Original Article

Role of Yoga in Modifying Certain Cardiovascular Functions in Type 2 Diabetic Patients

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Abstract

Objectives : 1. To study the effect of forty days of Yogic exercises on cardiac functions in Type 2 Diabetics. 2. To study the effect of forty days of Yogic exercises on blood glucose level, glycosylated hemoglobin.

Methods : The present study done in twenty-four Type 2 DM cases provides metabolic and clinical evidence of improvement in glycaemic control and autonomic functions. These middle-aged subjects were type II diabetics on antihyperglycaemic and dietary regimen. Their baseline fasting and postprandial blood glucose and glycosylated Hb were monitored along with autonomic function studies. The expert gave these patients training in yoga asanas and they pursued those 30-40 min / day for 40 days under guidance. These asanas consisted of 13 well known postures, done in a sequence. After 40 days of yoga asanas regimen, the parameters were repeated.

Results : The results indicate that there was significant decrease in fasting blood glucose levels from basal 190.08 ± 18.54 in mg / dl to 141.5 ± 16.3 in mg / dl after yoga regimen. The post prandial blood glucose levels decreased from 276.54 ± 20.62 in mg / dl to 201.75 ± 21.24 in mg / dl, glycosylated hemoglobin showed a decrease from 9.03 ± 0.29 % to 7.83 ± 0.53 % after yoga regimen. The pulse rate, systolic and diastolic blood pressure decreased significantly (from 86.45 ± 2.0 to 77.65 ± 2.5 pulse / min, from 142.0 ± 3.9 to 126.0 ± 3.2 mm of Hg and from 86.7 ± 2.5 mm of Hg to 75.5 ± 2.1 mm of Hg after yoga regimen respectively). Corrected QT interval (QT_c) decreased from 0.42 ± 0.0 to 0.40 ± 0.0.

Conclusion : These findings suggest that better glycaemic control and stable autonomic functions can be obtained in Type 2 DM cases with yoga asanas and pranayama. The exact mechanism as to how these postures and controlled breathing interact with somato-neuro-endocrine mechanism affecting metabolic and autonomic functions remains to be worked out. ©

Introduction

It is known that patients with Type 2 diabetes mellitus (Type 2 DM) have a high mortality rate. Most of them die due to diseases such as myocardial infarction, heart failure, or stroke.[1] Scientists have linked QT lengthening to an increased risk of unexpected deaths in Type 2 DM patients with severe autonomic neuropathy.[2-4]

This lengthening is associated with high insulin levels (Metabolic Syndrome) that cause Na reabsorption, and enhance smooth muscle contractility. This results in hypertension. Hypertension in diabetic patients aggravates both macro and microvascular disease, especially nephropathy. It is essential to lower blood pressure to below 135/85 mm Hg in diabetic patients. This may be done with medicines and or in combination or alone by non-pharmacological means in mild cases.

Yoga has been applied in the field of therapeutics in modern times. Yoga has given the patient hope to reduce medication and slow the progress of disease. *Yoga* employs stable postures or asanas and breath control or pranyama. Through regular practice of these, the autonomic equilibrium shifts towards a relative parasympathetic dominance.

Parasympathetic balance is essentially concerned with conserving and restoring bodily resources and energies. This is achieved by inhibiting the heart and alimentary activity, promoting secretion.

In addition of dietary management and physical exercise,[5,

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[6] the possible role of yoga merits study and so in order to find other ways of reducing the ensuing complications of diabetes we studied Type 2 DM patients for heart rate, rhythm, and blood pressure before and after yoga asanas.

Material And Methods

Selection of subjects

Patients of type 2 diabetes mellitus of 30-60 years with history of diabetes of 1 - 10 years were selected. Patients of nephropathy, retinopathy (proliferative) and coronary artery disease were excluded. The patients were recommended on diet and oral hypoglycemic drugs as per standard clinical practice. The patients were assessed before and after 40 days of Yoga asanas for biochemical and autonomic parameters.

Biochemical parameters

Fasting and postprandial plasma glucose levels were estimated by glucose oxidase method of Trinder.[7] Plasma glycosylated hemoglobin (GHb) was estimated by fast ion-exchange resin separation method using human GmbH kit.

Autonomic parameters

The pulse rate was recorded. Blood pressure was measured using mercury sphygmomanometer by standard method. QT interval was also measured in lead II ECG by BPL machine. QT interval was measured from the onset QRS to the end of T wave. Since ventricular depolarization (diastole) is affected by change in heart rate, QT interval is standardized for rate, by corrected QT interval Bazett formula QTc = QT / $\sqrt{RR}$ interval.

