Comparative Study Of Effect Of Mediation On Autonomic Nervous System In Healthy Meditators And Non Meditators

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Abstract: Background: Meditation is a type of relaxation technique produced by focusing attention to a particular theme. Meditation produces profound changes in almost all systems of human body including nervous system. The changes occurring can be recorded by assessment of various autonomic nervous system tests. Objectives: To assess and evaluate parasympathetic nervous system tests in meditators and non meditators. Methods: After approval by ethical committee, 200 subjects were included in the study. 100 were healthy meditators and 100 were healthy non meditators. Parasympathetic function tests of all 100 subjects were recorded after informed consent. Results: and interpretation: Parasympathetic function tests showed that Expiration : Inspiration (E:I) ratio, Valsalva ratio and 30:15 ratio was significantly higher in meditators than non-meditators ($p<0.001$). Conclusion: Regular meditation increases parasympathetic dominance in our body. Meditation helps to maintain normal homeostasis in our body. Hence, meditation should be practiced daily for overall well-being of the body. [Solanki A Natl J Integr Res Med, 2020; 11(1):11-15]

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Introduction: The English meditation is derived from the Latin 'meditatio'from a verb 'meditari' meaning "to think, contemplate, devise, ponder". Meditation is a practice where one focuses his or her mind on a particular object, thought or activity to achieve emotionally calm state[1]. Meditation is a complex cognitive task. It is more than relaxation, concentration, or posturing. It is a state of altered consciousness with neurological manifestations, according to some neuroscientists. Goleman[2] stated that in every meditation system, the meditator needs to focus his attention, whether through concentration or mindfulness.

Meditation techniques have also been used for counseling and psychotherapy, as it has been proved that it reduces stress and anxiety. Meditation produces mental and physical relaxation. From physiological point of view, meditation can induce an altered state of consciousness, corresponding to altered neuro-physiologic states. Meditation has been practiced all over the world, to increase calmness and physical relaxation, to improve psychological balance, to cope with illness, or to enhance overall health and well-being. Concentration is focusing our mind on an object or theme. When the concentration becomes continuous and deep and the goal is higher spiritual idea, it becomes Meditation. There are several techniques of meditation. Basically, all methods & practices of meditation come from following basic techniques. One can focus on breathing, one can focus on an object (e.g. light), focus on a sound, focus on a thought, focus on sensory perceptions. Based on these techniques, several masters have designed different methods: Patanjali Rajyoga, Anapan Sati, Smriti Upasthan, Vipashyana, Prekshadhyan, Jaindhyan, Transcendental meditation, Mantra dhyan, Zen meditation, Yoganindra, Nyas, Dynamic meditation, Sahajdhyan, Tratak, Kayotsarga, Atitdhyana, Bhavidhyana, Swapnadhyana, Tahata, Spanddhyan etc.

There are several advantages of meditation. Real meditation can restore physical, mental & emotional health. It can be helpful in controlling several lifestyle disorders, psychosomatic disorders including high BP, coronary artery disease, diabetes, asthma, rheumatism etc. In this stressful life, it is a powerful weapon or antidote to acute as well as chronic stress. Effects of meditation on metabolic, autonomic, endocrine, neurological & psychological system are multidimensional & interactive.

Meditation practices are beneficial for the brain's self-regulation and control by increasing activity in the anterior cingulate cortex. Meditation is associated with bringing relief in depression and anxiety, and guiding us towards happiness, relaxation, and emotional balance. Various studies have shown that meditation has resulted in increased antibody titers to the influenza vaccine[3].Examination of brain waves during meditation has shown that mental activity during

meditation is wakeful and relaxed[4]. Empathy and compassion are higher in those who practice meditation regularly. These attributes of meditators come from activity in the amygdala—the part of the brain that processes emotional stimuli. Other systematic reviews and meta-analysis[5] show that mindfulness meditation has many mental health benefits such as bringing about reductions in depression symptoms. Long term meditation has been shown to change brain anatomical structure like grey matter concentrations and the precuneus[6]. Several researches have shown that meditation serves as a neuroprotective factor that slows age-related brain atrophy[7].

The autonomic nervous system is a part of nervous system which control subconsciously and regulates bodily functions such as the heart, digestion, blood vessels, respiratory rate, pupillary reflexes, urinary bladder and all internal viscera. The sympathetic nervous system is considered to be 'fight or flight' system, while the parasympathetic nervous system is considered the "rest and digest" system. Disturbances of the autonomic nervous system play an important role in the pathogenesis and clinical course of many diseases. Various procedures have been described to monitor autonomic dysfunction.

Some of them are mostly used for research purposes. However, some are non-invasive and can be used for routine clinical evaluation. The autonomic function tests are based on evaluation of the cardiovascular reflexes triggered by performing specific provocative maneuvers. There is no single test that precisely reflects function of a specific part of autonomic nervous system. Hence, numerous tests based on diverse reflexes, are used to assess autonomic nervous system.

