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Effect of yoga on heart rate and blood pressure and its clinical significance

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ABSTRACT

The cardiovascular morbidity is increasing in India in recent years. The present study was done to know the effect of yoga on heart rate and blood pressure in healthy volunteers above the age of 40 years. The cardiovascular status of the subjects was assessed clinically in terms of resting heart rate and blood pressure before the start of yoga practice and again after 6 months of yoga practice. The results were compared and analysed with respect to age, sex and body mass index. From the study it was observed that significant reduction in the heart rate occurs in the subjects practicing yoga ($P < 0.001$). The systolic blood pressure was lowered to a highly significant level ($P < 0.001$). The diastolic blood pressure was reduced significantly ($P < 0.001$). This shows that the yoga provides significant improvement in ageing to reduce the morbidity and mortality from cardiovascular diseases.

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1. Introduction

The word yoga is derived from its Sanskrit origin "YUJ" which means "to bind", "to join" or "to apply". In the words of Maharshi Patanjali, "yoga is the restraint of the process of the mind". Yoga has been extensively studied for the beneficial effects on human health [1,2]. Yoga is practiced all over the world. It produces consistent physiological changes and have sound scientific basis [3]. The cardiovascular changes due to the process of ageing are being pre-poned ever since the past few decades [4].

Psychosocial stresses of our modern life precipitates various cardiovascular and other disorders by distorting basic neuro-endocrine mechanism. The psychosocial stresses activate limbic system and hypothalamus which controls the autonomic nervous system. When this system is stimulated, increase in output of both adrenaline and nor-adrenaline occur, both from sympathetic nerve fibres as well as from adrenal medulla causing increase in heart rate, systolic and diastolic blood pressures. Chronic exposure to psychosocial stimuli will result in the development of increase in blood pressure, coronary thrombosis and heart failure. In addition to the activation of sympatho-adreno-medullary system, exposure to psychosocial stresses also activates the

hypothalamus centre governing pituitary adrenal axis. An increased secretion of corticotrophin releasing hormone from hypothalamus. This hormone releases stimulates the release of adrenocorticotrophic hormone from anterior pituitary which in turn stimulates adrenal cortex. The psychosocial stressful situation activates hypothalamo-pituitary-adrenal gland axis, glucocorticoid and aldosterone levels increase in the plasma causing salt and fluid retention which increases blood volume and blood pressure imposing severe strain on the heart. The harmful effects of these stresses on bodily systems can be reduced effectively eliminated by enhancing the adaptive mechanisms of our body that can restore the equilibrium. By giving rest to the mind and body, yoga can shake off many disorders of psychosocial origin.

The present study however was under taken to ascertain whether yoga practice after 6 months has any effect on slowing the ageing changes in cardiovascular system, for reducing the morbidity and mortality from cardiovascular diseases

2. Materials and Methods

50 healthy volunteers above the age of 40 years (20 females and 30 males) performing yoga regularly were included in the study. All the volunteers were clinically examined to rule out any systemic diseases. The study protocol was explained to the subjects and written consent was obtained. The same subjects were chosen as both study and control group in order to minimize the confounding factors. Before recording the parameters, the

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subject was asked to relax physically and mentally for 30 minutes. The blood pressure was recorded with the sphygmomanometer in supine position in the right upper limb by auscultatory method. Similarly, three readings were taken at an interval of 15 minutes each and average of the three values calculated. ECG was recorded by an ECG machine (108 T, BPL) using standard chest and limb leads. Heart rate was calculated from the tracings. Each ECG was reported by trained physician. The subjects were trained under the guidance of a certified yoga teacher. They carried out yoga for 6 months for 1 hour daily between 6 am and 7 am.

Asanas : literally means “a posture”. The asanas can be performed in any place but they should be done with an empty stomach. Some of the common asanas performed in different postures are as follows

Standing

- 1.Vrikshasana
- 2.Trikonasana
- 3.Suryanamaskara

Sitting

- 1.Vajrasana
- 2.Baddhakonasana
- 3.Shashankasana
- 4.Parvatasana

Prone

- 1.Bhujangasana
- 2.Dhanurasana
- 3.Makarasana

Supine

- 1.Pavanamuktasana
- 2.Matsyasana
- 3.Chakrasana
- 4.Sarvangasana
- 5.Halāsana
- 6.Shavasana

Pranayamas: literally means “control of prana, in Indian philosophy, refers to all forms of energy in the universe”. Life force is one part of this energy. Life force, in an individual, is symbolized by breathing. That's why pranayama is generally considered to mean regulated breathing. Few varieties of pranayama are

- 1.Bhastrika
- 2.Kapalabhati pranayama
- 3.Nadishuddi
- 4.Anuloma viloma pranayama

Meditation: The meditation is the method of extending our ordinary consciousness and thereby discovering more about ourselves. When we gain this insight, we can change our habits and our deeper, inner personality has a better chance to show through. Our whole life changes for the better. Meditation is the technique of turning down the brilliance of the day so that the subtle sources of energy can be perceived within.

