EFFECT OF HOME BASED GRADED AEROBIC EXERCISE TRAINING ON GLUCOSE HOMEOSTASIS IN OBESE TYPE 2 DIABETES PATIENTS

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ABSTRACT

Objective: Evaluation of the effect of home based graded walking exercise program on glycemic control and BMI in overweight type 2 diabetes patients.

Methods:

Design: Prospective Clinical Trial.

Subjects: overweight and obese individuals both sexes having type 2 diabetes between age group of 40-60 years.

Procedure: The research was under taken on the assigned control groups or experiments group through convenient sampling to collect base line data, while both the groups were advised to continue with standard diet and medication as prescribed by the physicians, subjects in study group underwent a supervised orientation to the aerobic walking exercise program including warm-up and cool down there after, they were asked to continue the same at home for a period of three months duration .The duration of exercise was 20 to 25 min / session initially and progressed to 30 to 45 min/ session over a period of time, 4 to 5 times / Week, and at intensity of 4- 5 on Borg's scale RPE (Modified). Patients in study group were given log books to be maintained to ensure the regularity and adherence to the exercise regime.

Results: 21 patients in control group and 28 patients in study group completed the study duration. Study Group: n=28 (12 males, 16 females) mean Age: 50.03 ± 4.21 years. Control Group: n=21(13 males, 8 females) mean age=51±4.73 years.

Results were compared between groups and within group

using paired t test and unpaired t test. There was significant increase in the blood sugar levels and glycosylated hemoglobin in control group while significant reductions in study group was noted.

Conclusion: The home-based graded aerobic exercise improved the glycemic control, in obese type 2 diabetes patients as compared to control group.

KEY WORDS: type 2 diabetes, obesity, exercise, blood glucose levels, glycosylated hemoglobin, modified Borg's scale of RPE, Glut 4 receptors

INTRODUCTION

Diabetes mellitus is a metabolic disorder occurring as a result of insulin lack or a surplus of insulin antagonists leading to a relative insulin lack. It is characterized by hyperglycemia and glycosuria. The late stage complications like atherosclerosis, diabetic microangiopathy, diabetic nephropathy, diabetic neuropathy, diabetic retinopathy, infections etc are attributed to the established fact that in insulin resistant states, endothelial nitric oxide synthesis is reduced and insulin mediated vasodilatation gets impaired.[1] Effective management of diabetes comprises of drugs, diet and exercise. Importance of exercise in the management of diabetes is been recognized since decades The possible benefits of exercise for the patient with type 2 diabetes are substantial and recent studies strengthen the importance of long term exercise programs for the treatment and prevention of this common metabolic abnormality and its complications.

Aerobic physical activity is a major therapeutic modality for type 2 diabetes. [2,3] It is well known that regular aerobic exercise produces beneficial effect on glycemic

control, insulin sensitivity, lipid abnormalities and hypertension. [4,5]

Exercises can be done in a home based setup as well as in a well equipped institutional setup. Institutional setup is having benefits like supervision by the therapist, close monitoring of the vitals and daily assessment of the progression and specific necessary modifications in the program, but in the Indian setup, this has limitations like finance, time, place, and occupational constraints. In contrast to this, though unsupervised, the home based setup overcomes these limitations.

On the background of presence of a good literature revealing the effectiveness of supervised endurance and / or resistance training program for obese type 2 diabetes patients, there is relatively scanty literature focusing on the efficacy of a home based graded brisk walking program on improving lipids and glycemic control in obese type 2 diabetes populations in Indian set up.

Procedure

The study protocol was reviewed and approved by the institutional ethical committee of Manipal College of Allied Health Sciences (MCOAHS), Manipal Academy of Higher Education (MAHE), Manipal, Karnataka, India.

Inclusion Criteria: Biochemically diagnosed type 2 diabetes patients with BMI of 25 or more and between age group of 40-60 years of both the sexes.

Exclusion Criteria:

1. Patients already on regular exercise regime,
2. Those prediagnosed with cardio respiratory / musculoskeletal complications which would interfere with exercise program.

3. Those in which exercise might prove harmful by any means, 4.Subjects on regular lipid lowering agents, insulin.
4. Subjects with impaired cognition, and patients who would be irregular on doing the exercise i.e., less than three days/ weeks were excluded from the study.

