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Effect of exercise on blood glucose levels in type 2 uncomplicated diabetes mellitus patients: A pilot comparative study from a tertiary care center of north India

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Abstract

Study Design: Comparative pilot study.

Objective: Type 2 Diabetes Mellitus is a very common disease affecting Indian population and exercise is an effective method to control blood sugar levels. The aim of this study is to demonstrate the positive effect of exercise in the management of Type 2 Diabetes Mellitus.

Materials and Methods: The present study was carried out in Physical Medicine and Rehabilitation department of Patna Medical College and Hospital on the role of exercise in patients of Type 2 Diabetes Mellitus. A total of 40 patients were recruited for the study and divided into two groups- study and control group; 20 patients in each group.

Result: The study shows that exercising in Type 2 Diabetes Mellitus according to the designed protocol is safe, tolerable and effective, leading to decrease in blood glucose level. It was not surprising that reduction in blood glucose level was associated with a functional improvement and has been documented with the statistically significant differences blood glucose level on most of the scales.

Conclusion: We can say that supervised exercising in Type 2 Diabetes Mellitus under the condition described in this study seems to be a safe and effective treatment, with no associated systemic repercussions or complications. Nonetheless, further study and clinical trials are needed to confirm the results observed. It may be an error to limit to exercising as a single treatment. It can be applicable as a carrier or a co- adjuvant of other established therapeutic methods and diet modifications.

Keywords: Exercise, diabetes, blood glucose level, physical activity

1. Introduction

Diabetes Mellitus refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Several distinct types of DM are caused by a complex interaction of genetics and environmental factors. With an increasing incidence worldwide, DM will be a leading cause of morbidity and mortality for the foreseeable future.

Diabetes is classified based on the pathogenic process that leads to hyperglycemia & the two broad categories are designated Type 1 and Type 2. Type 1 Diabetes Mellitus is the result of complete or near total insulin deficiency. Type 2 Diabetes Mellitus is a heterogeneous group of disorders characterised by variable degree of insulin resistance, impaired insulin secretion, and decreased glucose production. Obesity, particularly visceral or central (as evidenced by the hip-waist ratio), is very common in type 2 DM (80% or more are obese).

1.1 Criteria for the diagnosis of diabetes mellitus

- Symptoms of Diabetes plus Random Blood Glucose concentration > 200mg/dl or
- Fasting plasma glucose > 126mg/dl or
- Hemoglobin A1C > 6.5
- Two-hour plasma glucose > 200mg/dl during an oral glucose tolerance test.

For many years, exercise along with diet and medication, has been considered one of the three cornerstones of diabetes therapy [1]. Regular physical activity is recommended for patients with type 2 diabetes since it may have beneficial effects on metabolic risk factors for the development of diabetic complications [2]. The low-cost, nonpharmacological nature of physical activity further enhances its appeal.

Exercise tends to lower the blood sugar in the diabetic in whose body there is an adequate supply of insulin whether this be of endogenous or exogenous origin. This effect is so striking and so beneficial that exercise along with diet and insulin is now accorded a definite and prominent place in the everyday treatment of diabetes [1].

Exercise plays a critical role in patients with Type 2 Diabetes Mellitus. It can help improve insulin sensitivity and assist with reduction and maintenance of body weight. Exercise, together with diet and pharmacologic therapies, is important as a part of the overall approach to improving glycemic control. Indeed, exercise often is 'prescribed' as a therapy for Type 2 Diabetes [1, 2]. The many benefits of exercise in these patients include improved long-term glycemic control, improved lipid abnormalities and lowered blood pressure. Although there have been numerous small studies on the effects of exercise in patients with type 2 diabetes, their findings have varied. However, the authors could not find any such study from India, where DM is very common. With this aim, the present study was conducted to demonstrate the positive effect of exercise in the management of Type 2 Diabetes Mellitus

2. Methodology

The patients of Type 2 DM attending PMR department of Patna Medical College, Patna were recruited for the study. A total of Forty (40) Type 2 Diabetes Mellitus patients were selected for this study. Twenty (20) patients were selected for experimental group and Twenty (20) patients were selected for control group. The patients were on same Oral Hypoglycemic Agents (OHA) or the last 5 months.

2.1 Inclusion criteria

- Type 2 Diabetes Mellitus patients
- Under same OHA for past 5 months
- Willingness to participate

2.2 Exclusion criteria

- Patients below the age of 35 years and above 55 years.
- Diabetes complicated by
- Diabetic foot

- Diabetic nephropathy
- Diabetic retinopathy
- Random blood glucose > 300mg/dl
- Ketosis
- In the experimental group, the exercise protocol, which was followed in keeping with the guidelines provided by American College of Sports Medicine and the American Diabetes Association: total duration – 55 minutes, frequency – three times every week, warm up and cool down period – 5 minutes each consisting of stretching and calisthenics (lunges, squats and stride jumps), aerobic exercises – cycling, stepping and walking, resistance exercises – resistive bands, weightlifting (gradually increased over the period of 6 months)

The assessment of blood glucose level was done at 1 month, 3 months and 6 months after initiation of exercise protocol.

