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High sensitive CRP levels, Plasma renin activity and blood pressure among Hypertensive patients practicing Yoga exercises

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Abstract

Introduction: Numerous studies have shown an increase in the risk of cardiovascular morbidity and mortality with raised blood pressure above 130/90 mm Hg. Good control of hypertension is very important to prevent its complications. Few studies suggested that yoga practice lowers the levels of inflammatory markers like hs-CRP, IL-6 as well as plasma renin levels, and blood pressure in hypertensive patients. Aim of the present study was to assess the changes in high sensitive CRP levels, plasma renin activity and blood pressure among hypertensive patients practicing yoga exercises.

Materials and Method: Forty five hypertensive patients involved, were subjected for six months of yoga exercises. Blood pressure, plasma renin and high sensitive CRP levels were estimated before the starting and at the end of six months study period. The data obtained were analyzed using MedCalc Statistical Software version 12.7.8 with t-test for paired data and P value was considered significant below 0.05.

Results: There was statistically significant decrease in both systolic as well as diastolic blood pressure and hs-CRP with $p<0.05$, however no significant change was observed in plasma renin activity.

Conclusion: Six months of yoga practice has significant effects by causing decrease in both systolic as well as diastolic blood pressure and hs-CRP, but no change was observed in plasma rennin activity and hence yoga can be used as adjunctive treatment with drug therapy.

Keywords: Yoga, High sensitive CRP levels, Plasma renin activity and Blood pressure.

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Introduction

Hypertension or high blood pressure is one of the most important modifiable risk factors for cardiovascular disease. It is an important public health problem in India, with rapidly increasing prevalence among urban and rural populations. Hypertension is estimated to account for about 10.8% of all deaths and 4.6% of all disability adjusted-life-years (DALYs) in India. In global context also, hypertension is estimated to be responsible for 9.4 million deaths.[1] Many pathophysiologic factors have been implicated in the genesis of essential hypertension: increased sympathetic nervous system activity, perhaps related to heightened exposure or response to psychosocial stress; overproduction of sodium-retaining hormones and vasoconstrictors; long-term high sodium intake; inadequate dietary intake of potassium and calcium; increased or inappropriate renin secretion with resultant increased production of angiotensin II and aldosterone; deficiencies of vasodilators, such as prostacyclin, nitric oxide (NO), and the natriuretic peptides.[2] Renin is produced from the juxta glomerular cells in the kidney. It acts on the angiotensinogen produced in the liver and converts it to angiotensin I. The latter is converted to Angiotensin II by the Angiotensin converting enzyme in the lung. Angiotensin II is a potent vasoconstrictor and acts on the angiotensin receptors. Both high as well as low levels of renin may be associated with hypertension.[3]

The activity of the renin-angiotensin-aldosterone system (RAAS) is directly related to overweight and sedentary lifestyles, both of which are associated with hypertension.[4] High-sensitive C-reactive protein (hs-CRP), interleukin 6 (IL-6) and interleukin 10 (IL-10) reflect the degree of inflammation in the body, and high levels of hs-CRP (≥2.78 mg/L) and IL-6 (≥3.19 pg/mL) have been associated with increased risk of hypertension, cardiovascular events and death.[5-9]

Yoga presents an effective method of treating hypertension that is nonpharmacologic and therefore there are no adverse effects and there are other valuable health benefits including decreasing the levels of oxidative stress in hypertensive patients.[10,11] Some studies suggest that yoga practice lowers the levels of hs-CRP and IL-6[6,12] and increases levels of anti-inflammatory proteins that in turn increases IL-10 levels.[13] Further yoga decreases levels of salivary cortisol,[14,15] blood glucose,[16,17] as well as plasma rennin levels, and 24-h urine nor-epinephrine and epinephrine levels.[18]

Even though many studies have been conducted to assess the effects of yoga on various types of inflammatory markers and hormones, many of these studies are limited by lack of controls and varied types, intensities, and durations of yoga protocols used,

making it difficult to compare and interpret results, hence the present study is focused in particularly assessing the changes in high sensitive CRP levels, plasma renin activity and blood pressure among hypertensive patients practicing yoga exercises.