MATERIALS AND METHODS

Patients

In this study all the patients were initially screened by physician clinically and biochemically to confirm the diabetic status.

66 subjects were identified as potential participants for this study. All of them were screened and assessed for inclusion and exclusion criteria as mentioned above. Before participating in the study, informed consents were taken from all the patients. Patients were allotted to the control group or study group through convenience sampling. Baseline data was collected. No change was done in the routine medical treatment that was going on and were instructed to report any change done in the medications by the respective physician. Subjects in the exercise group were given a home based graded brisk walking exercise program for a period of three months.

The study group

33 patients between age group of 40 to 60 years who were biochemically confirmed cases of type 2 diabetes. The patients who were willing to perform prescribed exercise were included in this group.

The control group

33 patients between age group of 40 to 60 years who were clinically and biochemically confirmed cases of type II diabetes who were not willing to participate in the exercise program.

Treatment protocol

At the beginning of the study, Glycosylated hemoglobin (GHb), fasting blood sugar (FBS), post prandial blood sugar (PPBS) and BMI levels were assessed. The Muscular strechability and strength in lower limbs were assessed and in case of tightness, appropriate physical therapy program was instituted for the study group.

Duration

The duration of exercise was 20 to 25 min / session initially. Patients were re assessed after three weeks and duration was increased based on individual needs, up to 30-45 min/session.

Frequency

4 to 5 times / Week

Intensity

4-5 on Borg's scale RPE (Modified) (Roughly corresponds to 60- 70 % of $VO_{2\ max)}$

Week	Duration	Intensity	Frequency
1 week	20 to 25min	4-5(Mod Borg RPE)	4 –5/Week
2 week to 6 weeks	25 to 35 min	4-5(Mod Borg RPE)	4 –5/Week
6 week to 12 weeks	35 to 45 min	4-5(Mod Borg RPE)	4 –5/Week

Patients in study group were given to be maintained to ensure the regularity and adherence to the exercise regime. Patients performed the exercises for a period of 3 months. The investigations were repeated for both the groups at the end of 3 months.

DATA ANALYSIS

The data analysis was done using SPSS 12. The level of significance was set at 0.05 and p value of less than or equal to 0.05 was considered to be significant. Paired t test

was used to compare the pre and post values of GHb, FBS, PPBS, BMI within exercise group as well as control group. Unpaired t test was used to compare the differences in the pre-post between the exercise and the control group.

RESULTS

Out of 33 patients in the study group, 5 patients were excluded from the study as 3 were started on lipid lowering agents by their physicians and 2 patients stopped the exercise regimen within 2 weeks. So total number of 28 subjects n=28 (12 males, 16 females) mean age =50.03 ± 4.21 years completed the study duration of 3 months. Out of 33 patients in the control group, 12 patients got excluded from the study due to reasons like starting of lipid lowering agents and insulin. So by the end of the study, Control Group: n=21(13 males, 8 females) mean age=51±4.73 years

Baseline and post exercise values of GHb, FBS, PPBS and BMI in exercise group and control group are shown in table no 1.There was a significant drop in FBS, PPBS, GHb and BMI after 3 months of exercise. in the exercise group ($p<0.05$), while after 3 months, there was increase in FBS, PPBS, GHb values ($p< 0.05$) in the control group after a period of 3 months while. GHb showed no significant change ($p>0.05$). p values are summarized in table no 2.Comparison of mean difference in the FBS, PPBS, GHb, BMI between the 2 groups showed a significant difference ($p= 0.001$)

DISCUSSION

This study was done to explore the effectiveness of graded home based exercise on glycemic control in obese type 2 diabetes population. During the study, GHb, PPBS, FBS and BMI values were used as out come measures This

study focuses that it is beneficial for diabetic population to get involved in regular graded aerobic exercise which need not be in out patient department set up only but even home based brisk walking exercise may lead to beneficial improvements in glycemic control and BMI.

