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Effect of Yoga on Lipid Profile in Mild Hypertensive Patients (Stage-I)

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Abstract
Background : *Dyslipiemia is a modifiable risk factor for coronary heart disease. Yoga which aims at harmonizing mind, body and spirit, has been shown to be useful in correcting dyslipidemia.*
Objectives : *To assess the effect of Yoga on lipid profile parameters in mild hypertensive patients (stage 1 of JNC 7 classification) who are not in any form of medication.*
Materials And Methods : *Fifty mild hypertensives (28 males and 22 females) with systolic blood pressure (SBP) 140 to 159 mmHg and/or Diastolic blood pressure (DBP) 90 to 99 mmHg in the age group of 25-65 years who came to practise yoga at the Yoga Training and Research Centre) Kwakeithel, Imphal were selected. Heart rate(HR), blood pressure(BP) and fasting serum lipid profile were estimated before any intervention. Physiological parameters viz, HR response to standing(30:15), BP response to standing, valsalva ratio (VR) and isometric hand grip test (IHG) were estimated to assess autonomic functions in these patients. They were subjected to yogic practices (asanas, pranayama and meditation) for 1 hour in the morning each day for 6 days a week. After 3 months, the same parameters were estimated again.*
Results : *We observed a significant decrease in the lipid profile parameters except HDL in which case there was a statistically significant increase after 3 months of yoga training. We also observed a statistically significant decrease in HR and BP in these patients. It was also seen that 3 months of yoga training improved autonomic functions in mild hypertensives.*
Conclusion : *Yogic asanas has been found to correct dyslipidemia which is a modifiable risk factor for coronary heart disease. It has also been found to be effective in reducing heart rate and blood pressure in mild hypertensives*
Keywords: *yoga, hypertensive, dyslipidemia , blood pressure, heart rate*

I. Introduction

Yoga is a discipline which aims at harmonizing mind, body and spirit. Yoga is based on one of the six systems of Indian Philosophy that have been transmitted orally through generations. Patanjali, the father of Ayurvedic medicine, wrote a treatise called the 'Yoga Sutras' in which he formalized this discipline. Iyengar yoga, developed and popularized by BKS Iyengar, emphasized the precise use of alignment in a wide variety of asanas to derive therapeutic benefit. There are 200 different asanas used for a variety of medical conditions ranging from musculoskeletal complaints to internal organ disturbances such as hypertension, diabetes mellitus and heart diseases [1]. The gentle physical activity, slowed regulated breathing and meditation in the practice of yoga are the key elements for bringing about the physiological changes in the body [2]. Common diseases such as coronary artery disease, hypertension and diabetes mellitus are being attributed to a faulty lifestyle. In 1990, Dean Ornish, an American cardiologist demonstrated the favourable effects of yogic lifestyle on coronary heart disease (CHD). Following his demonstration, yoga is finding increasing acceptance as a non-pharmacological intervention for prevention and treatment of several diseases [3].

Dyslipidemia is one of the important modifiable risk factors for CHD. It initiates atherosclerotic plaque formation and alteration in endothelial cell function which enhances the coagulability of blood. The modification of lipid profile may be important in both prevention and control of CHD [4]. Several studies have shown the therapeutic benefits of yoga in the management of dyslipidemia and hypertension. The present study has been undertaken to assess the effectiveness of yoga in correcting dyslipidemia associated with mild hypertension (Stage I of JNC 7 classification) without medical intervention.

II. Materials And Methods

The study was carried out in the Department of Physiology and Biochemistry, Regional Institute of Medical Sciences (RIMS), Imphal from August 2015 to August 2016 in collaboration with Yoga Training and Research Centre (YTRC bearing registration no. 38 of 1987) Kwakeithel, Imphal.

Fifty mild hypertensives (28 males & 22 females) with systolic blood pressure (SBP) 140-159 mm Hg and/or diastolic blood pressure (DBP) 90-99mmHg in the age group of 25-65 years irrespective of sex who came to practise yoga at YTRC were selected based on exclusion criteria.

2.1 Exclusion Criteria

1. Athletes, regular yoga practitioners and patients undergoing any other form of exercise.
2. Patients on antihypertensives with/without statin therapy.
3. Patients with any other chronic illnesses like angina, stroke, uncontrolled diabetes mellitus, chronic renal failure etc.

2.2 Study Design

It is an intervention study in which we compare the parameters between before and after yoga training in the same individual after 3 months of yoga training.

