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Original Article

Physiology Section

Effect of Yoga on Blood Glucose Levels in Patients with Type 2 Diabetes Mellitus

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ABSTRACT

Introduction: In view of people embracing sedentary life style, and the effectiveness of treatment becoming less, the role of regular exercise especially 'yoga' seems to be a beneficial and economical adjuvant in the management of the Type 2 diabetes mellitus (T2DM).

Objectives: To assess the beneficial effects of yoga on blood glucose levels in normal and T2DM volunteers.

Materials and Methods: A prospective case-control study was conducted in the Department of Physiology and Diabetic clinic of a tertiary care teaching hospital over period of two years. The study subjects consisted of 30 male diabetic patients attending diabetic clinic and 30 non-diabetic male volunteers constituted control group. The patients in the age group of 36 to 55 years with T2DM of at least one year duration and those on diabetic diet and oral hypoglycemic agents were included in the study group. The age matched healthy male volunteers who had come to join yoga training at yoga centre were included in the control group. All the participants were trained by yoga experts and subjected to regular practice under supervision for six months. In all the participants fasting (FBS) and post-prandial blood sugar (PPBS) was estimated before, during (at three months) and after (six months) yoga training. Paired Student t-test was used to estimate difference in means calculated before and after yoga training in a same group. A p-value of <0.05 was considered as statistically significant.

Results: The distribution of age, mean height and mean weight among both the groups were comparable. The reduction in mean values of FBS and PPBS at the end of six months was highly significant (p <0.001) in both the groups when compared with the mean values before and during (three months) yoga practice. The reduction in these values at three months during yoga was highly significant in T2DM group when compared with mean values before yoga (p <0.001), but it was insignificant (p>0.05) in control group.

Conclusion: The results of the present study demonstrated that the yoga is effective in reducing the blood glucose levels in patients with T2DM.

Keywords: Exercise, Hyperglycemia, Metabolic disorders

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic disorders characterized by chronic hyperglycemia due to relative insulin deficiency or resistance or both. India with an estimated 31million diabetics in 2000 and 79 mllions by the year 2030 has the highest number of type 2 diabetics in the world. Although patients with DM can have a reasonably normal life style, its late complications result in reduced life expectancy and considerable utilization of health resources [1]. The successful management of diabetes revolves around an individually tailored nutritional plan, exercise regimen, use of oral hypoglycemic agents and / or insulin. Regular monitoring by patient and physician, and supportive education are an integral and important part of management [2].

In developing countries, low-cost strategies to identify at risk individuals and implementation of inexpensive lifestyle interventions like yoga are the best options [3]. In view of people embracing sedentary life style, and the effectiveness of treatment becoming less, the role of regular exercise especially 'yoga' seems to be a beneficial and economical adjuvant in the management of the Type 2 DM (T2DM). Yogic exercise is a slow, static type of muscular exercise. It can be performed even by patients having limited joint mobility, physical unfitness associated with overweight and sedentary lifestyle that would otherwise be unwilling to participate in conventional type physical activities like gym-based training and vigorous strength exercises [3]. It seems to be the earliest and the most effective method for providing peace and maintenance of the tranquility of mind. It is known that yoga induces physiological and certain biochemical changes in volunteers [4]. A recent review suggested that yoga may reduce the stress, improve metabolic profile, regulate autonomic nervous system and alter hypothalamopituitory adrenal axis which act as neural mediators of hyperglycemia [5]. However, there are few reports as regards to the influence of yoga on blood glucose level. Hence, the present study was undertaken to assess the beneficial effects of yoga on blood glucose levels in normal and T2DM volunteers.

MATERIALS AND METHODS

A prospective case-control study was conducted in the Department of Physiology and Diabetic clinic of a tertiary care teaching hospital over period of two years after obtaining Institutional Ethics Committee clearance. The study subjects were consisted of 30 male diabetic patients attending diabetic clinic and 30 non-diabetic male volunteers constituted control group. The patients in the age group of 36 to 55 y with T2DM of at least one year duration and those on diabetic diet and oral hypoglycemic agents (OHA) were included in the study group. The age matched healthy male volunteers who had come to join yoga training at yoga centre were included in the control group. In all the participants, height and weight were measured. After taking written informed consent, all the participants were trained by yoga experts and subjected to regular practice [Table/Fig-1] under supervision for six months. The yoga was practiced daily in overnight fasting state at 6 AM according to standard principles and techniques regarding breathing, clothing, position, posture and movements.

