

Meditation, its Techniques and its Science

ABSTRACT

Meditation has been used by humanity for a prolonged period of time to derive various benefits. In today's fast-paced mechanised and reward-oriented life, it has become further important for people to be acquainted with the subject of meditation. This manuscript deals with the various aspects of this ancient process, delving into the principles, various methods of practice, neuroscience base of meditation and the benefits derived.

Key words: Meditation, Cognition, Methods of meditation, Neuroscience and meditation, Benefits of meditation

“When meditation is mastered, the mind is unwavering like the flame of a candle in a windless place”

The Bhagavad Gita

BACKGROUND

For thousands of years, people have been meditating. Meditation is one of the greatest gifts to humanity from ancient sages. It was created to aid in the comprehension of life's sacred and mystical powers and to connect to the higher consciousness. Meditation is widely utilized these days for relaxation and stress reduction and a way to get relief from physical illness and mental agonies as well as to achieve peace and happiness.

“Please do me a little favor, search your own self, within yourself”

Rumi Persian poet

Meditation can help achieve a deep state of relaxation as well as a calm mind. During meditation, you concentrate your attention and clear your mind of the muddled thoughts that may bother you and produce stress. Physical and emotional well-being may be improved because of this process. A discourse with one's own self/soul is achieved in the depths of meditation.

ORIGIN OF MEDITATION

Meditation is a practice that dates to India's ancient Indian spiritual scripture era and is documented in literature.^[1,2] Meditation is one of the methods employed in Ayurveda (Science of Life), as well as specifically highlighted in Yogsutra by Rishi Patanjali.^[1] Among Western religions, Christian, Islamic mystic currents, and some other religions have also described Meditation in some or other forms.

“When you truly know yourself, you don't try to impress people anymore. One way to know yourself is to meditate”

Maxime Lagacé: Ice hockey goaltender

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WHAT IS MEDITATION?

The term “meditation” has come to apply to a wide range of different practices. Concentration, contemplation, and transcendence, and so many other like the use of natural sounds (such as the ocean), guided meditation; meditative exercises such as Yoga and tai chi, qigong, breathing exercises, and Mantra chanting are just a few examples. These strategies act on various levels, including the senses, the mind, the intellect, and the emotions. Some approaches are simple to learn and apply, while others are more challenging and therefore people may abandon the practice sooner, if they are not committed. To start with one must learn a friendly technique, from an expert guide and do consistent daily practice with conviction. This way the chances of failure are less. According to Indian spiritual texts, the actual objective of meditation is to link oneself to one's profound inner Self. Techniques that achieve that goal serve the true purpose of meditation.

“Meditation is hard work. It demands the highest form of discipline which comes through constant awareness, not only of the things about you outwardly, but also inwardly. Meditation is choiceless, effortless awareness”

- J. Krishnamurti

DEFINITIONS

Meditation is thinking profoundly or spiritually about a subject. It is considered a complex cognitive task; it is more than relaxation,

concentration, contemplation, or posturing. It frees the mind from distractions and allows for communication with the “Master Within.” The ultimate goal of meditation is illumination and enlightenment.

Meditation is an exercise of the mind to keep it healthy and clean, as we do for our body. It is a state of altered consciousness (fourth stage of consciousness), spiritual ecstasy with neurological manifestation. It is not a hallucination, and it is reproducible, therefore a science itself.

Meditation provides stability when one concentrates on one target or develops unified thought process. It is then, that the wavering of the mind is stopped. Meditation is a way that gives the dedication to stay connected with almighty God or supreme power. The human being exists in three forms (Figure 1):

1. Physical body with senses
2. Inner faculty (mind): The working consciousness, which is constantly changing. This consists of:
 - a. Man (manas): Processes sensory perceptions; has the quality of duality, for example, pleasure and pain
 - b. Intellect: Analyses, judgement, and decision
 - c. Ego: Doer and experiencer
 - d. Chitta: The storehouse of all memories and impressions.
3. Deep inner Self: The deep inner Self is the source of all knowledge, intelligence, creativity, and follows all-natural laws that govern existence (non-changing pure consciousness - Atman).

Thus, we exist in at least three different forms: physical, mental-emotional, and spiritual. We devote most of our day and our energy toward care of our physical body well-being, exercises and pleasures. We are somehow not trained to take care of our mental and spiritual bodies, their workouts and well-being.

