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Physio-anatomical effect of Pranayama on PranavahaSrotas

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ABSTRACT
Ayurveda is an ancient Indian medical system that has been used for thousands of years. It places a strong emphasis on disease prevention and maintaining health. The circulatory and respiratory systems are regarded as PranvahaSrotas (System for Conduction of Vital Force or Life) in Ayurveda. Cardio-respiratory diseases can be prevented by ensuring that the PranvahaSrotas are working properly. Pranayam is a Yogik technique that is indicated for good health. The effects of pranayama on PranavahaSrotas (cardio-respiratory) are presented in this paper.

Keywords: Ayurveda, Pranayama, PranavahaSrotas

I. INTRODUCTION

The ancient science of life known as Ayurveda primarily focuses on an individual's quality of life. The word "Ayurveda" combines the terms "Ayu," which means "life," and "Veda," which denotes knowledge. Therefore, it basically seeks to increase longevity through maintaining good physical, mental, and social health.

The four fundamental components of Satva (Manas), Atma (soul), Indriya (the senses), and Sharir (the body) are thus harmoniously combined under the word "Ayu.[1] And it is said that the perfect fusion of all of these—namely, Dharm (moral obligation), Artha (economic prosperity), Kama(pleasure), and Moksha (spiritual emancipation)is the means by which one can achieve the Purusharth (goal of life).[2]

Ayurveda places a strong emphasis on the preventive side of medicine, and for this reason, many ideas exist to ward against illness and maintain a person's state of health.

Srotasis one of the fundamental concepts in Ayurveda. Srotas make up the internal transport system of the body and are particularly connected to the fine channels of circulation and pathways, carrying out all of the analytical tasks of the body. The appropriate form and operation of these bodily pathways affect both health and disease.

Srotas are therefore crucial for maintaining homeostasis, promoting physical growth, and providing patients with care. There are thirteen Srotas in all.[3] Because Prana (vital energy) flows through PranvahaSrotas, this Srotas is of utmost significance. Numerous cardiac and respiratory diseases may result from any deviation from the PranvahaSrotas' physiologically normal values.As stated by Acharya Charaka and Acharya Sushruta, Hridaya (Heart) and Mahasrotas, and rashvahidhamani are the Moolas (Origin) of PranvahaSrotas, respectively.[4,5]

So, according to both Acharya's perspectives, there is a connection between PranvayuSamvahan (respiration) and Rasa Samvahan (blood circulation), and when they work together, they maintain the flow of Prana (vital energy that is necessary for life). PranvahaSrotas, which contains all the anatomical structures, is best understood physiologically as a delicate functional link between the respiratory system and the cardiovascular system.

Numerous ideas and methods to raise one's quality of life and sense of well-being are found in our ancient science. Pranayama, a Yogika technique, is one among them. Pranayama is merely the control of the breath while extending the prana (vital energy). It is a very powerful Yogika Technique that falls under AsthangaYoga and has a significant physiological impact on the cardio-respiratory system. In the present study an attempt has been made to explore the effect of Pranayama on PranvahaSrotas in terms of cardiovascular and respiratory parameters. This study will also help to assess the better measure (preventive or curative) for the maintenance of health.

Pranayama

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It is one of the forms of Ashtanga yoga, which is a method of mental control through the regulation of Vayu (air) during inspiration and expiration[6]. It not only has psychological advantages, but also numerous bodily advantages[7].Pranayama is practised in three steps: Puraka, Kumbhaka and Rechaka. Additionally, there are eight other varieties of pranayama, including Suryabhedana, Ujjayee, Sheetalee, Bhramaree, Bhastrikaa, Sheetkaaree, Moorchaa, and Plavinee[9].

Deep inspiration, holding of the breath, and deep expiration are all components of each style of pranayama, and these actions have an impact on various physiological components of respiration and consequently dramatically increase lung volumes and capacities.[10,11,12]

Respiratory physiology [13]

The only autonomic process that can be actively overridden is breathing, which is also essential for balancing the sympathetic and parasympathetic nerve systems. The nares will inspire air that will pass through. Lungs take place in the alveoli, which are located at the end of the trachea, bronchi, and bronchioles and blood is breathed out through the respiratory membrane (external respiration). Internal respiration, or the exchange of gases between blood and tissues, also occurs at the level of the tissues.

Mechanism of respiration[14]

Respiration occurs in two phases i.e. inspiration and expiration. During inspiration (active process) thoracic cage enlarges and the lungs expand. During expiration (passive process), the thoracic cage and lungs decrease in size.