Results And Observations

Fig. 1 shows the yoga asanas and pranayama. Table 1 shows the different asanas and pranayama done with their time duration.[8] Table 2 shows glycaemic control, glycosylated hemoglobin and autonomic function values before and after 40 days of yoga asanas.

Fasting blood glucose (FBG) reduced from in 190.1 mg / dl to 141.5 mg / dl ($p < 0.001$), 2 hours postprandial blood glucose (PPG) from 276.5 mg / dl to 201.7 mg / dl ($p < 0.001$), and plasma glycosylated hemoglobin (HbA1) values from 9.03 to 7.83 ($p < 0.035$), indicating a better glycaemic control.

Systolic blood pressure (SBP) from 142.0 to 126.0 mm of Hg, ($p < 0.001$), diastolic blood pressure (DBP) decreased from 86.7 to 75.5 mm of Hg, ($p < 0.001$). No patients doing yoga showed a pressure rise.

Pulse rate (PR) from 86.45 ± 2.0 to 77.65 ± 2.5 pulse / min ($p < 0.001$) and corrected QT interval (QTc) from 0.42 ± 0.0 to 0.40 ± 0.0, indicating a shift towards parasympathetic dominance.

Discussion

There was a statistically significant decrease in heart rate, decreases in systolic, and diastolic blood pressure, and QTc interval after yoga asanas.

QT interval is measured from the starting of Q wave to end of T wave. This interval represents ventricular depolarization and repolarisation. It is purely an indicator of ventricular function. The ventricles receive sympathetic nerves only. Thus QT interval is an indicator of sympathetic function only. Any change in the interval represents a change in autonomic function for example a decrease in QT interval indicates a decrease in sympathetic system activity.[9]

Ventricle depolarisation and repolarisation varies with changes in heart rate.[10] The interval is corrected over time by

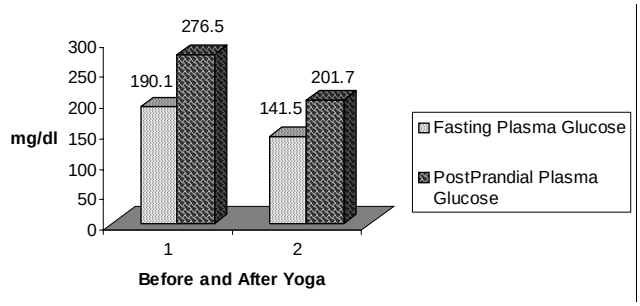

Fig. 1 :

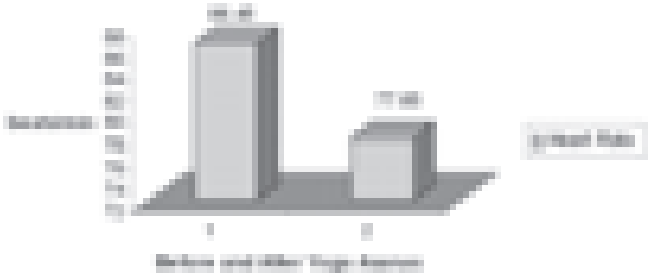

Fig. 2 :

Fig. 3 :

Fig. 4 :

Table 1 : Name and duration of various asanas included in yoga.

1.	*Surya Namaskar* - 1	Out of 12 asanas of suryanamaskar-4 comfortable postures were done, the pose being maintained for ten seconds.
2.	*Tadasana*	¼ minute to one minute for each side adding ¼ minute per week
3.	*Trikona-asana*	¼ minute to one minute for each side, adding ¼ minute per week
4.	*Sukhasana*	¼ minute to one minute, adding ¼ minute per week
5.	*Padmasana*	¼ minute to one minute, adding ¼ minute per week
6.	*Bhastrika Pranayama*	5 – 15 minutes per day
7.	*Paschimottanasana*	¼ minute to one minute for both sides, adding ¼ minute per week
8.	*Ardhmatsyendrasana*	¼ minute to one minute for each side, adding ¼ minute per week
9.	*Vajrasana*	¼ minute to one minute, adding ¼ minute per week
10.	*Pawanmuktasana*	¼ minute to one minute for both sides, adding ¼ minute per week
11.	*Naukasana*	3 – 7 turns of each, the pose being maintained for ten seconds adding one turn each, every fortnight
12.	*Bhujangasana*	3 – 7 turns of each, the pose being maintained for ten seconds adding one turn each, every fortnight
13.	*Dhanurasana*	3 – 7 turns of each, the pose being maintained for ten seconds adding one turn each, every fortnight
14.	*Shavasana*	2 - 10 minutes, adding 2 minutes per week

