Original Article

Effect of anapanasati meditation technique through electrophotonic imaging parameters: A pilot study

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ABSTRACT

Background: Mindfulness along with breathing is a well-established meditation technique. Breathing is an exquisite tool for exploring subtle awareness of mind and life itself.

Aim: This study aimed at measuring changes in the different parameters of electrophotonic imaging (EPI) in anapanasati meditators.

Materials and Methods: To carry out this study, 51 subjects comprising 32 males and 19 females of age 18 years and above (mean age 45.64 ± 14.43) were recruited voluntarily with informed consent attending Karnataka Dhyana Mahachakra-1 at Pyramid Valley International, Bengaluru, India. The design was a single group pre- post and data collected by EPI device before and after 5 days of intensive meditation.

Results: Results show significant changes in EPI parameter integral area with filter (physiological) in both right and left side, which reflects the availability of high functional energy reserve in meditators. The researchers observed similar trends without filter (psycho-physiological) indicating high reserves of energy at psycho-physiological level also. Activation coefficient, another parameter of EPI, reduced showing more relaxed state than earlier, possibly due to parasympathetic dominance. Integral entropy decreased in the case of psycho-physiological parameters left-side without filter, which indicates less disorder after meditation, but these changes were not significant. The study showed a reversed change in integral entropy in the right side without filter; however, the values on both sides with filter increased, which indicates disorder.

Conclusion: The study suggests that EPI can be used in the recording functional physiological and psychophysiological status of meditators at a subtle level.

Key words: Anapanasati meditation; electrophotonic imaging technique; gas discharge visualization; stress and health.

INTRODUCTION

Meditation is one of the well-known practices which bestows increased attention and deep internal relaxation.[1] There are different techniques of meditation to practice. Since 1960s several researches have been performed to observe the effect of meditation in practitioners versus nonpractitioners.[2,3] Anapanasati meditation is one of the meditation techniques discussed in Theravada School of Buddhism.[4] It is an initial part of Vipassana (psycho-physiological) meditation. It is a meditation in which one obtains mastery over one's unruly mind through objective observation of one's own natural and normal breath. In Pali literature, it is known as "anapanasati," which means awareness of one's own respiration. This practice of anapanasati meditation helps to sharpen the mind and to induce peace of mind to participants for the next step of Vipasana meditation. Vipassana means to observe things as they really are in their natural and true characteristics of impermanence.[5] Anapanasati meditation comes under the focused meditation category. In focused attention or concentrative styles of meditation, voluntary sustained attention is maintained on a given object, and attention is brought back to the object of attention when the mind wanders.[6,7] Meditator controls the contents of attention. In focused attention, the object of experience is sustained

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in awareness. Though the subject (experiencer) and object co-exists independently, they interact. Focused attention meditations when practiced over a prolonged period of time leads to "effortless" concentration. This automaticity results from long practice.[8] The practice of anapanasati meditation is based upon the great discourse on the Foundations of Mindfulness (Maha Satipatthana Sutta), which includes contemplation of the body, contemplation of feelings, contemplation of the mind, and contemplation of mental objects.[9]

Electrophotonic imaging

The measurement of electrophotonic imaging (EPI) is based on the electrical activity of the human organism. This activity is quite different in diseased condition of a human body as compared to the activity in a healthy body. The biophysical principles in the investigation of EPI technique are based on the ideas of quantum biophysics.[10] This method draws stimulated electrons and photons from the surface of the skin under the influence of a pulsed electromagnetic field. This process is well-studied through physical electronic methods and is known as "photoelectron emission."[11] EPI is being used in more than 63 countries.[12] It is important to note that this method of assessment is quite different from normal electrophysiological methods used in clinics, such as EKG and EEG. These terms are related to the electrical activity of the organs whereas EPI parameters are a measure of induced electron availability in organs.