In this study, we observed that home based walking exercise which was done by study group (n=28) gained a benefit in terms of beneficial improvements in glycemic control, and BMI. (ie weight reduction). Where as our subjects in control group, (n= 21) had deterioration in the same which can be attributed to the sedentary life style. These results are very much consistent with previous studies.[6,7]

It was observed that in control group, mean Sugar levels were found to be minimally elevated after a period of 3 months from the base line data. They were lacking the brisk walking exercise in contrast to study group. Various biochemical mechanisms can be attributed to this change. Exercise induced changes in Hexokinase (HK) and insulin signaling proteins can be one. Exercise rapidly improves the rate of glucose uptake in the muscle. Modulation of Hexokinase is a first rate limiting and committed step in glucose uptake. There are two HK. They are HK 1 and HK 2 and HK 2 being more specific to insulin sensitive tissues. Insulin and exercise both increase the HK 2 activity and expression. [8]

Exercise improves glucose tolerance by augmenting insulin sensitivity through enhanced receptor affinity and for adequate glycemic control.[9]

A significant reduction in insulin resistance is often seen with a long term exercise. Exercise is associated with the dynamic changes in the cellular content in the insulin stimulated glucose transporter in the muscle termed Glut 4 receptor.[10] Expression of citrate synthase (a regulator of

oxidative phosphorylation) also is seen to be increased as a response to long term aerobic exercises.[10]

Glycosylated Hb (GHb)

In the exercise group, GHb was reduced by 0.48% after the intervention when compared with the pre exercise values (Table 2). This was a significant change. In control group, it remained almost stable in the absence of intervention. A meta analysis, although the individual trials on the effects of exercise in patients with type 2 diabetes have had partially conflicting results, suggests that exercise training reduces GHb by approximately 0.66%, an amount that would be expected to reduce the risk of diabetic complications significantly. [4]

GHb represents the hemoglobin bound with the sugar in the blood. So higher the sugar level in the blood, higher the percentage of hemoglobin bound to sugars. Reduction in the average sugar levels in the exercise group and improved glycemic control would explain the reduction in the values of GHb.

GHb values provide us a measure of a patient's average glycemia over the preceding 2–3 months and, thus, assess treatment efficacy. GHb testing should be performed routinely in all patients with diabetes, first to document the degree of glycemic control at initial assessment and then as part of continuing care. Since the GHb values reflects mean glycemia over the preceding 2–3 months, measurement approximately every 3 months is required to determine whether a patient's metabolic control has been reached and maintained within the target range. Thus, regular performance of the GHb values permits detection of departures from the target in a timely fashion. [11]

The relation between the GHb and sugar levels is well been defined.[12] In which correlation coefficient is r=0.82. So, a

drop in the blood sugar level (BSL) in exercise group justifies the reduction in the GHb levels also.

We observed a significant reduction in the BMI of the exercise group and in contrast to this, there was an increase in the BMI of the control group after the period of three months. Various mechanisms play a role in the exercise induced lipolysis and loss of fat as expressed in the studies of Paul D, Thompson (2002) and Moro C, et al. (2005). [13, 14]

On the background of the established fact that diet and exercise play an important role in controlling type 2 diabetes, our study focused that these benefits can be acquired even in Indian home based set up. Further, this study needs to be done on larger population and in various states in India to ensure the feasibility. Also, we need to study how long the benefits of this intervention would last in case the subjects quit the exercise programme.

CONCLUSION

The graded aerobic exercise improves the glycemic and BMI in obese type 2 diabetes population as compared to control group. The home based exercise program is feasible and is effective in gaining the above effects.

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Appendix:

Table-1

PARAMETERS	Control Group		Exercise Group	
	Pre Mean ±SD	Post Mean ±SD	Pre Mean ±SD	Post Mean ±SD
FBS (mg)	157.2±24.2	159.3±24.9	181±7±31.8	172.8±30
PPBS (mg)	209±50.2	212.19±50.03	233±51.55	226.4±51.71
GHb (%)	7.84±1.61	7.89±1.64	7.86±0.99	7.37±1.05
BMI (kg/m²)	27.61±1.27	27.92±1.36	27.64±1.53	26.87±1.46

Table-2

Parameters	p value (paired t test) pre-post comparison	
	Control group	Exercise Group
FBS	0.002	0.000
PPBS	0.001	0.000
GHb	0.570	0.000
BMI	0.003	0.000

Table-3

Parameters	mean difference (pre-post)		p value (un paired t test)
	Control group	Exercise Group	
FBS	-2.048	8.94	0.001
PPBS	-3.190	7.54	0.001
GHb	-0.0524	0.482	0.001
BMI	-0.306	0.766	0.001