Long term meditation has been shown to affect the autonomic activity significantly creating a balance in favor of parasympathetic nervous system. Many studies have been conducted in past regarding effect of meditation on autonomic functions. The present study was designed to observe the effect of long term meditation, on the parasympathetic autonomic functions.

Aim: To study the effect of meditation on parasympathetic autonomic function tests in normal healthy subjects.

Objectives: To perform parasympathetic autonomic function tests in non-meditators and meditators. To evaluate and compare parasym pathetic autonomic function tests in non-meditators and meditators.

Material And Methods: Permission of the institutional ethical committee was taken before the commencement of the study. Ours was a cross sectional, comparative study. 200 subjects between 18-45 years were included for the study.

The subjects belonged to two groups: 100 meditators and 100 non-meditators. The meditators used to practice meditation every morning for at least 45 minutes, for 3 or more years at local meditation centre under supervision of meditation guru. Non-meditators included subjects who had never done any kind of meditation. All subjects included in the study were healthy and matched for age, gender.

Exclusion Criteria were smokers, on any medication, any known disease, those having any type of addiction. Before testing, the subjects were laid down or seated for about 30 minutes in a quiet room with neutral temperature and humidity. Written informed consent of all the participants was taken before the start of the study. Detailed clinical history, anthropometric measurement and examination of subjects was done.

Parasympathetic autonomic function of all participants was measured via an automated computerized apparatus.

Various Parasympathetic Tests Included In Our Study Are:

1) 30: 15 Ratio: In this test each subject lay quietly for 3 minutes, then stood up and remained motionless and a continuous ECG was recorded (automatic).

$$30{:}15\ \text{Ratio} = \frac{\text{R-R interval at beat 30 after standing}}{\text{R-R interval at beat 15 after standing.}}$$

2) Valsalva Ratio: In this each subject was made to perform Valsalva maneuver for 15 seconds by blowing against closed glottis through a mouth piece attached to aneroid manometer and maintained a pressure of 40 mm of Hg for 15 seconds. A continuous ECG was recorded 1

minute before the maneuver (resting period), during the maneuver (strain period, 15 seconds) and 1 minute subsequent to strain period.

$$\text{Valsalva ratio} = \frac{\text{Maximum R-R interval after the strain}}{\text{Shortest R-R interval during the strain}}$$

3) E/I ratio: Subject is asked to inhale deeply for five seconds and then exhale for five seconds for six cycles.

$$\text{E/I} = \frac{\text{Shortest RR interval in inspiration}}{\text{Longest RR interval in expiration}}$$

4) Basal heart rate was recorded.

Statistical Methods: Sample size was calculated using the formula for difference of means. The data was analyzed using demo version of SPSS 20.0 to obtain the arithmetic mean for age, height, weight, BMI, systolic and diastolic BP, heart rate, 30:15 ratio, Valsalva ratio and E/I ratio. Difference in the mean values was subjected to Mann-Whitney U test. Power of the study was 80% and significance level was set as $p<0.05$.

Results: Table 1 shows characteristics of non-meditators and meditators.

Table 1: Characteristics Of Non-Meditators And Meditators

Anthropometric variables	Non-Meditators n=100 Mean (SD)	Meditators n=100 Mean (SD)	p-value
Age	32.89 (6.28)	32.21 (5.71)	>0.05
Height (cms)	154.59 (2.74)	154.15 (3.67)	>0.05
Weight (kg)	62.17 (6.33)	61.45 (6.97)	>0.05

(p>0.05 Not significant)

There was no statistical difference in mean values of age, height and weight as shown in Table 1.

*The mean values of resting cardiovascular parameters like heart rate, systolic blood pressure, diastolic blood pressure were statistically significantly less in meditators than non-meditators as shown in Table 2.

Table 2: Mean Values Of Resting Cardiovascular Parameters In Meditators And Non-Meditators

Parameters	Non-Meditators N=100 Mean (SD)	Meditators N=100 Mean (SD)	P-Value
Resting Heart Rate (Per Minute)	80.99 (3.83)	73.61 (1.47)	P < 0.01
Systolic Blood Pressure (Mmhg)	122.6 (5.07)	116.9 (4.92)	P < 0.01
Diastolic Blood Pressure (Mmhg)	81.62 (2.17)	73.5 (4.77)	P < 0.01

(p <0.01 highly significant)

*Parasympathetic function tests showed that Expiration : Inspiration (E:I) ratio, Valsalva ratio and 30:15 ratio was significantly higher in meditators than non-meditators ($p<0.001$) as shown in Table 3.

Table 3: Comparison Of Results Of Parasympathetic Function Tests In Non-Meditators And Meditators.

