

Pranayama Could be the Best Nonpharmacological and Nonsurgical Method of Vagal Nerve Stimulation

Vagal nerve stimulation (VNS) has been established to be useful in the treatment of a number of diseases and has been used quite effectively for the treatment of epilepsy and depression in adults.^[1,2] There is accumulating evidence to suggest that VNS could be used to suppress inflammation in autonomic dysfunction or inflammatory disorders, which would make it useful for a wider range of geriatric and pediatric patients as well.^[3] Preliminary reports have revealed promising result of VNS in the treatment of stroke, autoimmune diseases, heart and lung failure, obesity, and pain management. Further, studies are being conducted to fully elucidate the mechanistic actions that explain VNS's potential role in treating these disorders. However, till date, many of these studies do not explain the detailed mechanisms of the therapeutic benefits of VNS. Hence, future studies should focus on the mechanisms by which VNS alters autonomic tone and that will be the key to the further our understanding of VNS modification in health and disease. However, it is known that the VNS interacts with the body's immune system to modify inflammatory tone by inhibiting the release of pro-inflammatory cytokines and facilitating the activity of anti-inflammatory cytokines.^[4] There are overwhelming data to suggest that vagal nerve is an important component of the immune response, and manipulating vagal tone is a way to improve the immune system. Using VNS to manipulate vagal tone provides an exciting new opportunity for minimally invasive therapeutic intervention in adult and pediatric patients.

Although VNS could be a promising therapeutic tool in many clinical disorders, it appears to have limitations due to its inherent risks and side effects in human beings. The vagal stimulation is easy to perform in animal models of various diseases, but VNS in human beings is not only a delicate procedure, but also could be hazardous as uncontrolled and indiscriminate stimulation can lead to cardiac slowing and arrest. Therefore, it will be advisable to have a method of VNS which will be easy to perform and would be less perilous.

In relaxation therapy of practice of yoga, the sympathetic discharge is inhibited and parasympathetic discharge is facilitated.^[5] Yoga relaxation therapies such as meditation, yoga nidra, concentration on devotional songs or music, asanas for body relaxation such as shavasana, and yoga breathing in the form of pranayama ensure mind-body relaxation, promote vagal activity, and facilitate sympathovagal homeostasis.^[6] However, for achieving sympathovagal balance and maximum mind-body relaxation, emphasis is given more on pranayama, the yogic practice of controlled breathing exercises. Pranayama (prana + ayama) is the controlled breathing in which the practitioner regulates his/her breathing (ayama)

and concentrates on imbibing cosmic energy (prana) from the atmosphere through breathings. In normal breathing, inspiration is longer and expiration is less than half of the inspiration. During inspiration, heart rate is more due to less vagal tone and during expiration, heart rate is less due to more vagal tone, the phenomenon called sinus arrhythmia.^[7] Thus, practicing breathing with longer duration of expiration than inspiration stimulates vagal discharge and strengthens vagal drive. In pranayama, the basic procedure is to prolong the duration of expiration that promotes vagal activity and this provides the scientific basis of VNS in pranayama practice. Taking advantage of this physiological phenomenon of sinus arrhythmia that happens during pranayamic breathing exercise, the ancient yoga practitioners had professed pranayama as a natural way of healthy living and by practicing pranayama, they lived a longer span of life free of diseases and dysfunctions.

Pranayama is classified into two categories: fast pranayamas and slow pranayamas. In fast pranayamas such as kapalabhati, bhastrika, and bellows breathing, the respirations are faster but deep.^[8] In slow type of pranayamas, such as anulom-vilom (alternate nostril breathing), chandranadi (left nostril breathing), sitkari (cooling breaths), and bhamari (breathing with vibrations through ear), respirations are slower, deeper, and more prolonged with greater duration of expiration. By reducing inspiration and lengthening expiration, the vagal nerve traffic is made robust in slow pranayama practice. Thus, practice of slow pranayama is known to improve cardiac vagal modulation and increase vagal tone.

Further, it has also been explained that in slow pranayamas, gradual and graded increase in lung volume and rib cage increases nerve traffic from thoracic cage proprioceptors that strengthen vagal tone through the central limbic-hypothalamic influence of the sensory projections to thalamus and cortex.^[9] Furthermore, it has been observed that such pranayamas augment cerebral blood flow and oxygenation that improves neuronal activities of the brain centers including those present in the limbic areas, hypothalamus, and medulla, and improves vagal tone and promotes sympathovagal outflow. Thus, slow pranayamic breathing has been reported to reduce sympathetic activity, stimulate vagal activity, and improve sympathovagal balance. Moreover, the practice of fast pranayama and suryanadi pranayama (right nostril breathing) has been reported to increase sympathetic activity, and the practice of chandranadi pranayama has been reported to decrease sympathetic activity and stimulate vagal activity.^[10,11]

As the practice of slow pranayama such as chandranadi type activates vagal drive, it will be of great scientific interest to

explore the possibility of doing VNS through such controlled breathing exercise. It will be a great scientific discovery to perform VNS of different grades through practice of different degrees of chandranadi variety of pranayama, which will be the natural way of achieving vagal stimulation without having risks and perils of surgical and pharmacological interventions. We are sure that the future advancement in yoga research will bring a sea of change in VNS therapy in a spectrum of clinical disorders.

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