In all the participants fasting (FBS) and post-prandial blood sugar (PPBS) was estimated before, during (at three months) and after (six

S.No.	Yogic Practices	Duration
1	Prayer	3 Minutes
2	Omkar recitation	3 Minutes
3	Pranayama	5 Minutes
4	Various asanas (Vajrasana, Halasana, Matsyasana, Bhujangasana, Paschimottanasana, Shalabhasana, Vakrasana and Sarvangasana)	30 Minutes
5	Shavasana	5 Minutes

[Table/Fig-1]: Schedule of yoga practice

Age in Years	No. of subjects		Mean weight (Kg)		Mean height (cms)	
	Control	T2DM	Control	T2DM	Control	T2DM
36-40	9	6	65.44	68.66	163.66	165.83
41-45	9	10	65.77	64.40	164.55	161.90
46-50	7	5	63.57	65.20	162.57	163.40
51-55	2	4	58.00	66.75	161.00	163.25

[Table/Fig-2]: Distribution of age, mean weight and mean height in both groups
Note: T2DM, Type 2 Diabetes Mellitus

S. No.	Time	FBS (mg%) Mean±SD		PPBS (mg%) Mean±SD	
		Control	T2DM	Control	T2DM
1	Before Yoga	84.38±4.86	154.13±8.29	84.78±3.65	181.13±8.77
2	During Yoga*	84.38±3.45	149.56±7.45	83.99±2.68	171.42±6.18
3	After Yoga*	82.14±2.42	141.42±4.60	81.34±1.80	162.52±6.20

[Table/Fig-3]: Mean values of FBS and PPBS in relation to yoga in control and T2DM group.
Note: FBS, Fasting blood sugar; PPBS, Post prandial blood sugar; SD, Standard deviation; T2DM, Type 2 Diabetes Mellitus; *During yoga, at 3 months; After yoga, at 6 months

S. No	Comparison	FBS				PPBS			
		Control		T2DM		Control		T2DM	
		t-value	p-value	t-value	p-value	t-value	p-value	t-value	p-value
1	Before Yoga and During Yoga*	0.46	>0.05	7.59	<0.001	1.8	>0.05	10.40	<0.001
2	During Yoga and After yoga*	4.75	<0.001	8.51	<0.001	4.73	<0.001	13.45	<0.001
3	Before yoga and After yoga	3.03	< 0.01	11.24	<0.001	5.32	<0.001	17.41	<0.001

[Table/Fig-4]: Comparison of significance of FBS and PPBS levels before and after yoga
Note: FBS, Fasting blood sugar; PPBS, Post prandial blood sugar; T2DM, Type 2 Diabetes Mellitus; *During yoga, at 3 months; After yoga, at 6 months

months) yoga training. The results were presented as percentages, mean and standard deviation (SD). Paired Student t-test was used to estimate difference in means calculated before and after yoga training in a same group. A p-value of <0.05 was considered as statistically significant.

RESULTS

Out of initial 60 participants, five patients with T2DM and three non diabetic volunteers did not complete the yoga practice for six months and were therefore excluded from the final analysis. The distribution of age, mean height and mean weight [Table/Fig-2] among both the groups were comparable. The reduction in mean values of FBS and PPBS [Table/Fig-3] at the end of six months was highly significant (p <0.001) in both the groups when compared with the mean values before and during (three months) yoga practice. The reduction in these values at three months during yoga was highly significant [Table/Fig-4] in T2DM group when compared with mean values before yoga (p <0.001), but it was insignificant (p>0.05) in control group.

DISCUSSION

The incidence of T2DM is increasing with increase in age, physical inactivity and sedentary life style [1]. Environmental factors, psychosocial factors and stress also play an important role in the development of T2DM in genetically susceptible individuals. Both T2DM and prediabetes dramatically increase the risk of cardiovascular diseases and stroke [6]. The advanced glycation end products (AGE) and sorbitol pathway resulting from chronic hyperglycemia are responsible for chronic complications like microangiopathy, nephropathy, retinopathy and neuropathy. To control blood glucose levels, numerous drugs are being invented and marketed for the benefit of diabetic patients. However, use of such drugs has its own drawbacks, such as drug dependency, drug resistance and adverse effects, if used for a long time. Hence, in recent years there has been an intense search for non-medical measures not only to control DM, but also to prevent its complications [7,8]. The significant decrease in FBS and PPBS levels after yoga in both groups in the present study indicates potential role of yoga in preventive and management strategies for T2DM. A significant decrease in FBS and PPBS has been reported in T2DM patients on oral hypoglycemic agents (OHA) undergoing yoga training when compared to those only on OHA [9,10]. Similarly, a significant decrease in FBS and PPBS after yoga training has been demonstrated in T2DM patients on OHA [11]. The beneficial effect of yoga in T2DM has been attributed to increased insulin sensitivity at target tissues which decreases insulin resistance and consequently increases peripheral utilization of glucose [12]. It has also been postulated that yoga can rejuvenate or regenerate beta cells of pancreas [13]. In addition, yoga has positive effect on general well-being and stresses [14]. Hence, in the view of complexities of treatment plans for control of T2DM, yoga can be considered as cost-effective and non-invasive adjuvant therapy. Apart from decreasing the dosage of oral hypoglycemic drugs/ insulin, yoga can also delay the progression of disease process [15].

CONCLUSION

The results of the present study demonstrated that the yoga is effective in reducing the blood glucose levels in patients with T2DM.

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