Autonomic Functions In Raja-yoga Meditators

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Abstract

Stress, an inevitable and constant feature throughout the lifetime, induces autonomic dysfunctions, for which meditation is considered to be an antidote. So the case control study was planned including 50 Raja-yoga meditators practicing meditation for 5 years and 50 age matched non-meditators. Autonomic function tests were performed and results were compared using the Student-t test. Mean values of resting HR, SBP and DBP were less in meditators. Galvanic Skin Response in meditators was significantly more (p<0.001). Mean increase BP response to Hand Grip Test and Cold Pressor Test was significantly less in meditators than non-meditators (p<0.001). Standing: Lying ratio, Valsalva ratio, Inspiration: Expiration ratio and 30:15 ratios were significantly increased in meditators than non-meditators. From the results, there was shifting of the autonomic balance to parasympathetic side in Raja-yoga meditators, which suggests its utility to combat the ill effects of stress.

Introduction

With the advent of modernization and mechanization today’s human being is subjected to far greater stress, strain and depression than before. As a result of which, it has taken toll on us by giving rise to various psychosomatic disorders. The remedial medicines used for these disorders are giving temporary relief. Yoga and meditation are one of the non pharmacological approaches to relieve stress and strain on long term basis (1, 2).

Meditation is considered as an antidote to the minds vulnerability to toxic emotions. Research on meditation has mostly focussed on changes that occur during the period of meditation compared with a resting condition (3, 4). All types of meditation claim to change everyday behaviour and the benefits of it are not restricted to the period of meditation practice (1).

Most of the studies on meditation have dealt with transcendental meditation, zen meditation and tantric yoga (4, 5). Raja yoga meditation is practiced widely
in India and has centres all over the world. It defines meditation as the highest state of consciousness in which the mind is fully relaxed even when the physical body is engaged in day to day work (6). This technique requires considerable commitment and involves concentrated thinking (3). The present study was designed to observe the effect of long term Raja Yoga meditation, on the autonomic functions.

Methods

The protocol for the case control study was approved by the Institutional Ethics committee. Hundred volunteers of either sex, between the age 25 to 45 years were selected. They were divided into 2 groups, meditators and non-meditators. The meditators were 50 in number, practising Raja yoga meditation every morning (7:30 am - 8:30 am) for more than 5 years, at the local Bramhakumari centre situated in Mahal, Nagpur. It was their daily practice and was under the guidance and supervision of the senior meditators. The Raja yoga Meditation was practiced in comfortable sitting posture with eyes open and gaze fixed on a meaningful symbol (light). At the same time they were actively thinking positive thoughts about a universal force pervading all over as light and peace (7).

The non-meditators were selected randomly from the non teaching staff of the Indira Gandhi Government Medical College, Nagpur who had never done any kind of meditation. All the volunteers were having similar dietary habits and working conditions.

After detail history and clinical examination those who were smokers, alcoholics, or suffering from any respiratory disease, hypertension, congenital or ischemic heart disease, chronic renal failure, diabetes, liver disease or taking medicine likely to alter the autonomic functions were excluded from the study. The objectives of the study were explained to the participants and their written informed consent was obtained. Equal numbers of men and women participants were included in each group. Menstrual history was taken for all women and they were investigated in their proliferative phase.

Anthropometric parameters like height and weight were measured. Body mass index (BMI) was calculated by the formula weight in Kg/height in meter squared. For assessment of autonomic functions all the participants were given appointment at 10 am in the physiology department. The investigations were carried out under similar conditions and by the same person. Resting blood pressure (BP) was recorded with the help of sphygmomanometer in the left arm in sitting (relaxed) position by auscultatory method. Three readings were taken at the time interval of 15 minutes and average was taken as the final reading. Resting heart rate was obtained from ECG recorded with the help of 16 channel computerised polygraph (PHYSIOPAC pp-4, Medicaid system, Chandigarh, India).

Autonomic assessment was done with the battery of tests for sympathetic functions and for parasympathetic functions (8).

Sympathetic function tests

1. Galvanic skin resistance (GSR): It was recorded using two silver chloride disc electrodes filled with electrode jelly placed at 4 cm apart on palmer surface of right hand. GSR values were sampled continuously at 20 sec interval (3). The value after one minute was noted which was calculated automatically by the computerised polygraph.

2. Handgrip test (HG): The participant was asked to hold the handgrip dynamometer (Medicaid system, Chandigarh) in the dominant hand and press it with maximum effort. The tension developed was measured. The procedure was repeated three times and the average was taken which was the maximum isometric tension (Tmax).Then the subject was asked to maintain 30% of the Tmax for 3-5 minutes. BP was recorded from the non exercising arm every 30 sec before the release of handgrip. Maximum increase in BP before the release of handgrip was noted (9).

