

Chapter 5

Influence of Yoga on the Autonomic Nervous System

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ABSTRACT

Increased interest in exploring the physiological benefits of yoga in last few decades resulted in plethora of scientific studies involving different physiological measures in healthy volunteers and patients with various disorders. Of these measures, autonomic functions assessment remained prime role because of wider regulation of autonomic nervous system functions over all visceral systems of the body. Through its two limbs (sympathetic and parasympathetic) autonomic nervous system regulates involuntary visceral organs and systems of the body, which is critical in maintaining the homeostasis of all the physiological functions. This homeostasis is altered in various disease conditions most of which resulted because of the increased stress, a product of modern day lifestyle. Yoga is perfect antidote for the stress, effectively tackling the dreaded effects of stress on physiological systems mainly acting through modulating sympathovagal balance to maintain the homeostasis and restoring the health. We will discuss how yoga achieves this balance in various disorders by reviewing the autonomic system, its functions, laboratory assessments and plenty of scientific studies conducted over last few decades in various disorders involving yoga and autonomic functions. Although we have general idea as to how yoga modulates the sympathovagal balance improving clinical condition, we need to have more long-term, in-depth, well-controlled studies not only to understand these complex interactions of yoga and autonomic functions but also to provide scientific credibility to yoga research in world's scientific community. These steps would hopefully enable mankind to lead the disease-free healthy life style effectively to achieve meaningfully the purpose of one's life.

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YOGA

Yoga is a philosophical, cultural and social gift of ancient India and perfect antidote to the modern stressful world. The word 'yoga' derived from 'yuj' meaning 'unite'. This union can be inferred at various levels: different systems of the human bodily functions; body and mind; ultimately soul (*atma*) and God (*paramatma*). Autonomic system regulates the functions of visceral organs in the body, which are not under voluntary control. Two components of autonomic system viz., sympathetic and parasympathetic nervous system which act in a reciprocate manner to maintain the balance of visceral functions. Thus yoga can be inferred to unite the functions of these two limbs of autonomic nervous system to maintain the balance for obtaining the harmony or homeostasis of the physiological system (*samatvamyogamuchyate*, Patanjali's yoga sutra).

AUTONOMIC NERVOUS SYSTEM (ANS)

ANS is an extensive neural network involved in regulating the human internal environment by controlling homeostasis and visceral functions. This is of survival importance for the maintenance of optimal environment for cells, tissues and organs so as to enable continuous adjustments to the varying internal and external demands on the body. The word 'autonomic' was coined by JN Langley in 1898 and he proposed that this word implied independent action but exercised under control of higher power. The functions of heart muscle, smooth muscle, secretory glands and hormone secretions are regulated by ANS thus maintaining these homeostatic functions essential to life, mostly independent of volitional activity.

Langley divided the ANS into sympathetic, parasympathetic and enteric nervous systems primarily based on anatomic considerations. Craniosacral outflow constituted the parasympathetic division, thoracolumbar outflow formed the sympathetic division whereas the enteric nervous system was intrinsically present in the wall of the gastrointestinal tract through its interconnecting plexus. Functionally, the sympathetic and parasympathetic nervous systems are complementary in maintaining the balance in the tonic activities of many visceral structures and organs (Figure 1). Sympathetic division - prepares the body for strenuous physical activity in stressful situations. This response is often referred to as the 'fight-or-flight' response because the sympathetic division prepares the body to fight against or flee from a threat. Parasympathetic division - regulates important body functions such as digestion & 'slows down' the body ('rest & digest') after a 'flight- or-flight' response.

Cardiovascular Autonomic Control: Anatomical Aspects

Heart tissue has got special properties to generate its own rhythmicity known as automaticity. But this function is significantly modulated by innervations from both the sympathetic and parasympathetic divisions of ANS. The parasympathetic innervation of the heart that originates in the cardiovagal motoneurons in the nucleus ambiguus and the dorsal vagal nucleus passes through two sets of cardiac nerves arising from each vagus nerve. The cardiac branches of the vagus nerve separate in the thorax and innervate several cardiac ganglion cells. The postganglionic fiber is very short as the parasympathetic autonomic ganglion (cardiac ganglion, in this case) situated very close to the end organ (heart, in this case). This property makes fast conducting myelinated preganglionic fiber to form the majority of the parasympathetic pathways making the conduction velocity faster than sympathetic system of innervations. This

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