

Nitric Oxide and Its Significance in Respiratory Muscle Training

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ABSTRACT

Paranasal sinuses are the primary site of production of Nitric Oxide in the human body. Nitric oxide leads to improvement in lung functions as it increases oxygen transport throughout the body. Nasal breathing has links to many breathing patterns and techniques employed in yoga. Humming exercise is a part of the ancient breathing technique used in yoga namely, Bhramari Pranayama and in humming, the nitric oxide peak is coming from the paranasal sinuses because of the oscillating sound waves produced. Pranayama or breath regulation has gained a special place in Yoga and includes various techniques such as bastrika (bellow's breath), Nadishodhana (alternate nostril breathing) etc. There are no definitive guidelines for indication and dosimetry of these techniques in various respiratory disorders. There is dearth of literature till date that provides an established protocol of breathing training with humming maneuver and with incorporation of other pranayama techniques.

Key words: Nitric oxide, Humming, Bhramari pranayama, Bhastrika.

INTRODUCTION

Role of paranasal sinuses in nitric oxide (NO) production: -

Nitric oxide (NO) is a gas that is frequently regarded as an environmental contaminant. In 1998, Robert F. Furchgott, Louis J. Ignarro and Ferid Murad won noble prize for the title "Nitric Oxide as a Unique Signaling Molecule in the Cardiovascular System." In current era, it's been recognized that nitric oxide (NO) is a wide signaling patch in all organs of the body, and not only in the

cardiovascular system. The paranasal sinuses help in regulations on lung functions and are sinuses are major directors of NO. Enzymes have been set up in the nose and in the paranasal sinuses that produce Nitric Oxide. These findings show that the main point for Nitric Oxide production is the paranasal sinuses. NO is involved in multiple functions in mortal body including nonsupervisory, defensive, protective processes, is also buried in response to seditious processes, acts as an important vasodilator and functions as a natural middleman. NO is produced by colorful cells throughout the body including the respiratory airways. Recent pathbreaking exploration by Weitzberg and Lundberg demonstrated that nasal Nitric Oxide situations in the airways increase vastly during humming compared to quiet nasal exhalation.^{1,2}

Correlation between "NO" production and Humming Maneuver

Nitric oxide leads to improvement in lung functions as it increases oxygen transport throughout the body. Nitric oxide after being inhaled reaches the lung zones in a diluted form and leads to increased pulmonary oxygen uptake via local vasodilatation.^{1,2} Research conducted during a previous Coronavirus epidemic i.e., the SARSCoV (Severe Acute Respiratory Syndrome Coronavirus) epidemic showed that NO inhibited the replication of SARSCoV in a dose dependent manner, meaning that higher levels had a greater inhibitory effect on the replication of the

virus.³ Nasal breathing has links to many breathing patterns and techniques employed in yoga. In Humming, the NO peak is coming from the paranasal sinuses because of the oscillating sound waves produced. Thereby, it causes a dramatic increase in sinus ventilation, nasal NO release and leads to a 15 to 20-fold increase in NO levels which helps to open airways and kill pathogens.⁴ Research supports that strong, prolonged humming increased endogenous nasal NO production, thus eliminating Chronic rhinosinusitis (CRS) by antifungal means.⁵

Protocol for various exercise maneuvers producing nitric oxide

Humming exercise is a part of the ancient breathing technique used in yoga namely, Bhramari Pranayama (BhPr), in which humming is performed only in the exhalation phase. Ancient pranayama techniques have proven to be beneficial for respiratory system. In various pranayama techniques, breathing training is practiced both during inhalation and exhalation phase. Also, breath holding is done in-between inhalation and exhalation. Pranayama or breath regulation has gained a special place in Yoga and includes various techniques such as change in the pace of breathing, use of nostrils, production of humming sounds, breath holding etc. The classical text of hathayoga includes various yogic patterns such as kapalbharti, bastrika (bellow's breath), Nadishodhana (Alternate nostril breathing), Suryanuloma Viloma (Right uninostril breathing), Chandranuloma Viloma (Left uninostril breathing) and Bhramari (Female honeybee humming breath). These various yogic patterns collectively given a broad name Pranayama, modify the abnormal breathing pattern and may allow bronchodilatation. Also, it helps to strengthen inspiratory and expiratory muscles and leads to improvement of lung functions. Bhastrika pranayama involves training in both inspiration and during expiration. Kapalbharti helps training of abdominal muscles along with primary

inspiratory muscle namely diaphragm.^{6,7} There are no definitive guidelines for indication and dosimetry of these techniques in various respiratory disorders. There is dearth of literature till date that provides an established protocol of breathing training with humming maneuver and with incorporation of other pranayama techniques. Further studies are needed to examine and establish such definitive guidelines so that specific protocols may be established for patients suffering from chronic ailments such as COVID-19, Chronic obstructive pulmonary disease (COPD).

CONCLUSION

Paranasal sinuses are the major producers of nitric oxide and endogenous nitric oxide is involved in many functions including host defense and pulmonary functions. Humming is proved to be an effective technique to increase lung functions. Further research is needed to establish definitive guidelines for application of such respiratory training maneuvers including humming and various yogic breathing training.

Declaration by Authors

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