Original research article

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EFFECT OF YOGA ON BLOOD GLUCOSE AND GLYCOSYLATED HAEMOGLOBIN LEVEL IN DIABETES MELLITUS TYPE-2 PATIENTS.

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ABSTRACT:

Aims and objectives: This study was planned to assess and compare the effect of yogasanas on fasting blood glucose (FBG), postprandial blood glucose (PPG) and HbA1C level (Glycosylated hemoglobin) before and after intervention (Yogasans) in patients of Type 2 diabetes mellitus. **Material and methods:** After obtaining written consent, patients with uncomplicated type 2 Diabetes mellitus, who are on oral hypoglycaemic medicines and diet control; are in the age group of 35-55 years with disease duration 1-10 years were selected in the study. The study population divided into two group study (n=40, undergoing yoga Training) and control group (n=40, not undergoing yoga Training). Subjects were taught 13 types of yogasans in the sequence for three continuous months. Subjects were made to practice yogic exercises by yoga instructor for 40-45 minutes, 5 days in a week in the morning. Blood sample for FBG, PPG and HbA1C were estimated at day 1 and at the end of each of the three month of the study period for both group. **Results :** There was statistically highly significant decreased mean values of FBG from 139.2±16.6 to 99.8±15.9 mg/dl (p value < 0.001), PPG from 174.1±7.9 to 141±8.4 mg/dl (p value < 0.001) and HbA1C from 9.3 ± 1.0 to 7.1 ± 0.7% (p value < 0.001) in the study group. There were no significant changes seen in control group. **Conclusions:** These findings suggested that yogasans have a beneficial effect on glycaemia control in Type- 2 diabetes and decrease the dosage of oral hypoglycaemic drugs.

Keywords: Yoga, Diabetes, Glycosylated haemoglobin(HbA1C), Oral Hypoglycemic Medicines.

INTRODUCTION

Diabetes mellitus (DM) is known since the evolution of civilization. Sushrutha (500BC) an ancient Indian physician had described it as 'Madhumeha'(excretion of sweet urine) **(1-4)**. Diabetes represents a spectrum of metabolic disorder, which has become a major health

challenge worldwide. The unprecedented economic development and rapid urbanization in Asian countries particularly India has led to shift in health problems from communicable to non-communicable diseases **(5)**. Globally, as of 2010 an estimated 285 million people had diabetes, with type 2 making up about 90% of the cases **(6)**. In 2013, according to International Diabetes Federation, an estimated 381 million people had diabetes **(7).** Its incidence is increasing rapidly, and by 2030, this number is estimated to almost double **(8)**. India has more diabetic patients in the world, so it is called Diabetic capital of the world according to the International Diabetes Foundation **(9).** The incidence of type 2 DM is also increasing with the increase in age, physical inactivity and sedentary life style. Diabetes mellitus is a psychosomatic disorder occurs due to sedentary habits, physical and mental stress and strain **(10)**, which is commonly found is modern man **(11).** Epinephrine released during stress, inhibit insulin secretion and also able to overcome the potent stimulant effect of glucose on β-cell islets **(12)**. Sympathetic nervous system and adrenal medulla act as the mediator of neural induced hyperglycaemia **(13)**. Hypothalamus is also involved in neural induced hyperglycemias and there is rise in circulating catecholamine after stimulation of hypothalamus **(14)**. The diabetes control and complications trial demonstrated that improvement of glycaemic control reduced early and late diabetic complications **(15)**. The maintenance of traditional dietary and living pattern should get high priority in the national health care programme of developing countries.

Yoga comprises of a series of coordinated movements, combined with conscious, full attention on the movement and breathing which results in healthy mind and body **(16)**.Yoga has always been an essential part of life and traditional system of treatment **(17-19)**. The aim of yogic intervention is a relaxation, voluntary breath control and maintenance of certain static body postures. In the present study, subjects were kept on isotypical and more or less isocaloric diet. Yoga training resulted in a better blood glucose control, with a decrease in oral hypoglycaemic medicines.

Meditation is the yogic tranquilliser, natural method to establish harmony and well being throughout the entire system. Yoga is a systemic method of inducing complete mental, physical and emotional relaxation. Relaxation therapy (yogic intervention) might serve to prevent the adverse effects of stress induced sympathetic nervous system activity on the metabolic control of diabetic patients **(10)**.

By various yogic practices over a period of time significant physical, physiological, psychological and endocrinal changes have been reported **(20,21)**.Complication free life for the diabetic patients has been possible through Yoga **(22)**. In present study effect of yogic practices on type-2 diabetes mellitus patients by measuring the parameters like blood glucose, glycosylated haemoglobin is emphasized.

