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The Effects of Pranayama on Pranvaha Srotasa: A Review

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Abstract

In our world people are facing many cardiovascular and respiratory disorders like bronchial asthma, bronchitis, tuberculosis and chronic obstructive pulmonary diseases along with cardiac diseases. Death due to cardiovascular, lung and blood diseases is 41% in 2010. Yogic practices have always been proved to increase vitality even at cellular level. This article summarizes the physiological effects of *Pranayama* on *Pranvaha Srotasa* with their probable explanation.

Keywords

Yogic practice, *Pranayama*, *Pranvaha Srotasa*

Greentree Group

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AIMS AND OBJECTS

To study the root of *Pranavaha Srotas* and *Pranayama,* and to evaluate the effect of *Pranayama* on *Pranvaha Srotasa,* specifically on respiratory system and cardiao-vascular system.

INTRODUCTION

In *Ayurvedic* classics *Tridosha, Triguna, Panchendriya* and soul- these twelve collectively are called as *"Prana"*[1]. *Vayu* which moves in mouth and holds the body is known as *Prana,* here moving in mouth is implicative and indicates head, chest, throat, and nose also as locations of 12 *Prana* (*agni somo* etc.)[2]. The *Srotasa* (channels) by which *Prana* are carried in function are termed as *Pranvaha Srotasa.* The *Moola* of *Pranvaha Srotasa* are *Hridaya* and *Mahasrotasa*[3]. *Acharya Sushruta* mentioned *Hridaya* and *Rasa Vahi Dhamaniyas* as *Pranvaha Srotasa*[4]. In brief we can consider *Hridaya, Mahasrotasa* and *Rasavahi Dhamniya* as *Moola* of *Pranvaha Srotasa*. As described earlier that *Pranavayu* is responsible for respiration. *Pranavayu* inhaled through lungs circulates in the whole body and maintains the body. *Pranayama* is a combination of various yogic Practices in which respiration is controlled by different techniques. It involves all the respiratory apparatus like lungs, heart and various muscles involved in process of respiration.

MATERIALS AND METHODS

The description related with *Pranavaha Srotas* and *Pranayama* are arranged from classical text book and work performed by different scholar. These are studied and evaluated on the basis of article published in reputed journal.

Effect of *Pranayama* on respiratory system

Pranayama has found to have very good effect on respiratory system as various studies have shown very highly significant increase in PFT's parameter like FEV1, PEFR and FEF. Some evidences are listed below:

1. A study in 50 individuals at *Patanjali Yoga* center, Kolar, in which individual under- went a 6 week (daily one hour) *Pranayamic* training program. The pulmonary parmeter were taken before their *Pranayamic* training and after 6 weeks of *Pranayamic* training and were found significantly increased[5].

2. A study in 53 patients of asthma who were given *Pranayamic* training for 2 weeks and were compared with a control group of 53 patients of asthma of matched age, gender, type and severity of asthma who continued to take thier usual drugs. There was significant improvement in the group who practiced *Yogic* exercises, in the weekly number of asthmatic attacks and in peak flow rate[6].
3. A study related to *Yogic* and *Pranayamic* practices indicated that these practices are helpful to improve aerobic capacity and in to decrease the perceived exertion after maximal exercise. Forty individuals from the Indian army (aged 19-23 years) were administered maximal exercise on a bicycle ergo meter in a graded work load protocol. The oxygen consumption, carbon dioxide output, pulmonary ventilation, respiratory rate, heart rate (HR) at maximal exercise and PE score immediately thereafter were recorded. The subjects were divided into two equal groups. Twelve subjects dropped out during the course of study. One group (yoga, n = 17) practiced *Hatha yogic* exercises for one hour every morning (six days in a week) for six months. The other group (PT, n = 11 underwent conventional physical exercise training during the same period. Both groups participated daily in different games for one hour in the afternoon. In the 7th month, tests for maximal oxygen consumption (VO2Max) and PE were repeated on both groups of subjects. Absolute value of VO2Max increased significantly ($P < 0.05$) in the *Yoga* group after six months of training. The PE scores after maximal exercise decreased significantly ($P < 0.001$) in the *Yoga* group after 6 months, but the PT group showed no change[7].
4. Some evidences are also found that breathing exclusively through one nostril may alter autonomic functions. Male subjects (n=48), with ages ranging from 25 to 48 years were randomly assigned to different groups. Each group was asked to practice one out of three *Pranayamas* (viz. right nostril breathing, left nostril breathing or alternate nostril breathing). These

practices were carried out as 27 respiratory cycles, repeated four times a day for one month. Parameters were assessed at the beginning and end of the month, but not during the practice. The "right nostril *Pranayama*" group showed a significant increase, of 37% in baseline oxygen consumption. The "alternate nostril" *Pranayama* group showed an 18% increase, and the "left nostril *Pranayama*" group also showed an increase, of 24%[8].