Materials and Method

The present interventional study was conducted from November 2015 to January 2017 in Department of Physiology, Dr. B R Ambedkar Medical College, Kadugondana Halli, Bangalore and Sakaria hospital and Yoga Centre, Bangalore, India. Ethical clearance was obtained from institutional ethics committee, Dr. B R Ambedkar Medical College, Kadugondana Halli, Bangalore, India and written consent was obtained from the participants and were informed of their right to withdraw anytime during the course of the study.

Inclusion criteria:

1. Hypertensives aged between 40-55 years.
2. No past history of any chronic illness

Exclusion criteria:

1. Type 2 DM patients.
2. Cardiovascular disease.
3. Hypothyroidism & hyperthyroidism.
4. Primary aldosteronism.
5. Renal artery stenosis
6. Nephropathy
7. Bacterial and viral infections

Sample size was determined by considering a mean beneficial difference in SBP of 5 mmHg between the yoga and control group, a standard deviation of 6 mmHg and a drop-out rate of 10 %, and standard normal variate of 0.84 for power of 80% and standard normal variate of 1.96 at 5% type I error. The data obtained was analyzed using MedCalc Statistical Software version 12.7.8 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2014) and parametrically distributed variables were expressed as means ± standard deviations, and non-parametrically distributed variables were expressed as medians and inter quartile ranges, t-test for paired data was used and P value was considered significant below 0.05.

Study protocol: Forty five hypertensive patients (male-26, female-19) were selected based on inclusion and exclusion criteria as mentioned above. Patients were matched with regard to age, weight, height, blood pressure levels, high sensitive CRP and plasma renin levels at Sakaria Hospital, Bangalore, India. All the patients were instructed to regularly monitor blood pressure and continue medications. The yoga group were taught yoga and pranayama for 6 continuous months, 1 hour every day by yoga expert in the morning between 7.00 am and 8.00 am and 8.00 am to 9.00 am in two batches as per the time/batch chosen by the patients.

Protocol of yogic practices and pranayama used in the present study:

1. **Yogasanas:** Loosening exercise, Makarasana, Tadasana, Trikonasana, Veerasana, Ardhakati Chakrasana, Vakrasana, Matsysana, Makarasana, shavasana.
2. Meditation.
3. **Pranayama:** Seethakari, Seethali, Bhramari Pranayama, Chandranadi Pranayama

Protocol of measurement of blood pressure, high sensitive CRP, and plasma rennin activity used in the present study: The patients were asked to avoid from heavy physical activity for 24 hours and from consumption of alcohol and caffeinated beverages for 12 hours prior to the measurements. The temperature of the laboratory was maintained between 25°C-28°C. The patients were asked to void urine before testing and made to sit in the laboratory comfortably to accustom to the new environment. First palpatory and Auscultatory blood pressure was measured after subject had been sitting quietly for 10 minutes. The mean of three consecutive measurements with a maximum variation of 4 mmHg of both systolic and diastolic blood pressures was accepted.[4] Blood test for plasma renin activity (ng/ml/hr) was done after 2 hours of standing,[4] early in the morning after an overnight fast of 12 hours using ELISA and high sensitive CRP was measured using laser nephelometry – Nephelostar Plus, a laser-based microplate nephelometer, BMG LABTECH, Germany with sensitivity down to 0.04 mg/L. Both plasma renin and high sensitive CRP levels were estimated before the starting and at the end of six months study period. All the data recorded were entered into master excel chart.

Drop outs: During the course of the study, out of 45 patients involved, 4 of them dropped out due to personal reasons.