MATERIAL AND METHOD

Present study was Randomized control Interventional Study. The study was conducted on 80 type 2 diabetes mellitus subjects aged 35-55 years of both sexes who were on diet restriction and oral hypoglycemic drugs. They were randomized in to two groups: control group

not undergoing yoga training (N=40; mean age= 48.65 years) and study group undergoing yoga training (N=40; mean age=47.8 years). Study group and control group were randomly selected from medicine OPD of S.M.S Hospital after obtaining written consent. A 12 week YOGA training was given to the subjects in Department of Physiology, SMS Medical College, Jaipur in the morning for 45 minutes at 8:00 A.M to 9:00 A.M. Subjects were advised to come empty stomach for YOGASANAS. Thirteen specific yogaasanas were taught to study group by trained yoga instructor. Subjects were made to practice yogic exercises for 45-60 minutes for 5 days in a week upto 12 weeks. At the end of each of the three month, both the groups were investigated. Thirteen specific Yoga asana viz. Trikonasana, Tadasana, Sukhasana, Padmasana, Mandukasana, Pranayama, Pashchimottanasana, Ardhmatsyendrasana, Pawanmuktasana, Bhujangasana, Vajrasana, Dhanurasana, and Shavasana and Pranayama were performed by study group, . The control group did not practice any type of yogic intervention.

Selection criteria:

Inclusion criteria:- for study group and control group –i) Diagnosed patients suffering from Non insulin dependent type-II diabetes mellitus for last one year or less then 10 years at the time of study**. ii)** Patients age between 35-55 yrs. **iii)** Patients who gave informed written consent. **iv)** Non smokers, Non alcoholic. **v)** Patients on oral hypoglycemic Medicines and diet control.

Exclusion criteria:– for study group and control group – i) Diagnosed patients suffering from insulin dependent type-II diabetes patients. **ii)** Patients with any major pulmonary, renal, endocrinal and neurological diseases.iii) History of any diabetic complications. iv) Variation in treatment regimes during study follow-up period of 12 weeks.

Parameters Measured

- The parameters FBG, PPG and HbA1C were measured every month for 12 weeks of study in both groups (study and control). Parameters were measured by independent to observer.
- The pharmacotherapy to both the groups (study & control) were continued and any change in doses was recorded during the study.
- If treatment regime was changed then that subjects were excluded from study.

Statistical Analysis:

Outcome variables:

1. Fasting blood glucose level, Post prandial blood glucose level and HbA1C level before & after intervention in the study group.
2. Fasting blood glucose level, Post prandial blood glucose level and HbA1C level before & after intervention in Control group.
3. Dose variation in treatment if any.

Outcome Analysis:

Unpaired‘t’ test’ to find out significance of the difference in mean value of study and control group. Paired‘t’test to find out significance of the difference in mean value of before and after intervention. Quantitative data were analyzed in the form of mean value with standard deviation.

Data thus collected were submitted to Microsoft excel 2007 worksheet in the form of master chart and were classified & presented with help of Microsoft excel 2007 worksheet. The data of general characteristics were analyzed paired and unpaired't' test. A p-value of < 0.001 was considered highly significant, p-value of < 0.05 was considered significant and a p-value of > 0.05 was considered not significant. These data was classified & analysed with the help of Microsoft excel 2007 worksheet.

RESULTS

Table no.1: Comparison of Fasting Blood Glucose in control and study Group before and after Intervention

S.No.	Time of Intervention	Control Group	Study Group	P Value LS
1.	0 Month	142.7±5.6	139.2±16.6	0.2057 NS
2.	1 Month	143.1±5.6	134.8±12.6	<0.001 HS
3.	2 Month	144.7±6.7	118.0±22.0	<0.001 HS
4.	3 Month	144.7±7.7	99.8±15.9	<0.001 HS

Table no 1, 2, 3,and figure no 1,2, 3, show the glycaemic control as well as HbA1c levels of 40 subjects and controls. Mean value of FBG was reduced from 139.2±16.6 to 99.8±15.9 mg/dl, PPG from 185.97±30.62 to 136±21.45 mg/dl and HbA1c from 9.07±1.72 to 7.09±0.89

Table no. 2: Comparison of Post Prandial Blood Glucose in control and study Group before and after Intervention

S.No.	Time of Intervention	Control Group	Study Group	P Value LS
1.	0 Month	179.4±11.6	174.1±7.9	0.0982 NS
2.	1 Month	181.1±10.9	170.8±9.1	<0.001 HS
3.	2 Month	181.5±10.6	162.1±8.3	<0.001 HS
4.	3 Month	184.6±12.6	141.7±8.4	<0.001 HS

