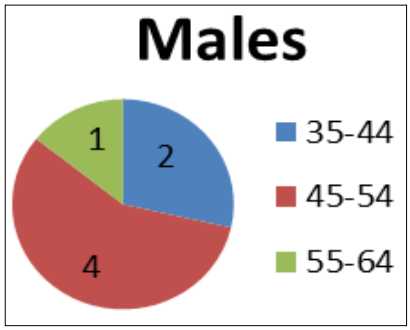

Fig 1b: represents age distribution for males

Table 2: glucometer changes pre and post intervention

Glucometer reading	Mean	P value
Pre intervention	118± 23.960	P=0.001
Post intervention	112.611± 21.217	

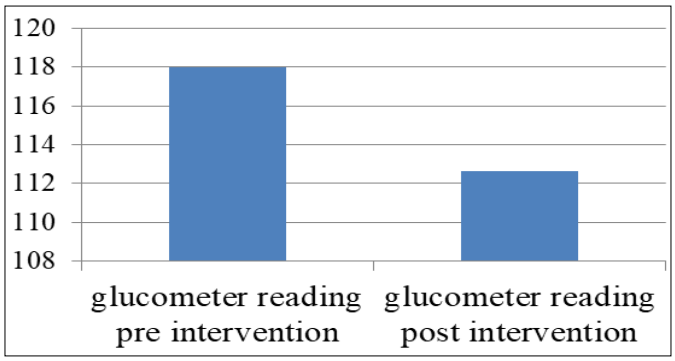

Fig 2: represents the effect of resistance exercise training on blood glucose level.

Interpretation

mean of glucometer reading pre intervention is 118±23.960 and post intervention is 112.611±21.217 which shows that there is significant variation in blood glucose level (p=0.001) noted post resistance exercise training.

Table 3: 6 min walk distance pre and post intervention.

6MWT	MEAN	P Value
Reference value	578.3908	P=0.001
Pre intervention	579.1667	
Post intervention	637.0833	

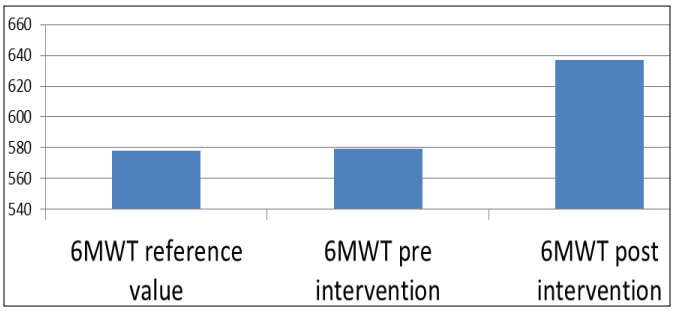

Fig 3: represents the effect of resistance exercise training on 6 min walk distance.

Interpretation

Mean of reference value of 6MWT is 578. 3908, pre intervention value is579.1667 and post intervention is 637.0833 there is significant variation in 6 minute walk test (p=0.001).

Table 4: nerve conduction velocity pre and post intervention.

Mean	Lat (ms)	lat2 (ms)	Duration (ms)	Amplitude (mV)	Area (mVms)
Pre	5.7881	18.928	13.071	14.285	45.088
Post	5.763	18.87	12.978	14.695	45.144
P value	0.0112	0.2108	0.0193	0.0344	0.0306

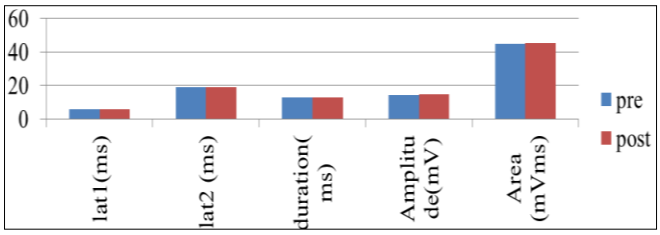

Fig 4: represents the effect of resistance exercise training on nerve conduction studies.

Interpretation

Variation in mean of pre and post intervention value of latency 1 (p=0.0112), latency 2(p=0.2108), duration (p=0.0193), amplitude (p=0.0344), area(p=0.0306) tibial nerve shows quite significant.