5. In a study related to cardiovascular and respiratory changes during the *Yogic* breathing exercise *Kapalabhati* (KB) in 17 advanced yoga practitioners. The exercise consisted of fast shallow abdominal respiratory movements at about 2 Hz frequency. Blood pressure, electrocardiogram (ECG), and respiration were recorded continuously during three 5 min periods of KB and during pre- and post-KB resting periods. The beat-to-beat series of SBP and DBP, R-R intervals, and respiration were analyzed by spectral analysis of time series. The mean absolute power was calculated in three frequency bands, band of spontaneous respiration, band of 0.1 Hz rhythm, and the low-frequency band > 15 s in all spectra. The mean modulus calculated between SBP and R-R intervals was used as a parameter of the baroreceptor- cardiac reflex sensitivity (BRS). The HR increased by nine beats per min during KB. The SBP and DBP increased during KB by 15 and 6 mm Hg respectively. All frequency bands of R-R interval variability were reduced in KB. Also the BRS parameter was reduced in KB. The amplitude of the high frequency oscillations in SBP and DBP increased during KB. The low-frequency blood pressure oscillations were increased after KB[9].

Effect on Cardiovascular System

Along with respiratory system *Pranyama* has a good effect on cardio vascular system. Decrease in pulse rate, diastolic blood pressure and in respiratory rate are the common effects of *Pranayama*.

1. A study was conducted on 60 healthy individuals regarding cardio vascular parameters before and after *Pranayama*. The result showed highly significant increase in 40

mm/Hg endurance time and significant decrease in pulse rate[10].

2. A study performed in patients of CAD found significant improvements in PFT measures after *Pranayama* compare to without *Pranayama* as in normal conditions. In healthy individuals *Pranayama* can produce different physiological responses, and the responses of alternate nostril breathing (ANB), the *Nadisudhi Pranayama* on some cardio-respiratory functions were investigated in healthy young adults. The subjects performed ANB exercise (15 minutes every day in the morning) for 4 weeks. Cardio-respiratory parameters were recorded before and after a four-weeks training period. A significant increment in PEFR (L/min) and pulse pressure (PP) was noted. Although systolic blood pressure (SBP) decreased insignificantly, the decrease in pulse rate (PR), respiratory rate (RR), diastolic blood pressure (DBP) was significant[11].
3. In an another study on 20 patients of CAD belonging age group 35-55 years, their parameters recorded were FEV1, FVC, FEV1/FVC ratio, PEFR, FEF 25-75%, PIFR and maximal voluntary ventilation (MVV), after that they all were advised to practice *Pranayama* (*AnulomVilom* and *Kapalbhati)* 10 minutes twice in a day. After 2 weeks of breathing exercises their pulmonary functions tests were repeated and compared with their basal PFTs, as result there were significant improvement in FEV1%, PEFR, FEF (25%-75%) and in MVV[12].
4. In a randomized controlled study, patients with angiographically proven coronary artery disease who practiced yoga exercise for a period of 1 year showed a decrease in the number of anginal episodes per week, improved exercise capacity and decrease in body weight. Serum cholesterol levels (total cholesterol, LDL cholesterol and triglyceride levels) also showed greater reductions as compared with control groups[13].
5. A randomized controlled study revealed that practicing *Yogic* practice for a year helped significant improvements in the ideal body weight and body density. The regular

yogic practice has shown to improve the serum lipid profile in the patients with known ischemic heart disease as well as in healthy subjects[14].

Discussion

By regular practice of *Pranayama,* it provide strength to muscles of respiration and increases the range of movement of diaphragm. Due to *Pranayamic* practice lung inflation is near to total lung capacity which is a major stimulus for the release of surfactant into alveolar space which increases lung compliance[15]and there is also a physiological stimulus for the release of prostaglandins which decreases bronchial smooth muscle tone which in turn decreases airway resistance[16].