The EPI effect occurs when an object is placed on a glass plate and stimulated with the high-frequency high-voltage; a visible glow occurs around the object, which is the gas discharge. This glow is quantifiable and reproducible for scientific research purposes. In a normal experiment, the fingertip images are collected individually and used for analysis. Images captured from all 10 fingers provide detailed information about the person's psychosomatic and physiological state.[13] Through investigation of the fingertip images, one can identify areas of energy congestion and overall health in the entire system. These fingertip images change dynamically with emotional and health states. Each captured fingertip image is analyzed through division into a number of sectors as per acupuncture meridian theory. The parameters related to the images captured under electrical stimulation create a neurovascular reaction of the skin, influenced by the nervous-humoral status of all organs and systems.[14] A specialized software complex registers these readings into parameters that elucidate the person's state of well-being at that time. It takes <5 min to obtain the images of 10 fingers and around 1 min to calculate parameters of EPI images, and <5 min to display and interpret the results.[15] EPI measurement is done in two ways; viz., with filter (physiological) and without filter (psycho-physiological). A filter is a thin plastic film placed between tip of the finger and a dielectric (glass) plate during test. The application of filter eliminates the sweat responses arising from sympathetic activities and gives only the response of parasympathetic activity. The quality and consistency of the fingertip images depend on the activity of the eccrine sweat glands when skin comes into contact with the surface of glass on electrophotonic impulse analyzer. These glands produce ionic sweat fluid that is associated with the activity of the sympathetic nervous system and determines the character of the discharge created around the fingertip.

A gap in a sector of fingertip image is indicative of possible energy imbalance in the organ concerned. Comparison of an electrophotonic image with filter (physiological) and without a filter (psycho-physiological) allows calculation of parameters having a high correlation with the level of stress in subjects. Thus, the EPI images without filter (psycho-physiological) reflect the person's current psycho-physiological state and EPI images with filter (physiological) reflect the body's somatic energy level.[14] There are three groups of images. The first group consists of Type-1, -2 and -3 images. Type-1 images are related to physically and psychologically stable healthy people. Type-2 images are produced from typically elderly people with unbalanced state of emotions at the psychosomatic and spiritual level. Type-3 images are associated with serious problems at the physical level with permanent stress which may lead to distress. Group-2 images are associated with severe health status ranging from different stages of diseases to mental problems. Group-3 images are least study. In available cases, it was found to be the terminal stage of cancer or cases wherein no interaction taking place between the patient and the environment.[13]

Electrophotonic imaging bioelectrographic systems have practical applications in several areas of research, such as medicine, sports, testing of liquids, water and materials.[16] In EPI measurements, the healthy individuals the average amplitude variations fall in the range 4.1–6.6%[17] while in EPI gram parameters of a metallic object, this range is 8–10%.[13] Thus, the electrophotonic emissions of the human body, referred to as EPI-grams, are fairly consistent and allow one to identify the functional state in an individual in real time.

Though meditation techniques have been studied extensively, the subtle energy changes have not been investigated so far. The current study attempts to measure such changes due to anapanasati meditation.

MATERIALS AND METHODS

To carry out this study, 64 volunteers were recruited from Pyramid Valley International, Bengaluru, India, attending

Karnataka Dhyana Mahachakra-1. Data of 13 subjects were excluded from the study after analyzing the finger image quality, sweat effect and outlier. Integral area (IA) values range from (−0.6 to + 1) which correspond to good health state. The present study focuses only on healthy subjects. Therefore, subjects who had values out of this range were excluded considering them as outliers. The remaining 51 subjects comprising 32 males and 19 females, age 18 years and above (mean age 45.64 ± 14.43) were included for this study. They practiced meditation for 3 h 30 min daily for 5 days; 2 h in the morning from 5 am to 7 am and in the evening from 7 pm to 8.30 pm consistently. The inclusion criteria were as follows: Healthy volunteers, age range between 18 and 65 years, both genders and willing to participate in the trial. Exclusion criteria consist of females during menstruation or during pregnancy, people with missing fingers or cut of fingers, subjects having smoked or taken alcohol on the day of measurement and people having any disease or on prescription drugs. The protocol was approved by the Institute Ethics Committee. Informed consent was obtained from all participants. Demographic information was collected to know their self-reported health status, age, and earlier meditation experience. During pre- and post-data collection, nostril dominance was also registered to account for possible effects of hemispheric dominance during analysis.