Table no. 3 : Comparison of Glcosylated Haemoglobin in Control and study Group after Intervention

S.No.	Time of Intervention	Control group	Study Group	P Value LS
1.	0 Month	9.6±1.0	9.3±1.0	0.1663NS
2.	1 Month	9.8±1.30	9.2±0.9	<0.001 HS
3.	2 Month	9.8±1.3	7.9±0.8	<0.001 HS
4.	3 Month	9.6±1.3	7.1±0.7	<0.001 HS

Figure no. 1: show trend of change in mean values of fasting blood glucose in study and control group

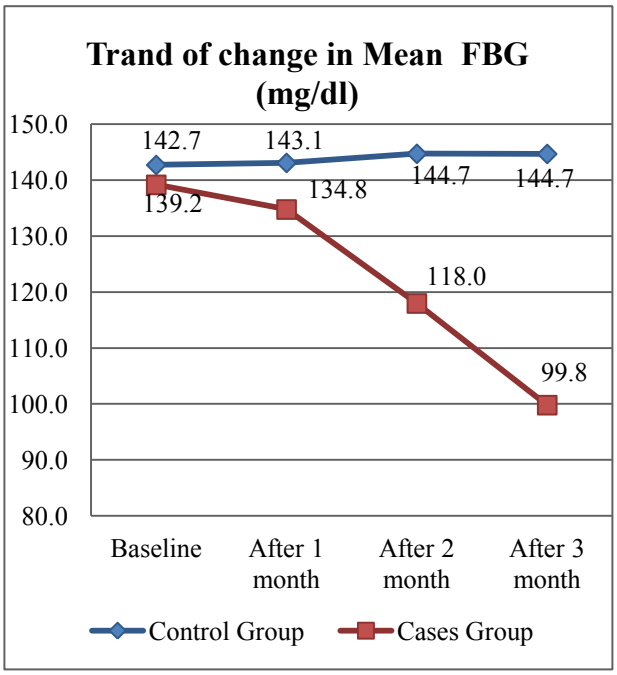


Figure .2: trend of change in mean values of postprandial blood glucose in study and control group

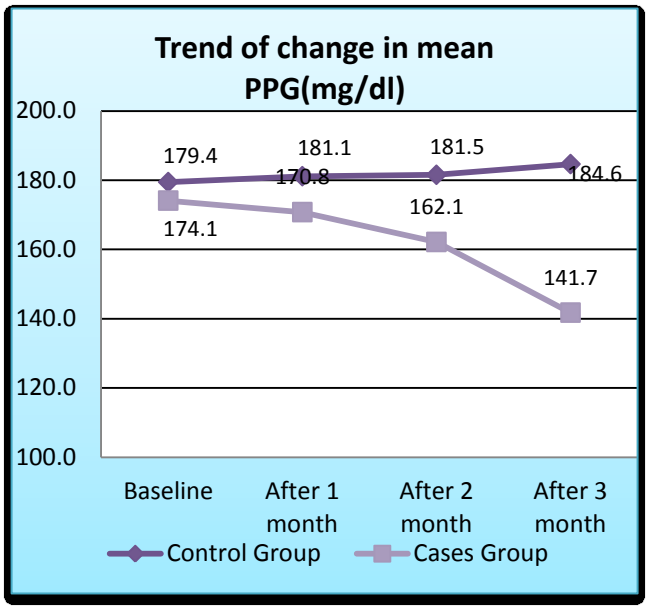
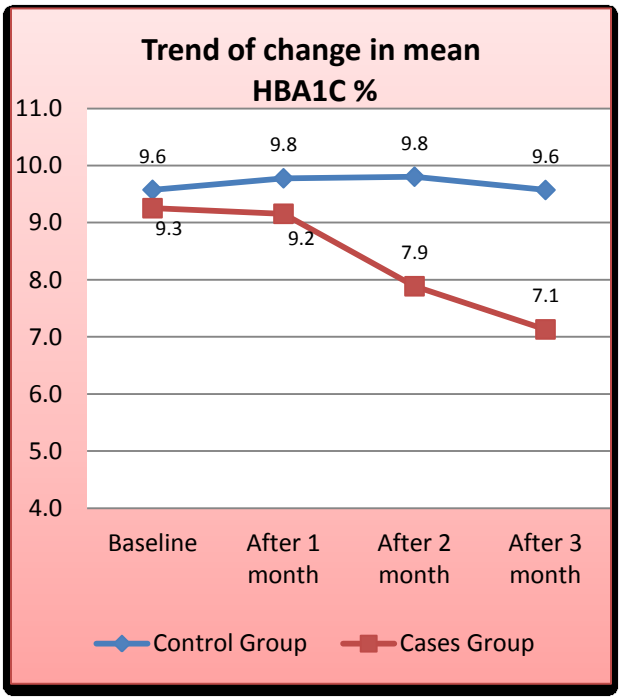