3. Cold pressor test (CP): It was done as one of the last test because of its unpleasantness. The
participant was asked to immerse his hand for 1 minute in cold water maintained at 4-6°C and BP was measured from the other arm at the end of 1 minute (10, 11, 12).

Parasympathetic function tests:

1. Standing: lying ratio (S/L ratio): The participant was asked to stand quietly and then lie down without any support. Continuous electrocardiogram (ECG) was recorded in lead II from 20 beats before and 60 beats after lying down with the help of computerised polygraph. A mark was made to indicate the point at which the subject started to lie down. The individual RR intervals were measured from the ECG and the results expressed as (9).

\[
\text{Standing : lying ratio} = \frac{\text{longest R – R interval during 5 beats before lying down}}{\text{shortest R – R interval during 10 beats after lying down}}
\]

2. 30:15 Ratio: The participant was asked to lie supine for 15 min. Then he was asked to stand up and remain motionless for 1 to 3 minutes. Continuous ECG was recorded in lead II. The ratio was calculated as (9).

\[
30:15 \text{ ratio} = \frac{\text{longest R – R interval 30 beats after standing}}{\text{shortest R – R interval 15 beats after standing}}
\]

3. Valsalva ratio (VR): The participant was informed to sit comfortably. Then he was asked to blow out in the rubber tube of mercury manometer (40 mm test) and maintain the pressure of 40 mmHg for 15 seconds. A continuous ECG was recorded one min before the strain, during the strain and 45 seconds following the strain release. Valsalva ratio was calculated as (9).

\[
\text{Valsalva ratio} = \frac{\text{longest R – R interval after the strain}}{\text{shortest R – R interval during the strain}}
\]

4. Expiration: Inspiration ratio (E/I ratio): In the sitting position, the participant was asked to breathe deeply at the rate of 6 breaths/min allowing 5 sec each for inspiration and expiration. Continuous ECG was recorded during this period and the ratio was calculated as (9).

\[
\text{Expiration : Inspiration ratio} = \frac{\text{longest R – R interval during expiration}}{\text{shortest R – R interval during inspiration}}
\]

Statistical methods:

The data was analysed to obtain the arithmetic mean for age, height, weight, BMI, systolic and diastolic BP, heart rate, GSR, S/L ratio, 30:15 ratio, valsalva ratio and E/I ratio. Difference in the mean values was subjected to students-t test. Sample size was calculated using the formula for difference of means. Power of the study was 80% and significance level was set as p<0.05.

Results

Meditators and non-meditators did not show statistically significant difference in the mean values of physical characteristics such as age, height, weight and BMI as shown in Table I.

The mean values of resting cardiovascular parameters like heart rate (p<0.01), systolic blood pressure (p<0.01) and diastolic blood pressure (p<0.05) were significantly less in meditators than in non-meditators as shown in Table II.

Sympathetic system assessment showed significant increase in GSR in meditators than non-meditators (p<0.001). The blood pressure response to handgrip test showed less rise in systolic BP in meditators than in non-meditators with p<0.001. Diastolic blood

| TABLE I : Physical characteristics of meditators and non-meditators. |
|----------------- |----------------- |----------------- |----------------- |----------------- |
| Parameters      | Non-meditators  | Meditators      | Z value         | P value         |
|                 | (n=50)          | (n=50)          |                 |                 |
|                 | (Mean±SD)       | (Mean±SD)       |                 |                 |
| Age (years)     | 35.82±5.21      | 37.42±5.58      | 1.48            | > 0.05          |
| Ht (meters)     | 1.57±0.06       | 1.55±0.06       | 0.67            | > 0.05          |
| Wt (kg)         | 56.34±9.12      | 55.44±8.64      | 0.10            | > 0.05          |
| BMI (kg/m²)     | 22.98±3.66      | 22.07±2.36      | 0.38            | > 0.05          |

p>0.05 non significant, Ht: Height, Wt: Weight, BMI: Body mass index.
Discussion

Resting cardiovascular parameters

The values for resting HR, SBP and DBP were significantly lower in Raja-yoga meditators. This could be because dominance of parasympathetic over sympathetic system in meditators. The findings of our study are similar to those by other researchers (2, 3, 13-15).