Results

Table: Comparison of baseline parameters and after six months of yoga practice among patients

Parameter	Yoga group (before) n= 41	Yoga group (after) n= 41
Age(years)	44.46±6.66	-
Height(cms)	166 ±3.58	-
Duration of hypertension (years)	5.047±2.12	-
Weight(Kg)	73.20±6.56	70.24±6.57*
SBP (mmHg)	143.65± 7.68	132.42± 5.01**
DBP (mmHg)	94.45 ± 6.89	83.85 ± 3.89**
PRA((ng/ml/hr)	0.98(0.78-	0.87(0.68-

	1.86)	1.89)
hs-CRP (mg/L)	4.56 ±3.4	2.4± 2.34*

*P< 0.05, ** P < 0.01, PRA – plasma renin activity, hs-CRP -High sensitive CRP

Discussion

The present study indicated that there was statistically significant decrease in both systolic as well as diastolic blood pressure and hs-CRP with p<0.05, however no significant change was observed in plasma renin activity. Selvamurthy W conducted a study on 20 male patients of Essential Hypertension (EH) in order to explore the possible role of baroreflex mechanism in the etiology of Essential hypertension and also to find out whether by restoration of baroreflex sensitivity to normal level by yogic postural exercise (Yogic asanas), the EH could be cured or controlled found significant reduction in blood pressure.[18] McCaffrey R conducted a study among hypertensive patients in Thailand and found there was significant decrease in both systolic and diastolic blood pressures[19] and Damodaran A found that yoga significantly helped in modifying cardiovascular risk profile by decreasing heart rate and systolic and diastolic blood pressures among middle aged men and women.[20] Study conducted in Sweden including adult hypertensive patients who underwent 12 weeks of Kundalini yoga practice found that yoga practice could reduce levels of inflammatory factors such as hs-CRP and IL-6.[21] Concordant findings were found by Kiecolt-Glaser JK[22] and Agte VV.[23] In study involving 130 heart failure patients at Puducherry showed that yoga therapy in addition to standard medical therapy reduces blood pressure, load on heart and improves parasympathetic activity in heart failure patients.[24] The mechanism of increased vagal tone by yoga exercise may be due to reduction of angiotensin II. Angiotensin II is known to inhibit cardiac vagal activity.[25] Exercise like yoga training suppresses Angiotensin II expression.[26] Studies have shown plasma renin activity levels were lower in athletes than in untrained individuals or non-athletes and sedentary individuals. These findings were suggest that athletes with lower plasma renin activity would have lower angiotensin II and higher associated levels of cardiac vagal activity. Nitric oxide may also play a role in increasing cardiac vagal control and may indirectly inhibit sympathetic influences.[27] Exercise training has been found to improve endothelial function and Nitric oxide bioavailability, hence indirectly reduces sympathetic activity.[28,29] Pranayama or voluntary slow deep breathing and exercises reset the ANS (autonomic nervous system) through stretch induced inhibitory signals and hyperpolarization currents propagated through both neural and non-neural tissue which synchronizes neural elements in the heart, lungs, limbic system and cortex. During inspiration, stretching of lung tissue produces inhibitory signals by action of slowly adapting stretch receptors and hyperpolarization current by action of fibroblasts. Both inhibitory impulses and hyperpolarization current synchronize neural elements leading to the modulation of the nervous system and decreased metabolic activity i.e., parasympathetic state.[30] In a study conducted by Michaels RR with intervention of 20--30 min of meditation evaluating the hormonal response to transcendental meditation, found no changes in renin and aldosterone levels, but these mediators were less responsive to acute stress.[31] Study conducted by Deepa T involving 30 hypertensive patients found significant fall of mean blood pressure after 3 months of yoganidra (P< .01, significant) and suggested that yoganidra can be used as adjunctive treatment with drug therapy on mild and moderate essential hypertensives.[32] In a study conducted by Bruno Martinelli involving twenty hypertensive patients with BMI greater than 25 kg/m^2 found that the aerobic exercise training failed to reduce plasma renin activity in overweight hypertensive patients.[4]

Conclusion

Six months of yoga practice among hypertensive patients has significant effects by causing decrease in both systolic as well as diastolic blood pressure and hs-CRP, but no significant change was observed in plasma rennin activity and hence suggesting that yoga can be used as adjunctive treatment with drug therapy.

Limitations of present study

1. Diet was not considered and differences in salt intake could alter the results.
2. Drug treatment was not monitored.
3. Other inflammatory markers like, interleukin 6 (IL-6) and interleukin 10 (IL-10) were not estimated.

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Conflict of Interest: Nil

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