Parameters	Non-Meditators N=100 Mean (SD)	Meditators N=100 Mean (SD)	P-Value
E:I Ratio	1.28 (0.06)	1.53 (0.17)	P < 0.001
Valsalva Ratio	1.28 (0.22)	1.38 (0.14)	P < 0.001
30:15 Ratio	1.12 (0.07)	1.29 (0.03)	P < 0.001

(p < 0.001 highly significant)

Discussion: It has been established that physiological effects of meditation are mediated through autonomic nervous system. Our results show that the mean values of resting cardiovascular parameters like heart rate, systolic blood pressure, diastolic blood pressure were statistically significantly less in meditators than

non-meditators. Our results are similar to results by Desh Deepak et al[8]. Regular long term meditation increases parasympathetic dominance resulting in increased vagal tone in meditators resulting in physiological bradycardia. Several studies by Cauthen and Pyrmk[9], Cuthburt, Kristeller, Simons[10] concluded that heart rate decreases by meditation. All these changes in meditators increases cardiac reserve in meditators compared to non-meditators. Jyotsana. R. Bharshankar[11], in their study also concluded that values for resting HR, SBP and DBP were significantly lower in Raja-yoga meditators.

Our results also show that there is increase in E:I ratio, Valsalva ratio and 30:15 ratio in meditators compared to non-meditators. This could be because of increased parasympathetic tone in meditators. Sahoo et al[12] in their study concluded the same.

As far as 30:15 ratio is concerned, changing from lying to standing position produces an integrated response of cardiovascular system which includes alteration in heart rate and blood pressure. There is a transient fall in blood pressure on standing with stimulation of carotid baroreceptor and consequent reflex tachycardia and peripheral constriction. In meditators, 30:15 ratio is more compared to non-meditators.

Valsalva manoeuvre is a test done to assess the low and high pressure baroceptor integrity. Changes in the arterial blood pressure have been used to access the response to the Valsalva manoeuvre but heart rate changes have also been shown to be reliable. The Valsalva maneuver, a natural response to lifting heavy loads, is characterized by a forced exhalation against a closed glottis. During forced exhalation, a sudden increase in intra-abdominal and intrathoracic pressures is produced by the contractions of the abdominal and respiratory muscles. Elevated pressures compress the blood vessels within the chest cavity, leading to a decrease in venous return and CO.

In addition, compression of the aorta leads to stimulation of the baroreceptors, producing a reflex-induced bradycardia to compensate for the increased pressures. Aortic pressure subsequently rises, stimulating sympathetic activity. HR and BP rise in response to maintain CO and perfusion. At the cessation of the forced exhalation, venous return rapidly increases, intra-abdominal pressures drop, and CO is increased, dramatically increasing the mechanical load on the heart. The Valsalva maneuver can be dangerous due to the sudden and abrupt changes in BP. These dramatic changes in HR, BP, and CO may produce symptoms including dizziness, light headedness, and syncope. In subjects who do regular meditation, Valsalva ratio is higher compared to non-meditators. Meditation increases vagal modulation of R:R intervals and reduces sympathovagal balance. Performing the valsalva maneuver tests the body's ability to compensate for changes in the amount of blood that returns to the heart (preload). The changes in heart rate and blood pressure observed during this test are regulated by the autonomic nervous system.

A study by Desh Deepak et all concluded that in a person practicing meditation initially basal parasympathetic tone is increased and this increase is greater in meditators of long term in comparison to those who have been practicing medication for a shorter term.

In their study, Solberg et al[13] had concluded that male runners who meditated regularly by repetition of soothing sound had lower levels of lactic acid after exercise, due to blunting of sympathetic activity leading to parasympathetic dominance. Body is able to relax more and perform better after performing physical activity before meditation. Regular deep relaxation normalized the function and improved the ability to cope by parasympathetic dominance. Out of sympathetic and parasympathetic, only one system is usually active at a particular time. Both systems exhibit reciprocal inhibition ie. When sympathetic nervous system is active, it inhibits parasympathetic nervous system and vice versa.

However, due to modern stressful lifestyle, sympathetic system is used more often leading to literal 'burning out' of body nutrients. Meditation blunts sympathetic nervous system leading to parasympathetic dominance, helping body to heal and replenish. Barnes et al[14] reported decrease in heart rate and systolic & diastolic blood pressure in school children after 3 months of meditation practice. Rajesh et al[15], in their study reported that regular practice of Meditation can significantly improve the autonomic balance, cardio-respiratory performance and mental well-being. These

results are similar to our results. Meditation can alter activity of hypothalamus, which in turn can stimulate or inhibit specific areas of thalamus and RAS. These changes cause stimulation of parasympathetic system and slight inhibition of sympathetic system.

Conclusion: From our study, it can be concluded that regular meditation increases parasympathetic dominance in our body. This result in better cardiac reserve in meditators compared to non-meditators. Hence, regular meditation helps meditators to combat anxiety and stress effectively. Meditation helps to maintain normal homeostasis in our body. Hence, meditation should be practiced daily for overall well-being of the body.

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