The decrease in respiratory rate by *Pranayam* can also be understood. We know that, usually breathing is not a conscious event & is regulated automatically by bulbopontine respiratory neuronal complex, which is further modified by suprapontine mechanisms in the conscious being. The pneumotaxic centre is supposed to relay suprapontine messages which promote voluntary inspiration & expiration. During daily practice of *Pranayamic* breathing the basic activity of bulbopontine complex, is modified in such a way that it slows down its rhythm voluntarily prolonging the phase of inspiration & expiration to their maximum extent. Thus it makes the lungs to work to their maximum extent to take O_2 & expire CO_2 maximally leading to decrease in respiratory rate[17].

The possible mechanism for improved PFT in above discussed cases may be due to increase in compliance of thorax by increasing mobility of chest by *Pranayama* practice. It also helps in removal of secretions of respiratory passage making easy entry of more air into alveoli. *Pranayam* training causes an increase in the voluntary breath holding time. This may be due to acclimatization of the chemoreceptor to hypercapnoea. The possible reason for decreasing the pulse rate may be due to decreased sympathetic discharge[18].

In patients of CAD the possible reason in improvement could be because of reduction of sympathetic activity attained with *Pranayamic* training. This may allow bronchodialtion by correcting the abnormal breathing patterns and reducing the muscle tone of inspiratory and expiratory process. Due to improved breathing patterns respiratory bronchioles may be widened and perfusion of a large number of alveoli can be carried out efficiently. In response to variations in breathing patterns a number of central and autonomic nervous system

mechanism as well as mechanical(heart) and hemodynamic adjustments are also triggered, thereby causing both tonic and phasic change in cardiovascular functioning[19].

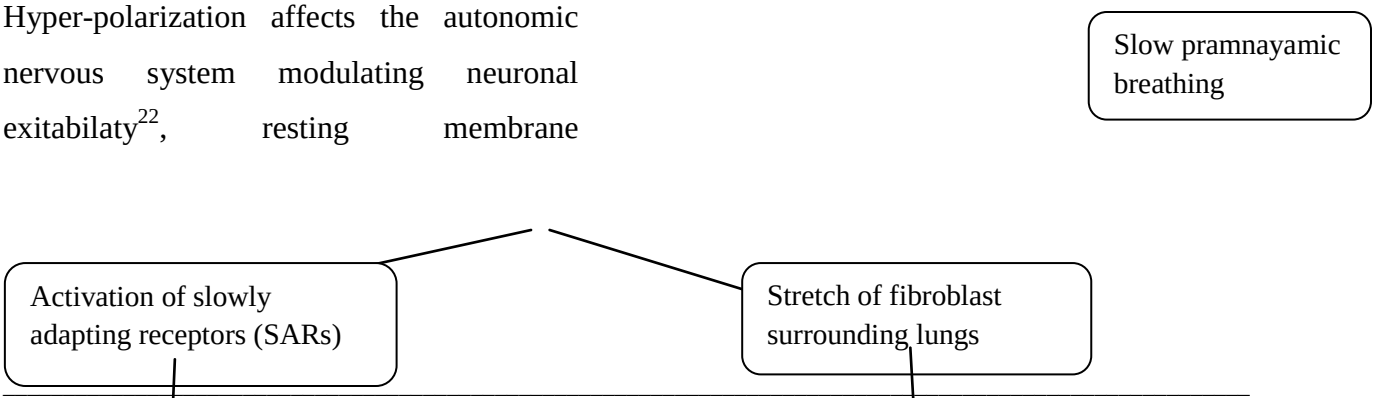
Deep *Pranyamic* breathing dynamically modulates the autonomic nervous system by these two ways:

- *Pranayama* increases frequency of inhibitory neural impulses by activating stretch receptors of the lungs during above tidal volume inhalation. As it is very well known that inhibitory impulses, produced by slowly adapting receptors (SARs) in the lungs during inflation[20] play role in controlling typically autonomic functions such as breathing pattern, airway smooth muscle tone, systemic vascular resistance and heart rate[21].
- *Pranayama* heightens generation of hyperpolarization current by stretch of connective tissue (fibroblast) localized around the lungs.

Hyper-polarization affects the autonomic nervous system modulating neuronal exitabilaty[22], resting membrane potential[23]and generating rythmatic brain activity[24]. As we know that hyper polarization of tissues manifests itself in parasympathetic like changes[25].

As a result of above discussed that inhibitory impulses in cooperation with hyper polarization current initiates the synchronization of neural elements in the central nervous system, peripheral nervous system and surrounding tissues ultimately causing shifts in the autonomic balance towards parasympathetic dominance.