The session was concluded by rajayoga meditation and finally shavasana. The cardiovascular status of each subject, after 2, 4 and 6 months of yoga practice was assessed clinically in terms of blood pressure and heart rate recordings. Statistical analysis was done by paired and unpaired t test.

3. Results

Fifty subjects who practiced yoga for 6 months regularly were analysed for the results. The results obtained are expressed as Mean \pm SD.

As depicted in Table-1 Time interval-related cardiovascular changes shows following results.

Table 1. Time interval-related cardiovascular changes

| Variable | Before yoga | After 2 months of yoga | P value | After 4 months of yoga | P value | After 6 months of yoga | P value |
|-----------------------|------------------|------------------------|----------|------------------------|----------|------------------------|----------|
| Heart rate (bts/min.) | 77.8 \pm 4.8 | 77.1 \pm 5.0 | <0.01* | 73.5 \pm 5.0 | <0.001** | 71.3 \pm 5.2 | <0.001** |
| SBP(mmHg) | 131.4 \pm 10.2 | 130.3 \pm 9.9 | <0.001** | 126.4 \pm 9.8 | <0.001** | 123.5 \pm 9.9 | <0.001** |
| DBP(mmHg) | 85.6 \pm 6.8 | 85.02 \pm 6.7 | <0.01* | 81.8 \pm 6.8 | <0.001** | 79.6 \pm 7.3 | <0.001** |
| Weight(Kg) | 64.1 \pm 10.7 | - | - | - | - | 62.2 \pm 9.9 | <0.001** |

** Highly significant

* Significant

Table 2. Age-related cardiovascular changes

| Variable | Age group (Yrs) | Before yoga | After 6 months of yoga | P value |
|-----------------------|-----------------|--------------|------------------------|----------|
| Heart rate (bts/min.) | < 50 | 77.8 ± 5.2 | 70.5 ± 5.5 | < 0.05* |
| | > 50 | 77.7 ± 4.1 | 72.5 ± 4.5 | |
| SBP(mmHg) | < 50 | 129.1 ± 10.7 | 120.6 ± 10.3 | <0.20 |
| | > 50 | 134.9 ± 8.4 | 127.9 ± 7.5 | |
| DBP(mmHg) | < 50 | 84.5 ± 7.3 | 77.4 ± 7.6 | <0.001** |
| | > 50 | 87.2 ± 5.8 | 83.0 ± 5.5 | |
| Weight(Kg) | < 50 | 64.6 ± 11.6 | 62.1 ± 10.7 | <0.01* |
| | > 50 | 63.2 ± 9.3 | 62.4 ± 8.8 | |

** Highly significant

* Significant

3.1.Heart rate:

Mean resting heart rate before yoga practice was 77.8 ± 4.8 . It reduced significantly to 77.1 ± 5.0 after 2 months of yoga practice. After 4 months, there was further highly significant reduction in resting heart rate to 73.5 ± 5.0 . The heart rate reduced further to a highly significant level of 71.3 ± 5.2 after 6 months of yoga practice

3.2.Systolic BP:

The mean systolic blood pressure before yoga practice was 131.4 ± 10.2 . After 2 months, of yoga practice, systolic blood pressure reduced to 130.3 ± 9.9 . After 4 months, there was highly significant reduction in the systolic blood pressure to 126.4 ± 9.8 . The systolic blood pressure reduced further to a level of 123.5 ± 9.9 after 6 months of yoga practice which is highly significant.

3.3.Diastolic BP:

The mean diastolic blood pressure before yoga practice was 85.6 ± 6.8 . After 2 months, of yoga practice, diastolic blood pressure reduced to 85.2 ± 6.7 . After 4 months, there was highly significant reduction in the diastolic blood pressure to 81.8 ± 6.8 . The diastolic blood pressure reduced further to a level of 79.6 ± 7.3 after 6 months of yoga practice which is highly significant.

3.4.Weight:

The mean weight before yoga practice was 64.1 ± 10.7 which reduced to 62.2 ± 9.9 after 6 months of yoga practice which is statistically highly significant.

As depicted in Table-2 Age-related cardiovascular changes shows following results--

3.5.Heart rate:

After 6 months of yoga practice, in the age group of < 50 years, the resting heart rate reduced from 77.8 ± 5.2 to 70.5 ± 5.5 ; where as in the age group of > 50 years, heart rate decreased from 77.7 ± 4.1 to 72.5 ± 4.5 .

The difference in response between these two groups was significant [$p < 0.05$].