3. Results

Among the 40 patients, majority of the patients were male comprising and the patients were in age group of 40 to 60 years.

The patients of Type 2 Diabetes Mellitus in our study belonged to different socio-economic status; majority being middle comprising 50% of the sample, 35% high and rest from low socioeconomic status. Most of the patients were literate.

3.1 Four different scales were used to assess these patients:

- Random blood glucose level (RBG)
- Fasting blood glucose level (FBG)
- Post prandial blood glucose level (PPBG)
- Glycated hemoglobin (HbA1c)

There was a highly statistically significant improvement in 3 scales (RBG, FBG and PPBG) and no significant difference in 1 scale (HbA1c) for blood glucose level.

3.2 Insert Table 1 here →

3.5 RBG was significant at 5% at 1 month (p value < 0.05), 0.1% at 3 months (p value < 0.001) and 1% at 6 months (p value < 0.001). FBG was significant at 5% at 1 month (p value < 0.05), 0.1% at 3 months (p value < 0.001) and 0.1% at 6 months (p value < 0.001). PPBG was not significant at 1 month (p value > 0.05) but significant at 1% at 3 months (p value < 0.01%) and 0.1% at 6 months (p value < 0.001). HbA1c was not significant at 6 months (p value > 0.05).

3.6 An improvement was observed in daily life activities too.

Table 1: Changes in blood glucose parameters post exercise intervention

Follow-up duration	Group/'p' value	RBG (mg/dl)	FBG (mg/dl)	PPBG (mg/dl)	HbA1c (%)
1 month mean value/S.D.	Control	173.45/18.78	126.65/7.36	173.2/18.62	6.14/0.38
	Experimental	164.45/20.02	121.35/8.79	161.9/18.85	6.14/0.49
	t score/'p' value	2.12/< 0.05	2.07/< 0.05	1.91/> 0.05	0.0/> 0.05
3 months mean value/S.D.	Control	174.6/20.67	125/6.65	172.3/16.44	--
	Experimental	153.45/19.04	116.55/8.54	156.6/17.35	--
	t score/'p' value	3.37/< 0.001	3.49/< 0.001	2.94/< 0.01	--
6 months mean value/S.D.	Control	172.75/18.88	125.55/7.03	172.55/16.9	6.13/0.39
	Experimental	144.95/18.38	108.4/10.49	148.9/16.39	5.92/0.48
	t score/'p' value	4.72/< 0.001	6.07/< 0.001	4.49/< 0.001	1.52/> 0.05

4. Discussion

In our study, we could find out the beneficial effects of exercise on blood glucose levels, though the sample size is

small. However, this sample size is comparable with other international studies [3].

In our study, we found significant improvement in fasting

blood glucose and post prandial blood glucose post intervention. Tapani Ronnema *et al.* In their study found significant improvement in post prandial blood glucose, but no significant improvement in fasting blood glucose^[4].

In this study, we did not find any significant improvement in HbA1c at 6 months which is in contrast with the study by Tanya D Agurs-Collins *et al.*, who found significant improvement after exercise^[5].

Regarding exercise protocol used in this study, it can be highlighted that it was designed in accordance with guidelines provided by ADA and ACSM and consists both aerobic and strengthening exercises^[6,7].

Unfortunately, there are some significant risks of exercise in the patient with T2 Diabetes, including symptomatic hypoglycemia, exacerbation of known or previously unknown cardiac disease, worsening of symptoms secondary to degenerative joint disease, and possible damage to joints in the setting of neuropathy^[6]. However, we didn't notice any of the complications in our patients. The meta-regression results suggest that the differences in HbA1c found between the exercise and control group after the intervention were not mediated by differences in weight loss, exercise intensity or exercise volume^[8]. The finding that exercise does not need to reduce body weight to have a beneficial impact on glycemic control is clinically important. Exercise training decreases hepatic and muscle insulin resistance and increases glucose disposal through several mechanisms that would not necessarily be associated with body weight changes.

In addition to above, we also found significant improvement in random blood glucose post intervention. However, we could not find any study on effect on glycated hemoglobin post intervention. Thus, we can say that exercise has only short-term benefits on reducing blood glucose, but no effect on long term sugar control as reflected by non-significant changes in glycated hemoglobin.

5. Conclusion

We can say that supervised exercising in Type 2 Diabetes Mellitus under the condition described in this study seems to be a safe and effective treatment, with no associated systemic repercussions or complications. However, as it is a pilot study; nonetheless, further study and clinical trials are needed to confirm the results observed. It may be an error to limit to exercising as a single treatment. It can be applicable as a carrier or a co- adjuvant of other established therapeutic methods and diet modifications.

6. Limitations of the study

An objective limitation of this study is the small sample, which is obstacle in reaching a definite conclusion.

7. Conflict of interest: The authors declare no conflict of interest

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