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STUDIES ON NEURO-ENDOCRINOLOGICAL CORRELATES OF YOGIC PATHWAYS

Summary: *Homeostatic mechanisms are hormonally regulated by different endocrine glands. This function is regulated by two parts of the autonomous nervous system: sympathetic and parasympathetic. Since the whole nervous system is controlled by anterior and posterior parts of hypothalamus, we can say state that the whole mechanism is controlled by the brain region. Hypothalamic region is supported by limbic system, including amygdala, hippocampus and a few more smaller structures. Yoga practicing stimulates work of endocrine system which is directly connected with activity of the energy centers (chakras) and energy pathways (channels – nadis). Correct functioning of ida, pingala and sushumna nadi directly influence the limbic system and mechanisms of homeostasis. Limbic system is responsible for regulation of the homeostatic (self-regulated) mechanism. This system carries out its regulatory functions through the hypothalamic region. Taking into consideration importance of the effects that are accomplished by yoga practicing, there is a growing need for scientific research of yoga practice with the aim of better understanding of these phenomena. By scientific researches, we reach the essence of the yoga mechanics and dynamics, with approach that really represents ‘thinking-out-of-the-box’, from the field of expended awareness.*

Key words: *endocrine system, nervous system, chakras, nadis, yoga, Kundalini yoga.*

Introduction

In western scientific thought, there has been a dichotomy in perception of body and mind – they are treated separately. There is the same approach in treating a patient. But the Ayurvedic Vaidhyas (Indian traditional healers) and yogis have had a holistic approach. There is no doubt that body- mind inter relationship was clearly understood by the ancient yogis. That’s why the fundamental book of yoga – Yoga Sutra by Patanjali begins with the two aphorisms that define yoga as “a discipline” (1.1) and “restrain of the modifications of mind” (1.2), where yoga brings balance of physical, mental and spiritual states and the whole harmony of the human personality – inside and outside.

Patanjali systematized knowledge about yoga, making it a scientific discipline, almost 2.500 years ago. In 1893, Swami Vivekananda declared yoga as a scientific discipline, when he said – “The aphorisms of Patanjali are the key source of Raja Yoga and form its text book. Yoga is one of the most important sciences”. Dr. Sarvepalli Radhakrishnan (1957) wrote: “Patanjali’s yoga assumes that we all have inexhaustible reservoirs of life that we draw from. It formulates the methods of attaining our deeper functional levels. The yoga discipline is concerned with the purification of the body, mind and soul, and preparing them for the life mission. Since the human life depends on the nature of citta (mind-stuff), it is always in our reach to transform our nature by controlling citta.

With devotion and concentration we can even overcome our ills. The normal limits of the human vision are not the limits of the Universe. There are other worlds than that which our senses reveal to us, other senses than those which we share with the lower animals, other forces than those of material nature. If we have faith in ourselves, than “supernatural” is also a part of the natural. Many people go through life with eyes half closed, with dull minds and heavy hearts, even those who have had moments of awakening fall back into somnolence.”

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Yoga acquired status of a scientific discipline only in 21st century, supported and authenticated by the inquiries of almost 100 years, and specially in the past four decades, because of interest shown by some devotees, lending a new life to yoga.

In his book "Yoga Sutra: Yoga – Alpha and Omega", Osho said: "Patanjali is the scientist of the inner. His approach is that of a scientific mind: he is not a poet. And in that way he is very rare, because those who enter into the inner world are almost always poets, those who enter the outer world are almost always scientist. Yoga is concerned with your total being, with your roots. It is not philosophical. So with Patanjali we will not be thinking and speculating. With Patanjali we will be trying to know the ultimate laws of being: the laws of its transformation, the laws of how to die and how to be reborn again, the laws of a new order of being". Patanjali is a rare flower. He has a scientific mind but his journey is inner. That's why he became the first and last word: he is the alpha and the omega. For five thousand years nobody could improve upon him. It seems he cannot be improved upon. He will remain the last word – because the very combination is impossible. To have a scientific attitude and to enter into the inner is almost impossible. He talks like a mathematician, a logician. He talks like Aristotle, and he is a Heraclitus. Patanjali is like an Einstein in the world of Buddhas. He is a phenomenon. If you follow Patanjali's instructions, you will realize that he is as exact as any mathematical formula. Simply do what he says and the result will happen. No belief is need, you simply do it and know. It is activity to be done, know and confirm."