3.6.Systolic BP:

After 6 months of yoga practice, in the age group of < 50 years the resting systolic blood pressure reduced from 129.1 ± 10.7 to 120.6 ± 10.3 ; in the age group of > 50 years the systolic blood pressure decreased from 134.9 ± 8.4 to 127.9 ± 7.5 .

Although, more response is seen in < 50 years age group clinically, the difference in response between these two groups was not statically significant.

3.7.Diastolic BP:

After 6 months of yogic practice, in the group of < 50 years the resting diastolic blood pressure reduced from 84.5 ± 7.3 to 77.4 ± 7.6 ; whereas, in the age group of > 50 years the diastolic blood pressure decreased from 87.2 ± 5.8 to 83.0 ± 5.5 . The difference in response between these two groups was highly significant ($p < 0.001$), the response being better in the age groups of < 50 years.

3.8.Weight:

The reduction in weight was compared between two groups age < 50 years and age > 50 years, it was found that after 6 months of yoga practice, in the age group of < 50 years, the weight reduced from 64.6 ± 11.6 to 62.1 ± 10.7 ; where as in the age group of > 50 years the weight reduction was from 63.2 ± 9.3 to 62.4 ± 8.8 . The difference in response these two groups is significant, the response being more in the age group of < 50 years.

4.Discussion

The mean values of heart rate, systolic blood pressure and diastolic blood pressure are highly significant reduction after 6 months of yoga practice.

Reduction in heart rate and blood pressure indicate a shift in the balancing components of autonomic nervous system towards the parasympathetic activity which was reported by Santha Joseph et al [5] and Anand BK et al [6]. This modulation of autonomic nervous system activity might have been brought about through the conditioning effect of yoga on autonomic functions and mediated through the limbic system and higher areas of central nervous system was reported by Selvamurthy et al [7].

Regular practice of yoga increases the baroreflex sensitivity and decreases the sympathetic tone, thereby restoring blood pressure to normal level in patients of essential hypertension was reported by Vijaya Lakshmi et al [8]. Meditation by modifying the state of anxiety reduces stress - induced sympathetic over activity thereby

decreasing arterial tone and peripheral resistance, and resulting in decreased diastolic blood pressure and heart rate. This ensures better peripheral circulation was reported by Bhargava et al [9] and blood flow to the tissues reported by Gopal et al [10]. The present study also revealed the significant response in subjects with BMI of >25. This may suggest that yoga is more effective in reducing the basal heart rate and blood pressure in morbid conditions like obesity. The study also revealed a highly significant reduction in weight after 6 months of yoga. Similar findings were reported by Udupa et al [11].

4.1. Clinical significance of yoga in various disorders

1. Hypertension [12]: Meditation has been shown to reduce systolic and diastolic pressures of hypertensive patients in several studies. Some of the asanas useful for hypertension are Padmasana, Vajrasana, Halasana, Shavasana and Paschimottasana.

2. Coronary artery disease [13, 14]: Long term changes in life style involving yogic exercises and stress reduction techniques led to angiographically demonstrable reduction in coronary stenosis in patients having coronary artery disease. Asanas are useful are padmasana, Matsyasana, paschimottasana, sarvangasana, bhujangasana and shavasana.

3. Psychological disorders [15]: Asanas useful are paschimottasana, sarvangasana, halasana and shavasana.

4. Diabetes mellitus [1,3]: Pranayama and asanas like dhanurasana, sarvangasana, paschimottasana and halasana are effective in reducing the blood glucose level.

5. Bronchial asthma [1,3,16]: Yogic practices reduces the frequency of asthmatic attacks, reduces the requirement for medication and increases the peak expiratory flow rate. Some of the useful asanas are bhujangasana, sarvangasana, paschimottasana and pranayama.

6. Orthopaedic problems [1,3,16] : Yogasanas have been used for orthopaedic problems such as cervical spondylosis, backache and also for muscle spasm. Asanas useful are sarvangasana, halasana, bhujangasana, matsyasana and dhanurasana.

In the present study, a highly significant reduction in heart rate and blood pressure is seen only after 6 months of yoga indicating that a prolonged practice shows a better response. A significantly higher response is seen in the age group of < 50 years showing that practice of yoga at younger age is more beneficial before the cardiovascular changes, due to the process of ageing have set in.

5. Conclusion

Non-pharmacological methods like yoga, meditation, diet, weight reduction and life style modification should be encouraged to control the modifiable risk factors. The cardiovascular parameters alter with age, but these alterations are slower in persons ageing with regular yoga practice.

It can thus be concluded that these results and their explanations would justify the incorporation of yoga as part of our life style in prevention of age-related cardiovascular complications.

“In a tension-filled society, yoga, pranayama and meditation alone will bring solace from all problems and hence they are the essence of life”.

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