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A CRITICAL APPRAISAL OF YOGA IN THE MANAGEMENT OF CLINICAL DISTURBANCE OF THE CIRCADIAN RHYTHM

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Abstract

Living organisms on the earth have evolved under the influence of a daily light and dark cycle. Exposure to the appropriate spectrum of light enhances human health and well being, immune response and productivity. This appropriate light exposure through the eye modifies 'The Circadian Rhythm' which is basically an approximately 24 hour internal clock that is running in the background of our brain coordinating between sleepiness and alertness at regular intervals. Nevertheless in the era of modernization humans have been facing complex health challenges. While prevention and treatment for infectious diseases have prolonged life span on one hand; on the other a stressful and exhaustive competitive world has ruined the quality of life leading to various lifestyles, psychosomatic and metabolic disorders eventually disrupting this circadian rhythm. Treating these disturbances in the circadian rhythm has been challenging as the modern pharmacological approach to disease management is unsatisfactory at times. Thus the present article to the possible extent describes the circadian rhythm and its clinical manifestations when it is disturbed. It peculiarly emphasizes on evaluation of the potential benefits of Yoga including current research findings and ways to integrate Yoga as a mainstream therapy to synchronize the clinical disturbances in the circadian rhythm.

Keywords: Circadian Rhythm, Yoga, *Ayurved.*

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INTRODUCTION

Diurnal rhythms are generated by an internal biological clock that is synchronized to the 24-hour day by environmental cues, primarily the light: dark cycle(see figure no.1).

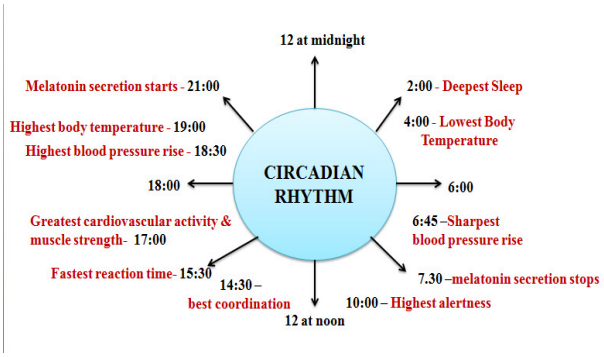

Fig. 1 Circadian Rhythms

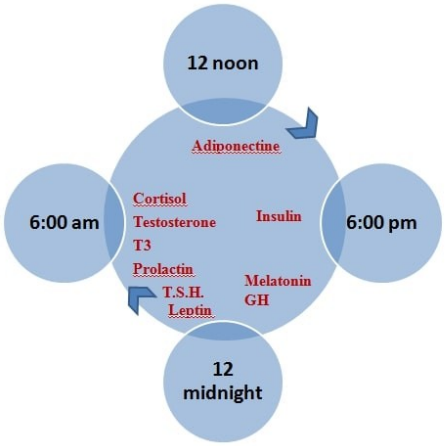

Fig.2 Circadian Rhythms and Harmones

The sleep–wake cycle is unarguably the master output rhythm of the circadian clock, because the regulation of most behaviors and physiological activities depend on whether the organism is asleep or awake. The Suprachiasmatic Nucleus (SCN) in the hypothalamic area serves as a central oscillator that generates daily rhythms of activity and rest, feeding and fasting, core body temperature balance and rhythms in several hormones such as cortisol, melatonin insulin and growth hormone. The SCN oscillator is adjusted to the ambient light in order to be in harmony with the 24 hr light/dark cycle. This physiological process ensures adaptation of the organism to changing day length under natural conditions. Also certain peripheral oscillators in different organs indirectly receive daily timing cues through systemic signals such as the core body temperature and hormonal release (glucagon, cortisol). Therefore, the light/dark cycle and the feeding/fasting cycle both predominantly affect the circadian system [1].The traditional science of *Ayurveda* also reveals its unique theory of the cyclic dominance of the *tridoshas (Vata, Pitta*, *Kapha)* diurnally (see figure no.3) [2].

