A STUDY OF ELECTROENCEPHALOGRAM IN MEDITATORS

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Abstract: Electroencephalographic patterns were studied in 30 normal healthy individuals practicing meditation and compared with 10 normal healthy controls not practicing meditation. In this study, we found prominent alpha wave activity and increase it its voltage in meditators as compared to controls.

Meditators had significantly more alpha rhythm as compared to control group. Percentage of alpha waves were higher in persons performing meditation with good coherence which suggested good homogeneity, uniformity and increased orderliness of brain.

Key words: meditation EEG alpha waves

INTRODUCTION

Stress and strain of modern life can be reduced either by relaxing or by meditation. Relaxation can be done by sleep, seeing films, reading interesting novels, etc. However, the effect of such methods is short lived. Complete mental and physical relaxation is possible by ancient procedures e.g. Yogic meditation and transcendental meditation.

Several investigators have noted EEG changes in the normal adults practicing Yoga meditation. Das and Gasteut (1) recorded the fast frequency waves during deep states of meditation. Anand et al (2) pointed out prominence of alpha activity associated with absence of reaction of external stimuli to patients practicing Kriya Yoga meditation. Wallace (3) observed the appearance of Theta waves in frontal area during practicing of transcendental meditation. Banquet (4) studied spectral analysis of EEG in transcendental meditators. Kothari and Bordia (6) reported study on a Yogi during eight days confinement in a sealed underground pit. They studied EEG and ECG in this Yogi.

There are three major types of meditation:

1. Yogic meditation.
2. American transcendental meditation.
3. Zen meditation or Zazen.

Yogic meditation is a type of meditation where concentration is done and subsequently person goes into meditation, this is also called Yogic Kriya Yoga Meditation or Astyang Yoga Meditation. While transcendental meditation is a type of meditation which is of relaxation type
and is different from yogic meditation. In Zazen, attention is focussed on breathe or logically challenging riddle called a Kaon. All forms of meditation require physical immobility.

Studies therefore were undertaken to investigate Electoencephalographical activity of brain during yogic meditation and transcendental meditation. The present work has been the subject of preliminary presentation of EEG in two types of meditation at this centre.

METHODS

The study was conducted in 30 cases practicing meditation at M.G.M. Medical College, Indore. All cases were in age group ranging from 17 to 66 years and all were males. They were divided into two groups comprising of 15 cases in each group.

1. Meditator group
   i. Those practicing transcendental meditation. All were males (15 cases).
   ii. Those practicing yogic meditation. All were males (15 cases).

2. Control group
   Comprised of 10 cases of similar age and sex matched who were not meditating any time. Both the groups were taking vegetarian diet only. All meditators were doing their practice for a period of 3 months. The present study was performed in meditators as:
   i. EEG before meditation.
   ii. EEG during meditation.
   iii. EEG after meditation.

   Whereas in control group, EEG was taken before and during eye closed relaxation and after relaxation.

The examination during meditation included:

i. Electroencephalograms (EEG) were recorded with Grass Instrument Co. Quincy Mass (USA). Electroencephalograph model 8, manufactured by Grass Instrument Co. The EEG traces were recorded on ink paper. The skin electrodes were placed according to international 10–20 system at FP1, FP2, F3, F4, C3, P3, P4, O1, O2. Grass Instrument Company plated cup electrodes and EEG electrode cream was applied. Recording were bipolar.

The EEG, was analyzed for alpha frequency, alpha voltage, alpha percentage, alpha coherence and hemisphere symmetry in both control and meditative subjects.

EEG was studied by two different persons who were unaware of the subjects.

Planning was as follows:

1. Eye closed relaxation for 2 min and EEG was recorded during which eye open response was also noted.

2. During meditation EEG was recorded at every 5 min. interval while control were asked to relax as much as during this period (20 minutes).

3. Photic Stimulation response was also noted during meditation and control cases.

4. After the period of meditation was over, subjects were asked to relax for 2 min. and then eye open response was recorded.

EEG tracings were recorded on paper and then stored on analogue data on tape and they were converted to digital data by a system data computer. These digital data
### TABLE III: Showing alpha percentage in frontal area in cases (TM) and Controls and effect of meditation.

<table>
<thead>
<tr>
<th>Study group</th>
<th>Control</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± S.D.</td>
<td>Mean ± S.D.</td>
<td></td>
</tr>
<tr>
<td>Before R: 58.4 ± 24.04</td>
<td>33.00 ± 13.60</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>L: 61.58 ± 23.74</td>
<td>34.34 ± 19.35</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>During R: 68.78 ± 19.33</td>
<td>28.79 ± 28.49</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>L: 66.72 ± 19.66</td>
<td>28.16 ± 29.01</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

### TABLE IV: Showing coherence before and during meditation.

<table>
<thead>
<tr>
<th>Study group</th>
<th>Before</th>
<th>During</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± S.D.</td>
<td>'t'</td>
<td>'p'</td>
</tr>
<tr>
<td>Study group</td>
<td>12.79 ± 8.34</td>
<td>8.75 ± 5.65</td>
</tr>
<tr>
<td>Control</td>
<td>13.42 ± 5.35</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE V: Showing mean R/L alpha amplitude before and during meditation in TM and controls.