2.3 Data Collection Procedure

The study protocol was explained to the subjects and informed written consent was taken. Ethical clearance was sought from the Institutional Ethics Committee, RIMS, Imphal. The study parameters were recorded before starting the yoga training. The subjects practised yoga which included asanas, pranayama and meditation at the yoga centre under the guidance of a yoga instructor for one hour in the morning, each day for six days a week. The same parameters were estimated again after 3 months of yoga training.

The subjects were advised to report to the Department of Physiology, RIMS Imphal between 9:00am & 10:00am and their physiological parameters were recorded. Two ml of venous blood sample was drawn from the same subjects for serum lipid profile at the yoga centre after 12 hours of fasting in the next morning before starting yoga training. After a rest of 15-20 minutes in a comfortable sitting posture, their physiological parameters were recorded. They were advised to wear loose fitting clothes. Tight under clothing and metallic objects were not allowed. The resting time after each test was 5-10 min.

2.4 Parameters Studied

2.4.1. Resting Heart Rate:

Lead II of the ECG was selected for measuring heart rate (HR). HR was recorded in supine position during normal quiet breathing for a period of 1 min. The average R-R interval gives the HR.

2.4.2. Resting Blood Pressure:

BP was recorded with a mercury sphygmomanometer (Diamond) in the supine position in the right upper arm. Three readings were taken at an interval of 10 min and the average of the three values was calculated.

2.4.3 HR Response to Standing (30:15 Ratio):

After a complete rest of 10 minutes, the ECG recording was started and the subject assumed erect posture as quickly as possible within 3 seconds with continuous ECG recording.
The longest R-R interval occurring at about 30 beats after standing divided by the
shortest R-R interval occurring at about 15 beats after standing gives the result for 30:15 ratio (RR ratio).

2.4.4 BP Response to Standing:

After 5 minutes rest in the supine position, the subject was asked to stand up immediately and remain still without movement. BP was recorded after 0.5 minute, 1 minute and 3 minutes of standing.

2.4.5 Valsalva Ratio (HR response to valsalva manoeuver):

After a rest of 5 mins in the sitting position, the subject was asked to exhale forcefully with closed nostrils through the mouthpiece of a modified mercury sphygmomanometer (in which a mouth piece and a body tube of a 50 ml disposable hypodermic syringe is connected in place of the air pump) and to maintain pressure in the manometer upto 40 mmHg for 15 seconds. ECG recording was taken during the manoeuver and continued for 30 seconds after the manoeuver. The ratio of the longest R-R interval after blowing to the shortest R-R interval during blowing gives the valsalva ratio.

2.4.6 BP Response to sustained handgrip:

For this, the subject was asked to perform maximum grip of the handgrip dynamometer with the dominant hand and the maximum capacity from the graduation marking was noted. After 5 minutes rest in the sitting position, the subject was asked to hold the grip with 30% of the maximum capacity for 5 minutes. While performing this sustained handgrip, BP was recorded on the contra lateral arm at 2 minutes, 4 minutes and just before the release. The average of the three readings was taken.

2.4.7 Lipid Profile:

Lipid profile was measured by Digital Photo colorimeter in the Department of Biochemistry.

a) Serum total cholesterol was estimated by enzymatic colorimetric test using commercially available CHOD-PAP Kit method of Human, Germany.
b) Serum triglyceride was estimated by enzymatic colorimetric test using commercially available GPO-PAP Kit method of Human, Germany.
c) Serum HDL was estimated by precipitin test with commercially available human cholesterol liquicolor test kit.
d) Serum LDL and VLDL were estimated by using Friedewald formula.

2.5 Collection Of Sample

2ml of blood was drawn from the antecubital vein in the morning after 12 hrs of fasting. Serum was separated within one hour of collection. Serum total cholesterol, triglyceride, HDL, LDL and VLDL were estimated within 4 hours of serum separation.

2.6 Statistical Analysis

Statistical analysis was done using SPSS 18 for windows. Paired 't' test was used to analyze the quantitative data and to determine the p-values. A p-value of <0.05 was taken as significant and interpretations were made accordingly.

III. Results

We observed a statistically significant decrease in the lipid profile parameters except HDL in which case there was a statistically significant increase after 3 months of yoga training in mild hypertensives(stage I). We also observed a statistically significant decrease in HR and BP. It was also seen that 3 months of yoga training improved autonomic functions in these patients.