Fig.3. Circadian Rhythms and Dosha

This can be correlated with the theory of Circadian Rhythm stated by the modern

However one of the major concurrent health issues today is the severe reduction in

the average daily amount of sleep time resulting in a disturbed circadian rhythm. The causes include alterations in lifestyle, erratic food habits, work profile, leisure activities and enormously stressed life. The rapid advent of the '24/7' society involves round-the-clock activities which uses artificial light during the night majorly by shift workers for industrial production, public and health care workers, transportation, entertainment, information technology and food and hospitality industry. These industries and services in turn, enable larger number of people to stay awake, active, and hungry at any time of the day. Such an erratic lifestyle has lead to uninterrupted sleep becoming increasingly compromised which ultimately causes chronic sleep deprivation and associated issues.

Treatment options for circadian rhythm related sleep quality impairment include: pharmaceuticals like – sleeping pills. These are either not effective or effective for a short span of time and disturb the normal sleep architecture of REM, NREM sleep. They can also lead to toxicities, dependency, and rebound impairment after discontinuation. Thus a natural resynchronization method is one of the better options. Studies are evident that Yoga and a balanced diet have eventually proven to be a well-tolerated intervention with promising results in improving insomnia and sleep quality impairment and synchronizing the biological rhythm. And thus the current article will further elaborate the effects of Yoga in the management of clinical disturbances in the circadian rhythm

MATERIAL AND METHODS

Classical texts of Yoga were studied and data was compiled. Also Modern text books of Physiology, Chrono-biology, Internal Medicine were studied for data on Circadian Rhythm. Along with it various research articles and current findings on the respective research title were thoroughly studied to put forth the followings results.

RESULTS –

The Circadian Rhythm [3] , [4]

The Circadian master clock (aka the suprachiasmatic nucleus or SCN) is a group of ~20,000 nerve cells in the hypothalamus area of the brain that coordinates all the body clocks and downstream physiological processes and thus acts as the circadian pacemaker. The cells in these nuclei spontaneously generate rhythms with a period close to, but not exactly, 24 hours, and in order for the circadian pacemaker to ensure that physiology and behavior are appropriately timed to anticipate events in the outside world, environmental time cues must be able to reset this internal clock to 24 hours. Although these circadian rhythms are endogenous ("built-in", self-sustained), they are adjusted (entrained) to the local

environment by external environmental cues called zeitgebers, commonly the most important of which is daylight. A zeitgeber is any external or environmental cue that directs or synchronizes an organism's biological rhythms to the earth's 24-hour light/dark cycle. E.g. light, temperature, social interactions, pharmacological manipulation, physical activities, yoga and diet etc. However, the major environmental time cue that resets these rhythms in mammals is the 24-hour light-dark cycle generated by the earth's axial rotation. Light information is captured exclusively by the eyes using specialized retinal photoreceptors and transuded directly to the SCN via a dedicated neural pathway- the retino-hypothalamic tract (RHT). Each day the light-dark cycle resets the internal clock, which in turn synchronizes the physiology and behavior of the body and is controlled by the clock. The major biochemical correlate of the light: dark cycle is provided by the pineal melatonin rhythm; a hormone cycle known to trigger sleep. Thus the major clinical disturbance in the circadian cycle is a disturbed sleep wake cycle causing- Delayed Sleep Phase Syndrome (DSPS), Advanced Sleep Phase Syndrome (ASPS), Irregular Sleep-Wake Pattern, Non -24-Hour Sleep-Wake Syndrome, Shift Work and Time-Zone Change Disorders.[5] Symptoms mainly include intolerance, persisting fatigue, emotional irritability, indigestion, over eating, mood alteration and poor subjective quality of sleep.[6]

RESYNCHRONIZING THE CIRCADIAN RHYTHM

Ayurved scholars and the yoga preachers certainly knew about circadian rhythms. All physiological phenomenon according to Ayurveda are governed by a delicate balance of doshas and to precisely regulate the doshas, biological clock adjustments are made in the form of *dinacharya* (day routines), *ratricharya* (nightly routines) and *ritucharya* (seasonal routines) (see figure no.3) [7].