One effective technique to address these errors is practice of meditation. You might think of it as a mental workout to maintain your mind healthy and clear of perversions. In fact, in the depths of meditation, one has a conversation with one's own self/soul. However, for the time being, let us put the soul question aside; at the very least, we are conscious of our mental and emotional faculties.

Thoughts, emotions, desires-aspirations, ego, perceptions, liking-disliking (raga-dvesha), attitude, and our frequent swings between past and future tense are the root causes of our misery as human beings. These are all the functions of our mind if we examine them closely. Our problems would be solved if we could improve on these. Meditation is the best way to tide over these miseries.

BENEFITS OF MEDICATION

Level 1: At the initial level, meditation benefits physical, mental, and emotional health, helps control psychosomatic disorders including high blood pressure, coronary artery disease, diabetes, asthma, and rheumatism, etc. In addition to that, meditation has the power to relieve stress. Meditation assists in improving concentration and sharpness, and it produces relaxation and reduces reactivity. It improves job performance and interpersonal relations. It brings a profound change in our attitude, inner peace, patience, and happiness. It cultivates and promotes positive emotions and removes

negative thoughts, helps control anger, and conquer fear, and brings control over the thought process. Overall, it improves the quality of life.

Level 2: As the next level, meditation is the key to eliminate ego and calm the mind, which is the real purpose of meditation. Here, one is able to tame mind completely and get into the state of A-man (no mind).

Level 3: At the spiritual and philosophical levels, meditation helps self-realization, God realization and it provides total bliss (total relief of pain) and leads to liberation of our soul.

TECHNIQUES OF MEDITATION

Meditation can be done in a variety of ways. About 120 meditation methods with their several modifications are derived from the basic eight techniques. Here, it must be noted that all the techniques and methods are good. One may choose according to one's own preference and ease of doing (Table 1).

Let us discuss one of the techniques in some details. Anapan Sati is a technique for becoming mindful of one's own breathing in the present moment. It is not a pranayam; instead, it's a neutral attention or focus on natural breathing (while pranayam is the regulation of breathing). Anapan Sati requires the observer to notice and recognize each natural breath entering and exiting the body. There should be no other thoughts or distraction. Moment by moment, be aware of your natural breathing in an effortless, choice-free manner. You don't have to hold or control your breath. When the mind starts wandering instead of remaining focussed on one's breathing, one must gently bring it back to breathing. One doesn't have to judge or curse one's mind, but befriend it. After practice of months or years, one can learn to remain present with each breath for over several minutes. Lord Buddha said “If one remains completely with breath for 48 min at a stretch, one becomes enlightened “ Buddha.”

There is no deity, sect, or religion in Anapan sati. Therefore, it is an entirely secular technique. Breathing is also an essential activity; without it, no one can exist; so, it is a practice of vital. Your Breath is always with you, no matter where you are or where you go; so, it is a hassle-free, easily available, simple, and helpful method.

Our breath carries our emotions. With various feelings and perversions, our breathing alters. When you're angry or hateful, your breathing gets rapid. It gets irregular when jealousy is present. It becomes slower and deeper with love for living beings; it becomes quieter, slower and more effective with compassion.

As a result, for a regular practitioner breathing meditation becomes feedback of one's own emotions and perversions. It's an auto-check mechanism that activates whenever a destructive feeling or thought arises. Then one's breathing pattern start giving signals: look here, something is wrong, improve it! This is a beautiful reason a breath practitioner becomes quiet, serene, and empathetic and is full of pleasant feelings and energy.

“Please remain aware every second, at every fraction of second. Please do not become unaware (pramad). Please watch and guard your every thought, every word, and every action. This is beginning of your absolute meditation”

Lord Mahavir

Finally, and most importantly, our breathing reflects our present tense, present moment. While concentrating on our breath we learn to stay in the present moment, that is, “Now,” One of the major tragedies, and the source of our misery, that our minds constantly fluctuate between past and future. This meditation approach focuses on practicing staying in the present tense. Although, it is difficult to achieve sustained focus on breathing; hard work, dedication, constant practice, and devotion can make it possible.