Psycho-physiological implications of Yoga

There is noticeable close relation between Indian twin disciplines – Yoga and Ayurveda, when one studies the original ancient yogic and ayurvedic (ancient Indian medicine) scriptures and associated literature. The very first thing one comes to realize with the in-depth study of yogic philosophy and ayurvedic medicine is that the yogis and Vaidyas (Ayurvedic healers) were having a clear understanding of the mind-body interrelationship, and utilized it in yoga and medicinal practices for integral healthy and happy life, adopting it as a way of life, almost 2500 years ago. This knowledge reached to China in early times with spreading of Buddhism from India to China during the reign of King Ashoka (304 BC – 232 BC), and in modern times to the west with increase of intellectual interaction between east and west and with the dawn of the New Age movement in latter years of the 19th century.

In India, yoga (science of essential realization) and ayurveda (medical science) grew side by side strengthening each other from the very beginning. This is clearly reflected in the famous Shivananda's verse dedicated to Patanjali – who praised the sage with gratitude as follows:

“Yogena Chittasya paden vacham,
Malam sarirasya cha vaidyake-na
Yopakarottam pravaram muni-nam,
Patanjalim Pranjalir anato'smi.”

With great reverence I bow with hands folded to Patanjali,
The most excellent of sages, who removed
Impurity of consciousness through yoga
Impurity of speech through word (grammar) and
Impurity of the body through medicine (Ayurveda)

Richness, significance and contribution of both ancient tradition of yoga and ayurvedic medicine in enhancing quality of human conditions has been described in details in modern literature about yoga, psychology, medicine, and related scientific disciplines. Carl Jung (1978) indicated that yoga is “one of the greatest phenomena that the human mind has created.” George Feuerstein (1996) emphasizes

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significance of yoga: "As a spiritual discipline, yoga has universal validity. It is a practical approach to self-understanding, self-transcendence, self-transformation, and self-realization. Although it has grown out of the Indian cultural experience and was developed in close association with Vedic and non-Vedic religious life, in its highest purpose and most refined articulation, it is equally meaningful and efficient outside of India."

About ayurvedic medicine, Virender Sodhi, M.D. from the American School of Ayurvedic Sciences in Bellevue, Washington, says: "Disease is the result of a disruption of the spontaneous flow of nature's intelligence within our physiology. When we violate nature's law and cannot adequately persists the results of this disruption, then we have disease." Pointing to the central philosophy of 'Aurveda, famous bestsellers-writer Deepak Chopra, MD says: "The first question an ayurvedi physician asks is not 'What disease does my patient have?' but 'Who is my patient?' By 'who', the physician does not mean about your name, but how you are constituted." Elaborating this point, Vasant Lad, ayurvedic physician and Director of the Ayurvedic Institute in Albuquerque, New Mexico, says: "'According to Ayurvedic principles, by understanding oneself, by identifying one's own constitution, and by recognizing sources of doshic disorders, one can not only follow the proper guidelines to cleanse, purify and prevent disease, but also uplift oneself into a realm of awareness previously unknown."

Yoga and modern psychology

In his article "Yoga and Modern Psychology", R.S. Bhogal (2002) writes: "Modern psychology, an offshoot of the western philosophy, in its attempt to look more scientific, seems to have become divorced from these metaphysical but practical quests. Yoga, often termed as Indian psychology, not only deals with these problems convincingly but also delves deeper... the discipline of yoga and modern psychology evidently differ... However, their common interest in solving the existential problems raises a hope of developing a pragmatic synthesis between these two, which in turn may enrich both the sciences." Unlike psychoanalysis, yoga alone proposes both transcendental consciousness (Atman or Self) and phenomenal consciousness (mind-brain and their dynamics) as inherent part of psychosomatic assets, apart from the practically sound metaphysical reasoning pertaining to the meaning and purpose of human life and living."