Dinacharya includes traditional practices that are performed in the day time and ritucharya implies dietetics, habits and behavioral adjustments to seasonal changes. The concept of chronobiology is thus inherent in Ayurveda. All the rhythms here are recognized according to doshaic dominance, both qualitatively and quantitatively. Annual seasonal rhythms are seen as extension of circadian rhythms, as Susruta says- that in a day and night also one should observe – in forenoon the features of spring, in mid-day those of summer, in afternoon those of early rains, in early night those of rainy season, in mid night those of autumn and at dawn those of early winter. [8]

YOGA

The core idea of promoting dinacharya and ritucharya is to encourage the practice of Yoga and a balanced diet. The five techniques of Yoga have a tremendous contribution together

in the management and regulation of the clinical disturbances in the circadian rhythm. The one with disciplined and dedicated practice (*Abyasa*), and perspicacity (*Viveka*) practice Yoga and a Satvik Diet and Lifestyle have surely proven to benefit with. The following Yoga Kriyas have a worth appreciating role.

The Yoga Nidra [9]

One of the most important and effective practices of yoga for insomnia and sleep disorders is yoga nidra (or yogic sleep) as it brings deeper relaxation on both mental and emotional levels. Half an hour practice of *yoga nidra* is equivalent to four hours of deep sleep.

Omkar and Mantra chanting

In a Study, the plasma melatonin showed an increase after three months of yogic practices. However, the maximum night time melatonin levels in yoga group showed a significant correlation with well-being score. Observations suggest that yogic practices can be used as psycho-physiologic stimuli to increase endogenous secretion of melatonin, which in turn might be responsible for improved sense of well-being [10].

Asanas and Shatkarma

Asanas are probably the best tool to attain stability. Asanas as practiced in Yoga system are not only a form of physical exercises but are also the methods of achieving perfect mental and physical relaxation. The practice of *yogasanas* essentially tends to exercise and relax almost all the muscles of the body to prepare it for a prolonged steady, stable and coordinated activity without producing fatigue [11]. Relaxation poses such as *Shavasana* has been reported to help effectively in hypertensive and insomnia patients [12]. *Shatkarma* consists of six groups of purification or cleansing practices which helps to attain physical and mental balance. They help in balancing the three doshas or humours in the body (*kapha*, *pitta* and *vata*) [13].

Meditation and Pranayam

The effect of meditation on sleep was first reported by Mason et al. (1997) in practitioners of transcendental meditation [14]. The sleep architecture of senior practitioners of Vipassana meditation was endowed with enhanced states of SWS and REM sleep compared to that of non-meditating control group[15], [16]. Meditation also brings a sustained hypometabolic state termed as relaxation response by Herbert Benson and helps in sleep initiation [17].

Lifestyle and Diet

Regular meal timing and frequency are essential to the integrity of the circadian system. In fact, irregular meal frequency decreases diet-induced thermogenesis compared with a regular meal frequency at the same level of calorie intake [18].In humans,

regularizing erratic eating patterns and shortening the habitual feeding period from 14hrs to 10-11hrs decreased energy intake, body mass, and interestingly increased sleep quality [19]. Low-crab dieting decreases sleep quality, while evening carb intake can increase brain concentrations of the amino acid tryptophan, the precursor to serotonin [20].

DISCUSSION

Patients with Circadian Rhythm Sleep Disorder present with mainly either insomnia or hypersomnia and may be associated with disorders of sleep timing or sleep generation. Sleep timing disorders can be organic (intrinsic defect in circadian pacemaker or its input from the stimuli) or external (environmental). Irrespective of the cause, the symptoms usually reflects the influence of underlying circadian pacemaker on sleep-wake function. Accordingly the main Circadian Rhythm Sleep Disorders and their Symptoms are as follows -

A) Rapid Time-Zone Change (Jet Lag Syndrome) Disorders- The symptoms include excessive daytime sleepiness, sleep onset insomnia associated with gastro-intestinal discomfort. These symptoms last upto 2-14 days.

B) Shift work sleep disorder- Symptoms include sleep deprivation, increased time span of staying awake prior to work and misalignment of circadian phase causes decreased alertness and performance. They also have high rates of cardiac, gastro-intestinal and reproductive disorders.

C) Delayed Sleep Phase Syndrome (DSPS) – Patient exhibits an abnormally delayed endogenous circadian phase.

D) Advanced Sleep Phase Syndrome (ASPS) – Patients with this condition report excessive daytime sleepiness during the evening hours. These people have great difficulties remaining awake even in social settings.

E) Non -24-Hour Sleep-Wake Syndrome – Typically the patients present with an incremental pattern of successive delays in sleep onset and wake times. It fluctuates out of phase with local time.