Similarly, all other techniques each one contain elements of science and logic. In “Thought” meditation, one might either focus on a single, coherent thought process, such as a good or a noble thought or observe the stream of thoughts as they come one after the other, one after the other, in a non judgemental manner; a plain natural awareness. Similarly, for sound meditation, one might chant a mantra numerous time (loudly or internally without vocalizing) or listen to the subtle sound that enters the ears in a peaceful spot at night or a forest and concentrate on it. In object-based meditation, one stares and focusses at the object without blinking the eyes for an extended period and finally identifying one’s self with the object so as to ultimately be one with the object. When the observer disappears completely to dissolve with the object, the meditation is accomplished (Patanjala yogasutra) and one enters into state of Samadhi (unremitting bliss).

Based on these techniques, several masters have designed different methods. We know them as Patanjala Rajyoga, Anapan Sati, Smriti Upasthan, Vipashyana, Prekshadhyan, Jaindhyan, Transcendental meditation, to name few important techniques. Among others are Mantra Dhyana, Zen meditation, Yoganindra, Nyas, Dynamic (Hoo Dhyana) meditation, Sahajdhyan, Tratak, Kayotsarga, Atitdhyan, Bhavidhyana, Swapnadhyan, Tahata, Spand dhyana, etc.

If one grasps the fundamentals of meditation, one can create a uniquely tailored system to one’s needs. Initially, one should learn one conventional method and follow it for a few years before modifying it.

These eastern approaches are based on Lord Shiva, Patanjali, Buddha, Adinath, and Mahavir.

“Now Monks, I don’t have to tell anymore. Remember, whatever is composed, will decay. Continue working in the direction of your salvation, sincerely, incessantly.”

Lord Buddha: (At his death bed)

In reality, no one method is superior to the others. All the strategies are excellent and beneficial in almost equal proportion. Comparison is both hazardous and meaningless. One must select the method that is most appropriate for himself/herself. It’s important to remember that all approaches teach you to stay in the current moment. Awareness that is choiceless, effortless, and non-judgmental. This offers delight

and happiness. Meditation is, in fact, a corrective operation of the mind, by the mind and the tool used are also of the mind. Vipassana (Vipashyana) method eloquently describes this. A calm and tranquil mind, an awake and attentive mind, and an equanimous mind are the tools of the mind. Similarly, Mindfulness meditation is one such technique where awake state is attained at all times over weeks, months, and years. Here meditator remains in a state of constant awareness, in whatever he/she does, For example, eating meditation, sitting meditation, working meditation, and walking meditation.

A pilot exercise might be to observe utter quiet (a complete silence of body and speech) for beginners. It’s beneficial to remain completely isolated from all distractions. Pranayam is beneficial as a warm-up before each meditation session, although it is not mandatory. Chanting (sound) meditation may be simple for a beginner. For a slightly advanced meditator, focusing on an object with open eyes (followed by closed eyes), may be considered. Meditation techniques that focus on breathing and thoughts are more complicated but equally gratifying. Ultimately, soul meditation takes one to deeper state of consciousness.

EFFECTS OF MEDITATION

During the process of meditation accumulated negativity and stressors are released/removed, energy is enhanced, and general health is improved. Meditation has been linked to a variety of health advantages, according to research. Stress reduction,^[3] anxiety reduction,^[4] depression reduction,^[5] pain reduction (both physical and psychological),^[6] with enhancement of memory,^[7] and increment of efficiency^[8,9] are some of these benefits.

Some other benefits are reduction in blood pressure and^[10] respiration and heart rate.^[11] Reduction in lactate,^[12] cortisol,^[13] and epinephrine;^[14] as well as reduction in metabolism^[15] are also reported. Respiration, oxygen utilization^[16] and carbon dioxide elimination^[17] are regularized. Increased melatonin,^[18] dehydroepiandrosterone sulfate (DHEA-S),^[19] skin resistance,^[15] and relative blood flow to the brain are some of the other physiological benefits of meditation.