Table 1: Heart Rate/RR/VR

Test parameter	Before yoga (mean ± S.E.)	After yoga (mean ± S.E.)	t-test (p value)
Resting Heart Rate (Beats/min)	75.02 ± 0.34	69.30 ± 0.25	0.000**
RR Ratio	1.11 ± 0.003	1.17 ± 0.006	0.000**
VR	1.35 ± 0.01	1.49 ± 0.01	0.000**

**Indicates that p value is highly significant (<0.001)

Table -1 shows the comparison of resting heart rate, heart rate response to standing (RR ratio) and Valsalva ratio (VR) before and after yoga training. The mean resting heart rate decreases from 75.02 ± 0.34 beats /min to 69.30 ± 0.25 beats/min after yoga and the change is highly significant. It is also seen that the RR ratio increases significantly from 1.11 ± 0.003 to 1.17 ± .006 and VR from 1.35 ± 0.01 to 1.49 ± 0.01.

Table 2: Resting Blood pressure

Resting Blood Pressure (mmHg)	Before yoga (mean ± S.E.)	After yoga (mean ± S.E.)	t-test (p value)
Systolic	143.86 ± 2.99	135.64 ± 0.60	0.005*
Diastolic	89.08 ± 0.67	84.64 ± 0.59	0.000**

In table -2 resting blood pressure is compared before and after three months of regular yoga training. Both systolic and diastolic readings show significant decrease after yoga training as indicated by the significant p values in the last column. The SBP decreases from 143.86 ± 2.99 mmHg to 135.64 ± 0.60 mmHg and the DBP decreases from 89.08 ± 0.67 mmHg to 84.64 ± 0.59 mmHg.

Table 3: Blood Pressure Response to standing

Blood Pressure Response to Standing (mmHg)		Before yoga (mean ± S.E.)	After yoga (mean ± S.E.)	t-test (p value)
0.5 min	Systolic	144.96 ± 0.72	135.28 ± 0.63	0.00*
	Diastolic	88.88 ± 0.64	84.96 ± 0.60	0.00*
1 min	Systolic	129.92± 0.76	125.32± 0.63	0.00*
	Diastolic	87.12 ± 0.57	83.72 ± 0.59	0.00*
3 min	Systolic	146.36± 0.71	135.44± 0.62	0.00*
	Diastolic	87.96 ± 0.66	84.40 ± 0.61	0.00*

Table -3 shows the change in blood pressure response to standing at 0.5 min, 1 min and 3 min before and after yoga training. All the changes are statistically highly significant as indicated by the corresponding p values.

Table 4: BP Response to Sustained Handgrip

BP Response to Sustained Handgrip (mmHg)	Before yoga (mean ± S.E.)	After yoga (mean ± S.E.)	t-test (p value)
Systolic	165.32 ± 0.94	160.80 ± 0.72	0.00*
Diastolic	107.66 ± 1.57	104.48 ± 0.58	0.00*

Table - 4 shows the blood pressure response to sustained handgrip before and after yoga training. The mean SBP decreases from 165.32 ± 0.94 mmHg to 160.80 ± 0.72 mmHg and the mean DBP decreases from 107.66 ± 1.57 mmHg to 104.48 ± 0.58 mmHg.

Table 5: Percentage change in Blood Pressure (Before and After Yoga)

	Before Yoga			After Yoga		
Parameter (mmHg)	Rest	IHG	%Change	Rest	IHG	%Change
SBP	143.86 ±2.99	165.32 ±0.94	14.91	135.64 ±0.60	160.80 ±0.72	18.54
DBP	89.08 ± 0.67	107.66 ±1.57	20.85	84.64 ± 0.59	104.48 ± .58	23.44

Table -5 shows the percentage change in blood pressure response to sustained hand grip before and after yoga. In case of SBP, the percentage change increases from 14.91% to 18.54% and in case of DBP, the percentage change increases from 20.85% to 23.44% after yoga training.