Table 2 : Fasting blood glucose (FBG), postprandial blood glucose (PPG), cardiovascular function, and glycosylated hemoglobin (GHb) values before and after 40 days of yoga asanas

	N	Mean ± S.E.	Sig.
* FBG (mg%)	24	190.1 ± 18.54 141.5 ± 16.3	0.000*
* PPG (mg%)	24	276.5 ± 20.62 201.8 ± 21.24	0.000*
* SBP (mm Hg)	20	142 ± 3.9 126 ± 3.2	0.001*
* DBP (mm Hg)	20	86.7 ± 2.5 75.5 ± 2.1	0.001*
* PR (beats/min)	20	86.45 ± 2.0 77.65 ± 2.5	0.001*
* QT_c	20	0.42 ± 0.0 0.40 ± 0.0	0.246NS
* GHB (%)	19	9.03 ± 0.29 7.83 ± 0.53	0.035*

Legend

*	Significant at p value of < 0.05
NS	Not-significant
FBG (mg/dl)	Fasting blood glucose
PPG (mg/dl)	Post prandial blood glucose
SBP (mm Hg)	Systolic blood pressure
DBP (mm Hg)	Diastolic blood pressure
PR (beats/min)	Pulse rate
QT_c	Corrected QT interval
GHB (%)	Glycosylated hemoglobin

using Bazett' Formula.

Heart rate adjusted QT interval (QT_c) predicts mortality in diabetic patients with coronary heart disease, nephropathy, and in autonomic neuropathy.[11] An increase may also be associated with an imbalance of sympathetic nervous system and an increased risk of sudden cardiac death.[12,13]

A decrease in QTc interval suggests a stable balance, which is seen after Yoga asanas. There occurs a shift towards parasympathetic relative dominance as observed by a decrease in heart rate.[14] This may be due to improved vagal tone after slow stretch exercises. Changes of heart rate and respiration accompanying a Yogic subjective activity are intended to alter the state of mind alone.[15] It has been seen that certain Yogis can alter the patterns of their cardiovascular functions voluntarily create atrial fibrillations or stop their heart at will.[16] Other types of voluntary control of heart such as tachycardia, bradycardia, reduction of P wave amplitude, achieving T-wave amplitude more than that of R-wave and atrial flutters have also been recorded. There is also a rapid decrease of red cell glycotic rate during meditation.[17]

There was a reduction in both systolic and diastolic blood pressure in hypertensive Type 2 DM subjects after two to three weeks of *Yoga* practice. This was associated with significant reduction in drug requirements. The relief from high blood pressure diminishes gradually if meditation is discontinued. The blood pressure was observed to return to normal in patients who restarted the yoga asanas. This confirms the "cause and effect relationship between Yoga asanas and the blood pressure levels".

The cause may be attributed to the improvement of lipid profile and decrease in weight.[18] The observations suggest that *Yoga* asanas shift the autonomic equilibrium to the parasympathetic side.[19,20]

In contrast to physical exercises such as walking, that improve blood flow by movement of skeletal muscles, Yoga postures restore internal balance and homeostasis of the body by influencing every organ system.

In the human body, there are some glandular structures which have both an internal as well as an external secretion. The best examples are the pancreas and the testes. The pancreas secretes insulin. The testes secrete testosterone and sperm. *Yogic* therapeutics helps in restoring the internal secretions to their normal value by securing the health of all the endocrine organs. For example - ardthmatsyendra asana influences the pancreas and restores insulin balance.[8]

The relaxation stretch exercises also result in a relative hypometabolic state and improvement of physical and mental efficiencies.[21]

The subjects felt relaxed. In previous studies the patients have showed lower scores in excitability, aggressiveness, openness, emotionality and somatic complaints.[22] They felt happy which has been associated with increased levels of endorphins and encephalin after yoga.[23]

Yoga-asanas in combination with conventional medical treatment provides a better metabolic control giving a feeling of general well being, alertness and attentiveness without any side effects. Yoga practice improves the status of Type 2 DM probably by more than one way.[24] Various yoga-asanas may be directly rejuvenating/regenerating cells of pancreas as a result of which there may be increase in utilisation and metabolism of glucose in the peripheral tissues, liver and adipose tissues through enzymatic process.[25,26] Combined beneficial effects could be utilised by performing asanas, meditation along with conventional antidiabetic regimen. However, a detailed study of the levels of insulin and enzymes as well as pancreatic functions is necessary to know about the underlying mechanism.

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