Thus, effective management approaches should be planned to entrain the oscillator at an appropriate phase.

Management - It is been observed that the cyclic fluctuations of key hormones like Cortisol, Insulin and Human Growth Hormone in the Circadian Cycle notably approximate to the events of cyclic fluctuations of *Vata, Pitta and Kapha* respectively in a day and night (see figure no. 2 and 3). Thus the state of dosha prevalent at that particular point of time shall be given utmost priority while planning the management of a desynchronized circadian rhythm. Further the integration of Patanjali's *Ashtanga Yoga* which include; (1) *yamas* (cultivate healthy attitudes in relationship to others), (2) *niyamas* (cultivate positive rapport

with self), (3) *asana* (physical postures), (4) *pranayama* (breath work), (5) *pratyahara* (turning inward), (6) *dharana* (internal focus, concentration), (7) *dhyana* (meditation), and (8) *samadhi* (liberation, freedom from suffering) as the eight constituent parts of the discipline of Yoga shall be promoted. Though the practice of each of these constituents of the *Ashtanga Yoga* involves its own art and ethics , but the first two stages namely the *Yama* and *Niyama* are primarily the ethical practices preparatory not only for the further technical practices but also for an organized and scheduled life.

Asanas - Postulated so broadly that by virtue of them, the yogic practices have proven to rehabilitate various vital organs and make them functionally more competent. Due to similar effects various endocrine glands also get vitalized and endocrine functions improve which reflect into an improved pattern of enhanced metabolic activities in the body. Similarly *Pranayama* and *Pratyahara* are extremely efficient techniques to divert the individual's attention from the objects of the outer environment and increase every person's energy potentials and 'interiorize' them, to achieve control of one's inner functioning. But the only problem is that sleep deprived people have little enthusiasm to practice. Thus purificatory methods like Shatkarma have proven beneficial in detoxifying the body and rebuilding enthusiasm. After overcoming this first dislike, they may find Yoga practices interesting.

Meditation (Dhyana Dharana) practices viz; *Nadanusandhana***,** *OM meditation*, *Tratak* have strongly reported to regulate the hypothalamo pituitary adrenal (HPA) Axis and thereby the cortisol and cat-echolamine levels[21] , anterior Pituitary hormones like growth hormone, thyroid stimulating hormone (TSH), prolactin [22], and melatonin levels [23]. Melatonin plays a vital role in the physiological regulation of sleep in both blind and normal individuals [24]. It follows a raising and falling phase with corresponding alterations in sleep propensity. Melatonin exerts its hypnotic effect by acute inhibition of suprachiasmatic nucleus and also by facilitating hypothermic response through peripheral vasodilatation [25]. Meditation also increases melatonin concentration by slowing its hepatic metabolism or augmenting the synthesis in the pineal gland [26].Aging attenuates the melatonin secretion and hence affects the sleep quality in aged population. Meditation practices are reported to enhance the melatonin levels [27], the precursors of melatonin especially the serotonin [28] and noradrenalin [29] .Thus, meditation helps to maintain a wakeful hypo-metabolic state with parasympathetic predominance. It is also true that meditation influences sleep and its

functions. It appears that various components of sleep generating mechanisms can be altered with meditation. Meditation, with its global effects on body and brain functions helps to establish a body and mind harmony. Thus meditation practices as an auto regulatory integrated global phenomenon, opens a wider scope for understanding the unique aspects of human sleep and consciousness.

CONCLUSION

Thus to conclude, Yoga mainly Meditation, has proved most effective in nurturing the body with necessary training mechanism in order to promote enhanced relaxation and regulation of the biological rhythm. The theory behind all the eigth fold paths of yoga is that - it is a preparation for a disciplined and a well organized lifestyle irrespective of the affection of the external irritants. In other words, to be truly able to focus attention on calming oneself internally one must first inculcate a healthy lifestyle, practice good eating habits to rid the body of external irritations and then focus the mind. Hence it can be concluded that Yoga and Meditation has promising results in the management of clinical disturbances of Circadian Rhythm. The study thus sets a future scope for more evidence based studies which can be conducted on individuals with a disrupted biological clock and to be corrected by a holistic and a Yogic approach.

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