Data analysis

"Electrophotonic imaging-camera" instrument produced by "Kirlionics Technologies International," Saint-Petersburg, Russia (GDV camera Pro with analog video camera, model number: FTDI.13.6001.110310), along with R statistical packages (R Development Core Team, 2012) were used to collect data and process for statistical analysis, respectively. Parametric Paired *t*-test was used where a level of $P < 0.05$ was considered as statistically significant. Calculation of effect size was carried out using Cohen's d-test. Temperature and humidity were also measured (using a Hygrometer-Equinox, EQ 310 CTH) to account for the undue effect of atmospheric influence during pre- and post-data collection time. The recorded temperature during predata acquisition was 27.56 ± 1.27 C, taken three times at 2 h intervals and during postdata collection, the mean was 33.83 ± 0.47 C. Fluctuation of humidity during predata acquisition was 0.69 ± 0.1 and during post 0.35 ± 0.02, measured in percent, three times at 2 h intervals.

RESULTS

The present study showed significant changes in IA with filter (physiological) for both right ($P = 0.002$) and left-side ($P = 0.004$) of the body. The same decreasing trends were seen for without filter (psycho-physiological) but not significant. Positive decrease was observed in activation coefficient (AC), but this was not statistically significant. Integral entropy was reduced in without filter condition (psycho-physiological) only at the left-side showing less disorderliness in energy distribution in meditators. The increased change was observed in integral entropy in the left-side with filter (physiological). The values reduced in the right side with filter (physiological) and without filter (psycho-physiological) but these results were not statically significant. The influence of nostril dominance could not be found contributory to the results observed and hence brain hemispheric dominance effects are not considered important in these experiments. Table 1 shows pre- and post-values of AC, IA and integral entropy in meditators with filter (physiological). Table 2 shows pre- and post-values of IA and integral entropy in meditators without filter (psycho-physiological).

DISCUSSION

The effect of different meditation practices on various aspects of mental and physical health is receiving growing attention. Though scientists have been investigating meditation for a long time, there has not been a consensus about its definition. Diversity in the range of possible definitions reflects the vast number of different methods of meditation. Western definitions emphasize that meditation is a self-regulatory technique focused on maintaining one's attention. However, in the spiritual tradition, meditation is perceived as a tool for spiritual development, growth of inner peace, concentration, positive emotions such as selfless love and compassion, and reduction of negative emotions, such as fear and anger.[18]

It is envisioned that EPI measurement technique could provide finer details of psycho-physiological states in meditators. The comparison with an electrophotonic

Table 1: Pre- and post-values of activation coefficient, integral area and integral entropy in meditators (with filter)

Variable	Pre	Post	*t*	df	es	*P*
AC	2.80±0.90	2.65±0.94	0.85	50	0.12	0.40
IAWL	0.49±0.13	0.42±0.12	2.98	50	0.42	0.004**
IAWR	0.49±0.11	0.43±0.12	3.21	50	0.45	0.002**
IEWL	1.96±0.17	1.99±0.14	1.00	50	0.14	0.32
IEWR	1.95±0.14	1.97±0.14	1.02	50	0.14	0.31

*$P<0.01$. es = Effect size (Cohen's d), AC = Activation coefficient, IAWL = Integral area with filter left, IAWR = Integral area with filter right, IEWL = Integral entropy with filter left, IEWR = Integral entropy with filter right, df = Degree of freedom

Table 2: Pre- and post-values of integral area and integral entropy in meditators (without filter)

Variable	Pre	Post	*t*	df	es	*P*
IANL	0.18±0.19	0.15±0.19	1.06	50	0.15	0.29
IANR	0.16±0.21	0.13±0.19	0.86	50	0.12	0.39
IENL	1.87±0.22	1.86±0.17	0.22	50	0.03	0.83
IENR	1.89±0.18	1.91±0.20	0.64	50	0.09	0.52

es = Effect size (Cohen's d), IANL = Integral area, no filter left, IANR = Integral area, no filter right, IENL = Integral entropy, no filter left; IENR = Integral entropy, no filter right, df = Degree of freedom