Discussion

The purpose of the study was to see the effectiveness of resistance training in type 2 diabetic patients asymptomatic to autonomic symptoms on Nerve conduction velocity. Residential based people were approached in Pune for the sample collection. Both male and female were included in the study. The age criteria were set to 35-60, as extreme age inclusion may vary the results on Nerve conduction velocity as there is age related ages in Nerve conduction. Patients who were asymptomatic to autonomic symptoms were included in study irrespective to the period a patient was diabetic as the need for study is to find an effective treatment method which can prevent or modify the nature Diabetic autonomic neuropathy which is the most common complication of

diabetes and a quality of life damaging factor. Type 1 diabetic patients were not included as they may require a change in dosage post exercise training. Evaluation form was maintained to gain the patients past history of medical and surgical history.

A study by Stefano Balducci *et al* mentions in the study that Exercise training can prevent the onset or modify the nature of Diabetic autonomic neuropathy. The aim of the study was to examine the effect of long term exercise training on the development of DPN in both type 1 and type 2 diabetic patients. The patients with no signs and symptoms were included and the study included two groups one group performed and supervised exercise program and the other was control group. The study showed there was significant difference on Δ(delta) in NCV and the percentage of diabetic patients that developed motor and sensory neuropathy between control and exercise group during the study period was higher in control group than on exercise group. The study concluded that long term exercise program can prevent the onset or modify the natural history of DPN.

So with the outcome measures like Nerve conduction study, glucometer reading and 6 minute walk test performed pre and post intervention program. The intervention program consists of three phases: rest, resistance exercise session, and recovery. Initially, the volunteers remain seated for 10 min (rest stage). Then, they are submitted to a RE session in which they performed two sets of 20 repetitions at 50% of 1 RM on the following exercises: leg extension, leg press, leg curl, calf raise and squats.

Significant changes pre intervention and post intervention program are noted in blood glucose level on glucometer (fig no. 2).a study by David W Dunstan *et al* state that High intensity resistance training improves Glycemic control in older patients with type 2 diabetes. The aim of the study was to examine the effect of high intensity progressive resistance training combined with moderate weight loss on glycemic control and body composition in older individuals. Sedentary, overweight men and women with type 2 diabetes were randomized to high intensity progressive resistance training plus moderate weight loss or moderate weight loss plus a control program. The study concluded that high intensity resistance training, in combination with moderate weight loss, was effective in improving glycemic control in older patients with type 2 diabetes. The mechanism for improvement in glycemic control is when muscles contract during activity cells are able to take up glucose and use it for energy whether insulin is available or not.

6MWT results show that there is significant improvement in functional capacity (fig no.3). This test is widely used for evaluating and measuring the response to therapeutic intervention. The results for 6 minute walk test will help us assume that resistance training can be used in asymptomatic diabetic patients for improving exercise tolerance of the patients which will help in prescribing an exercise program to the patients as exercise prescription is a limited in type 2 diabetic patients with autonomic symptoms due to presence of exercise intolerance.

NCV of tibial nerve shows quite significant difference pre and post intervention period (fig no.4). Evaluation of diabetic polyneuropathy is based on patients symptoms and physical examination so it means it can be diagnosed post the appearance of symptoms and cannot be diagnosed by simple screening method in early neuropathy, but nerve conduction studies are the most sensitive and specific diabetic polyneuropathy detection method. A study conducted by Xuan Kong *et al* state that patients with diabetes and presumed DPN may not have a large fiber polyneuropathy or may have focal polyneuropathy, performing NCS at the point of service would identify these patients who would then be subjected to different evaluation and treatment plan. There is minimal changes noted on the NCV as this study was limited to small duration but considering if this study was of a longer duration a significant difference would be noted on NVC as pathophysiology of diabetic polyneuropathy mentions reduced endoneural blood flow and nerve hypoxia leads to altered nerve function so exercise can have significant impact on nerve function.

Conclusion

With this study we concluded that with supervised resistance training there is significant improvement noted in exercise tolerance, glucose control and Nerve conduction velocity of tibial nerve.

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