Meditation reduces cholesterol and helps remove habits of smoking by reducing sympathetic overstimulation.^[20] Meditation significantly increases exercise tolerance and maximal workload. It delays the onset of ST-segment depression, according to a study on the effects of meditation on exercise-induced myocardial ischemia in individuals with coronary artery disease.^[21] Meditation and health education effects were explored in a randomized, controlled experiment of 201 African American men and women with coronary heart disease. After 5 years, the meditation group had a 48% lower risk of death, heart attacks, and strokes. There was also a significant drop in blood pressure and a considerable reduction in psychosocial stress factors.^[4]

In prostate cancer patients who were not treated with surgery, radiation, or hormone therapy, research has demonstrated that a comprehensive lifestyle modification program (including a vegetarian diet and stress management - meditation and breathing exercises) improved health and altered gene expression. More than 500 genes were regulated in this three-month study, with 48 genes up-regulated and 453 genes down-regulated. Disease-promoting genes that play a crucial role in carcinogenesis were among the genes that were downregulated.^[22] The development of psychosocial genomics has discovered that physical effects and psychological, social, and cultural variables generate different gene expression variations. Meditation and Yoga have been shown to have a favorable impact on gene expression.^[23]

Telomerase is an enzyme that protects and maintains the length of telomeres, which are protective caps at the ends of chromosomes that help maintain chromosomal stability. Shorter telomeres are linked to accelerated aging and illnesses. Telomerase activity is reduced by chronic stress, which increases telomere shortening and premature aging.^[24] Telomerase activity and telomere length are improved by meditation and yoga. Ornish.^[25] According to a study on the influence of meditation on the aging process, long-term meditators have a much younger biological age than short-term meditators and controls.^[26] A government health insurance agency has reduced payments to physicians by a significant amount due to meditation. When comparing high-cost meditators to high-cost nonmeditators over 5 years, there was a 28% drop in high-cost meditators.^[27]

Meditation improves regional cerebral blood flow (rCBF) in the frontal and anterior cingulate regions of the brain and the efficiency of the brain's executive attentional network and electroencephalography (EEG) coherence.^[28] According to a study, meditation positively affected the executive attentional network, and meditators were faster at all activities.^[29] The thickness of the brain cortical layer (gray matter, which contains neurons) diminishes with age, but meditation increases gray matter in the brain.^[30]

CONTRAINDICATION

Certain persons, however, should avoid meditation. Persons with psychosis, severe depression, or confusional states; acute anxiety states; and dementia cannot and should not meditate.

"Like many of you, I was concerned about going into the world and doing something bigger than myself. Until someone smarter than myself made me realize that there is nothing bigger than myself."

Jim Carrey: Canadian American actor

PHYSIOLOGY OF MEDITATION

Meditation produces a particular pattern of physiological response involving different bodily systems. Metabolic,

autonomic, endocrine, neurological, and psychological systems are affected by meditation. These impacts are interactive and multidimensional.

NEUROELECTRICAL EFFECTS

EEG changes

Four waves commonly exist in EEG: alpha, beta, theta, and delta. The brainwave model of meditation is a combination of alpha and theta, in which theta provides the depth and profundity of the experience and the subconscious space within which creativity, vision and intuitive knowledge emerge. While the alpha give the link with the conscious mind so that you can recall the content of your meditation.

With persons who meditate perfectly over years, an awakened brainwave pattern arises.

In higher levels of awareness, meditators can gain top-height experience in any form of creativity, high performance regardless of faith, philosophy, or meditation style.

In general, the alpha wave amplitude improves while its frequency slows down. Rhythmic theta waves arrive, and the alpha sync pattern is intensified.^[31] Transcendental signal and perception detachment from external sense organs can occur. We even find gamma waves in the chronic meditator.^[32]

Alpha waves can be found during quiet and concentrated attention. High beta activity can be noticed with highly focused attention, while with the imagery and reverie theta pattern are seen.

It is noticed that there are detectable modifications of waves even after the first meditation session in a beginner (ordinary person) Figure 2.

Evoked potentials

Meditation sometimes induces changes in amplitude, with the practitioner appearing to show reduced amplitude and latency for sensory EPs.^[31]

Neurobiology of meditation

EEG and neuroimaging with magnetic resonance imaging (MRI), single-photon emission computerized tomography (SPECT) for rCBF, magnetoencephalography allow the extensive study to understand the effect of neural meditation.

A study from Philadelphia by Newberg *et al.* published a roadmap that transformed science's belief. It was a Buddhist lama SPECT study. Higher meditative conditions have been demonstrated to be no longer hallucinations; those are actual neurological events, a neurobiological phenomenon (Newberg *et al.*, 2001) and these are reproducible events (Figure 3).