Application of yoga along side with modern medicine has given excellent results. In an article "The Power of Yoga", Richard Corliss (2001) mentions : "In 1998, Ornish published a new study in the American Journal of Cardiology, stating that 80% of the 194 patients in the experimental group were able to avoid bypass or angioplasty by adhering to lifestyle changes, including yoga." He also argued that lifestyle changes, by practicing yoga, would save money to the individuals and society. The average cost of the treatment of patient in the control group was more than \$47,000.

Analyzing the role of yoga in mental health, Richa Sharma(2004) states: "The last four limbs of Paranjali's Yoga: Pratyahara (sense withdrawal), Dharana (concentration), Dhyana (meditation) and Samadhi (enlightenment) have direct relation with the mental processes. Pratyahara is the stage where channeling of the psychic energy takes place. By concentration on the supreme self, on connection of the body and mind sources, individual integrates asleep energy flows. Newly emergent discipline called the psycho-neuro-immunology (PNI), substantiated the link between the mind and the body.

Yoga energy pathways and their correlates

It is scientifically established importance of the nervous system in maintenance and development of the human, and ultimately in evolution of the consciousness of individual. Yogis and ancient Indian healers were aware of and anatomy and physiology of the human body, which is confirmed by ancient literature. Certain techniques for maintaining healthy body, mind and spirit have been developing in India for centuries integrated and infused in daily living of a common man through religious and cultural

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influences. That's the reason why the happiness index of an average Indian has always been comparatively high in spite of all the odds throughout the ages, till present uncertain times around the world. References related to human body structure and functions are scattered invariably throughout Indian philosophy, scriptures and general literature. As about nadis and chakras and yogic philosophy, the Indian philosopher Kabir of Bhakti age (Devotional period 1400-1600) sang: "Jheenee-Jheeni Beeni Chadriya" in which he has described the details of the subtle body system of chakras and nadis. He has used an analogy familiar to a Weaver, as he himself was a humble weaver, a translation of one such poem is given here:

"Only He knows as He is the Eternal.
What is the wrap (lengthwise thread) and what is the weft (cross threads)?
What are the threads from which the Chadr (Cloth/body) is woven?
Ida and Pigla are the wrap and weft.
Shusumna are the threads from which the Chadar (human body)
Five are the elements and three are the qualities of the chadar!"

The system of chakras and nadis have an important place in the Yoga philosophy and practice, which has been extensively elaborated and discussed in ancient scriptures of Yoga, specially Hatha yoga and Tantra Yoga. Mechanism of yoga effects is the most visible in the systems of chakras and nadies, which specifically and the most directly correlates with nervous and endocrine system. Swami Satyananda (1996) says: "On a physical level, chakras are associated with the major nerve plexuses and endocrine glands in the body. Many asanas have particularly powerful and beneficial effect on one or more of these glands or plexuses, for example, Sarvangasana (Shoulder stand) exerts strong pressure on the thyroid gland in the throat region which is associated with the Vishuddhi Chakra (Throat Chakra). Practicing this asana stimulates correct acitivity of thyroid gland and its functions. Pointing to the effects of Shoulder stand (Sarvangasna) on health, B.K.S. Iyengar (1991) says: "The importance of Sarvangasna cannot be over emphasized. It is one of the greatest boon conferred on humanity by our ancient sages. Sarvangasna is the mother of asanas (postures). As mother strives for harmony and happiness in the home, so this asana strives for the harmony and happiness of the human system."

K.N. Udupa (1996) traced further: "The human body maintains a constant environment, even though our environment continually under goes changes. All the homeostatic mechanisms are regulated by body hormones, secreted by various endocrine glands. However, even this function is further regulated by the two parts of the autonomous nervous system: sympathetic and parasympathetic. Since the entire nervous system and the endocrine system is controlled by the anterior and the posterior parts of the hypothalamus, it can be stated that the entire mechanism is controlled by this region of the brain. Hypothalamic region is further supported by the limbic system including amygdale, hippocampus and several other minor structures. It is this limbic system which is predominantly responsible for the regulation of homeostatic (self-regulating), mechanism. This system carries on its regulatory functions through the hypothalamic region. Among the various functions conducted by the hypothalamus the regulation of temperature, eating and drinking are very important ones. This area also regulates our emotions such as anger and fear. A particular emotional state is further regulated by the amygdale, which is part of the limbic system." Important classical texts related to energy centers (chakras) and endocrine and nervous system are: "Shiva Samhita", "The Shat-Chakra-nirupana", "Shakti and Shakta" (1951), "The Chakras" by Charles W. Leadbeater (1927, 1996).

