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Adjunct Efficacy of Nitric Oxide Dumping Exercise with Conservative Management in Type 2 Diabetes: A Case Report

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Abstract

Along with medicine, lifestyle modification is the first line of treatment for Type 2 diabetes mellitus (T2DM) (diet and exercise). T2DM has now reached epidemic proportions due to a sedentary lifestyle and a lack of physical activity (PE) due to a lack of time, which acts as a barrier to regular participation. The exercise of nitric oxide dumping (NOD) is a type of high-intensity interval training (HIIT). Although it is a quick way to elicit physiological changes similar to other workouts, little is known about the impact of NOD exercise on T2DM. In this case report, a 42-year-old woman was diagnosed with T2DM in 2016, had hyperlipidemia and hypothyroidism, and was classified with grade 1 obesity. She has been taking metformin 500 mg and elthroxin 50 mcg since then. Until 2020, the patient adhered to the diabetes diet and walked. Because the patient did not respond to traditional therapy, NOD was combined with a vegan diet.

Keywords

HIIT, metabolic disorder, diet.

Introduction

T2DM places a heavy burden on individuals, their families, health-care resources, and society as a whole [1]. T2DM is still on the rise in terms of

prevalence, incidence, and as a leading cause of human suffering and death. Despite significant investments in clinical care, research, and public health measures, the pace of increase appears to be increasing. Because several countries throughout the world are dealing with an unusually high burden [2] as a result of chronic disease, blood glucose regulation is critical.

Around 415 million people worldwide (9 percent of adults) have diabetes, with the great majority living in low- and middle-income nations. This number is expected to rise to 642 million people in the following decade [3]. One of the main causes of type 2 diabetes is physical indolence owing to a lack of time combined with a sedentary lifestyle. Although there is agreement that diet and exercise, in addition to drugs, are significant strategies for controlling type 2 diabetes. There isn't much agreement on the optimal diet. The American Diabetes Association's (ADA) current dietary and exercise recommendations state that "for weight loss, either low-carbohydrate (LCD), low-fat calorie-restricted (LFD), or Mediterranean diets (MD) may be effective," and that "the mix of carbohydrate, protein, and fat may be adjusted to meet the metabolic goals and individual preferences of the person with diabetes" [4]. Vegan diets have been proven to enhance glycemic control, fasting plasma glucose, hemoglobin A1c (HbA1c) levels, and even psychological well-being in people with poorly controlled T2DM [1].

According to the ADA, the current exercise approach includes 150 minutes of moderate-intensity aerobic activity (AE) each week, which is (40–59 percent) of heart rate reserve (HRR), resistance exercise (RE) for at least two days per week, and flexibility exercises [5]. Due to its potentially significant impacts on numerous aspects of cardio metabolic health and its shorter duration need, HIIT has progressively become a popular kind of exercise. HIIT is defined as alternating intervals of strenuous activity (defined as exercising at 70% of maximum aerobic capacity) with periods of rest or recovery. HIIT isn't standardized; instead, it's based on each person's cardiorespiratory fitness. Healthy people may engage in running or sprint cycling, while people with T2DM may engage in brisk or uphill walking. HIIT can be tailored to your specific needs and does not have to cover all exercises [6]. Nitric Oxide Dump (NOD) is a novel type of high-intensity interval training (HIIT) that aims to increase the production of nitric oxide, which has the ability to catalyze and promote health. It's quite effective, and it's becoming more popular [7].

As the most effective exercise plan for improving glucose control and decreasing cardiometabolic risk in T2DM has yet to be identified, there is a need for innovative, time-competent, and effective exercise protocols that can be easily done by people without putting them at financial risk.

Case

A 42-year-old woman with T2DM, hyperlipidemia, and hypothyroidism, as well as grade 1 obesity, has been on metformin 500 mg and elthroxin 50 mcg since 2016. A thorough evaluation was performed before to beginning the diet and exercise program, and she was requested to submit to blood tests such as fasting, postprandial sugar, HbA1c, lipid profile, thyroid stimulating hormone (TSH), and a 12-lead electrocardiogram (ECG) to rule out any cardiac issues. The patient was asked to complete a questionnaire on their readiness for physical activity (PAR-Q). When the patient answered "no" to all of the questions, the patient signed a written consent form, the task was explained, and ethical approval was obtained.

Under the guidance of a medical specialist, a 12-week program was developed by an expert nutritionist and physical therapist. The patient must check his or her blood sugar levels four times a day with a digital glucometer, once while fasting and three times after exercising two hours later, PP1 (postprandial) after breakfast, PP2 after lunch, and PP3 after dinner [8]. After each meal, NOD exercises were performed, and the patient was taught further exercises to practice at home.

The exercise technique employed was a 4-minute NOD. At 70 percent HRR, the NOD exercise takes about 3 to 4 minutes to complete. There are 4 movements in each session – 10 repetitions each movement at first, then 20 repetitions – 4 cycles of repetition (movements are 1. Squats 2. Alternate arm raises 3. Non-jumping jacks (raising the shoulder only but not lifting the feet off the ground) and 4. Shoulder press) [7, 8, 10]. Warm up at 25% HRR (10 reps of shoulder exercises and 10 reps of marching) and cool down at 25% HRR before beginning the workout (20 to 30 reps of ankle grabber). The Karvonen HRR method [11] was used to compute the target HR training zones, and the daily exercise routine was followed according to the ADA.150 minutes/week, moderate to vigorous, at least 3 days/week and 2 days RE, utilizing free weights using major muscle parts at 1–4 sets, AE in any form that engages large muscle groups (eg, brisk walking), 150 minutes/week, moderate to vigorous, at least 3 days/week and 2 days RE, Reps are 8–15. 5–10 moderate to intense workouts were performed unattended throughout each session [11].