Muscles of respiration[15]

These are skeletal muscles (with the capability to increase in their bulk with regular efficient usage).

Inspiratory muscles & expiratory muscles

Primary- Muscles of Diaphragm & External intercostal muscles

Accessory inspiratory muscles- Sternocleidomastoid, scalene, anterior serrati, elevators of scapulae and pectorals are the accessory inspiratory muscles.Primary expiratory muscles

Primary expiratory muscles -internal intercostal muscles

Accessory expiratory muscles-Accessory expiratory muscles are the abdominal muscles

Thoracic Cage Movements[16]

The thoracic cage moves as a result of four different movements, including those of the diaphragm, upper costal series, lower costal series, and thoracic lid. This causes the ribs to rise and the diaphragm to descend.

Lung movements[17]

• Positive pressure in the thoracic cavity increases during inhalation due to the widening of the thoracic cage. Lungs expand as a result. As the thoracic cage contracts during expiration, negative pressure returns to the pre-inspiratory position, and the lungs are compressed, expelling air.

Inspiration and expiration are the two stages of respiration. The thoracic cage and lungs expand during inspiration (an active process). The size of the thoracic cage and lungs decreases during expiration (a passive process)

II. DISCUSSION

When the respiratory muscles are used regularly and effectively, their bulk increases, and their elastic and collagen fibers become stronger and more extensible, improving their ability to contract effectively, improving their ability to inhale and exhale and clean the secretions from their airways, which reduces airflow resistance and allows the full and free use of alveoli.[18]

In Pranayama, pulmonary surfactants, and prostaglandins are secreted as a result of lung inflation that is close to the entire lung capacity. Lung volumes and capacities rise as a result of increased lung compliance caused by pulmonary surfactant and decreased bronchiolar smooth muscle tonicity caused by prostaglandins.[19]

The laryngeal and tracheobronchial smooth muscles spontaneously relax when the lungs are almost fully inflated, enhancing lung volumes and capacity.[20]As a result of practicing pranayama, the skeletal muscles become more relaxed, which, aids in the thoracic cage relaxing more completely than before and, by relaxing the smooth muscles in the bronchi, removes the broncho-constrictor effect, which allows us to observe an improvement in the parameters measuring pulmonary function.[21]

The Pneumotaxic Respiratory Centre is in charge of regulating conscious, tightly regulated breathing during pranayama. The apneustic center, which is in charge of peaceful, regular breathing, will be controlled by the respiratory center. Therefore, during Pranayama, the Apneustic Centre

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may adopt this controlled breathing pattern, leading to regular quiet breathing and a decrease in respiration rate.[22]

Regular use of pranayama may block the Dorsal Group Neurons, which control inspiration in quiet, normal breathing, leading to an extended expiratory time.[23]The respiratory center may have become less responsive, the respiratory musculature may have evolved more quickly, the lungs' chemoreceptors may have become used to hypercapnia and hypoxia (lower oxygen levels), leading to prolonged muscle endurance and delayed weariness. [24]

In Pranayama practice, there was a considerable reduction in heart rate, respiration rate, blood pressure, and autonomic balance between the sympathetic and parasympathetic neural systems.By activating the stretch receptors of the lungs during the tidal volume inhalation, similar to the Hering-Breuer reaction, pranayama lengthens and increases the frequency of inhibitory brain impulses. This results in a reduction of sympathetic tone in the blood arteries of the skeletal muscles, which causes broad vasodilatation, which lowers peripheral resistance and lowers diastolic pressure.[25,26]

Pranayama helps a person relax by getting him to focus on his breathing. This could reduce sympathetic activity, which would reduce the release of adrenaline and potentially lower heart rate and blood pressure.[27]

The intrathoracic pressure rises during voluntary expiration as blood is forced into the heart from the lungs, increasing the volume of the stroke. The carotid sinus baroreceptors also experience increased pressure, causing them to release more fluid. As a result of the enhanced baroreceptor discharge, which also stimulates the heart's vagus innervations and suppresses the tonic discharge of vasoconstrictor nerves, the blood pressure falls, bradycardia develops, and vasodilation occurs.[28]

III. CONCLUSION

Pranayam is highly beneficial for modern living. Many people in the population have cardiorespiratory conditions such as asthma, COPD, and heart illnesses. Pranayama aids in chemoreceptor acclimatization, surfactant and prostaglandin release, stretch receptor activation, excessive tension release, and respiratory muscle strengthening. By expanding lung sizes and capacities, it benefits both healthy and injured (by restrictive & obstructive respiratory disorders) lungs.

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