Meditation by reducing the anxiety levels minimizes the sympathetic hyperactivity induced by stress. Decreased sympathetic activity causes decrease in the catecholamine secretion which leads to peripheral vasodilatation and improvement in peripheral circulation (15) resulting in decrease in DBP. Regular yogic practices also reduces basal metabolic rate and resting oxygen consumption (16). All these factors decrease work load on the heart leading to decrease in heart rate leading to decreased cardiac output and hence the systolic blood pressure.

Sympathetic Functions

The GSR was significantly increased in meditators than in non-meditators (P<0.001). Other studies also showed similar results (3, 4, 19, 18). Decrease in skin resistance is a sign of increased sympathetic tone (9). Thus the significant increase in GSR in meditators observed in present study as compared to non-meditators support the explanation that the sympathetic activation in meditators in response to stress was lesser due to changes attributed to head ganglion of autonomic nervous system by regular practice of meditation.

Table II: Mean values of resting cardiovascular parameters in meditators and non-meditators.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Non-meditators (n=50)</th>
<th>Meditators (n=50)</th>
<th>Z value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resting HR (bpm)</td>
<td>81.28±7.19</td>
<td>77.55±6.58</td>
<td>2.71</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Systolic BP (mmHg)</td>
<td>111.36±13.28</td>
<td>105.64±8.27</td>
<td>2.59</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td>73.96±8.09</td>
<td>70.36±6.92</td>
<td>2.39</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Table III: Mean values of sympathetic parameters in meditators & non meditators.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Non-meditators (n=50)</th>
<th>Meditators (n=50)</th>
<th>Z value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSR (kΩ)</td>
<td>314.6±161.75</td>
<td>881.88±370.98</td>
<td>9.91</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Rise in SBP during HGT (mmHg)</td>
<td>23.48±11.87</td>
<td>17.08±5.19</td>
<td>3.49</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Rise in DBP during HGT (mmHg)</td>
<td>21.56±6.99</td>
<td>16.2±4.80</td>
<td>4.47</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Rise in SBP during CPT (mmHg)</td>
<td>16.84±7.45</td>
<td>13.88±5</td>
<td>2.33</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Rise in DBP during CPT (mmHg)</td>
<td>13.04±4.35</td>
<td>10.32±2.59</td>
<td>3.80</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table IV: Mean values of parasympathetic parameters in meditators and non-meditators.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Non-meditators (n=50)</th>
<th>Meditators (n=50)</th>
<th>Z value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/L ratio</td>
<td>1.07±0.11</td>
<td>1.19±0.15</td>
<td>4.56</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>30:15 ratio</td>
<td>1.12±0.11</td>
<td>1.18±0.08</td>
<td>3.12</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>valsalva ratio</td>
<td>1.14±0.14</td>
<td>1.33±0.24</td>
<td>4.84</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>E/I ratio</td>
<td>1.27±0.17</td>
<td>1.41±0.18</td>
<td>4.00</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

p<0.05: significant, p<0.01: highly significant, p<0.001: very highly significant, S/L: standing/lying, E/I: expiration/inspiration.

Assessment of parasympathetic system showed that S/L ratio, valsalva ratio & E/I ratio were significantly higher in meditators than non-meditators (P<0.001). The 30:15 ratio also showed significant increase in meditators than non–meditators (p<0.01) as shown in Table IV.
The results of Handgrip test are in accordance with the studies (21, 20, 16). Results of cold presser test can be compared with the findings of other researchers (2, 22). Under conditions of stress of either physical or psychological origin, there is activation of sympathetic nervous system. The cold presser response which consists of placing hand in ice cold water acts as a painful stimulus (23). Handgrip exercise is also characterised by increase in blood pressure and heart rate. (24) Meditation causes decreased sympathetic activity and increased vagal tone, these may be possible reasons for less increase in BP in meditators with HG and CP test.

Parasympathetic parameters

The increase in S/L, 30:15, VR and E/I ratio in meditators indicates increased parasympathetic activity in meditators than non-meditators. The findings of our study are matching with other studies (2, 14, 20, 25). Increased parasympathetic activity (20) and increased baroreceptor sensitivity (26) were attributed as possible mechanisms for the improvement of parasympathetic parameters in meditators by these researchers.

Thus from our study we can conclude that there is a better balance between the sympathetic and parasympathetic components of the autonomic nervous system in persons practising Raja yoga meditation daily for at least one hour for minimum 5 years. These changes might help an individual to combat stress in household and working environment and thereby reducing the related morbidity due to psychosomatic disorders. The simple and easy to practice method of meditation should be looked as an effective intervention and not merely a spiritual gesture or a relaxation technique.

References

20. Mourya M., Sood A. Mahajan, Singh NP, Jain AK. Effect