The regulatory part of lung is governed by local stretched receptor and autonomic nervous system. *Pranayama* increases the frequency and duration of inhibitory neural impulse. The deep breathing technique reset the autonomic nervous system by shifting of parasympathetic activity and synchronization of neural element of lung, heart and brain.



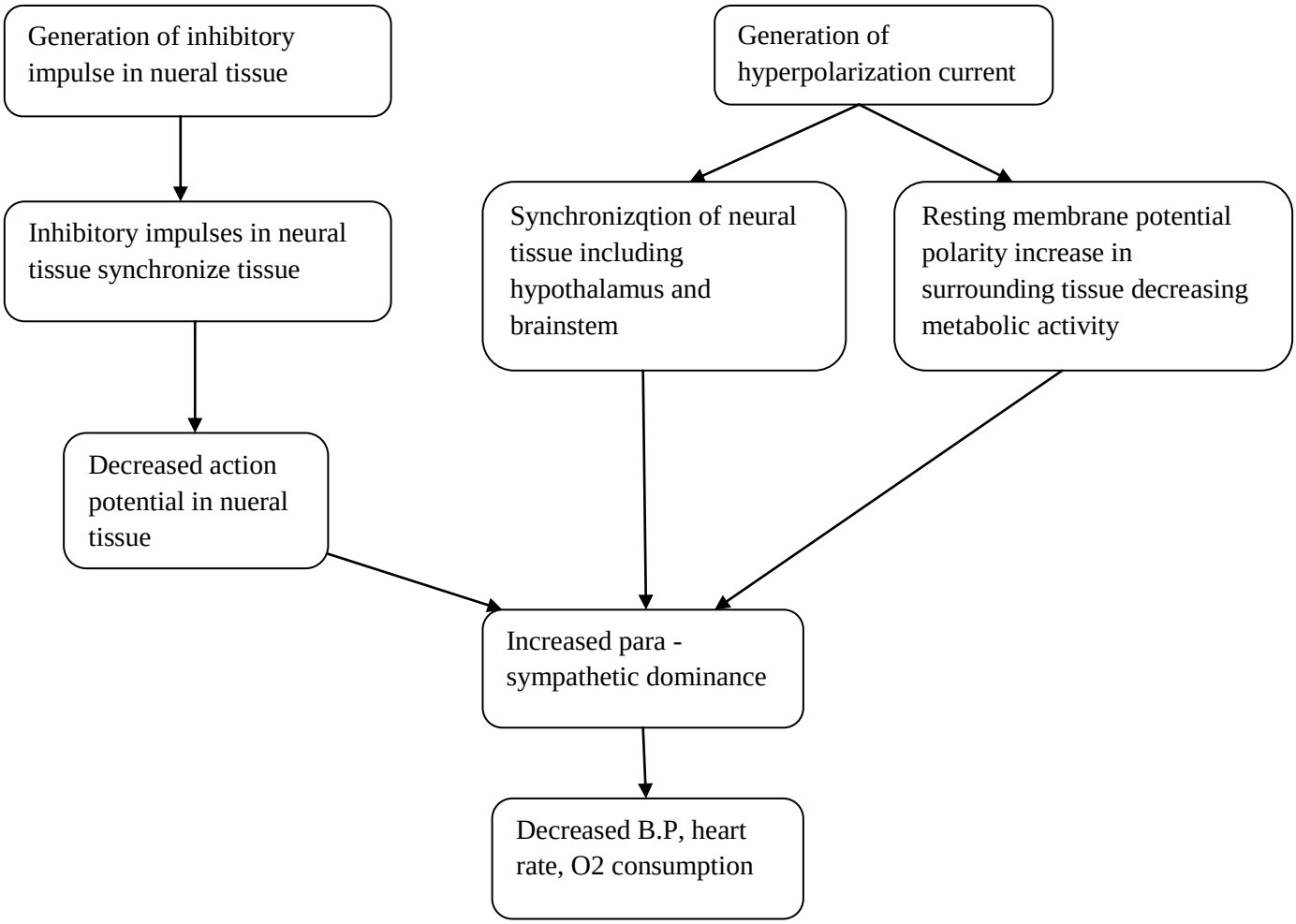


Figure 1 "Schematic presentation of the series of events that occur during *Pranayamic* breathing leads to autonomic shift"

CONCLUSION

Pranayama increases the lung functions and has good effects on cardiopulmonary disease. It used for prevention of lungs and cardiovascular activity diseases.

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