1. The brain's parietal lobe is believed to provide us a feeling of time and spatial guidance. By eliminating every sensory and cognitive input into this area, meditation leads to no space or time. That means desire, thought, ego, attitude, and emotions, all these faculties arising from the orientation of time and space are suppressed. These faculties of mind

Table 1: Eight techniques of meditation

	Focus on..
1	Breathing
2	An object, light
3	A sound
4	A thought
5	Sensual object
6	Sensory perception
7	Imagery
8	Soul meditation

are the root cause of miseries. The SPECT study showed that rCBF decreased here considerably during Lama’s meditation depth

2. In the prefrontal lobe, the second key finding was found. As we know, this area is well developed solely in humans. Hence, human beings have more remarkable intellect, judgment, intuitive memory, planning, executive functions and complex jobs and are supposed to be courteous and rationally evolved in social etiquette behavior. The more this area is developed, the smarter the person. And exactly, the rCBF increases in this location during profound meditation. I suppose thus that all meditators who practice for a few months to years have evolved more cognitively (they are enlightened) and they are more sympathetic about their behavior. It also tells us that a higher state of consciousness is meditation. Meditators have increased cortical thickness as found on autopsy. Lazarus *et al.*, 2004.

In addition, several groups did functional magnetic resonance imaging (fMRI) investigations with comparable results. fMRI studies revealed the complete circuitry involved in meditation. They showed substantial increases metabolism in dorsal lateral frontal lobe, parietal lobe, hippocampus, amygdala, temporal lobe, striatum, and post-central gyri during meditation. (Mohandas, 2008) This means that meditation activates brain areas in which the cognitive brain circuits and autonomic nervous system control reside. Meditation improves neuroplasticity as per many research papers.

MRI CHANGES DURING MEDITATION

- Positron emission tomography, SPECT, and fMRI enable the investigation of changes in regional blood flow, metabolism, or receptor (sites of neurochemical and pharmacological action)^[33,34]
- Increased regional blood circulation and/or glucose metabolism in the prefrontal and cingulate body are associated with most meditation types that involve first focusing attention
- The frontal lobes, especially prefrontal regions, are essential for organizing, prioritizing, planning, and focusing attention

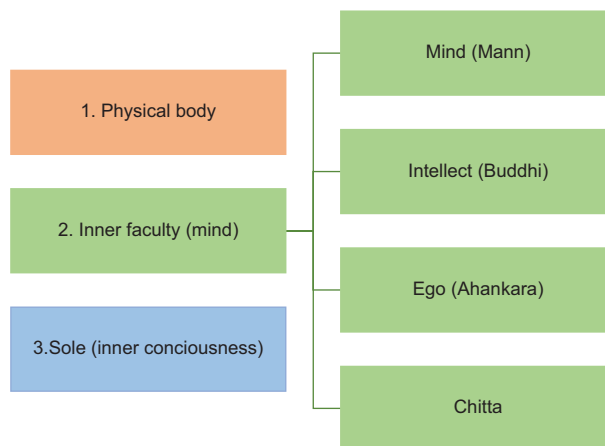


Figure 1: Three aspects of human existence according to Indian holy texts

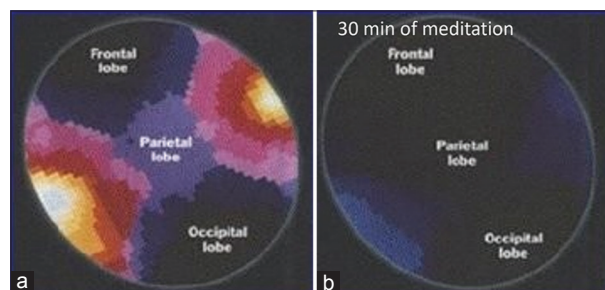


Figure 2: Decrease in beta wave activity after meditation. (a) before meditation, (b) after meditation

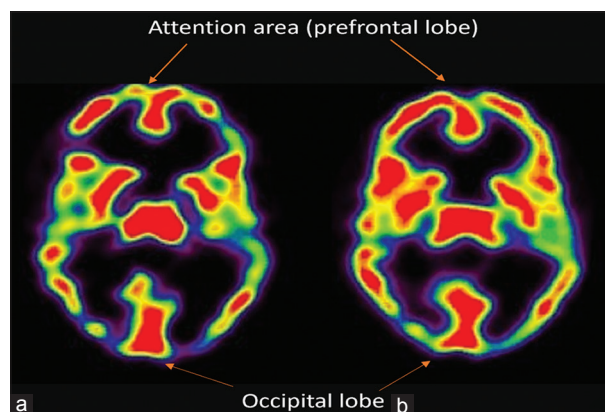


Figure 3: Single-photon emission computerized tomography images. (a) Baseline, (b) during meditation