Figure 3: Trend of change in HbA1C in mean values of both study and control group



% in study group. All these variables were reduced significantly ($p < 0.001$) in study group as compare to control group. In study group the blood glucose level of 4 subjects dropped below baseline glucose value even with reduced dose of oral hypoglycaemic drug so they were advised to stop the medicine under the supervision of treating physician. In control group there was no significant reduction in blood glucose level.

DISCUSSION

The present study was aimed at studying the effect of practicing yoga in subjects with type -2 DM for 3 months. Following 12 weeks of yoga-asanas practice there was highly significant ($p \leq 0.001$) reduction in the mean FBG, mean PPBG, mean HbA1C in study group.

Although improvements were seen in some parameters in control group, but none were highly significant. This may be because they were already on medication for more than one year. There was a trend towards highly significant improvement in subjects practicing yoga and taking standard treatment.

In present study there was significant decrease in FBG and PPBG values in those subjects practiced yoga for 3 months. After analysing the results of present study, it can be stated that our findings were consistent with the results of MalhotraV.et al, Singh S. et al, Upadhyay AK.,et al(21,22,23).The exact cause of decrease in the blood glucose level is still unknown.

The possible mechanisms may be 1**)** Direct rejuvenation/ regeneration of beta cells of pancreas due to abdominal stretching during yogic exercise, which may increase utilization and metabolism of glucose in peripheral tissues, liver and adipose tissues through enzymatic process **(20,24,25)**. 2**)** More active practices followed by relaxing ones lead to deeper relaxation than relaxing practices alone, and possibility of neuroplasticity bringing about changes in the hypothalamic- pituitary-pancreatic axis **(26)**. 3**)** Muscular relaxation, development and improved blood supply to muscles might enhance insulin receptor expression on muscles causing increased glucose uptake by muscles and thus reducing blood glucose **(27)**.

Amita S, Gordon LA suggested the positive effects of yoga on blood glucose levels that are consistent with the results of present study **(28,29)**. The reason of this consistency between these studies can be explained by the mechanism, that muscle contraction and relaxation in yogic postures during yogic exercises stimulate the pancreas gland, so that the relaxation, deep breathing, bending and twists and turns of the spine where the pancreas is located, directly stimulate pancreatic beta cells, thus performing the asana increases insulin secretion and regulation **(30)**.

Sahay BK et al, reported significant reduction in fasting and post prandial blood glucose within 3 months of yoga exercises in type-2 DM **(31)**.They reported an improvement in insulin sensitivity and decrease in insulin resistance in subjects practicing yoga, while Manjunatha et al studied the effect of four sets of asanas in random order for 5 consecutive days and reported that the performance of asanas leads to an increased sensitivity of the beta cells of pancreas to glucose signals **(32)**. Gore et al selected shavasana and tranquillisation and their results showed that fasting and postprandial blood glucose was significantly decreased after 2-month of yogic treatment **(33)**. Similar mechanism may be responsible for the improvement in blood glucose level of subjects in present study.

In present study, there was also statistically significant decreased in HbA1C in Type 2 diabetes subjects undergoing 3 months Yoga practice. Similar finding was observed by Sahay BK. **(20)** , Mukherjee A.et al**(34)** , Bijlani RL. et al**(20,34,35)**.

In present study subjects reported a feeling of well being, more relaxed and satisfied, and a sense of relief from anxiety. They were more alert and active which could be due to Yoga-asana with its change in posture and controlled

breathing in pranayama influences mental status of an individual allaying apprehension, stress and brings about feelings of well being and hormonal balance. Concordant findings were observed by Shirley T**(36)** and Udupa KN **(37)**.

Finally after yogic intervention results of present study suggested that beneficial effects of yogic practices in diabetes mellitus may be due to increase in rate of transport of glucose, increase in release of insulin like substance from muscle into the circulation, decrease in secretion of adrenaline resulting from diminished sympathetic tone leading to inhibition of glycogenolysis, Change in biochemical profile lactate, pyruvate, adrenaline, noradrenaline etc.in antioxidant status. These results consistent with Mukhrjee A. et al **(34)**, Udupu KN.et al**(38)** , Yadav RK.**(39)**, Weiner N **(40)**.

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