Discussion

In the scientific article entitled "Neurophysiology of Enlightenment, Dr. Robert Keith Wallace (1974), Professor of Physiology, at the 26th Congress of Physiological Sciences, held in New Delhi in

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October 1974, said: "In the last few decades there have been established the neuro-physiological criteria for awoken, dreaming and sleeping states of consciousness. With the advancement of implementation of the transcendental meditation, this decade is establishing the criteria for the fourth state of consciousness (enlightened state). As the sophistication in research is increasing along with the increasing practice of more than half a million meditators in the world, inevitably the criteria for higher states of consciousness is forth coming, and it will not be long before the neuro-physiological standards for the state of enlightenment are firmly established. This will be the supreme achievement of modern physiological sciences which connect the ancient descriptions of enlightenment with the results of scientific research on meditation in the fields of physiology, psychology and sociology."

It is a privilege of modern scientists to be able to objectively verify the effects of the practice of different yoga techniques. According to Dr. M.L. Gharote (1990), yoga and meditation have been investigated mainly for their effects on psychosomatic disorders. The results show that yoga discipline can be to the significant extent instrument for lowering hypertension and treatment of asthma. Many studies done on the effects of yoga techniques practice have been proved effective in reducing heart disorders, normalization of the blood pressure, hypertension, reduction of advent of gastric ulcers, hyperacidity and headaches. In several countries, drug addictions and alcoholics have also been positively helped to free themselves of their addictions through a combination of techniques of meditation, techniques of breathing and asanas.

Yoga, along with affecting body muscles, helps in the improving the functions of the whole system of an individual. Asanas indicate the most directly that medical studies continue to show that regular meditation works magical in reducing blood pressure and stress-related illnesses, including heart disease. Brain images show that regular practicing of asanas (yoga postures), meditation and breathing techniques (pranayama) help to calm the most active sensory-assaulted parts of the brain. Beneficial effects of meditation on cholesterol level have been reported by M.J. Cooper, M.M. Aygen (1979), B.K. Anand (1991), Calderon, et al. (1999), Rashmi Vyas and Nirupama Dikshit (2002). A decrease in sympathetic discharge and better ability to overcome stress can be cited as possible mechanism for this change (in cholesterol level). In research conducted by Rashmi Vyas and Nirupama Dikshit (2002), the level of physical activity in the examinees was similar, but those who meditated had a significantly lower cholesterol level. In summary our study indicates that practicing Raja yoga meditation confers significant benefits in respiratory functions, cardiovascular system and lipid profile, as well as all body functions which continued to improve further with yoga meditation practice.

Connecting "fight-or-flight response" and relaxation response with yoga, Richard Faulds, president of the Kripalu Center elaborates that the autonomic nervous system is divided into the sympathetic system, which is often identified with the "fight-or-flight response", and the parasympathetic – which is identified with what's been called the relaxation response. When you do yoga – the deep breathing, the stretching, the movements that release muscle tension, the focus on the presence of relaxation in the body – you initiate a processes that turns the "fight-or-flight" system off and the relaxation response on. That has a beneficial effect on the body. The heartbeat slows down, blood pressure decreases. The body seizes the chance to turn on the healing mechanisms."