<table>
<thead>
<tr>
<th>Study group</th>
<th>Before</th>
<th>During</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meditators (TM)</td>
<td>0.844</td>
<td>0.876</td>
</tr>
<tr>
<td>Controls</td>
<td>1.027</td>
<td>1.003</td>
</tr>
</tbody>
</table>

3. In this study, there was no evidence of theta waves in meditator group as well as in control group.

4. **Eye opening response**: Meditators showed persistence of alpha waves after eye opening in 28.9% of cases, as compared to mean alpha wave 12.4% in control cases.

5. **Coherence**: In meditators good coherence was recorded during meditation. The interhemispheric time difference in alpha frequency was 12.79 ± 8.34 milliseconds which becomes 8.75 ± 5.65 indicating good coherence (Table IV).

6. **Hemispherical symmetry**: Right and left voltage ratio which was 0.844 before meditation became 0.876 during meditation. Which suggested good symmetry in both hemisphere (Table V).

7. **Photic stimulation**: No difference was observed in meditators and control group in EEG.

8. **Cardio-respiratory parameter**: Showed that pulse and heart rate slowed down in meditators groups. Respiratory rate also became less in group practicing meditation. Blood pressure showed fall of systolic blood pressure only. There was no change in diastolic blood pressure. ECG did not reveal any abnormal tracing in them.

**DISCUSSION**

The alpha waves are suggestive of increased relaxed state of mind. Alpha voltage in inversely related to mental activity. Increase in voltage is accompanied by decrease in the frequency which occurs due to decrease in brain activity. Desiraju (7) postulated that showing of alpha frequency is due to decreased energy metabolism of brain. In our study alpha activity was significantly higher in meditators. These results
are similar to those reported by Banquet et al (5).

EEG pattern which characterised sleep (High voltage slow wave pattern 12–14 cycles/sec.), sleep spindles and low voltage mixed frequency with or without rapid eye movements were not seen during meditation. After 6 to 7 hours of sleep high voltage slow wave activity was seen. Whereas only 5 to 10 minutes of meditation, alpha waves activity predominated in the electroencephalogram (10).

Alpha activity is produced in meditators by activation of diaphragmatic breathing than thoracic breathing. The breath becomes the object of awareness in most methods of meditation (8).

Wallace et al (3) found that those persons who practiced meditation can continue to exhibit alpha and theta waves after meditation period had ended. Our group also showed persistence of alpha waves after meditation (Table III).

The cortex of brain consists of two halves the left and right hemisphere. Speech, logical thinking, analysis and sense of time are thought to function in left hemisphere, while ability to recognize faces and comprehend maps and intuitive function is thought to function in right hemisphere.

Right hemisphere is also a centre for motor skills and spatial awareness (3).

Meditation leads to development of right hemisphere associated abilities (10). This has been further verified by several researchers and they found that EEG alpha and theta wave coherence is most marked in right hemisphere during meditation (9, 13, 15).

Our study also revealed good coherence in both hemispheres which is in accordance with above authors. A good coherence between two hemispheres represents the synchronization of logical with intuitive functions of brain (8). A significant finding that emerged from Banquet’s researches (5) was that brain wave patterns tend to synchronize during deep meditation to this phenomena of marked uniformity of frequency and amplitude in electrical activity from all areas of brain, Banquet gave the name of “Hypersynchrony”. According to him this may have something to do with feeling of pure awareness or consciousness (4, 5).

Meditator groups showed persistence of alpha waves after eye opening in 28.9% cases. Our observations are in conformity with Kras et al (11) who found that meditators experienced calm and alert state of mind which is maintained even during dynamic activity and there was increase in

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### TABLE VI: Showing comparison of beta percentage in frontal area in control and trancedental meditators.

<table>
<thead>
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<th>Control</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± S.D.</td>
<td>Mean ± S.D.</td>
</tr>
<tr>
<td>Before</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R:</td>
<td>41.42 ± 24.06</td>
<td>66.89 ± 13.52</td>
</tr>
<tr>
<td>L:</td>
<td>40.93 ± 22.12</td>
<td>64.45 ± 18.16</td>
</tr>
<tr>
<td>During</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R:</td>
<td>31.04 ± 19.46</td>
<td>71.31 ± 28.57</td>
</tr>
<tr>
<td>L:</td>
<td>30.63 ± 19.75</td>
<td>71.55 ± 29.00</td>
</tr>
</tbody>
</table>
alpha percentage in meditators even when eyes were open. In our study right and left hemispheric alpha voltage ratio which was 0.844 before meditation became 7.876 during meditation. Kiloh et al (12) found decrease in alpha activity on left side during performance of mental arithmetic. During act of meditation, there occur inter-hemispheric symmetry in alpha rhythm, which is found in our cases too.

In conclusion, we found that meditation enhance greater self-confidence, sense of well-being, empathy, improves cognitive function as evidenced by increased alpha wave activity and its synchronization. It also increases mental concentration and reduces susceptibility to stress and strain thus promotes complete health and well-being in an individual.

REFERENCES