Result

After commencing the routine, blood glucose levels began to drop day by day, and the need for hypoglycemic medication decreased. After one month, the diabetic medication was totally removed under the supervision of the physician. Patient was constantly encouraged and coached in terms of diet and activity, with daily glucose levels averaging 90 mg/dl fasting and 120 mg/dl after each meal. After 3 months, studies were repeated, and a change in parameter was observed after 12 weeks. [Table 1].

After 3 months, the patient also did the Glucose Tolerance Test (GTT). [Table 2].

The change in the parameters was favorable without medications

Table 1: Blood investigation

S. No	Parameter	Before	After 12 weeks
1	FS	99 mg/dl	87.7 mg/dl
2	PP	119 mg/dl	86 mg/dl
3	HbA1C	6.5 %	5.6%
4	Insulin fasting	7.32	3.60
5	TC	208 mg/dl	176 mg/dl
6	LDL	131 mg/dl	123 mg/dl
7	HDL	37 mg/dl	45 mg/dl
8	TG	201 mg/dl	95.4 mg/dl
9	TSH	3.97 uIU/mL	1.4 uIU/mL
10	Body mass index (BMI)	31 kg/m^2	27 kg/m^2
11	Body fat % (BF %)	30 %	25 %
12	Waist hip ratio (WH)	0.9	0.8

Table 2: Glucose tolerance test

Fasting (mg/dl)	30 min (mg/dl)	1 hour (mg/dl)	2 hour(mg/dl)	Remarks
95.9	142	109.5	109.4	cleared

Discussion

The first line of non-pharmacological treatment for T2DM is lifestyle change, which includes a balanced diet and adequate physical activity (PA) and/or physical exercises (PE) [12]. This example demonstrates how a conservative management strategy involving a vegan diet and NOD activity is beneficial in demonstrating changes in blood parameters, anthropometry, and GTT clearance.

The important element for achieving effective glycemic control (GC) in T2D patients with vegan diet interventions was weight loss due to decreased total calorie intake. Other options include dietary fiber, which can lower the glycemic index of carbohydrates by slowing glucose absorption in the intestine, and reduced exposure to persistent organic pollutants (POPs) by vegan diets due to the prohibition of animal products. [8].

The ADA-recommended daily exercise plan was followed, which included a combination of AE and RE. Many studies have found that doing AE and RE together is more useful for reducing glucose levels, HbA1c, and insulin resistance in T2DM than doing them separately [12]. Lower insulin resistance (IR), insulin receptor substrate (IRS), and phosphoinositide 3-kinase (PI3K) protein content, IRS-1 and IRS-2 phosphorylation, and a decrease in serine/threonine-specific protein kinases (AKT) activation and abridged Glucose transporter type 4 (GLUT4) translocation and

glucose uptake are all linked to impaired insulin-related glucose transport in T2DM muscle [13]. PE increases insulin receptor phosphorylation, IRS-1 tyrosine phosphorylation, and PI3K activity via inducing GLUT4 overexpression. It also increases myokine circulation, which stimulates skeletal muscle metabolism and improves intramuscular, fatty acid oxidation, triacylglycerol, GLUT4 translocation in plasma membrane, and skeletal muscle insulin sensitivity. It's also been observed that glucose uptake induced by a single session of exercise can last the next day. Insulin resistance leads to T2DM as well as an increase in fat mass, which raises cardiovascular risk. PE has the potential to influence the occurrence and treatment of T2DM and its consequences [12].

After 2 hours, NOD exercise, which is equivalent to HIIT, performed directly after a meal after 1 hour 45 minutes demonstrated a decrease in postprandial glucose levels. NOD exercise also helps to maintain mitochondrial function by slowing down age-related muscle deterioration. Doing the NOD exercise, mitochondria may begin to produce proteins that will keep muscles acting at their highest level, mainly for aging adults [7], in one of the review study, Sgrò P et al claimed that exercise is an effective technique for managing postprandial glucose, depending on the exact protocol used. [12]. HIIT consumes glucose at a faster pace than the liver produces it, therefore blood sugar levels fall [11]. Exercise has been shown to boost insulin sensitivity in muscle cells as well as the activity of oxidative enzymes. It's possible that the rapid increase in skeletal muscle mitochondrial capacity after HIIT is linked to lower insulin resistance and better glycemic control. There is also an increase in GLUT4 protein level, which could aid glucose management [14, 15].

After 12 weeks, the GTT was normal. Madsen et al used HIIT which showed improve glucose control and pancreatic cell function in T2DM patients. They speculated that the pancreas' ability to awaken insulin-producing -cells for tissue action could be increased without a compensatory drop in hyperglucagonemia [16].

Exercise has also been linked to improvements in BMI, WH, blood glucose level (BGL), HbA1c, and lipid profile. Sayed Z et al showed significant improvements in HbA1c, BGL, BMI, and WH in a systematic review and meta-analysis [17]. The nature of the meal, timing, intensity, frequency, and duration of exercises, gastric emptying rate, intestinal absorption, beta-cell response, liver insulin extraction, hepatic glucose production, glucose uptake by the tissues, insulin sensitivity, and renal glucose reabsorption are all factors that play a role in improving all parameters [12].

Conclusion

Following each meal with a NOD exercise provided an extra impact in regulating BGL, clearing GTT, and lowering the requirement for hypoglycemic medicine in T2DM patients. As drugs have numerous negative effects, T2DM patients will benefit from short-term NOD exercise performed after each meal, as if it is a drug.

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