image of a finger taken with and without plastic film filter allows calculation of parameters having a high correlation at the level of stress of the practitioner.[19] It has been widely speculated that long-term meditation training has a significant positive impact on neuropsychological functioning in both cognitive and affective domains.[6,20] Comparison of psycho-diagnostic data demonstrates the correlation between indices of voluntary attention, logic, memory, and focused thinking with EPI parameters of AC.[21] There is an increasing amount of literature suggesting that there are many areas which could be influenced through the practice of meditation. The most commonly studied topics include physiological, psychiatric, and psychological conditions (e.g., anxiety, depression, quality of life, or impact on ADL) or general medical conditions.[22] The present study also observed a reduction in AC which is associated with organism's involvement in stress adaptation; a reduction in AC shows more relaxed state after anapanasati meditation. It also observed quieting of the sympathetic system and activation of parasympathetic system during meditation practice as indicated by a shift from sympathetic to parasympathetic resulting in a decrease in physiological variables like heart rate, respiratory rate, systolic blood pressure, and diastolic blood pressure.[23] Thus, meditation reduces stress-induced sympathetic over-activity by modifying the state of anxiety.

Further, we observed decreased IA in meditators. IA is associated with overall health of organism with a normal range of -0.6 to $+1.0$.[13] However, it is likely reduction of IA observed in meditators could be due to reduced availability of electrons in the body. This in its turn depends on the reduction of free radicals in healthy meditators. Since radicals possess one unpaired electron, they are highly reactive and hence, may cause damage to cellular structures.[24] The presence of excess free radicals in the body is not a sign of good health. This supports the idea that increased free radicals increase rate of aging. Higher emission of photons is linked to higher oxidative stress within the body.[25] Moreover, meditation relaxes the subject and thereby decreases arterial tone, peripheral resistance, and metabolic rate.[26] Thus, it is also documented that free radical generation reduces due to meditation practice in response to reduced metabolic activities.[27] This may be another possible reason that IA decreased significantly. This reduction was seen in both physical and psycho-emotional levels. Hence, reduction pattern without filter (psycho-physiological) on both right and left sides in IA shows the impact of meditation at the psycho-physiological level possibly due to reduced redox reaction and reduced metabolic rate.

Integral entropy indicates the functional state of cell, organ and the entire human body. Decreased integral entropy without filter (on the left-side) in the study shows less chaos and disorderliness within the system in the subtle energy of meditators.[28,29] The same trend was expected at other three measurements also, namely, with filter (physiological) right and left sides, and without filter (psycho-physiological) right side in Integral Entropy. The mean values of these parameters were increased but not significantly. The most possible reason regarding this unexpected change may be due to increased atmospheric temperature[28,29] and fluctuation in humidity during postdata collection. Another possible factor may be the feeling of discomfort at the physical level due to 5 days of intense sitting in meditation. However, these hypotheses could not be tested.

This study is the first one to report changes in EPI parameters in meditators. The strength of this study can be summed up as follows: The trends in expected variables, possible use of EPI parameters for meditators and paves the way for planning a good research design to observe the usage of EPI parameters for detecting subtle mechanisms in meditators. Limitations of this study were no control over confounding variables such as temperature, humidity, and no medical screening before recruitment of subject except demographic information. Moreover, prior experience of meditation in some volunteers and long range of age were also limitations in the study.

Recommendations for future studies yet to be undertaken, should consider the following points: (a) For meditational studies, AC (stress parameter) and IA (health parameter) must be considered to get reliable outcome measures; (b) to enhance internal validity in the studies, temperature, humidity, and persons' diet intake must be taken care; (c) similar studies must be undertaken to get repeatability following the same methodology.

CONCLUSION

Thus, this pilot study gives a substantial clue for a clear and systematic research design to produce scientific, evidence-based correlation regarding the mechanism in meditators, which could bring out more reliable interpretation of data to scientific community. EPI may be a useful tool to understand better different meditation techniques. It is likely that the introduction of EPI bioelectrography into the mainstream medical practices could enrich and expand clinical assessment tools beyond those presently employed. Thus, the result from this pilot study is very encouraging to come up with stronger and convincing results with a strong rationale.

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