K.N.Udupa (1976) infers that the practice of Kundalini yoga is mainly directed towards the improvement of the nervous system. Regularly practicing of yoga exercises improve the functions of the brain, spinal cord and autonomic nervous system which will be greatly helpful in maintaining good health and also improving the level of consciousness. Shri Gopikrishna (1971) goes to the extent of advocating that it will be one of the ways by which a person can possibly accelerate evolutionary process of human species. R.S. Bhogal (2000) at another place points out that scientific studies indicating parasympathetic dominance and general autonomic balance, as a result of yoga practices, have been reported by Gahrote (1971). "Yoga practices, by their nature, tone down the heightened hypothalamic, cortical and sympathetic nervous system activity, leading to an inward awareness", state Bhogal. Therefore, nervous (autonomic balance) and hormonal balance can be restored and maintained through regular practice of

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yoga techniques (asana, pranayama, dharana, pratyahara...), by utilization of chakras and nadis concept, as advocated by Hatha and Kundalini/Tantra yoga practitioners and scientific researchers. Besides mentioned results of researches, number and quality of scientific researches is insufficient. There is a greater need to study, understand, redefine, interpret and reinterpret experiences of beneficial techniques of this old discipline, directing researchers on researching the core of yoga mechanics and dynamics, with indeed an "out-of-the-box thinking" approach, from the field of expanded consciousness.

Conclusion

Yoga obtained the status of a global culture. This has attracted even the scientists, working in different specialized fields, to conduct researches related to some aspects of yoga. As it is evident from bibliometric studies of M.K. Kulkarni (1996) and S.S. Khalsa (2004), basic scientific researches in yoga began in the early 1920's in India itself, latter followed by England and U.S. in early 60's. Khalsa also point to a gradual increase in publications up till 1989, after which an interest and the numbers of articles have remained at the same level. Lately, research groups from other countries also took interest in conducting scientific researches in yoga, which includes countries like Serbia, Czech Republic, Spain, Germany, Russia, Italy, Poland, Sweden and The Netherlands. Relevance of yoga in modern world is evident. While summarizing environmental, social and political problems of the present world, George Feuerstein says: "I believe that the looming ecological crisis combined with increasing terrorism will change the face of the Earth in the decades to come. Yoga must be made more relevant to this issue, which involves the practice of yoga as a spiritually based and ecologically sensitive lifestyle." In the paper "Bimodal Consciousness", by Arthur F. Deickman assesses: "The crises now facing the human race are technically solvable. Controlling population, reducing pollution and eliminating racism do not require new inventions. Yet, these problems may prove fatally insolvable, because what is required is a shift in values, in self-definition and in world view on the part of each person for it is the individual consciousness that is the problem. If each person were able to feel and identify with other persons and with his environment to see himself/herself as part of a large unity, he/she would have the sense of oneness that supports the selfless actions necessary to regulate population growth, minimize pollution and end war. The receptive mode is i.e., the yogic approach in which identification, the I-Thou relationship exists."

But these and similar objectives can be realized only if some serious efforts are made to carry yoga forward from a fitness exercise with a difference to the next level of enhancing spiritual contents in its practice and encouraging it as an experimentally proved scientific and authentic way of living, giving meaning to life and fulfilling its purpose of expansion and evolution of human consciousness to the next level of super-mind, super consciousness. Happy and socially responsible life on this very planet, in the very lap of our dear Mother Earth. Looking to the popularity of yoga among the intellectuals and scientists, and from "elites" to the common people, there is no doubt that yoga has emerged not only as a full fleshed scientific discipline but as a culture for the 21st century. Swami Satyananda Saraswati emphasized: "Yoga is not an ancient myth buried in oblivion. It is the most valuable inheritance of the present. It is the essential need of today and the culture of tomorrow." Bob Smith and Linda B. Smith (1986) have expressed similar thoughts in their book "Yoga for New Age": "Yoga's contribution to truly global culture is immense. Yoga has all the elements to become a global ethics and culture in the times to come. Yoga for new age is turning to be a new age to yoga."

We are still aware of the great need for the further scientific interdisciplinary researches of the yoga practice effects (I emphasize the example of the scientific conference in Serbia, in Belgrade), which is the need of the time itself.

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"Ye children of immortality, even those who live in the highest sphere, the way is found; there is a way out of all this darkness, and that is by perceiving Him who is beyond all darkness; there is no other way."
Sheveteasvara Upanishad, II.5

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