- The parietal lobes on each side are stimulated during the contemplation of “self-type of meditation”
- Meditation seems to begin with activating brain areas such as prefrontal and cingulate, that is linked to the desire to clear one’s mind or focus on an object
- There is also a decrease in distractive stimuli to the striate cortex and PSPL (posterior superior parietal lobules) during

contemplation meditation (open Meditation). The increase in focus during meditation leads to an altered awareness of self-experience during spiritual or contemplative practices

- Thalamus is a relay and filter station for sensory information reaching the cerebral cortex
- The Thalamus filters the sensory information to a section of the Parietal Lobe (the PSPL) during meditation, which results from reduced activation of PSPL through “body awareness”
- An increased thalamic blood flow during meditation means an active process in which information’s about the body are filtered and processed
- Some meditation studies demonstrate an increase in hippocampal activity or the inner part of the temporal lobe. Hippocampus is closely related to the hypothalamus and the autonomic nervous system and acts by increasing parasympathetic activity
- During some types of meditation, the integration of autonomic nervous system activity in various brain areas is increased
- Kundalini Yoga meditation fMRI studies support enhanced activity in hippocampus and amygdala.

NEUROCHEMICAL EFFECTS

Meditative practices result in an enhanced serotonin release. Serotonin is a significant neurotransmitter and neuropeptide that in many ways affects mood and behavior. The higher availability of melatonin was also connected with meditation. GABA is usually raised in dorsal raphe nuclei during meditation. Cortisol in the paraventricular nucleus is lowered, and diurnal rhythms of B-endorphins are improved, that is, sentiments of calm and fun. This happens with most types of meditation.^[34]

During meditation, the heart rate and respiration decrease, and stress responses are reduced. The parasympathetic system activity during meditation is significantly more robust, which minimizes the generation of catecholamines. Therefore, meditation is beneficial for hypertension, coronary disease, and other stress-related conditions as well as life style disorders.

Increased levels of serotonin assist in improving person’s mood. The skin resistance is increased with meditation. Limbic excitement decreases, which explains why meditation strengthens and enhances a person’s ability to cope with stress and minimizes reactivity. Hence, these are the sound effects on the autonomic nervous system during meditation.

Meditation effects on central nervous system are also apparent when neuronal conduction accelerates or neurotransmitters release increases, reducing synaptic time. This changes the pattern and threshold of muscle firing.

The sense of time and logic no longer dominates the mind during meditation by blocking the left cerebral hemisphere. There is therefore suppressed manifestation of the ego. The thoughts, wishes, perceptions, mistakes, and duality are all

diminished. As we know, all these are functions of mind and hence during the depth of meditation, (particularly in long-term practitioners) the faculty of mind is suppressed evermore. The meditator gets immense happiness and calm once his faculty is suppressed and controlled. That’s because our untamed mind is the root cause of our sorrows and miseries. Let us meditate and get rid of our miseries.

“Wait and meditate till I call you back. Hence, let’s meditate from today and now! From this moment on!”

Swami Vivekanand

CONCLUSION

Looking at all the above positive benefits of meditation at physical, mental, emotional, and spiritual levels, we can conclude that meditation is an invaluable treasure; we have lost in the stride of day-to-day hassles and plights.

“Pain may be inevitable, but suffering is optional.” Lord Buddha said: “That there is a problem,” we all have several problems. However, we must realize that there is always a cause behind each problem. If we pinpoint the cause (the root of our miseries), we also will know, the way out. If we follow that path, our problems will be solved. We will get peace, joy, and bliss (inner happiness).

Now, we have learned that the root cause of our problems/miseries are activities of our own mind, our own thoughts, desires, emotions, ego, perceptions, attitude, duality of mind etc., They create the problems. Hence, we may conclude here that the powerful way to tackle our minds is meditation.

However, meditation serves much higher purposes and it’s a kalpavruksha, Kamdhenu. It can help not only in taming mind, but also help in self-realization, and even liberation! Hence, lets us meditate from today and now.

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