Table 6: Lipid Profile

Lipid Profile (mg/dl)	**Before yoga (mean ± S.E.)**	**After yoga (mean ± S.E.)**	**t-test (p value)**
TC	187.56 ± 2.84	169.94 ± 2.59	0.00*
TG	176.80 ± 4.69	161.44 ± 4.35	0.00*
HDL	45.86 ± 1.42	52.46 ± 1.46	0.00*
LDL	106.24 ± 3.46	84.58 ± 2.26	0.00*
VLDL	35.30 ± 0.93	32.10 ± 0.89	0.00*

Table -6 compares the lipid profile parameters before and after yoga training. Serum total cholesterol (TC) , serum triglyceride (TG), serum low density lipoprotein(LDL) dl and serum very low density lipoprotein(VLDL) decreases significantly but, serum high density lipoprotein (HDL) increases from 45.86 ± 1.42 mg/dl to 52.46 ± 1.46 mg/dl after 3 months of yoga training.

IV. Discussion

In our study, it was found that following three months of yoga training (asanas, pranayama and meditation), there was significant improvement in serum lipid profile parameters and reduction in HR, SBP & DBP. These findings are consistent with the studies of Mahajan AS et al [5], Prasad KVV et al [4], Murugesan et al [6], Indla Devasana et al [7] and Cohen et al [8].

The reduction in HR and increased RR ratio and VR after 3 months of yoga training show parasympathetic dominance with practice of yogasanas [9][10]. Vagal control allows more rapid adjustment in HR than does sympathetic nervous system (SNS) control, which takes longer to turn on and longer to turn off [11]. Vagal dominance is a sign that shows that stress response system has greater flexibility to respond to

challenges [12]. Underactivity of the parasympathetic nervous system leads to greater dependence on sympathetic excitation of the cardiovascular system (CVS) and other systems with negative health consequences such as hypertension, hyperarousal and over reactivity [13].

Parasympathetic dominance after yoga training does not mean that the sympathetic response will be blunted in times of stress or emergency. As we can see in our finding, the fall in blood pressure from the baseline value in response to standing is less after yoga training. In response to isometric hand grip test (IHG) also, the percentage rise of blood pressure response is increased after yoga. In case of SBP, the percentage increase is from 14.91% to 18.54% and in case of DBP the percentage increase is from 20.91% to 23.44% as shown in table 5. This shows that yoga training optimizes the sympathetic response to stressful stimuli like isometric handgrip test and restores the autonomic regulatory reflex mechanisms in hypertensive patients[14].

The practice of yoga increases baroreceptor sensitivity in hypertensives thereby restoring BP to normal levels[15]. The meditation element of yoga also has an effect in lowering BP as it reduces anxiety and stress. Meditation has a balancing effect on autonomic nervous system [16]. Controlled breathing exercise in the practice of yoga (pranayama) improves vagal activity and therefore decreases baseline heart rate and blood pressure [17].

In our study, there was a significant decrease in all lipid profile parameters except HDL in which case there is a significant increase after 3 months of yoga training. This finding is consistent with the studies of Mahajan AS et al [5] and Prasad KVV et al [4]. Serum HDL increases from 45.86 ± 1.42mg/dl to 52.46 ± 1.46mg/dl which is quite significant as indicated by the p value. It is known that decreased concentrations of plasma HDL – cholesterol lead to increased risk of coronary heart disease whereas rise in its value exerts a protective effect [18]. Every 1.2 mg/dl rise in HDL appears to be associated with at least 3% reduction in CHD risk [19].

Increased physical activity in the practice of yoga is associated with more favourable lipid profile. It increases hepatic lipase and lipoprotein lipase at the cellular level. This could effect metabolism of lipoprotein and lead to an increase uptake of triglyceride by the adipose tissue [20]. Meditation is believed to bring about a stable autonomic balance and improve biochemical and hormonal profile [21].

Yoga exercise also increases regression and retards progression of atherosclerosis in patients with severe coronary artery disease. Lipid lowering and plaque stabilizing effects of yoga exercise seem to be similar to that of statin drugs (HMG COA reductase inhibitors). Statin activity is associated with the increased production of nitric oxide in the vascular endothelium, which has local vasodilator properties in addition to anti atherogenic, anti proliferative and leucocyte adhesion inhibiting effects. The regular practice of yoga has shown to improve serum lipid profile in patients with known ischemic heart disease as well as in healthy subjects [22].

V. Conclusion

Based on our findings, it can be concluded that 3 months of yoga training has been found to be useful in improving serum lipid profile parameters and in reducing HR, SBP & DBP in mild hypertensives (stage I). Pharmacological interventions are always associated with unwanted side effects. Non pharmacological methods like yoga should be encouraged and incorporated in our daily lives for correcting dyslipidemia which is a modifiable risk factor for coronary heart disease.

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i. _____